THURSDAY, FEBRUARY 15, 1917.

AERONAUTICAL THEORIES.

(1) *Bases Théoriques de l'Aéronautique. Aérodynamique.* By Prof. N. Joukowski. Pp. xviii+227. (Paris: Gauthier-Villars et Cie, 1916.) Price 11 francs.

(2) *Dynamical Stability of Aeroplanes.* By Jerome C. Hunsaker, assisted by T. H. Huff, D. W. Douglas, H. K. Chow, and Capt. V. E. Clark. Pp. 78. (Smithsonian Miscellaneous Collections, lxii., 5; Hodgkins Fund.) (Washington: Smithsonian Institution, 1916.)

(3) *Air Screws: an Introduction to the Aerofoil Theory of Screw Propulsion.* By M. A. S. Riach. Pp. viii+128. (London: Crosby Lockwood and Son, 1916.) Price 10*s.* 6*d.* net.

(4) *Aérodonétique.* Par F. W. Lanchester. Traduit de l'anglais sur la deuxième édition par le Commandant C. Benoît. (Paris: Gauthier-Villars et Cie, 1916.) Pp. xvii+478. Price 14 francs unbound.

(1) FOR the French translation of Prof. Joukowski's work we are indebted to Dr. S. Drzewiecki. In a separate preface the latter writer emphasises the fact that the use of the principles of mathematical physics did not receive adequate attention in the early days of artificial flight, and he advocates the recognition of aerodynamics as a separate branch of theoretical science. We regret to find that whatever extraneous arguments may be and have been adduced for placing this subject on an independent footing, there is nothing, either in the translator's eloquent introduction or in the subject-matter of the book, to justify the present claim.

Dr. Drzewiecki admits the important part which the study of fluid motions has played in the development of aeronautical theories. But he fails to realise that the matter of which the book treats is hydrodynamics pure and unadulterated. There is nothing in it of a sufficiently distinct and novel character to form the nucleus of a distinct subject with such a name of its own as aerodynamics.

On the purely mathematical side, the treatment does not extend very much beyond the formulation of the equations of motion and continuity for perfect and viscous fluids, together with the pressure equation, and a somewhat diffuse treatment of the laws of vortex motion. This, together with considerations of a practical character, occupies the first five chapters. The subsequent sections contain accounts of some of the more recent attempts to solve the equations of motion in the case of cylinders and laminæ resembling the sustaining surfaces of an aeroplane. In this connection prominence is given to the theories and experiments of Profs. Kutta, S. A. Tchapliguine, and Karman, and the Aerodynamic Laboratory at Moscow is described in an appendix. It must not, however, be forgotten that there are two ways of reconciling the existence of a pressure on a moving lamina with the properties of a perfect fluid. One method is to assume that there is circulation of the fluid round the lamina. Thus, for example, a cylinder in a perfect liquid acted on by gravity tends to travel horizontally if there is cyclic motion round it. This method appears to form the basis of most of the work in Prof. Joukowski's later chapters. On the other hand, we have the theory of discontinuous motion, originated by Kirchhoff, which has now been greatly elaborated in this country by means of the Schwartz-Christoffel transformation. Of this theory Prof. Joukowski's treatment is practically *nil.*

Up to the present time very little has been done in investigating the motion of solids through *compressible* fluids. It is true that compressibility does not greatly affect the character of the motion so long as the velocities are everywhere small compared with the velocity of sound in the same medium. But this condition can scarcely be regarded as binding in the neighbourhood of a sharp-edged boundary; in fact, according to Boyle's law, the pressure would simply vanish and would not become negative at a point at which the velocity was infinite. The problems treated by Prof. Joukowski are essentially based on the hypothesis of a velocity potential satisfying Laplace's equation of continuity, and they therefore belong to the subject of hydrodynamics proper. According to the usual convention in this country, experimental and practical considerations regarding the motion of fluids are classified under the designation of *hydraulics.* It is very important that engineering students who are proposing to take up aeronautical work should be equipped with a knowledge of the necessary hydrodynamics and hydraulics, and Prof. Joukowski's lectures were probably admirably adapted to the students in his classes. But the book goes only a very little way towards covering the subject-matter contained in the English treatises on hydrodynamics of more than thirty years ago, with their chapters on sources, doublets, and images, motion in rotating cylinders in the form of lemniscates and cardioids, motions of a solid in a liquid, tides and waves, and detailed treatment of discontinuous motion in two dimensions. It is quite clear that the advanced student will find it much more helpful to turn to one of these early books for a thorough grounding in hydrodynamics than to rely on a more superficial and fragmentary treatment of the same subject, which is all that he will find in the present volume.

(2) An examination of the paper by Messrs. "Hunsaker and others" suggests that in the scientific study of aeroplane stability America is far behind Great Britain. The only part of this paper which has any claim to novelty consists in the determinations of the coefficients of stability of two aeroplanes (the Clark and Curtiss types) based on experiments with models. The methods of experimenting were identical with those used in our National Physical Laboratory, of which the details were developed by the energies of Mr. L. Bairstow.

The publication of these experimental data derives additional interest from the fact that owing

to war conditions the National Physical Laboratory has been unable to issue published results of experiments with any machines other than a Blériot monoplane which was tested as an illustration of the general method before the war broke out. On the other hand, the paper deals largely with mathematical considerations, and on examination there will be found to be scarcely a single feature for which chapter and verse cannot be found in the present reviewer's "Stability in Aviation," published five years ago. It scarcely appears desirable, when so much further work remains to be done, that the resources of the Hodgkins Fund should be expended in duplicating what has previously been said and worked out in greater detail elsewhere. Furthermore, several changes that have been introduced into the treatment are open to serious objections. We all regret the discrepancy between the co-ordinate axes of the National Physical Laboratory papers and those used in the mathematical theories; unfortunately, as the result of mutual discussion, it is evidently impossible to break the continuity of the Teddington investigations. But there is no justification for extending this lack of uniformity to an entirely new set of investigations started in America. The main reason for objecting to the system in question is that the notation is unfamiliar to English students, all of whom have acquired their knowledge of applied mathematics, in the first instance, from the study of two-dimensional problems, and afterwards extended it to three-dimensional space. This objection applies with special force to the problem of longitudinal stability, which is essentially two-dimensional. But Messrs. "Hunsaker and others" make further changes which are not only very confusing, but out of accord with the usage of both our mathematicians and our physicists. The most objectionable feature is the use of the letter D in two entirely different meanings in the same equation with only a suffix to distinguish them. The writers would have done well to study a little more carefully the long alphabet at the end of "Stability in Aviation."

The exclusive reference to Mr. Bairstow in connection with the splitting up of the two biquadratics is open to the objection that it would be quite impossible for anyone without exceptional mathematical ability and power of insight to deduce the formulæ in question by any method of factorisation or numerical substitution indicated in the advisory committee's National Physical Report, Paper No. 77, and even verification by long multiplication is none too easy, whereas the proof in "Stability in Aviation" is perfectly straightforward and simple.

The omission of references to methods of *successive* approximation is again unfortunate when the authors come to describe the character of the lateral motions. Why, for example, is one root of the biquadratic said to represent a "spiral dive" and another pair to represent a "Dutch roll"? These things can be found partially explained in "Stability in Aviation" (although the late Prof. Harper worked the subject out in greater detail in a paper he never published) and also in Mr. Bairstow's National Physical Laboratory researches, but a reader of this paper would think that the difference in the periods and logarithmic increments or decrements was the only essential distinction.

A still worse feature of the whole investigation is that while acknowledging the influences of circular motion on stability, the writers completely ignore the "Harper effect." The present reviewer hopes that a fitting recognition may be given to the work of his former assistant and colleague, the late Lieut. E. H. Harper, M.A. (professor of mathematical physics in University College, Cork, and recently killed in action), by thus associating his name with his independent discovery that stability, both longitudinal and lateral, is greatly affected by even small changes in the inclination of the line of flight to the horizon. An aeroplane fatality has recently been reported which was clearly attributable to this cause.

It was no intention of the author of "Stability in Aviation" to extend his criticisms to statements, conclusions, and expressions of opinion which fall within the province of the physicist or engineer rather than within that of the mathematician. But apart from specific references to the two machines which formed the subject of the experiments, the similarity between the present treatment and that of the Science Monograph obtrudes itself on one's notice in the most unexpected quarters. It will be most interesting to learn whether Mr. Hunsaker fares better than did the present writer in appealing to practical men to study stability with models rather than to rely on experiments in the open air. He states (p. 5) that he actually "knew a pilot" who nearly lost his life by trying a spiral dive in the air! But when "Stability in Aviation" was in the press fatalities occurred daily, and killing off the pilots of unsafe machines was the only method that the practical man would have anything to do with. To invoke the assistance of a mathematician would have been an idea too terrible for words, and as for compensating him for his loss of time over the work, this might have cost 100*l.*, which would have been a preposterous waste of money when the same thing could be done by smashing up ten machines costing 1000*l.* each.

Mr. Hunsaker claims that laboratory experiments and calculations are superior to tests made in the open air, and remarks that "weather conditions, motor troubles, personal peculiarities of pilots, etc., tend to add to the complexity of an otherwise very simple problem." But exactly the same considerations were invoked in 1910 by the opponents of theoretical and physical methods as proving that the latter methods were practically useless. The large number of mathematical investigations (some of them in progress) that were bundled into the collection of "problems" at the end of "Stability in Aviation" will give some idea of the amount of work which, as the result of this opposition, was suspended on the ground that no useful purpose would be served by its continuance.

(3) It was in 1882 that Drzewiecki first propounded a theory of propeller action based on the supposition that if the length of a screw-blade be split up into small elements the fluid motion in the neighbourhood of any element may be regarded as two-dimensional, and independent of the differences of shape of the neighbouring elements, so that the effect is the same as if the element in question formed a section of a cylinder moving through the same medium with uniform velocity. Reference to the same method will be found in Lanchester's "Aerodynamics." But at the time of Drzewiecki's first papers the principal screws occurring in engineering practice were the propellers of ships, and these are sometimes broad enough to account for considerable divergences between theory and experiment. Parenthetically, too, it will be seen from Sir G. Greenhill's "Dynamics of Mechanical Flight" that Newton's "sine squared" law of resistance still figures largely in some of the well-known theories of propeller action.

The assumption under consideration is the same as that made by the present writer in connection with lateral stability under the title, "Further Hypotheses regarding Narrow Planes." Mr. Riach's figures of the blades of modern air screws suggest that these are sufficiently narrow to justify an investigation of their efficiency based on this admittedly rough-and-ready, approximate method.

It is the object of the present work to develop this method of investigation to its ultimate logical conclusions. This is a perfectly definite piece of purely mathematical work involving nothing harder than writing down integrals, except that the solid geometry of the screw and the different kinds of pitch associated with it is rather puzzling. It would thus be easy for anyone to work out all the results for himself, and it is doubtful whether it is worth paying ten shillings to have this done. But even if nothing else could be said in favour of the book, it is a great gain to have the formulæ ready worked out and displayed in print. And, after all, there is a great deal to be said on the subject, and there are many minor details which not everyone would think of working out. The various forms of blade proposed and described as the "efficiency curve," "rational," "normal," and "constructional limit" outlines are interesting.

Mr. Riach is under no misapprehensions as to what his investigation does and does not prove. If the fundamental assumptions are admitted, the rest follows as a logical consequence. Divergences between theoretical and experimental results will depend on the extent to which the actual stream-lines of the medium differ from those based on the two-dimensional or aerofoil hypothesis. The author finds that in many cases a fairly close agreement has been found between theory and practice, but, as he freely admits, there are cases in which the differences may be considerable. It is important to bear these facts in mind, because there is a certain type of individual, unfortunately very common, who cannot, or will not, appreciate the value of an investigation conducted in this spirit, and we can only hope that Mr. Riach will not find himself dragged into a hornet's nest of controversy by cranks and faddists. There is nothing that retards progress and wastes time so much as the irrelevant "discussions" which are so often started on a perfectly straightforward piece of work. What is now required is further comparison of theory with experiment.

The book also contains chapters dealing with the stresses in propeller-blades, their design and construction, and other similar matters. It would be well, however, to point out that in working with a theory which is at best an approximation, it would be sheer waste of time to worry about evaluating complicated integrals, as a process of summation over a finite number of elements would be sufficiently accurate. At the same time, many of the integrals are comparatively simple, and some of them can be simplified by a trigonometrical transformation to an angular co-ordinate the geometrical meaning of which is obvious from the figures.

(4) Mr. Lanchester's books are too widely known to require further comment, and Commandant Benoît has adhered fairly rigorously to the original text in his translation, not even venturing to insert a preface of his own in addition to that dated May, 1908, by the author. Probably this was the best plan, for everything has now changed so greatly that it would be impossible to bring a book up to date nearly nine years after publication. G. H. BRYAN.

MILK AND THE PUBLIC HEALTH.

Milk and its Hygienic Relations. By Dr. Janet E. Lane-Claypon. Pp. viii + 348. (London: Longmans, Green and Co., 1916.) Price 7*s.* 6*d.* net.

THIS book is published under the auspices of the Medical Research Committee, which is charged with the administration of the Research Fund which has become available under the provisions of the National Insurance Act for the advancement of medical knowledge by research. Milk has very important relations to the public health, but the study of milk has been conducted by workers in chemistry, physiology, bacteriology, agricultural science, and clinical medicine, and the results of their researches have appeared in journals devoted to all these branches of science. With the view of collating this mass of literature, the Medical Research Committee invited Dr. Janet Lane-Claypon to assist them in collecting the available scientific evidence upon the hygienic relations of milk from all the best sources of information, however widely scattered, and the present volume is the outcome of her labours. Not only has a large mass of literature been abstracted, but critical summaries are provided in addition, and extensive bibliographies are appended to the subjects dealt with which will be very valuable to future workers.

The general composition of milk and its organic and inorganic constituents are summarised in chaps. ii., iii., and iv. The "biological" proper-

ties of milk are next considered, first the ferments or enzymes, and then the substances concerned in the production of immunity; important properties have been attributed to the former which do not, however, seem to be borne out by the clinical and experimental work which has been carried out concerning them. Breast-feeding, the nutritive value of raw and boiled milk for the young of the same and of different species, and clinical data on the nutritive value of raw and boiled milk for infant feeding and on the alleged production of Barlow's disease and rickets by the use of heated milk for infants, are rightly dealt with at some length. Dr. Lane-Claypon arrives at the conclusions:—(1) The superiority of breast-feeding over artificial feeding is striking; (2) little difference, if any, appears to be detected between feeding with raw and feeding with boiled milk; (3) the changes which occur on heating milk to a temperature of about 100° C. for a short period cannot be regarded as having any detrimental influence from the nutritional point of view; (4) there may be a connection between the *twofold* heating of milk and Barlow's disease, but the ætiology is not clear; and (5) there is no evidence to show that the use of heated milk is productive of rickets.

The cellular content of milk, the changes which ensue in milk on heating, pathogenic organisms in milk, sources of contamination of milk and the means whereby such contamination may be lessened or prevented, are other subjects dealt with.

A few errors have been noted and one or two criticisms might be made. On p. 10, in a table giving the composition of milk for different breeds of cows, the total solids are given as ranging from 26·7 to 34·7 per cent. These figures, of course, are utterly wrong (they should be in the neighbourhood of 12·0–13·0 per cent.), and it is difficult to surmise to what they refer. On p. 50 Fe_2O_3 is three times referred to as "ferrous oxide." Minute quantities of iron are present in milk—1–2 parts per million for human milk, and 0·3–0·7 part per million for cows' milk, of Fe_2O_3. May not so small a quantity be derived from admixed red-blood corpuscles? We believe that a few red-blood corpuscles are *always* present in milk, but no reference is made to this. In dealing with the composition of milk, while German and other foreign figures are largely quoted, no mention is made either in the text or in the bibliography of the numerous analyses by Droop Richmond—in fact, his name does not appear in the volume—and some of the data quoted are derived from papers twenty to thirty years old.

These, however, are minor points in a volume of such general excellence. We think the Medical Research Committee has been well advised to expend some of the funds at its disposal on the preparation of a work of this kind—a precedent which we hope to see repeated for other branches of medical science—and we congratulate Dr. Lane-Claypon on the admirable summary she has presented of so great a mass of material at her disposal. A number of plates, and of figures and charts in the text, add to the completeness of the volume, which is issued at a very moderate price.

OUR BOOKSHELF.

The Towns of Roman Britain. By the Rev. J. O. Bevan. Pp. viii+66. (London: Chapman and Hall, Ltd., 1917.) Price 2*s.* 6*d.* net.

THE compilation of this little book was suggested by the author's work in connection with the preparation of an archæological map of Herefordshire. His object, as he states it, was "to provide a compendious guide to readers who desire to study the fruits of the Roman occupation, to trace the roads they laid down, and to possess themselves of the position and essential features of the centres where they congregated for commerce, pleasure, or defence." After a short account of the history and results of the Roman occupation of Britain, Mr. Bevan gives, in alphabetical order, a short account of the chief Roman cities. This is useful so far as it goes, but it is confined to the chief Roman cities, and leaves untouched the numerous other places of interest, in particular the villas, the excavation of which has thrown such clear light on the life of the invaders. It may be hoped that the author will be encouraged to extend his survey. This scheme, carried out within reasonable limits, does not require, as he supposes, "a volume of stupendous size." If, in a new edition, he confines himself to the restricted plan which he has adopted, he would do well to add to his accounts of Roman cities references to the best authorities. A list of the more important general works on the subject would also be a useful addition.

Decennial Index of the "Analyst: The Journal of the Society of Public Analysts and other Analytical Chemists." Vols. xxxi.–xl. (1906–1915). Compiled by Muriel A. Baker. Pp. 733. (London: Simpkin, Marshall and Co., Ltd., n.d.)

THE subject-matter of this index has been classified under three heads, namely, authors, subjects, and original communications. The last group refers to papers read before, or contributed directly to, the Society of Public Analysts; the others, by far the more extensive, include also references to the numerous abstracts which form so valuable a feature of the society's journal. By the use of heavy type the name, or the subject, as the case may be, is brought prominently before the reader's eye, as is also the date of the paper indexed—a matter which is often of importance in looking up references. A system of punctuation is adopted which, combined with the heavy type, renders it easy to turn up a subject and to see at a glance the scope of the paper indexed, in so far as this is conveyed by the title and sub-title. Two instances taken almost at random will indicate the fullness of the record. The entries under "Arsenic" alone occupy three pages of the index, and those under "Milk" seven pages. In short, the index forms a valuable guide to the development of analytical chemistry in all its branches during the decennial period which it covers; and it may safely be said that during this period not much of practical importance in this branch of chemistry has been published which cannot be traced by means of the references supplied.

LETTERS TO THE EDITOR.

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

The Atomic Weight of "Thorium" Lead.

In continuation of preliminary work published by Mr. H. Hyman and myself (Trans. Chem. Soc., 1914, cv., 1402) I gave an account in NATURE, February 4, 1915, p. 615, of the preparation of 80 grams of lead from Ceylon thorite and of the determination of its density in comparison with that of ordinary lead, which proved the thorite lead to be 0·26 per cent. denser. Taking the new international figure, 207·20, for the atomic weight of common lead, that for the thorite lead would be 207·74 on the assumption that the atomic volume of isotopic elements is constant.

This lead and the comparison sample were each distilled in three fractions, and the atomic weights of the two middle fractions were determined from the ratio, Pb : $PbCl_2$, by converting the metal into chloride, *via* nitrate, in a quartz vessel. Only single determinations were done, which gave the values 207·694 and 207·199 respectively, which are in the ratio of 100·24 to 100.

This result, which indicated clearly that the atomic volume of isotopic elements is constant, was communicated in a lecture to the Royal Institution, May 15, 1915, and to Section A of the British Association at Birmingham, 1915.

Since then Prof. T. W. Richards and Mr. Wadsworth at Harvard have shown that the density of lead derived from uranium minerals is less than that of common lead, but, as in the case of thorium lead, the atomic volume is constant. Varieties of lead of atomic weight from 206·08 to 207·18 varied in density from 11·273 to 11·337. The latter values refer to common lead.

Dr. R. W. Lawson, at present interned in Vienna but allowed full liberty to continue his investigations at the Radium Institut under Prof. Stefan Meyer, communicated to me in July last year the desire of the investigators in that institute to examine independently the atomic weight of some of my thorite lead, and I accordingly sent him the first fraction of the distilled lead, weighing some 12 grams. He has now written to me, and it is a pleasant duty first to mention that he speaks in the warmest terms of the utmost kindness and consideration shown him by the staff of the institute and of the courtesy and consideration of the police and other authorities during his internment. He reports that Prof. Hönigschmid has made four determinations of the atomic weight of my lead, according to the method of gravimetric titration and the relation of chloride to silver, and four by gravimetric analysis, whereby the weights of the chloride and silver chloride were determined. The complete mean of the eight results was $207·77 \pm 0·014$, which is in excellent agreement with my own figure, 207·74, found indirectly from the density, and shows that my single atomic-weight determination, 207·694, was not seriously in error.

It is especially gratifying to have the conclusion that the atomic weight of thorium lead is higher than that of common lead confirmed by an investigator of the training and experience of Prof. Hönigschmid. For, although the converse proposition that the atomic weight of lead from uranium minerals is lower than that of ordinary lead has, since the publication of the first paper by Mr. Hyman and myself on thorite lead, been thoroughly and conclusively established by the work of many investigators at Harvard, in Vienna, and in Paris, several of them famous for their atomic-weight determinations, doubt has lingered with regard to our results for the very much more difficult case of thorium lead. In the first place, no one but myself has been able to obtain a suitable material by which to test the question, and I, of course, can claim no previous experience of atomic-weight work. In the second place, there has been an unfortunate confusion between my material, Ceylon thorite, and thorianite, a totally distinct mixed thorium and uranium Ceylon mineral. Lastly, there has been the widespread view, due to Holmes and Lawson, Fajans, and others, mainly derived from geological evidence, that thorium-E, the isotope of lead resulting from the ultimate change of thorium, was not sufficiently stable to accumulate over geological periods of time. This confirmation from Vienna thus clears up many controversial matters, and we now know of varieties of lead differing from 206·08 to 207·77 in atomic weight, and from 11·273 to 11·376 in density, the atomic volume in all cases examined being constant.

According to analyses by Miss A. F. R. Hitchins and myself, the 20 kilos of selected thorite worked upon contained 0·4 per cent. of lead, 57 per cent. of thorium, 1·03 per cent. of uranium, and 0·5 c.c. of helium per gram. Taking the ratio of the period of thorium to that of uranium as 3·2, and assuming that *the whole of the lead is of radioactive origin and is stable*, 94·5 per cent. is derived from thorium, and 5·5 per cent. from uranium. If 206·0 is the true atomic weight of uranium lead, Prof. Hönigschmid's value, 207·77, for thorite lead gives the figure 207·87 for the atomic weight of thorium lead, whilst his figure, 232·12, for the atomic weight of thorium gives a total loss of 0·25 unit of mass in the six α- and four β-ray changes suffered by the thorium atom. From these data and from Silberstein's and his own theories of mutual electromagnetic mass, perhaps Prof. Nicholson may be able to give us further information as to the constitution of the nucleus of the thorium atom.

FREDERICK SODDY.

Marischal College, Aberdeen, February 1.

The Bursting of Bubbles.

PRESUMABLY all bubbles when they burst on the surface of a liquid commence to do so at the top and thus give rise to gaseous vortices. In the ordinary way these are not apparent, but recently we have accidentally discovered a neat way of making them easily visible. The method consists in creating the bubbles by sparking with a Ruhmkorff coil between two wires beneath the surface of some resin oil and thus gasifying the latter. As the bubbles are full of smoke, when they burst the vortex effect is clearly indicated by the formation of beautiful little smoke rings. The size of the bubbles and of the rings depends upon the viscosity of the oil, greater viscosity causing bubbles and rings to become larger. This can easily be shown by cooling or warming the oil.

A. A. CAMPBELL SWINTON.
EVELYN BEALE.

66 Victoria Street, London, S.W.
February 6.

A Plea for a Scientific Quadruple Entente.

THE letter of Prof. Eugenio Rignano in NATURE of January 25 may have recalled to some a discussion on literature which took place in Section D at the British Association meeting at Manchester in 1915, a discussion which was introduced almost precisely from the same point of view as that now given by Prof. Rignano. It is the fact that Germany, by welcoming and publishing papers in French, Italian, and English, as well as in German, and by printing the material practically as fast as it arrived, had gained

an ascendancy and even an actual or presumptive international position with regard to scientific publication. For example, the *Internationale Revue der gesammten Hydrobiologie und Hydrographie* is published in Leipzig, and it must be confessed that it is conducted with considerable ability and adequately fulfils its function. Such works, too, as the "Nordisches Plankton" show how keen our present enemies have been in publishing monographs which have become indispensable. It is not necessary, however, to look for sinister intentions in the progress which Germany has made in publication. In all countries scientific literature has had a similar history, and its evolution may be said to mark the progress made by each with respect to science. In all countries, societies, museums, and laboratories have sought an outlet for their investigations by publications which have the primary advantage of securing by exchange similar publications from institutions at home and abroad.

The result is somewhat chaotic, and for this reason we are thankful to the societies and publications and agencies which attempt to give us periodical lists of literature and summaries of papers. I confess I do not see how the national output of scientific papers is to be controlled, or, indeed, if it is desirable that it should be controlled. This is a matter which it appears must be left to the editor and the writer. But now that our attention has been directed to the subject, the opportunity should be taken to discuss whether we should be content with pre-war conditions, or if improvements could be suggested so far as the nation is concerned, and especially with regard to the control of such publications as are meant to be international in character. We have to recognise that each country must necessarily have an output of material for publication for which provision must be made. The fact that so many English papers have been published in Germany raises the question whether the provision is adequate. It might be suggested that each country should publish its own material, and that the desirability of publishing year-books bringing together summaries of the important papers and discoveries in each subject should be considered. If this were done by each country, probably the necessity for international journals would disappear, and better so, for it would be difficult to determine in each case which country and which language to choose.

An improvement of great value would result if a suggestion which has been made before were carried into effect, viz. that a size of page for octavo and for quarto periodicals should be decided upon. If this were agreed to by each country, and the effort made to issue the more monographic papers separately, it would be possible to bind in any way suitable to the institution or worker. A. MEEK.

Armstrong College, Newcastle-upon-Tyne,
January 27.

Science in Education.

ON p. 432 of your issue for February 1 it is stated in an unsigned article that "in the early fifties of the nineteenth century a little experimental science crept in almost shamefacedly, introduced by the peripatetic teacher with his box of tricks." Then after mentioning Queenwood in 1847 it goes on: "But it was not until twenty years later that this example was followed in other schools. Then Clifton took the lead in 1867, and was followed immediately by the Manchester Grammar School."

Your correspondent is not very well informed.

At Rugby in 1849 William Sharp, F.R.S., was appointed by Dr. Tait reader in natural philosophy, and gave systematic teaching to classes of boys. He was succeeded by Henry Highton, a distinguished electrician (see Arago's "Tonnerre"), who taught chemistry and physics to about forty boys. He became headmaster of Cheltenham College in 1859, and Dr. Temple appointed me to succeed him. A chemical laboratory was built, and I taught physics, chemistry, and a little geology to somewhat larger classes. Then in 1865, after the Public Schools Commission, a great increase in science teaching took place; the Rev. T. N. Hutchinson was appointed to take chemistry, and Mr. Kitchener took botany with large classes. I went on with physics and geology. All this happened before 1867.

Clifton College is an excellent school, but it need not be exalted at the expense of its mother.

JAMES M. WILSON,
Sometime mathematics and science master at Rugby, and afterwards headmaster of Clifton College.

OBVIOUSLY the article referred to did not profess to give a complete history of the introduction of science teaching into schools. That would be a long story, and would necessitate reference to several schools besides Queenwood, such as the Friends' School at Ackworth, in Yorkshire, where for many years some teaching of science subjects had been established long before Rugby and other public schools had made a beginning. The claim for Clifton is based on the fact that it is believed to have been the first great school in which natural science was introduced as a constituent of the curriculum imposed on *the whole school* (except the Classical VI.), and not as a voluntary subject taken up by a small number of boys as an alternative to modern languages or other subjects, as was the case at Rugby in 1859.

THE WRITER OF THE ARTICLE.

"Frost Thistles."

IN NATURE of January 11 Dr. R. T. Gunther describes a very beautiful freezing effect. I recently obtained a similar effect on a much larger scale. One of the large bottles, holding several litres, used for collecting rainfall in the London parks, in connection with the investigation of atmospheric pollution, was found, when brought into the laboratory for examination, to contain a hollow cylinder or annulus of ice, perforated with silvery air-tubes arranged, as Dr. Gunther remarks, for all the world like lines of force round a magnetic pole. We were unable to detect any visible specks of solid matter at the peripheral ends of the tubes; but these ends were pointed, whereas the inner ends were rounded and expanded, probably terminating thus where ice and the central core of water met. The surface of this central portion was covered with a scum of air-bubbles. One feature which was noticed particularly was that, in addition to the air-tubes, other channels filled with something (probably liquid water containing dissolved matter) were arranged radially throughout the mass.

The water represented the accumulated rainfall of January, and, in addition to matters in solution, contained an appreciable deposit. It is, therefore, quite probable that small particles were present on the sides, and thus formed collecting points for the air first liberated when congelation began.

The various points observed agreed entirely with those already described, except that the very much larger quantity of water had not solidified throughout its mass. If this had occurred it would have probably been a slow action and the opaque central mass would not have been seen. J. H. COSTE.

Teddington, February.

Note.—Since writing the above I have seen another mass of ice solid throughout, which had broken the bottle; a small opaque central cylinder, or inverted cone, was observed.—J. H. C.

THE NATION'S FOOD.[1]

AN important White Paper has just been issued which deals with this most pressing problem of the day. It is a report drawn up by a committee of the Royal Society at the request of the President of the Board of Trade. The committee consists of physiologists (Profs. A. D. Waller, chairman; F. G. Hopkins, Noël Paton, and W. H. Thompson) and agriculturists (Mr. A. D. Hall, Mr. T. H. Middleton, and Prof. Wood); the remaining names are those of Prof. Ashley of Birmingham, and Mr. Flux of the Board of Trade. It is a sign of the times that scientific men of this type should be called in to advise the Government, and an earnest of that scientific mobilisation in the nation's service that we all long to see fully accomplished. Physiologists have always taken the flattering unction to their souls that all their work is for the benefit of humanity, but it is not often that they have had such a striking opportunity of placing their knowledge to such an immediate practical use, or, what is more, seen their recommendations so promptly acted upon. The report in question is crammed full of valuable statistical data, and it, moreover, possesses the rare merit of being clear and brief. There can be no doubt that the recent actions of the Government in reference to the milling of flour and the limitation of grain used in brewing have been the direct outcome of this report. The more recent enactment relating to the voluntary restriction in meat, flour, and sugar which Lord Devonport has suggested is also founded on the general principles here laid down.

The first section of the report deals with the period before the war, and it is remarkable that the allowance then of protein, fat, and carbohydrate should so closely have coincided with the standard dietary usually associated with the name of Voit. Per head per day, these figures are a little below the Voit regimen, and give a total of 3090 Calories; but per "man" (*i.e.* making due allowance for women and children, whose needs are smaller), it works out above the standard (4000 Calories), so that a margin of waste was provided for. Part ii. deals with the year 1916, and shows that here again the available food was more than sufficient, so that reduction is possible; but the increase in prices has accentuated inequalities of distribution, and, as the committee points out, reduction below the necessary amount causes a large diminution in the working capacity of the individual. Organisation in distribution is therefore called for; it would be foolish economy to produce a harmful effect upon the working population who form the backbone of the nation in its present crisis.

The final section of the report treats of methods of economy. The milling of flour and the reduction of beer we have already alluded to, but one important set of recommendations still remains to be mentioned; it deals with meat production, and is important as it is probably here that we shall shortly be experiencing the severest pinch. One of the recommendations is that cattle should be slaughtered at seventeen months old instead of two and a half years; such young beef would be a little poorer in fat, but that is counterbalanced by the enormous saving in feeding-stuffs; economies may also be effected by certain changes suggested in the amount and character of the fodder employed. Finally, an increase in the making of cheese as compared with butter is urged.

These are the main features of the report, but the full report, which can be obtained for fourpence, is worth careful perusal and study.

Although it is dated 1917, it was drawn up last year—that is, before the threatened renewal of the German submarine menace; and until that menace is overcome the people of this country must first loyally and faithfully abide by the restrictions imposed by Lord Devonport's decree, and next be prepared for still further and more stringent reductions which may be rendered necessary either by the partial success of the German blockade, or by their own foolishness in not following out the present voluntary system. For it must be clearly understood that although the figures of the present allowance are within the normal physiological limits, there is no margin for waste now; some difficulties may be experienced in getting along with 4 lb. of bread or its equivalent in flour per week, but that is only because bread has come to be regarded, not in the proverbial, but in the actual sense, as the staff of life. Many nations and vast populations never eat wheaten preparations. We do not want to advocate the Japanese dietary; that has its own peculiar evils. Still, the carbohydrate supply, which is the biggest fraction of our daily food, may be made up by a more generous use of rice and other grains which are comparatively neglected by the average Englishman, just as the protein supply in meat may be compensated for by the greater utilisation of the protein-rich pulses.

One omission we notice in the report which furnishes the text for this article, though it must have been in the minds of the authors, and no doubt was a factor in their resolve to recommend the use of "straight-run" flour. We mean the "vitamine" question. Pure protein, fat, and carbohydrate, with the necessary salts and water in addition, will not maintain health, still less promote growth. Certain unknown food-accessories in small quantities are necessary also: some of these so-called vitamines are present in the outer portion of the grains, but others equally vital are only soluble in fat, and are particularly abundant in butter. As they are absent in the vegetable fats, and so much vegetable fat is used in the preparation of butter substitutes, it really is a matter of national importance that the inferior nutritional value of the cheaper brands of margarine should be widely known.

[1] "The Food Supply of the United Kingdom." A Report drawn up by a Committee of the Royal Society at the request of the President of the Board of Trade. (Cd. 8421.) Pp. 35. Price 4*d.* net.

THE NEW CANADIAN OBSERVATORY AT VICTORIA, B.C.

THE erection of the new Canadian Government Observatory on Saanich Hill (elevation, 732 ft.), near Victoria, B.C., is progressing very satisfactorily, as the accompanying illustrations show.

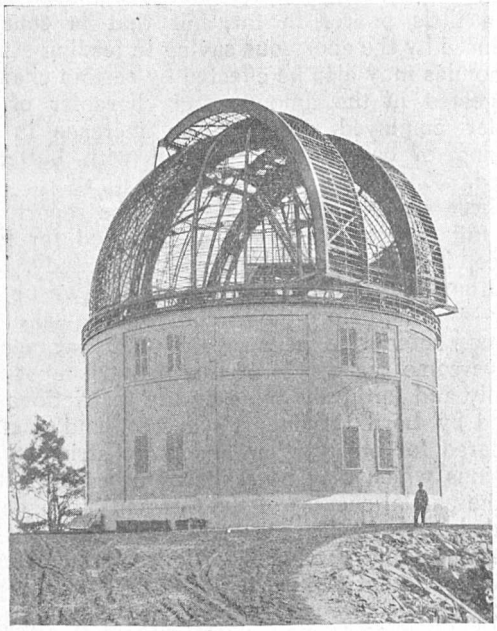

FIG. 1.—The Canadian Observatory at Victoria, B.C., on July 15, 1916.

The dome, which is 66 ft. in diameter and weighs 120 tons (of 2000 lb.), was completed by the Warner and Swasey Co. in March last, and, after being put together and tested at Cleveland, was shipped on March 28. It reached Victoria about April 15, and the structural work was finished about July 1. Both the building and the dome have double walls of sheet-iron, with openings at the foot of the walls and louvres at the top of the dome. Being entirely of metal, the building quickly assumes the temperature of the surrounding air, which circulates freely between the double walls. Though so massive, the dome revolves with great ease.

The mounting of the telescope was complete in May, and on May 25 its operation was shown to a number of invited guests. After the inspection a luncheon was given by Messrs. Warner and Swasey, the guest of honour being Dr. J. S. Plaskett, who will be director of the new observatory. The instrument was then taken down, and after a few slight additions was finally shipped from Cleveland on July 29. It reached Victoria on August 15. The erection began on September 5, and the heavier parts were in place in ten days. However, considerable time was required for the wiring, as seven motors are used to produce the various motions. Fifty wires pass through the polar axis, thirty-four of them being led along the declination axis.

Fig. 1 shows the condition of the building on July 15. The walls are covered with sheet metal, and the dome is ready to receive its sheathing, which was fastened to the lighter iron strips passing in horizontal circles about the dome. In Fig. 2 is shown the way in which the 9½-ton polar axis was transported from Victoria to the summit, a distance of 9½ miles, over the new road built by the British Columbia Government. The great mass of iron left Victoria at 5.30 a.m., August 28, and was at its destination at 1 p.m. The observatory and an observer's house (the only one yet built) are seen in the background. In Fig. 3 the telescope is shown. As will be seen, the mounting is of the English type. The polar axis is nearly 23 ft. long, and consists of two conical tubular portions bolted to a central cubical section.

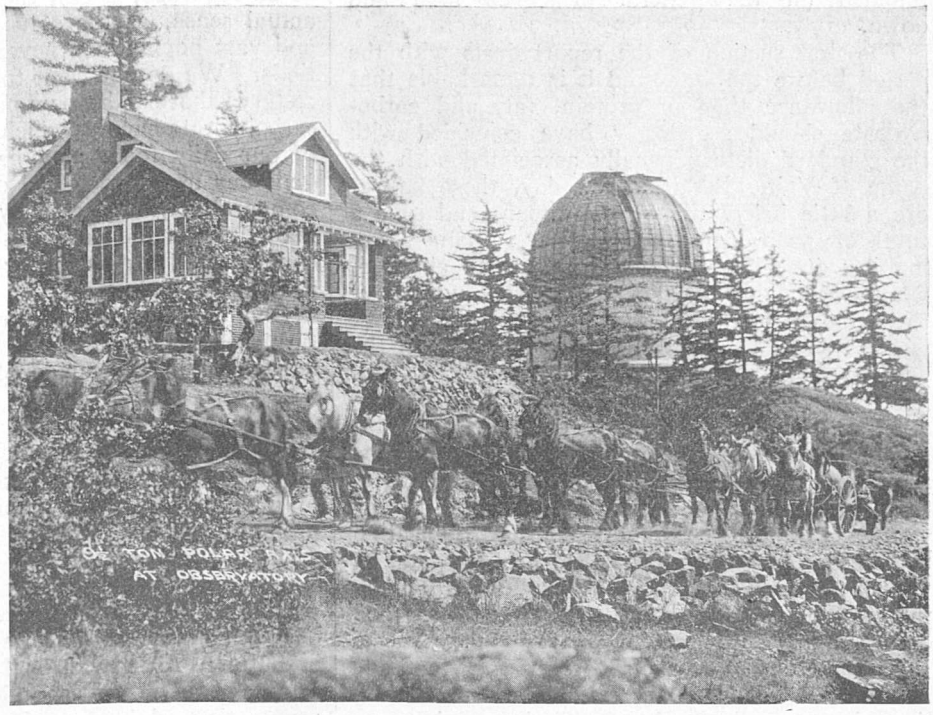

FIG. 2.—Transporting the 9½-ton polar axis to the Observatory, August 28, 1916.

These are castings of the best steel. The driving clock is at the lower end of the axis. The worm-wheel by which the axis is turned is 9 ft. in circumference, and weighs 2 tons. When hoisted into its position the entire weight of the polar axis was about 14 tons. The approximate positions of its bearings had been determined beforehand by means of a wire stretched from one to the other and adjusted by observations with a surveyor's transit. The declination axis is a steel forging $5\frac{1}{4}$ tons in weight, $14\frac{1}{2}$ ft. long, and $15\frac{1}{2}$ in. in diameter.

The telescope tube is composed of three sections. At the bottom is the steel mirror cell, $7\frac{1}{2}$ ft. in diameter, which, with mirror counterpoises and mirror, weighs 6 tons. It is bolted to the central section, a steel casting 6 ft. long

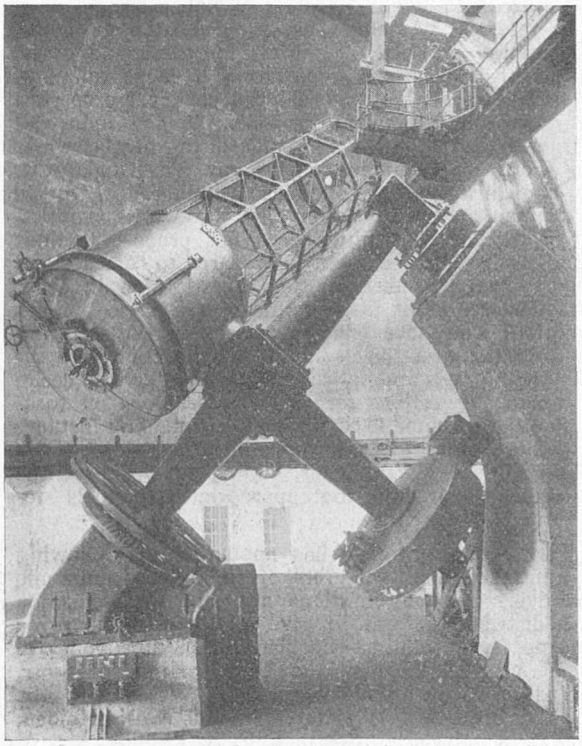

FIG. 3.—The 72-in. reflector, October 22, 1916.

and weighing 7 tons; while surmounting this is the skeleton tube, more than 23 ft. long, and weighing, with attachments, about 2 tons. Through the centre of the mirror there is a circular hole $10\frac{1}{8}$ in. in diameter, and behind this the eyepiece is placed when the telescope is used as a Cassegrain reflector. There are two 4-in. finders, one on each side of the tube, and one of aperture 7 in. and focal length 30 ft. To assist in the adjustment of the axis of the telescope, the long-focus finder was mounted centrally in the tube. The objective can be seen at the upper end of the tube (Figs. 3 and 4), and the eyepiece at the centre of the mirror cell. The correction required to be made to the upper end of the polar axis was 1/50 in. in altitude and 1/25 in. in azimuth. The observing platform is seen near the upper end of the tube. It is moved up and down the shutter opening on rails fastened to the main ribs by cables operated by an electric motor. At each side of the platform are wings, one of which is shown in the figure, movable in and out, to embrace the tube at any convenient position for observing.

In order to operate the telescope there are two similar switchboards on the south pier, one on each side, that one being used which happens to be most convenient. In operation the assistant will stand at either one of these switchboards and set the telescope and dome to the required approximate position by means of the three operating switches shown on the switchboard. The one on the left turns the dome east or west at the rate of 60° per minute, the centre one moves the tube north or south 45° per minute, and the switch

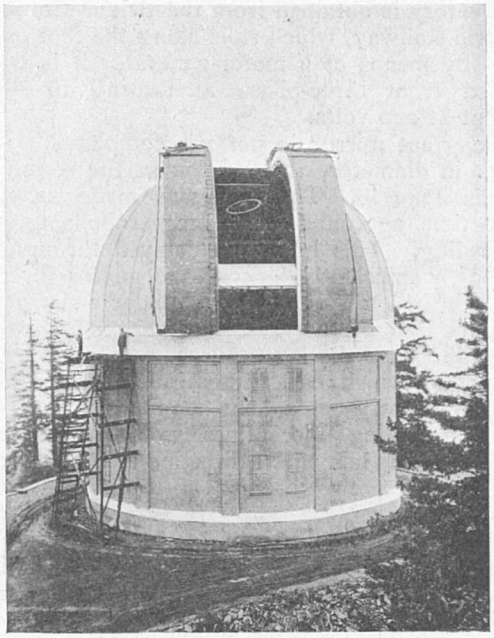

FIG. 4.—The Observatory, October 22, 1916. The shutters are open their full width (15 ft.), and the wind-shield is seen before the telescope.

to the right moves the whole telescope east or west on the polar axis 45° per minute. The push-button switches above serve to illuminate the declination, sidereal, and hour circles, by which the approximate positions are obtained, and to clamp and unclamp the slow motions in R.A. and Declination. The fine setting and guiding are performed by the observer at either the upper or lower end of the tube by small keyboards carried by him when observing, the one at the lower end being shown attached to the cable passing across the lower end of the cell. By pressing the keys on this board two motions are given in either direction in either co-ordinate, the fast one for fine setting 1° in five minutes, and the slow one for guiding at 1/20th of this speed. The telescope responds instantly to all these motions, and can be handled with as great ease as a small refractor.

When it is desired to remove the mirror from the telescope the tube is turned to a vertical position, and a carriage running on rails is brought under it and raised to the required height to receive the cell as it is unbolted from the tube. As the mirror and cell weigh almost 6 tons, a steel strut, running in vertical guides below the floor and counterweighted so as to be easily raised or lowered, is brought up and placed under the other end of the declination axis to prevent it from sinking downwards.

The entire mass of the moving parts is 45 tons, and yet it moves with the greatest ease and smoothness. A small pressure on the upper end of the tube suffices to put it in motion, while the power required to move the telescope at quick speed over that required by the motors when running idle is about 50 watts. The electric power required for the various purposes at the observatory is obtained from the British Columbia Electric Railway, which runs along the foot of the hill. By means of a motor-generator it is transformed from three-phase alternating to direct current at 220 volts.

The great mirror is not yet completed. It is 73 in. in diameter, 12 in. thick at the edge, and weighs 4340 lb. The face was made spherical some time ago, and work on parabolising it is proceeding. This has been delayed through the lack of a sufficiently large plane mirror for testing. Such a mirror has been under construction for some time by the John A. Brashear Co., which expects to have the great mirror completed by the spring, in which case the regular work of the observatory will begin next summer.

The mounting and adjusting of the telescope were under the immediate direction of Dr. Plaskett. Indeed, the entire project must be considered largely his own creation. It was he who first proposed it, and his enthusiastic advocacy of it led the authorities to approve of its construction; his experience as an observer and his great mechanical skill have had much to do with the perfection of the instrument; and his energy is shown in the rapid progress which has been made.

C. A. CHANT.

NOTES.

THE New Year Honours List, the publication of which had been postponed, was issued on Monday, and contains, among others, the following names:—Dr. R. Armstrong-Jones, Prof. R. Lodge, Edinburgh, Mr. Y. L. Raven (formerly chief mechanical engineer of the North-Eastern Railway Co.), and Prof. P. Vinogradoff, Oxford (the honour of knighthood); Dr. A. Newsholme (K.C.B.); Sir Cecil Harcourt-Smith, Victoria and Albert Museum (C.V.O.); Dr. F. Watts, Imperial Commissioner of Agriculture for the West Indies (K.C.M.G.); Mr. L. Rodway, Government Botanist, Tasmania (C.M.G.). A later list states that the honour of knighthood has been conferred upon Prof. Jagadish Chandra Bose, of Calcutta, and Rai Bahadur Sundar Lal, Vice-Chancellor of the Benares Hindu University.

THE committee of the Athenæum Club has elected the following under the provisions of the rule 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 services":—Sir R. Hadfield, Field-Marshal Sir Douglas Haig, and Prof. G. Gilbert A. Murray.

THE Advisory Council of the Government's Department of Scientific and Industrial Research has added to the list of its technical committees a Standing Committee on Glass and Optical Instruments. The membership of the committee is at present as follows: Prof. H. Jackson (chairman), Mr. Conrad Beck, Prof. C. V. Boys, Mr. F. J. Cheshire, Mr. A. E. Conrady, Mr. A. S. Esslemont, Mr. J. W. French, Dr. R. T. Glazebrook, Sir Howard Grubb, Mr. E. B. Knobel, Dr. T. R. Merton, Prof. J. W. Nicholson, Capt. Creagh Osborne, Mr. H. J. Stobart, Mr. J. Stuart, Mr. M. P. Swift, Mr. W. Taylor, Mr. F. Twyman, Lt.-Col. A. C. Williams, and Mr. W. F. J. Wood. The committee, having regard to the urgency of the problems requiring investigation in respect of these essential industries, has appointed a series of subcommittees to which various special problems have been referred. Among these problems the more important are: (*a*) Raw materials for glass and glass-making. (*b*) Optical properties of a large range of glasses. (*c*) General physical and chemical properties of glass and glassware for scientific and industrial purposes. (*d*) Testing and standardising of glassware. (*e*) Workshop technique. (*f*) X-ray glass apparatus. (*g*) Optical calculations and lens designing. (*h*) Optical instruments. (*i*) Translation of foreign works on optics. The Standing Committee does not propose to limit itself to these subjects, but is prepared to consider and report upon the necessity for investigation in other directions relevant to its terms of reference. Manufacturers who have experienced difficulties requiring investigations for their solution in connection with the subjects of glass and optical instruments, or who desire to make suggestions for special researches on these subjects, are invited to communicate in the first instance with the secretary of the Research Department, Great George Street, Westminster, S.W., who will direct the correspondence into the appropriate channels for attention.

THE Food Controller has appointed the following committee of manufacturers of sulphate of ammonia to advise him on questions affecting its production and distribution, and to give effect to an approved scheme for regulating the distribution of supplies to farmers in all parts of the United Kingdom:—Mr. D. Milne Watson (chairman), Mr. W. Fraser, Mr. E. J. George, Mr. W. R. Hann, Mr. N. N. Holden, Mr. A. K. McCosh, Alderman F. S. Phillips, Mr. A. Stanley, and Mr. F. C. O. Speyer, secretary.

THE Director of Army Contracts, War Office, has issued a circular letter to timber merchants directing attention to the fact that the Army Council has assumed control of all stocks of soft wood, planed and unplaned, excluding pit-props, in the United Kingdom. This step has been taken owing to the urgent necessity of safeguarding essential supplies of timber for military purposes, and in view of the growing scarcity of tonnage it is imperative that existing stocks of wood shall be conserved to the utmost, and that no wood shall be consumed for any purpose not essential or where any substitute for wood can be utilised. Pending further regulations, which will be drawn up in consultation with the Timber Trades Federation, dealings in the timber referred to will be permitted, subject to the conditions laid down in the letter.

MAJOR P. A. MACMAHON has been elected president of the Royal Astronomical Society in succession to Dr. R. A. Sampson.

THE gold medal of the Royal Astronomical Society has been awarded to Prof. W. S. Adams, of the Mount Wilson Observatory, California, in recognition of his research work and papers on solar and stellar spectroscopy.

A BRANCH of the Ministry of Munitions, to be known as the Munitions Petroleum Supplies Branch, has been established. It will deal with the provision and distribution of petroleum and similar mineral oils for the purposes of the Ministry, and be under the direction of Mr. E. Houghton Fry. Sir Boverton Redwood has consented to take charge of the research section, and will be known as Director of Munitions Petroleum Research.

THE Marquess of Crewe has been appointed a member of the Committee of the Privy Council on the Organisation and Development of Scientific and Industrial Research.

THE following awards of the Society of Engineers (Incorporated) were presented on February 5: The president's gold medal to Prof. C. G. Cullis for his paper on "The Mineral Resources of the British Empire as regards the Production of Non-Ferrous Industrial Metals"; the Bessemer Premium to Prof. W. G. Fearnsides for his paper on "The Mineral Requirements of the British Iron and Steel Industries"; the Bernays Premium to Prof. J. A. Fleming for his paper on "Engineering and Scientific Research"; the Nursey Premium to Mr. J. E. Lister for his paper on "Modern Coal and Coke Handling Machinery as used in the Manufacture of Gas"; and the Society's Premium to Mr. Ewart S. Andrews for his paper on "The Design of Continuous Beams."

THE Alvarenga prize of the Swedish Medical Association for 1916 has been awarded to Dr. E. Nilsson for his study of the physical development and fitness for military service of the young men of Sweden between the years 1861 and 1913. The jubilee prize of the association has been won by Mr. H. B. Lundborg for his medical-biologic study of generations of certain Swedish families.

THE following have been elected as the officers of the Optical Society for the year 1917–18: *President,* Mr. F. J. Cheshire; *Hon. Treasurer,* Mr. H. F. Purser; *Hon. Secretary,* Mr. W. Shackleton; *Hon. Librarian,* Mr. J. H. Sutcliffe; *New Members of the Council,* Mr. L. G. Martin, Dr. W. Rosenhain, Mr. T. Smith, Mr. F. Twyman, Dr. R. Mullineux Walmsley, Mr. R. S. Whipple, and Lt.-Col. A. C. Williams.

THE annual general meeting of the Institution of Mechanical Engineers will be held at the Institution of Civil Engineers, Great George Street, Westminster, at 6 o'clock to-morrow evening, when the annual report of the council will be presented, and a paper read by Dr. W. Mason entitled "Alternating Stress Experiments."

THE trustees of the late Lord Kitchener have loaned to the London County Council, for exhibition at the Horniman Museum, Forest Hill, the collection of Eastern weapons and armour made by Lord Kitchener. Most of the weapons of northern India, and of the advanced peoples of other parts of India, are represented in the collection, together with a few from Persia, China, Japan, the Sudan, and elsewhere. The collection is in course of arrangement, but may be seen whenever the museum is open to the public.

WE regret to have to record the death, on Sunday last, at the age of sixty-nine years, of the Duke of Norfolk, Chancellor of the University of Sheffield.

THE *Aurora*, under the command of Capt. J. K. Davis, with Sir Ernest Shackleton on board, arrived at Wellington, N.Z., last Friday, bringing the survivors of the Ross Sea party of the Imperial Antarctic Expedition. A despatch from Sir Ernest Shackleton to the *Daily Chronicle* amplifies the brief account sent by wireless last week, which announced the death of Capt. Macintosh, Mr. V. G. Hayward, and the Rev. A. P. Spencer Smith. Between January and March, 1915, this party of men had been engaged in laying depôts as far as 80° S. lat. in anticipation of Shackleton's cross-continental journey. On March 14, 1915, one sledge party returned to Hut Point three days after the *Aurora* had been forced to move to Cape Evans on account of MacMurdo Sound freezing. Eight days later the second sledge party returned, badly frost-bitten, and having lost all their dogs. Open water or thin ice prevented their reaching Cape Evans until June 1, when they found the *Aurora* had gone. The winter was spent in the hut at Cape Evans. Provisions were abundant, but coal was short, as the main coal supply had been washed away soon after being landed. Blubber, however, served as fuel, and the deficiency in clothing was made good from the materials left by the Scott expedition. In September, 1915, a sledge party again set out for the south, and a depôt was successfully laid near Mount Hope, at the foot of the Beardmore Glacier, on January 26, 1916. Two of Capt. Scott's sledges were found. On the return journey scurvy appeared among the party, and Capt. Macintosh and Mr. Spencer Smith were seriously affected. Near One Ton Depôt they were overtaken by a furious blizzard, just as Scott was, from February 17 to March 1, but they decided to push on, as their provisions were very short. Forty miles from Hut Point the strength of the six men was almost exhausted. Capt. Macintosh then elected to be left behind to give the others a chance, as neither he nor Spencer Smith could walk, and had to be carried on sledges. The following day (March 9) Spencer Smith died, and two days later Hut Point was reached. A relief party succeeded in bringing Capt. Macintosh back in safety. Early in May the ice between Hut Point and Cape Evans seemed thick enough for travel, and Macintosh and Hayward, who had by that time recovered from scurvy, set out to reach Cape Evans, but broke through thin ice on the way and perished. The winter of 1916 was spent in sledging stores from Shackleton's old hut at Cape Royds to Cape Evans, in view of a possible third winter of detention. On January 10 this year the *Aurora* arrived at Cape Evans and picked up the seven survivors, H. E. Wild, E. Joyce, A. Stevens, Cope, Gaze, Richards, and Jack. No new geographical discoveries were made and none were expected, for this Ross Sea party was merely a supporting one in the event of Shackleton crossing the continent. However, the meteorological records will prove of great value.

BY the death of Dr. C. V. Burton on February 3, owing to an accident at the Royal Aircraft Factory, the country loses a mind of great originality and power. In 1891, when his strain figure theory of the constitution of matter was first published, he was only twenty-four years of age, and had already shown his capability as an investigator. During the next four or five years he added greatly to his reputation by his papers on the propagation of explosive waves through gases, on the rise of pitch of the note of a tuning-fork as it dies away, and on the mechanism of electrical conduction in metals. In 1905 he gave in these columns an account of his researches on the artificial production of diamonds, and three years later investigated the pressure oscillations in an atmosphere subjected to periodic heatings and coolings.

In 1909 he developed a suggestion of Prof. Hicks into a "pulsation theory" of gravitation. Problems connected with gravitation and with the relations between matter and ether occupied his attention during the succeeding years, his papers appearing in the *Philosophical Magazine*. With the analytical powers necessary for the prosecution of these researches Dr. Burton combined an insight into the construction and capabilities of instruments which made his position almost unique. His micro-azimometer may be taken as an example of his powers as a designer of instruments. The necessity for an instrument of great sensitiveness arose out of his search for a possible effect of the motion of the earth on the azimuth of a thin metal sheet suspended *in vacuo*, a search on which he was still engaged when the war broke out. An echelon grating, built up of reflecting elements and having a resolving power in the neighbourhood of the D-line of more than two millions, was also under construction by Dr. Burton, and shows his great skill. From the time when he was a demonstrator in physics at University College, London, Dr. Burton was an active member of the Physical Society of London, and his quiet manner and clear method of exposition made him a valuable asset at any meeting he attended.

CHARLES OWEN WATERHOUSE, whose death, at the age of seventy-three, was announced in NATURE of last week, was an entomologist of a type which, in these days of specialisation, is gradually becoming rarer. Few entomologists of his time had a wider or more varied knowledge of insects, although, as a specialist on the Coleoptera, he probably published less work than did many of his contemporaries. His papers were very numerous, and the mere titles of them would fill some pages, but the majority of them were very short, and related chiefly to species which, possessing some exceptional or striking character, attracted his attention. These species were drawn from almost every family of Coleoptera, and not a few belonged to other orders of insects. He was not fond of descriptive writing, and, in fact, wrote comparatively little, his most sustained effort in this direction being his contribution on the Buprestidæ to the "Biologia Centrali-Americana," in which he had to deal with 434 species, 300 of which were new. The morphological side of his subject seemed to have the greatest interest for him, and he often turned to it as a relief from the monotony of arranging long rows of specimens in cabinet drawers, or writing out pages of descriptions. His hands were at all times rather shaky, and it was wonderful to watch with what great success he could carry out the most delicate piece of manipulation. In his later years he co-operated with the late Fred Enock in collecting and studying the Mymaridæ—parasitic Hymenoptera of the smallest dimensions, some of which could pass readily through the eye of a needle. The exhibited series of insects in the insect gallery of the Natural History Museum, the guide-book to this series, and the many drawings, diagrams, models, and explanatory labels were nearly all prepared by him or under his direction, and afford some of the best evidence of the value of his work. He must have commenced his study of entomology at a very early age and under the most favourable auspices. His father, G. R. Waterhouse, the friend of Darwin and Owen, although officially connected with the British Museum as keeper of the Department of Geology, was himself almost more distinguished as an entomologist than he was as a geologist. Mr. Waterhouse entered the British Museum as an assistant in 1866, and from 1905 until his retirement in 1910 was assistant-keeper of the Zoological Department, and head of the Entomological Section. Just before his retirement the Companionship of the Imperial Service Order was conferred upon him.

THE death is announced at the age of sixty-seven of Rai Bahadur Sarat Chandra Das, C.I.E., the Bengali explorer of Tibet. In his younger days he was a schoolmaster at Darjeeling, and at the age of thirty paid his first visit to Tibet. In the following year he explored the Yarlung valley and Lake Palti and visited Lhassa. In 1882 he accompanied the late Mr. Macaulay on his mission to Sikhim and the Tibetan frontier, and in 1885 he again accompanied Mr. Macaulay when he went to Peking to ask permission of the Chinese Government for a mission to enter Tibet. For his services on this occasion Chandra Das was awarded the C.I.E. In 1888 the Royal Geographical Society awarded him the Back bequest for his geographical researches. For political reasons his researches in Tibet were not published until 1902. He was a great student of Buddhist writings and the founder of the Buddhist Text Society of India. Chandra Das was a man of great ability and conspicuous daring. To his initiative and courage is due much of our knowledge of the Indian frontier lands.

WE regret to note from the *Engineer* the death of Mr. James Gilchrist, chairman of Messrs. Barclay, Curle and Co., Ltd., of Glasgow. Mr. Gilchrist was born in Glasgow in 1847, and was associated with his firm for about fifty-five years. The ocean-going motor-ship—the *Jutlandia*—was built and engined by his firm in 1912, and was the first vessel of this class built in the United Kingdom. Mr. Gilchrist was a member of the Clyde Navigation Trust.

THE death of Mr. Isaac John Mann is also announced in the *Engineer*. Mr. Mann was educated at Trinity College, Dublin, and was for several years assistant engineer to the Dublin Port and Docks Board. He was associated with Sir John Fowler in the construction of Rossclare Harbour, and was afterwards resident engineer at the harbour construction works at Fishguard. He was a member of the Institution of Civil Engineers, and was awarded a Telford premium for his book on the formation of river bars.

THE death is announced in *Science*, at the age of 105, of Mr. John Finlayson, after whom Finlayson River and Finlayson Lake in Yukon Territory were named. Finlayson was a gold miner in California and Oregon until he was eighty-six years old, and then did much pioneer exploration work in British Columbia and Yukon Territory.

THE death is announced of Mrs. P. Amaury Talbot, wife of the District Commissioner of the Nigerian Political Service, and author of "Woman's Mysteries of a Primitive People: the Ibirios of Southern Nigeria." Mrs. Talbot travelled extensively, accompanying her husband for many years on all his journeys.

THE lecture given before the Aeronautical Society on February 7 by Mr. F. Handley Page on "The Case for the Large Aeroplane" reminds us that after the war the problem of the large aeroplane will assume even greater importance than at present. The demand in war time is for a machine having high speed and good climbing powers, but after the war the problem of using large aircraft for the transport of passengers and mails will certainly receive much attention. The success of the large aeroplane depends more upon constructional questions than upon aerodynamics. A

large machine can be designed which is certainly not inferior to the small ones from a purely aerodynamic point of view. The same performance can therefore be secured if the weight of the machine and the horse-power are proportional to the wing area, *i.e.* to the square of the linear dimensions. If it be assumed that engines of the same weight per horse-power are used, the problem resolves itself into that of constructing large machines with a sufficient factor of safety, and with the actual constructional weight proportional to the wing area. Whether this can be done or not is an open question; Mr. Handley Page is of the opinion that it is possible. Of course, it must further be remembered that, in peace time, the same high performance in speed and climb will not be so necessary as it is for war purposes, and this will materially simplify the problem of building larger machines.

AFTER the first day or two of February a change occurred in the character of the cold weather which had been so persistent since the commencement of January, and the night frosts, which were at first of a very mild character, became generally severe over Great Britain. In the Midland district of England the sheltered thermometer fell below zero at well-equipped stations. The reports from the health resorts which are issued daily through the Meteorological Office show 2°, or 30° of frost, at Ross-on-Wye, while at coast stations the thermometer in the screen registered 12° at Southport and Skegness, 13° at Aberystwyth, 17° at Yarmouth and Weston-super-Mare, and 18° at Eastbourne and Dover. The lowest temperature recorded at South Kensington was 21°, but the thermometer fell 5° lower in parts of the London suburbs, on higher ground. Frost had become more general and was more severe than on any occasion since the winter of 1894–95, but the intense cold was much less continuous. A break in the frost occurred over Scotland and the northern districts of England towards the close of last week, and by the commencement of the present week it had extended to all parts of England, although the thaw at first was by no means rapid.

THE report of the Medical Officer of the Local Government Board for 1915–16 has recently been issued. So far as infectious diseases are concerned, with the single exception of measles, the record of 1915, like that of 1914, remained favourable. Eighty-one cases of smallpox occurred, but the disease failed to obtain more than a temporary footing in any district. More than a million and a half tubes of vaccine lymph have been distributed from the Board's establishment. The work of the medical department has centred chiefly around the military position, and a dual problem has arisen with regard to several infectious diseases: the increased risk arising within the United Kingdom, and the increased risk of the importation of infection. Dr. Bruce Low contributes to the report an account of the epidemiology of acute anterior poliomyelitis (infantile paralysis) in recent years. A number of reports on scientific investigations undertaken for the Board have been unavoidably postponed, but Drs. Eastwood and Griffin have contributed a report on the characteristics of tubercle bacilli in human bone and joint tuberculosis, and Dr. Griffin one on bovine actinomycosis in which he shows that the disease occurring among cattle in this country is frequently identical with the special form described by Lignières and Spitz in Argentina as actinobacillosis.

IN the January issue of *Man* Sir Hercules Read describes two interesting bronze castings of Siberian or Scythian work and a monstrous animal in jade, the castings having been presented to the British Museum by Mr. Louis Clarke, the jade figure the property of Mr. Oscar Raphael. In one casting an animal with a horse-like body, griffin head, and ibex-like horns stands calmly while a wolf-like creature bites its foreleg. The second represents a combat between a lioness and an eagle. The jade figure shows an animal in a crouching posture. The recent work of Mr. Minns, "Scythians and Greeks," supplies much information which helps towards the interpretation of these objects of art, which are of special interest because many well-known features of our pagan Saxon art, and that of Western Europe generally, have their roots in the Siberian culture, and it is claimed that Carlovingian art is equally in its debt.

THE object of the elaborate monograph by Dr. H. B. Ferris, reprinted from vol. iii. of the Memoirs of the American Anthropological Association, on the Indians of Cuzco and the Apurimac, is to provide materials for the solution of some important problems: the derivation of the Peruvians; the time of their advent into the country; the extension and physical characteristics of the Aymara and Quichua; and the cultural relations of the Peruvian to the Argentine and Chilean aborigines. Dealing with the pure Quichuas, the author finds them to be mesocephalic, and in very large proportion hypsicephalic, the facial index being similar to that of the North American Indian. The results are not worked out in detail, but he arrives at the interesting conclusion that "in many of the body proportions and in some physiognomic characters the Quichua resemble certain North American Indians."

MR. E. J. WEYLAND, in *Spolia Zeylanica*, vol. x., part 38, describes and figures the canine and the first left upper molar of a horse found in a bed of grey sandy clay at a depth of 23 ft. below the surface during the digging of a trench by the Colombo Drainage Works at Wellawatta. The author inclines to the view that these teeth represent a Pleistocene species scarcely distinguishable from the existing horse, but for which he proposes the name *Equus zeylanicus*. The author discusses at length the possibility that horses may have been introduced into Ceylon by human agency, but is of opinion that the evidence, on the whole, justifies the assumption that they entered the island with the elephant by means of a land-bridge.

PROF. CLAYTON SMITH, of the University of California, contributes to the *American Naturalist* for January a valuable summary of his experiments on the comparative resistance of Prunus to Crown gall. This disease, known also as plant tumour and plant cancer, is due to the presence of the motile *Bacterium* (*Pseudomonas*) *tumifasciens* in the cells at the point where the root is given off from the trunk. By artificially inoculating various forms of Prunus with pure virulent laboratory cultures, he sought to find a suitable resistant stock which could be adapted to the propagation of the stone fruits. The variety known as Golden Beauty, *P. hortulanum*, has so far shown more marked resistance than other varieties of the species hitherto tested, and it further displays a number of excellent qualities that would recommend it as a stock. *P. pumius* is entirely resistant to artificial inoculation, which constitutes a far more severe test than obtains under the usual field conditions. The work conducted to the present shows that seedlings of the German and Italian prunes might be promising stock for certain of the stone fruits, probably of the *domestica* type. However, no definite recommendations can be given, as the work is now only in its preliminary stages.

IN *Physis, Revista de la Sociedad Argentina de Ciencias naturales* (No. 11, tome ii.), an account is given by Ana Manganaro of cleistogamic flowers in *Ranunculus hilairei, Cardamine chenopodifolia,* and *Trifolium argentinense.* The article is illustrated by photographs of the plants showing the cleistogamic, or self-fertilised, flowers, and the way in which they bury themselves in the ground. In the Ranunculus these small flowers are produced in the axils of the outer radical leaves, and the flower stalks bend over and lengthen, carrying the developing fruits underground. In the Cardamine the contrast between the normal flowers borne on long inflorescences and the small abnormal flowers borne in the axils of the leaves of the basal rosette is very striking. In the Trifolium the abnormal heads contain some five to eight flowers, whilst the normal ones contain as many as thirty.

M. DE MONTESSUS DE BALLORE, the director of the Chilean Seismological Service, recommends that scales of seismic intensity should be abandoned (Bull. Seis. Soc. America, vol. vi., 1916, pp. 227–31). The suggestion, if carried out, would involve the disappearance of isoseismal lines from our earthquake maps. He would retain only the following lines:—The curve which bounds the disturbed area, and those which surround the places of greatest intensity and the area of damage. The last-mentioned curve would be fairly definite, but the first would be illusive, for the perception of a shock depends on certain accidental conditions. An earthquake which occurs on a Sunday afternoon, for instance, will be felt over twice the area of one in the middle of a weekday.

IT is commonly taught by the agricultural chemist that one of the many useful effects of an application of lime to the soil is the bringing into solution of a portion of the potash contained in the soil. The present lack of potash manures has, indeed, caused stress to be laid upon the increased use of lime or calcium sulphate as one means of drawing more rapidly upon the potash reserves of the soil. The assertion seems, however, to rest upon a very slender basis of evidence, and, as regards a certain type of soil, is directly challenged by Messrs. L. J. Briggs and J. F. Breazeale in the *Journal of Agricultural Research,* vol. viii., No. 1 (January, 1917). In experiments with orthoclase and pegmatite, and also with soils of granitic type, they failed to detect any increase of the solubility of the potassium on treatment with various proportions of calcium hydroxide or sulphate. In the case of orthoclase and of one of the soils, the presence of calcium sulphate in solution actually depressed the solubility of the potassium, the quantity of the latter in solution decreasing progressively as the concentration of the calcium sulphate increased. These results were fully borne out by the amounts of potash taken up by wheat seedlings grown in the respective solutions. The experiments thus indicate that the availability to plants of the potash in soils derived from orthoclase-bearing rocks is not likely to be increased by the application of lime or gypsum.

AN interesting article on "The Training of an Analyst" is contributed to the *Chemical News* for January 26 by Mr. Frank Browne, who was formerly Government analyst at Hong Kong. Mr. Browne ventures to assert that a chemical student may leave college with a good degree and yet know little of the practical side of the analytical profession. Such a student, going directly into a works laboratory or that of a public analyst, will probably in the course of time acquire sufficient experience to become very useful so long as his scope is limited to routine analyses. But, given a sample of unusual kind for analysis, he may be found wanting on account of lack of training in good, rapid analytical methods. The training of an analyst should be such that from a work of reference he can devise an analytical method for any strange sample and apply it successfully without interfering overmuch with his routine duties. Emphasis is laid on the fact that, by careful study, nearly any system of analysis can be shortened to a remarkable degree, and some methods of doing this are indicated. The author strongly supports Mr. A. Chaston Chapman's recommendation that to the curriculum of chemical students who intend to become professional chemists a year should be added in which they would be trained under conditions resembling those of a technical rather than those of an academic laboratory. He suggests that the programme for the year should include analyses of water, fuel, oils, fats, and waxes, alcoholic liquids, metals and alloys, whilst a good working knowledge of the microscope, polarimeter, refractometer, and spectroscope should be acquired. It is also desirable that the student should have a sound knowledge of the British system of weights and measures.

WE are asked to say that the work of Prof. Percy Groom upon the Indo-Malayan Yang wood (Dipterocarpus sp.), referred to on p. 450 of NATURE for February 8, was carried out at the Imperial College of Science and Technology, and not at the Imperial Institute as stated in the article.

THE spring list of announcements of the Oxford University Press (Mr. Humphrey Milford) includes: "Three Lectures on Experimental Embryology," the late Capt. J. W. Jenkinson, with a short biographical notice of the writer by Dr. R. R. Marett; "The Beginnings of English Overseas Enterprise," Sir Charles P. Lucas, with notes, references, and an appendix of the First Charter to the Merchant Adventurers; "Sir Walter Raleigh: Selections from his 'History of the World,' Letters, and other Writings," edited, with introduction and notes, by G. E. Hadow, with maps, a portrait, and a facsimile of his handwriting; "The Casting Counter and the Counting-Board: A Chapter in the History of Numismatics and Early Arithmetic," F. P. Barnard, illustrated; "Education To-day and To-morrow," P. Matheson; "The Origin and Meaning of Some Fundamental Earth Structures," C. F. Berkey; "Milk Production Cost Accounts: Principles and Methods"; "Aristotle: Meteorology," edited by F. H. Fobes; "The Order of Nature," L. J. Henderson; "An Adequate Diet," P. G. Styles; "Calculus of Variations," W. E. Byerly; "Organism and Environment," J. S. Haldane.

OUR ASTRONOMICAL COLUMN.

A GREAT SUN-SPOT.—A group of spots large enough to be seen with the naked eye has been visible on the sun during the past week. A writer in the *Times* of February 9 describes it as one of the largest groups ever photographed at Greenwich, and gives the heliographic co-ordinates as long. 10°, lat. 15° south. It is further stated that the disturbed area was 125,000 miles long and 64,000 miles broad, and consisted of two very large spots connected by a group of small ones. The diameter of the preceding spot was 35,000 miles, that of its umbra being 13,000 miles. The following spot was larger, with several umbræ. The spot passed the central meridian on February 9 and will remain visible until February 15, when it will be near the west limb.

Prof. Fowler informs us that on February 7 observations with the spectroscope indicated great activity, especially among the smaller connecting spots; in this region many brilliant reversals of the Hα line were noted.

PARALLAXES OF PROCYON AND ALTAIR.—Among the large number of stellar parallaxes recently determined by photographic methods at the Leander McCormick Observatory, Dr. S. A. Mitchell has directed special attention to the results for Procyon and Altair (*Pop. Ast*, vol. xxv., p. 38). For Procyon, the values which have been previously determined are remarkably consistent, ranging from 0·287″ to 0·34″, and Dr. Mitchell's parallax of 0·309″ ± 0·007″ is in perfect agreement with the mean of all. The parallax arrived at for Altair is 0·218″ ± 0·007″, and this again accords very closely with the weighted mean value 0·220″ derived from earlier determinations.

DENSITIES OF VISUAL BINARY STARS.—An interesting attempt to advance our knowledge of the densities of stars of different classes has been made by E. Öpik, of Moscow, in a discussion of the probable densities of visual binaries for which orbits have been calculated (*Astrophysical Journal*, xliv., p. 292). He proceeds by developing a series of formulæ by which the density can be determined when the surface brightnesses of the components are known. The surface brightness itself is determined from the spectral type, in conjunction with the corresponding effective temperatures given by Wilsing and Scheiner, and an application of the radiation formula of Planck. The mass-ratio of the two components must also be known, and where such data are not available, approximate values are estimated from the differences in magnitude. The densities calculated in this way for forty pairs cover a wide range (0·012 to 5·9, in terms of the sun), but a considerable proportion of them approach the density of the sun. The mean values for the different spectral classes, which are only to be regarded as roughly approximate, are as follows :—

Spectral type	No. of stars	Density
A 0–A 5	9 ...	0·65
F 0–F 8	19 ...	0·59
G	7 ...	0·23
K, K 5	5 ...	0·072

So far as they go, though the author does not comment upon this point, the figures show an order of density opposite to that which would be expected on the supposition that celestial evolution is along a line of descending temperature only. When accurate magnitudes and spectral types (or colour-indices) become available for each component, it will be possible to obtain separately the densities of the components, and an important region of stellar statistics will be opened up.

EXPERIMENTS ON ASCARIS INFECTION IN HONG KONG.

AN important paper by Capt. F. H. Stewart, Indian Medical Service, appeared in the *British Medical Journal* for July 1, giving the life-history of *Ascaris lumbricoides*, which is extremely common both in man and the pig at Hong Kong, where the author is stationed with the 74th Punjabis. In this preliminary communication he showed that the parasite presents an alternation of hosts. Thus, when ripe eggs reach the alimentary canal of the rat or mouse the larvæ are liberated, and six days after infection they are found in the blood-vessels of the lungs and liver, and the host is seriously ill with pneumonia. They next pass from the blood-vessels into the air-vesicles of the lung, causing hæmorrhage into them. On the tenth day they occur only in the vesicles and in the bronchi. If the disease does not prove fatal, the host recovers on the eleventh or twelfth day, whilst on the sixteenth day it is free from parasites. The affected animals could readily contaminate by the nose or mouth the food of man or the dust and earth of his surroundings.

Capt. Stewart has continued his experiments since the foregoing date both with *A. lumbricoides* and *A. suilla*, and finds that the larvæ appear in the bronchi, trachea, and mouth of the rat and mouse on the night of the seventh day and during the eighth day after infection by the mouth, and he believes that they pass by means of the saliva on to the food which is being nibbled by the rodents. It is possible that one attack of Ascariasis in rats renders them immune against subsequent attacks, but further confirmation is necessary. He found that the larvæ survived longest (twenty-four hours) in blood on moist bread. In water, normal salt-solution, and in mouse's blood they survived three hours.

Out of five experiments to test the infection of pigs from the foregoing rodents, three gave positive results, two negative. In estimating the value of the negative experiments the very high mortality among the parasites employed under somewhat unnatural conditions must be kept in mind. Capt. Stewart endeavoured to obtain an estimate of this mortality by comparing the number of ripe eggs given to a mouse with the number of larvæ found in the lung. An average dose contained about 5000 eggs, whilst the number of larvæ found in the lungs did not exceed fifty. The transfer from the rodent to the pig is probably the most vulnerable part of the life-cycle, since the larva is a very delicate organism. The author also carried out control experiments with the pig.

Lastly, Capt. Stewart carried out some experiments which demonstrated that *A. marginata* of the dog has also its intermediate host in the mouse.

He concludes by stating that if ripe eggs of *A. lumbricoides* are swallowed by rats or mice they hatch. The larvæ bore into the venules of the portal system or ascend the bile-duct. They are found in the dilated capillaries of the liver between the second and the fifth days. As their diameter is three times that of a blood-corpuscle in the mouse, they cannot pass through a normal capillary. The liver-cells in the neighbourhood of the larvæ undergo rapid degeneration, and the larvæ are thus enabled to pass by the hepatic vein and vena cava to the heart, and by the pulmonary artery to the lungs, where they are filtered off at the entrance to the capillary field. Embolism of the arterioles takes place, and the larvæ pass with the effused blood into the air-vesicles on the sixth day. They are found in the bronchi on the seventh day, and in the trachea and mouth on the eighth day, after infection. The larvæ from the lungs of rodents can infect the pig, and it is probable that in Nature infection of both man and the pig takes place by food contaminated by rats and mice. W. C. M.

SEX-LIMITED FACTORS IN HEREDITY.

FEW of the results obtained in recent years by students of heredity on Mendelian lines have appealed to biologists as a whole more forcibly than such cases of "sex-limited" inheritance as are exemplified by colour-blindness in mankind or the special type of wing-marking in the magpie-moth (*Abraxas grossulariata*) described by Dr. Leonard Doncaster in his work on the "Determination of Sex." Those who have followed the progress of research on the subject during the last five years recognise how important have been the results obtained by Prof. T. H. Morgan and his colleagues in their studies of inheritance in fruit-flies of the genus Drosophila.

An admirable summary of these studies, entitled

"Sex-Linked Inheritance in Drosophila," by Prof. T. H. Morgan and Dr. C. B. Bridges, has now been issued by the Carnegie Institution of Washington (Publication 237, 1916). These flies are excellent subjects for investigation, as they can be reared in very large numbers, and they show an extensive series of characters in eye-colour, body-pattern, wing-nervuration, etc., which are definitely sex-linked, being transmitted by the male to his daughters only, who show a character if dominant, and conceal it if recessive, while the female transmits such characters to her offspring of both sexes impartially. Many of these characters have appeared as "mutants" in the course of the experiments, which have thus furnished proof of the segregation of new forms. But the most striking feature of the researches on Drosophila is the apparently certain connection between the observed inheritance of the sex-linked characters and the behaviour of the sex-determining (x) chromosomes. "Over a hundred characters that have been investigated as to their linkage relations are found to fall into four groups, the members of each group being linked in the sense that they tend to be transmitted to the gametes in the same combinations in which they entered from the parents. . . . A most significant fact in regard to the linkage shown by the Drosophila mutants is that the number of linked groups corresponds to the number of pairs of the chromosomes."

The authors claim that there is conclusive evidence of the x-chromosome's part as sex-determinant, and they believe that they can locate the position in this x-chromosome of many of the sex-linked factors. In a small proportion of individuals of the F_2 generation it sometimes happens that the sex-linked characters are not distributed according to expectation. In such cases "an interchange has taken place between the two x-chromosomes in the female in such a way that a piece of one chromosome has been exchanged for the homologous piece of the other." This "crossing over" of pieces of paired chromosomes is one of the most remarkable hypotheses founded on sex-limited inheritance, and would help to explain various anomalies in Mendelian results. "There are," the authors remark, "certain facts familiar to the cytologist that furnish a clue as to how such an interchange might take place." Those who wish to follow the subject further may consult with profit Dr. H. J. Muller's series of papers on "The Mechanism of Crossing Over," the last of which, with a summary, appeared in the *American Naturalist* of July, 1916 (vol. l., No. 595), as well as Dr. A. H. Trow's "Criticism of the Hypothesis of Linkage and Crossing Over" (*Journ. of Genetics*, v., No. 4), enforcing the "extraordinary difficulties" which prevent some students of heredity from accepting a theory "simple enough at first sight."

A short paper on "Sex-Limited Colour in Ayrshire Cattle," by Prof. E. N. Wentworth, has been published in the *Journal of Agric. Research* (vi., No. 4). The author concludes that black-and-white—a combination long known in the breed—is a simple allelomorph to the more favoured red-and-white, black-and-white being dominant in bulls and red-and-white in cows.

Miss R. Haig Thomas describes studies of "Colour and Pattern Transference in Pheasant-Crosses" (*Journ. of Genetics*, v., No. 4); her paper is illustrated by a good series of coloured plates and photographs. The Swinhoe, Silver, Formosan, and Reeves species formed the subjects of the experiments, which afford interesting examples of sex-limited inheritance analogous to those shown in other organisms. "The male parent always transmits the female characters of his species to his female offspring, and the female parent transmits to her male offspring many of the male characters of her species. . . . The phenomenon of pattern- and colour-transference is present in all the experiments made in pheasant-crosses up to date. These consist sometimes of transference from one area to a different area in the same sex, or from one area to a different area in the opposite sex, or from an area in one sex to the same area in the opposite sex. . . . In the fertile hybrids, plumage, dimension, leg colour and structure, habit, call, are all correlated, but moult is independent and liable to great disturbance in hybridisation."

Sex-linked factors in domestic animals may determine characters of much economic importance. For example, the work of Dr. Raymond Pearl with barred Plymouth Rock fowls has shown that high winter egg-production depends on two Mendelian factors, one of which is sex-linked. In the *American Naturalist* (xlix., 1915, No. 586) Dr. Pearl gives an account of the results of selection-breeding for this character over a period of seventeen years. From 1898 to 1907 "mass selection" for breeding of high producers was carried on without any test of the progeny from particular matings, and this was found to be ineffective in improving the strain. Since 1907 the light thrown on the problem by research on Mendelian lines has enabled selection to be based on the genetic nature of the birds as shown by the performances of their progeny, and such selection "was extremely and quickly effective," so that "if one selects genetically high producers . . . he succeeds very rapidly in fixing a high-producing strain."

To many students the facts of sex-linked inheritance, together with the difference indicated by the presence of one or two x-chromosomes in the nuclei of one or the other sex, have strongly suggested the conclusion that maleness and femaleness are themselves to be regarded as Mendelian alternative characters (allelomorphs), and that sex is irrevocably determined in the fertilised egg. As mentioned above, this conclusion is strongly urged in Morgan and Bridges's memoir on Drosophila. Yet such facts as the development of female characters in male crabs parasitised by Sacculina, demonstrated by the late Dr. Geoffrey Smith's well-known researches, forbid sweeping generalisations as to the determination of sex throughout the animal kingdom solely by the nuclear constitution of the germ-cells. On this fascinating subject Dr. O. Riddle has lately published a contribution (*American Naturalist*, l., No. 595) on "Sex Control and Known Correlations in Pigeons." Acknowledging that "when one nowadays states that he has obtained a real control—a reversal—of the development of sex, he can feel assured that his biological audience demands a very large volume of rigid proofs," the author believes that such proofs are forthcoming from the work on pigeons of the late Prof. Whitman, supplemented by researches of his own. He states that "width of cross" in pairing leads to a high proportion of males in the offspring, and that in the ordinary reproduction of pigeons of the same species males predominate among chicks hatched from the early, small-yolked eggs, and females among those from the later, large-yolked eggs. By appropriate treatment it was found possible to "begin the production of females at earlier and earlier stages of the season." It is likely that Dr. Riddle will not succeed in convincing those biologists who have faith in the absolute determination of sex from the nuclear structure of the fertilised egg, but his paper may be effective in checking the tendency to too positive statements on this fascinating subject.

G. H. C.

RECENT WORK IN PALÆONTOLOGY.

SEVEN new genera of trilobites, Menomonia, Millardia, Dresbachia, Norwoodia, Saratogia, Vanuxemella, and Hanburia, are described in C. D. Walcott's second paper on "Cambrian Trilobites" (Smithsonian Miscell. Coll., vol. lxiv., No. 3, 1916). The first four are placed in Beecher's Proparia, and "establish the existence of a strong group of the order in Cambrian time."

Part 3 of vol. lxxi. of the Quarterly Journal of the Geological Society of London (September, 1916) contains evidence that the honours of research in Cambrian faunas are not to be left entirely to workers in North America. V. C. Illing (p. 386) describes a rich fauna of Middle Cambrian age from ninety feet of strata in the Stockingford Shales near Nuneaton. More than fifty distinct forms of trilobites are recorded. T. C. Nicholas, in "Notes on the Trilobite Fauna of the Middle Cambrian of the St. Tudwal's Peninsula (Carnarvonshire)" (p. 451), somewhat modestly regards his work as a supplement to the remarkable discoveries near Nuneaton. Prof. C. Lapworth, who first recognised the Cambrian age of the beds near Nuneaton, has added some stimulating remarks in the discussion on both these papers.

Prof. H. Douvillé, in describing the marine invertebrate fossils collected during the British expedition to Tibet (Mem. Geol. Surv. of India, Palæontologia Indica, vol. v., Mem. 3, 1916), is able to revise the classification of the strata in this little-known district. The interest centres in the passage-beds from the Cretaceous to the Eocene (p. 44), which are marked by gastropods of Danian and Cainozoic types side by side, while a Cretaceous type of nautilus occurs in Operculina limestones, and, with other fossils, is held to carry these beds down into the Danian stage.

Little by little our knowledge of dinosaurs in South Africa spreads. In April, 1915 (Proc. Geol. Soc. S. Africa, vol. xviii., 1916, p. xxxiii), H. B. Maufe, director of the Geological Survey of Southern Rhodesia, communicated a report by S. H. Haughton on bones found twenty-five miles from Bulawayo. These came from the Forest Sandstone, and resemble Thecodontosaurus and Gyposaurus from the Cave Sandstone of the Cape Province and the Orange Free State. Mr. Maufe consequently regards the Forest Sandstone as of Stormberg age. A month later, A. W. Rogers read a paper on "The Occurrence of Dinosaurs in Bushmanland" (Trans. Roy. Soc. S. Africa, vol. v., 1915, p. 265). The remains were found in the ancient infilling of a valley cut in gneiss, and the author draws the interesting conclusion (p. 268) that the present valley was initiated in Mesozoic times, when the climate was wetter than at present, and that continuous infilling has since gone on. S. H. Haughton (*ibid.*, p. 259) refers the bones and a tooth to a new genus, Kangnasaurus, intermediate between the Upper Jurassic Camptosaurus and the Upper Cretaceous Mochlodon. It is thus probable that the alluvial deposit is of Cretaceous age.

E. L. Troxell describes two interesting birds' eggs of Oligocene age from near Harrison, Nebraska (Journ. Washington Acad. Sci., vol. vi., 1916, p. 422). They are probably those of a water-fowl, and are now filled by calcite. In one case chalcedony has crept in at the narrow end, and a layer of agate preceded the deposition of the calcite. In the other case a large central amber-coloured crystal of calcite, surrounded by white crystals of smaller grain, reproduces by a coincidence the colouring of the original contents.

G. E. Pilgrim and G. de P. Cotter describe "Some newly discovered Eocene Mammals from Burma" (Records Geol. Surv. of India, vol. xlvii., 1916, p. 42). The remains are of special importance, as representing the earliest known Asiatic mammals. The Yaw Clays and underlying Pondaung beds in which they are found probably "correspond with some part of the Upper Eocene." Ninety-five per cent. of the specimens from the Pondaung sandstones represent Anthracotheres. A Titanothere, *Telmatherium* (?) *birmanicum*, n. sp., shows by its teeth an intermediate character between the Eocene and Oligocene members of the family.

Clement Reid and J. Groves (Proc. Roy. Soc., B, vol. lxxxix., 1916, p. 252) find that the remains of Characeæ in the Purbeck limestones are partly silicified. This has enabled them to etch out certain interesting structures connected with the stem, including clusters of small club-shaped processes set on the "sheathing tubes" of a new genus which they style Clavator. In addition to the photographs of specimens, which are faithfully given, a sketch would be welcome showing the author's reconstruction of the plant in its habit as it lived.

The investigation of the Mesozoic floras of Queensland has been aided by the discovery of a Cretaceous marine fauna below plant-beds that were supposed to be Triassic (A. B. Walkom, "Flora of the Ipswich and Walloon Series," Queensland Geol. Survey, Publication No. 252). It is possible that the two underlying series dealt with in the present memoir may prove to be of Jurassic age. The equisetales of the Ipswich beds have affinities with Rhætic forms.

G. A. J. C.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A Grace passed the Senate on February 10 approving the establishment of the new research degrees, Master of Letters and Master of Science. The object of these is to encourage students to remain in residence for one or two years after they have completed their work for the Tripos, and engage in research under competent direction. These new degrees are mainly intended for Cambridge graduates, but they will be open to properly accredited students from other universities. The proposal to establish new research degrees has been under careful consideration by the University throughout the greater part of the duration of the war. A suggestion that a doctorate should be awarded to research students of the standing in question was rejected on the ground that the degrees of Litt.D. and Sc.D. were already in existence and demanded a much higher standard of attainments.

The Senate also formally approved the proposal to found an Institute of Agricultural Mechanism in the University. The Board of Agriculture and Fisheries and the Development Commission have had under consideration the question of an institute for investigating problems relating to agricultural machinery, and they suggested that such an institute might be most suitably established at Cambridge in association with the schools of engineering and agriculture, financial support being provided from the Development Fund. The proposal was cordially welcomed by the authorities concerned, and the Senate has authorised the appointment, as soon as the necessary funds are available, of an engineer as director and an agriculturist as assistant-director, the first duties of whom will be to formulate a definite programme of work for the institute.

LEEDS.—In the twelfth annual report of the University of Leeds, for the year 1915–16, attention is specially directed to the generous gifts of Sir James

Roberts, Lord and Lady Cowdray, and Mr. Walter Morrison for the endowment of the chairs of the Russian and Spanish languages and literatures.

Reference is made to the departure of the chancellor, the Duke of Devonshire, on his appointment to the position of Governor-General of Canada.

Rawdon College (Baptist) has been affiliated to the University, following the precedent of Mirfield College (Church of England) and Headingley College (Wesleyan Methodist). In spite of a diminished staff, members of which have been seconded by the Government for war work, the teaching has been maintained with its usual efficiency, and a substantial amount of pure research has been published; in addition to which several of the science and technical departments of the University have continued to give valuable aid to the Ministry of Munitions in connection with the textile industries, leather, and the testing of the raw material for explosives and of the finished product; and to the Royal Society War Committee in the preparation of necessary drugs. The many activities of the University in other departments, such as the training of welfare workers, of munition workers, and of women for farm work, are enumerated on pp. 45 and 46. The total number of day students was 698 (465 men and 233 women), and of evening students 103.

A loss of income through the reduction in the number of students is estimated at several thousand pounds, but the economies effected, together with a special grant from the National Exchequer, have saved the University from financial embarrassment. A list of nearly one thousand students, staff, and members of the University O.T.C. who have joined the Colours is given in an accompanying pamphlet.

LONDON.—Applications for grants from the Dixon Fund for assisting scientific investigations will be received not earlier than April 1, and not later than by the first post of May 15. Particulars of the grants may be obtained from the Academic Registrar, University of London, South Kensington.

An appointment to the Gilchrist studentship for women will shortly be made, and the Lindley triennial studentship of the value of 100*l.* will be awarded. The studentship is open to students qualified to undertake research in physiology, and will be held in the physiological laboratory of the University. Particulars of the candidate's qualifications and of the mode in which he proposes to carry out his research must reach the Academic Registrar by April 30.

The Rosebery prize of 25*l.* for the session 1915–16 of the London School of Economics and Political Science has been awarded to Messrs. W. G. Chapman and W. H. Jarvis for their joint paper on "Workmen's Trains." The Rosebery prize of 10*l.* for the same session has not been awarded.

IT is reported from Zurich that, in consequence of lack of coal and the impossibility of heating the buildings, all lectures in the University of Vienna have been suspended since January 29.

MR. C. J. STILL has resigned his position as lecturer and demonstrator in chemistry at the Municipal Technical Institute, Belfast, to become a research chemist with Messrs. Levinstein, Ltd., Manchester.

WE learn from *Engineering* that the Liebig Scholarship Society of Germany has recently been formed, with a capital of upwards of a million marks from German industries, for the purpose of assisting young German chemistry students to proceed with their studies, after their examinations, by working as assistants in the technical high schools.

THE following gifts in America for educational work are announced in *Science*: 200,000*l.* by the Billings family of Chicago to the University of Chicago towards the endowment of the medical school; 10,000*l.* by Mr. J. H. Schiff to New York University for the division of public affairs in the school of commerce; and a bequest by Mr. J. D. Archbold to Syracuse University amounting to 100,000*l.*

ACCORDING to *Science*, a school of fisheries in connection with the University of Washington is to be established within the next two years, provided that the Appropriation Bill for the University is passed as it stands. The passing of the appropriation would make possible the addition to the University staff of an expert authority on fishing and fisheries, increased laboratory space and equipment, and the enlargement of the scope of the University.

PROF. W. RIPPER, having been appointed vice-chancellor of the University of Sheffield in place of the Rt. Hon. H. A. L. Fisher, will be unable to deliver the course of Howard lectures on "Works Organisation and Efficiency" at the Royal Society of Arts in April and May; he will, however, deal with the subject in a paper at one of the ordinary meetings after Easter. Howard lectures on "The National Shortage of Cheap Iron-ore Supplies" will be delivered at the Royal Society of Arts on April 30 and May 7 by Prof. W. G. Fearnsides.

BY the will of Sir George Franklin, Pro-Chancellor of the University of Sheffield, who died on September 23, 1916, the following sums, among others, have been bequeathed, in the event of his adopted daughter leaving no issue:—25,000*l.* to the University of Sheffield to be applied for founding such chairs (to be called after him) as the council may decide, hoping that a portion may be applied in the foundation of a chair having for its object the advancement of some branch of medical science connected with the relief of human suffering; and 5000*l.* to the Corporation of Sheffield, the income to be applied by the local education committee in providing scholarships tenable at Sheffield University for boys and girls educated at the Central Secondary School.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 25.—Sir J. J. Thomson, president, in the chair.—Hon. R. J. **Strutt**: Spectroscopic observations on the active modification of nitrogen. V. The faint red bands 6394·45, 6468·53, 6544·81, and 6623·52, belonging to the first positive group, truly belong to the afterglow spectrum of nitrogen. The second positive group is entirely absent from the afterglow spectrum. The β and γ groups only appear when oxygen-containing gases are introduced into the afterglow, or are originally present in the nitrogen used. Using nitrogen that only gives the β and γ bands very faintly, it is found that oxygen or nitric oxide added to the afterglow brings in the β and γ bands with a certain relative intensity which may be called the standard. Carbon dioxide gives greater relative intensity to the β bands, and carbon monoxide to the γ bands. If nitric oxide or nitrogen peroxide is introduced in sufficient quantity into the overglow, the β and γ groups disappear and a visually greenish continuous spectrum is substituted. Nitric oxide in a blow-pipe flame gives this same greenish continuous band, together with the γ, but not the β, group. Chemical tests show that when oxygen is introduced into the afterglow there is no detectable oxidation of nitrogen, and certainly not nearly enough to account for the β and γ bands on the view that

these are due to nitric oxide generated.—Prof. J. W. **Nicholson** and Prof. E. **Wilson**: Magnetic induction and its reversal in spherical iron shells. A solution of problems which arise in the production of an effective magnetic shield for large spaces. These relate mainly to the effective demagnetisation of the shells of which the shield is constituted. Theoretical solutions of problems relating to the effects of indefinitely closely wound coils on various shells of such a shield are given, and compared with the experimental values for an actual coil. The experiments supply an estimate of the deviations of Maxwell's formula, for the field inside a spherically wound helical wire, from the true values, when the spacing in the helix is of importance. A study of the necessary interval between current reversals in the process of demagnetisation has been made, and it is shown that the delay in reversal of magnetic phenomena in considerable masses of iron, due to eddy currents, is negligible when the magnetic inductions are fewer than 300 C.G.S. units.—S. **Brodetsky**: The two-dimensional motion of a plane lamina in a resisting medium. Some of the types of motion of a plane lamina in a resisting medium, such as the air, are discussed. Experimental laws of resistance are used for varying circumstances of shape and motion. The motion is in two dimensions. Part i. deals with a lamina of large moment of inertia. For the case of no forces acting on the lamina other than the resistance of the medium, relations are obtained connecting the components of velocity, the rotation, and the time. In the case of a wide lamina an investigation is given of the oscillatory part of the motion. The graphical method is then extended to the case where forces in addition to the resistance act on the lamina, notably gravity. In part ii. the case of a lamina the moment of inertia of which is negligible is considered, and equations are found for correcting the paths found in Lanchester's phugoid theory. Part iii. treats of the oscillations about a steady fall. The vertical fall of a lamina is shown to be unstable unless the centre of mass is at a distance below the centre of figure lying between two limits given by a quadratic equation. The stability of a parachute with a hanging body attached to it is also considered.

February 1.—Sir J. J. Thomson, president, in the chair.—Sir Ronald **Ross** and Miss H. P. **Hudson**: An application of the theory of probabilities to the study of *a priori* pathometry. Part ii. A number of hypothetical epidemics on the basis of the equations of part i. are constructed. The influence of some of the principal parameters is considered. The equations are generalised to include a wider range of *a priori* suppositions as to the laws of the happening, and further suggestions are made as to the comparison of the results with mortality statistics. The following tentative conclusions are arrived at: The cases considered have led to exactly the series of curves required by the facts: 1. The steadily rising curve of a happening that gradually permeates the whole population (VII., iii.). 2. The symmetrical bell-shaped curve of an epidemic that dies away entirely (VII., v.). 3. The unsymmetrical bell of a new happening that begins with an epidemic and settles down to a steady endemic level (VII., v.). 4. The periodic curve with regular rise and fall due to a seasonal disturbance (XI., iv.). 5. The more irregular curve where there is recrudescence before the end of an epidemic, or where outbreaks differing in violence occur at unequal intervals (XI., v.). This suggests that the rise and fall of epidemics may be explained by the general laws of happenings as studied.—Dr. J. **Brownlee**: An investigation into the periodicity of measles epidemics in London from 1703 to the present day by the method of the periodogram. The statistics for the epoch of registration give the main periodicity of measles in London for the last seventy-two years as almost exactly ninety-seven weeks. The amplitude of this period is 0·4 of the mean number of cases. Periods with amplitudes of about one-half of this are found for one year and for six months. These periods probably reflect the influence of the weather upon the deaths from measles, though the evidence is not complete. There are two sets of periods grouped on either side of the main period in such a way as could be explained by interference with long waves of prevalence or severity of the disease. These periodicities are probably the expression of something in the life-history of the organism causing the disease.—Capt. J. **Hammond**: The causes responsible for the developmental progress of the mammary glands in the rabbit during the latter part of pregnancy. Experimental results show that the development of the mammary gland of the rabbit during the second half of pregnancy is under the same influence as that which controls the development during the first half, namely, the *corpus luteum*. This gland is active during the second half of pregnancy. The further development of the *corpus luteum* is due to the influence of the fœtus. The view that milk secretion in pseudo-pregnancy takes place in correlation with the involution of the *corpus luteum* is confirmed. Apparently the secretion of milk results whenever the influence causing the glandular growth is removed or lessened in amount, provided that the initial development has gone far enough.—F. H. A. **Marshall** and E. T. **Halnan**: The post-œstrous changes occurring in the generative organs and mammary glands of the non-pregnant dog. The uterus and mammary glands of the non-pregnant bitch undergo pronounced post-œstrous development under the influence of the *corpora lutea* during a definite pseudo-pregnant period. Retrogressive changes do not set in with any of these organs until about thirty days after ovulation. The developmental changes are similar to those taking place during pregnancy. The relatively long persistence of the *corpora lutea* in the bitch is probably correlated with the monœstrous habit. This persistence elucidates the phenomenon of bitches which had not been impregnated secreting milk at or near the end of the pseudo-pregnant period. The changes which occur in the generative organs and mammary glands after œstrous are now brought into relation with the rest of the œstrous cycle.

Physical Society, January 26.—Prof. C. V. Boys, president, in the chair.—C. O. **Bartrum**: A clock of precision. The principal feature is the employment of a "slave" clock to do most of the work, leaving the master pendulum no function beyond that of controlling the rate of the other. The master pendulum swings freely except for a short period every minute, during which it receives an impulse from a falling pallet electromagnetically released by the slave clock. At the end of its fall the pallet closes a second circuit and is restored to its initial position. The electric circuits also energise parts of the mechanism in the slave clock by which the latter is kept in time with the master pendulum. The lagging of correction behind error, with the resulting periodic fluctuation in the rate, is reduced almost to the vanishing point by a "negative backlash" in the control mechanism. A mathematical discussion of the best working conditions and of the possible magnitude of errors is given.—Dr. F. **Schwers**: The effect of water vapour in the atmosphere on the propagation of electromagnetic waves. The probable influence of moisture in the atmosphere on the refraction of electromagnetic waves round the earth's surface is discussed. The conclusion of Kiebitz that the presence of mois-

ture does not affect the dielectric constant by more than 10 per cent. is shown to be erroneous. In the absence of more accurate data for ordinary temperatures, the author prefers to assume a value for the dielectric constant of water vapour obtained by extrapolating the results secured by Baedeker for higher temperatures. It is shown that the lowest layers of the atmosphere refract electromagnetic waves towards the earth, so that the greater part of the space waves will reach the receiver, contrary to the conclusion of Kiebitz.

Challenger Society, January 31.—Dr. S. F. Harmer in the chair.—G. H. **Fowler**: (i) The currents of the United States Atlantic coast, illustrated by the drift of the Nantucket Shoals buoy, 1915–16. The buoy was at large for twenty months; it drifted down the Labrador current to off Cape Hatteras, was drawn into the Gulf Stream, went east, and was thrown out southward; this occurred three times, the buoy being returned to the Gulf Stream twice by the Bahama branch of the N. Atlantic Drift and once by towage. (ii) A graphic method of finding the density of sea-water from the salinity and temperature based on Knudsen's tables.

BOOKS RECEIVED.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, September–November, 1916. By R. M. Milne. Pp. 32. (London: Macmillan and Co., Ltd.) 1*s.* net.

A Bibliography of British Ornithology. By W. H. Mullens and H. Kirke Swann. Part v. (London: Macmillan and Co., Ltd.) 6*s.* net.

High-speed Internal Combustion Engines. By A. W. Judge. Pp. ix+350. (London: Whittaker and Co.) 15*s.* net.

A Practical Manual of Autogenous Welding (Oxy-Acetylene). By R. Granjon and P. Rosemberg. Translated by D. Richardson. Fourth edition. Pp. xxv+244. (London: C. Griffin and Co., Ltd.) 5*s.* net.

The Study of Animal Life. By Prof. J. A. Thomson. Revised edition. Pp. xi+477. (London: J. Murray.) 6*s.* net.

Plants, Seeds, and Currents in the West Indies and Azores. By H. B. Guppy. Pp. xi+531+3 maps. (London: Williams and Norgate.) 25*s.* net.

A Text-book of Thermochemistry and Thermodynamics. By Prof. O. Sackur. Translated and revised by Dr. G. E. Gibson. Pp. xvi+439. (London: Macmillan and Co., Ltd.) 12*s.* net.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 15.

ROYAL SOCIETY, at 4.30.—Structure and Development of the Tubular Enamel of the Sparidæ and Labridæ: Dr. J. H. Mummery.—And other papers.

ROYAL INSTITUTION, at 3.—The Mechanism of Chemical Change: Prof. F. G. Donnan.

SOCIETY OF GLASS TECHNOLOGY, at the University, Western Bank, Sheffield, at 4.30.—The Annealing of Glass: F. Twyman.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indian Silk Industry: Prof. H. Maxwell-Lefroy.

INSTITUTION OF MINING AND METALLURGY, at 5.30.—The Wet Assay of Tin Concentrate: H. W. Hutchin.—Hydraulic Tin Mining in Swaziland: J. Jervis Garrard.

LINNEAN SOCIETY, at 5.—The Home-life of the Sparrow-hawk: J. H. Owen.

FRIDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 5.30.—Authors' Dedications in the Seventeenth Century: The Dean of Durham.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Annual General Meeting.—Alternating Stress Experiments: Dr. W. Mason.

GEOLOGICAL SOCIETY, at 3.—Annual General Meeting.

SATURDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 3.—The Mystery of Counterpoint: Dr. H. Walford Davies.

MONDAY, FEBRUARY 19.

ROYAL SOCIETY OF ARTS, at 4.30.—The History and Practice of Town Planning and Civic Architecture. Lecture iv.: Prof. A. Beresford Pite.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—The Baghdad Railway and its Tributaries: H. Charles Woods.

ARISTOTELIAN SOCIETY, at 8.—The Nature of Knowledge as conceived by Malebranche: Morris Ginsberg.

VICTORIA INSTITUTE, at 4.30.—From World Dominion to Subjection; the Story of the Fall of Babylon: Dr. T. G. Pinches.

TUESDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 3.—Pain and its Nervous Basis: Prof. C. S. Sherrington.

ZOOLOGICAL SOCIETY, at 5.30.—(1) Notes from the Caird Insect House, with Exhibition of Specimens and Lantern-slides: (2) The Coleoptera of the Family Cissidæ found in Britain, with Descriptions of Two New Species. A New Species of the Coleopteran Genus Cryptorrhynchus, Illiger: C. J. C. Pool.—Heude's Collection of Pigs, Sika, Serows, and Gorals in the Sikawei Museum, Shanghai: A. de C. Sowerby.—The Lizards of the Genus Philochortus, Matschie: G. A. Boulenger.

ROYAL STATISTICAL SOCIETY, at 5.15.

ILLUMINATING ENGINEERING SOCIETY, at 5.—The Effect on the Eye of Varying Degrees of Brightness and Contrast: Dr. James Kerr.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—Liquid Fuel and its Combustion: Prof. J. S. S. Brame.

WEDNESDAY, FEBRUARY 21.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Parasitology of Pyorrhœa: Dr. A. H. Drew and Dr. Una Griffin.

ROYAL SOCIETY OF ARTS, at 4.30.—The Training of Educated Women for Secretarial and Commercial Work, and their Permanent Employment: Mrs. C. Hoster.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Heat Balance of the Atmosphere: W. H. Dines.—Continentality and Temperature: C. E. P. Brooks.

THURSDAY, FEBRUARY 22.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Fossil Human Skull found at Talgai, Queensland: S. A. Smith.—The Magnetic Storm of August 22, 1916: Dr. C. Chree.—The Ordinary Convergence of Restricted Fourier Series: Prof. W. H. Young.

ROYAL INSTITUTION, at 3.—Memorial Art in History: Prof. E. S. Prior

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Origin and Growth of the Dry Lakes in Western Australia: J. T. Jutson.

FRIDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 5.30.—Some Guarantees of Liberty: H. Wickham Steed.

SATURDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 3.—The Pronunciation of Languages in General: Daniel Jones.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.