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The Langley Aeroplane and the Hammondsport Trials.

THE Americans most intimately associated with the work of Prof. S. P. Langley have written to the Royal Aeronautical Society and to NATURE protesting vigorously against the conclusions reached by Mr. Griffith Brewer and summarised in a paper[1] read before the society in October last. The conclusions were[2]:—

(*a*) The Langley machine was not capable of sustained free flight.

(*b*) The Langley machine was not successfully flown at Hammondsport, New York, on June 2, 1914.

The correspondence is published in full in the Journal of the Royal Aeronautical Society, and when discussion is closed it is to be hoped that the society itself will consider the whole matter and express an official opinion. In the meantime it may be assumed that the American presentation of the case is better than that of Mr. Brewer when they claim that in all substantial respects the original Langley aeroplane was capable of sustained flight. It is true that certain modifications were made for the Hammondsport trials which changed the machine in some of its details, but the secretary of the Smithsonian Institution, Dr. Walcott, appears to put the matter very fairly when he says:—

"I was present at Hammondsport on May 31, 1914, and saw the machine with the original engine giving only two-thirds the original thrust and with wings approximately of the original design, but far rougher executed, get under way from rest and fly gracefully, carrying, besides a man, more than 300 lb. of floats in excess of what the machine was designed to carry. I am still confident that what it did under these relatively adverse circumstances is far inferior to what it was capable of doing in its original condition."

It is much to be regretted that anything happened to prevent a successful flight of the Langley flying machine on October 7, 1903, for no one with an intimate knowledge of the subject can doubt that, aerodynamically and structurally, the machine was good. Aerodynamically it had been preceded by a long series of experiments on a whirling arm, culminating in the flight of a power-driven model based on the results obtained. Although the practical man is loth to admit the fact, it is nevertheless true that the very great bulk of trustworthy information is derived from tests on models by men of science. For very many years to come aviation will continue to draw its inspiration from results obtained on models. Structurally the Langley aeroplane had been carefully made and tested by loading with sand; it is difficult to give credence to Mr. Brewer's suggestion that the structure was obviously defective. Nor is there lack of evidence in the other direction in the later flights. The account of the original failure, vouched for by Mr. C. M. Manly, the pilot on the occasion, is that:—

"The machinery was working perfectly and giving every reason to anticipate a successful flight, when this accident (due wholly to the launching mechanism) drew the aeroplane abruptly downward at the moment of release and cast it into the water near the houseboat."

This explanation is supported by clear observations of damage to the clutch which held the aeroplane on the launching ways, but is apparently not accepted by Mr. Brewer.

Despite the failure to crown his efforts with a striking popular flight, Langley's work was a very great achievement and removed many difficulties from the paths of his successors, amongst whom were the Wright brothers.

The claims made for Langley by the Smithsonian Institution are:—

(1) His aerodynamic experiments, some published and some as yet unpublished, were complete enough to form a basis for practical pioneer aviation.

(2) He built and launched, in 1896, the first steam model aeroplane capable of prolonged free flight, and possessing good inherent stability.

[1] *Aeronautical Journal*, December, 1921.
[2] *Ibid.*, p. 629.

(3) He built the first internal-combustion motor suitable for a practical man-carrying aeroplane.

(4) He developed and successfully launched the first gasoline model aeroplane capable of sustained free flight.

(5) He developed and built the first man-carrying aeroplane capable of sustained free flight.

Only the last of these items appears to be in dispute, and, even were adverse criticism justified, the merit of Langley's work would scarcely be affected. It is not disputed on the other side that the Wright brothers made the first sustained flight and so marked a stage of progress which appealed to the world at large instead of to a limited number of men of science. The list of earlier contributors to progress in aviation is long, and all deserve some credit for the ultimate result, but the modern phase took its beginning with the publication of Langley's researches on aerofoils, etc., and the additional spur given by the successful flights of his power-driven models.

It is not too much to say that more original and personal solid work underlay the Langley aeroplane than is the case for any other aeroplane, not excepting those of the present day. The solution of the problems of stability which Langley reached as a pioneer in one instance is still beyond the powers of the majority of his successors in the art of aeroplane design.

Intestinal Protozoa of Man

The Intestinal Protozoa of Man. By Clifford Dobell and F. W. O'Connor. Pp. xii+211+8 plates. (London: Published for the Medical Research Council by J. Bale, Sons, and Danielsson, Ltd., 1921.) 15*s.* net.

THIS is a treatise which will be very valuable to the medical investigator of the microscopic intestinal parasites of man—other than those belonging to the great group of Bacteria. Its origin is due to the continuous and comprehensive study, made during the great war, of the relation to parasitic Protozoa of dysenteric disease occurring in the British Army. Mr. Clifford Dobell has previously published various reports of his masterly work on this subject, and two years ago (December 11, 1919, vol. 104, p. 369) we noticed in these columns his critical essay entitled "The Amœbæ Living in Man." In the present publication Mr. Dobell has been assisted by Mr. F. W. O'Connor, who had independently carried on investigations on intestinal Protozoa in connection with the Egyptian Expeditionary Force. Mr. O'Connor was to have been specially responsible for the medical parts of this book, and Mr. Dobell for those parts which are purely zoological. But, owing to the departure of his medical colleague in 1919 on an expedition to the Gilbert and Ellice Islands, the task of completion of the work and responsibility for the greater part of it have fallen on Mr. Dobell. The treatise is distinguished by that patient inquiry into previous work and critical judgment as to nomenclature and synonomy which have rendered Mr. Dobell's earlier publications of special value. It is absolutely necessary that medical men and protozoologists should agree upon a terminology in order that they may understand each other's writings, and this result Mr. Dobell's careful review and original observations enable them to achieve.

The book is divided into nine chapters, followed by a very complete bibliography and an index and eight plates. Chap. 1 is an introduction to the whole subject, and is followed by chap. 2 on the intestinal Amœbæ of man; chap. 3, Amœbiasis (the name given to infection by Amœbæ, and especially by *A. histolytica*); chap. 4, the intestinal Flagellates of man; chap. 5, the intestinal Coccidia of man; chap. 6, the intestinal Ciliates of man; chap. 7, the diagnosis of intestinal protozoal infections; chap. 8, the treatment of intestinal protozoal infections; and chap. 9, the coprozoic Protozoa of human fæces.

One of the chief sources of error which has to be guarded against by the novice in this study is that of supposing that parasites found in the fæces are necessarily parasites of the intestine. There is a whole series of Amœba-like and flagellate Protozoa which are present in the soil and may obtain access to, and develop in, the fæces after deposition. These are called "coprozoic Protozoa." They may also obtain access to the fæces by means of resistent spores which are swallowed with dust and pass uninjured and undeveloped into the intestinal contents. Apparently the high temperature of the intestine is unfavourable to their development, which occurs only when they have passed to the cooler conditions of the outer world. Many mistaken descriptions of protozoal parasites have been due to this source of error.

The Protozoa which are not merely coprozoic, but actually live in the intestine of man, are only seventeen in number—viz. five Amœbæ, five Flagellata, four Coccidia, and three Ciliata. Some of these are very rare or exceptional; others are abundant, but are not shown to be harmful. Only two which actually sometimes (but not always) destroy the tissue of the intestinal wall or of other organs when present in man are admitted by Mr. Dobell to be pathogenic—viz. *Entamoeba histolytica* and the ciliate *Balantidium coli*. The work of recent years, and much of that of Messrs. Dobell and O'Connor, has led to this interesting result. The tendency among medical men was to regard every intrusive Entozoon in the human body as "a dangerous parasite," and now we know not only that parasitic Protozoa are not necessarily dangerous, but also that many parasitic bacteria and even some worms are not harmful to their hosts.

Mr. Dobell is inclined to modify the ancient and, as it seems to me, convenient use of the word "parasite." It is not usual to regard every parasite as "a dangerous parasite." One hears of a "harmless parasite" also, and of "mere parasites." In fact, the Greek word means "alongside the victuals," and signified in early times one who had a seat at the table of sacrificial meats—an officially established guest or messmate of the priests. He was "venerable" rather than dangerous, and only when rich men took to entertaining such pensioners for the purpose of display and self-advertisement did "the parasite" fall into contempt and was sneered at as a "toady." The use of the word in zoology has been primarily in accordance with this. The parasite of zoology infests or hangs on to a host from which it obtains shelter and food, but it does not necessarily injure its host. There are many gradations between the harmless necessary parasite and the deadly pest which converts a "host" into a "victim"—absorbing its life-blood or spreading deadly poison into its tissues.

It is difficult to create a terminology which shall in single words indicate the varieties of relationship of parasite and host. The word "commensal" was introduced by the elder Van Beneden. Etymologically it has the same meaning as parasite, but Van Beneden used it to signify specifically an association in which the host suffered no injury or inconvenience, but allowed a distinct species of animal or plant to benefit by the scraps of food rejected by itself, and even to get shelter and carriage by its hospitality. At the same time, Van Beneden pointed out that such close parasitism as that of the intestinal worms is not necessarily injurious to the animals infested, and he cited the fact that, whilst in their normal wild condition the larger carnivorous animals apparently without exception harbour parasitic worms and are perfectly healthy, it is found that the same animals in captivity tend to lose their parasites. They, in fact, become unhealthy and abnormal in captivity. The presence in these animals of a few parasites is (according to Van Beneden) normal and an indication of life in health-giving conditions. For such reasons I should prefer to retain the word "parasite" with its original wide and general meaning, and to classify by name (a somewhat troublesome task) the varieties which it presents.

E. RAY LANKESTER.

Electric Furnaces.

The Electric Furnace. By Dr. J. N. Pring. (Monographs on Industrial Chemistry.) Pp. xii+485 + 19 plates. (London: Longmans, Green and Co., 1921.) 32s. net.

LITTLE more than 100 years have elapsed since the first experiments on electric furnaces were performed, when Davy, in 1810, succeeded in isolating aluminium and the alkali metals by the electrolysis of electrically fused salts. Five years later Pepys carried out experiments on the cementation of iron heated by passing an electric current through it. About half a century elapsed, however, before a commercial furnace was put into operation, one of the earliest being built by the Cowles brothers at Milton, Staffs. The development that has taken place since that date may be gauged from the fact that the estimated production of electric furnace steel during 1918, in Great Britain alone, was 110,000 tons. This development was largely due to the war and, as the last edition of Stansfield's classic volume (bearing the same title as the book at present under review) is dated 1914, a demand doubtless exists for a further book on electric furnaces.

After dealing with the history and the principles of electric furnaces, the author discusses the types used in laboratory and experimental work. He claims that it is possible to maintain a temperature of 1200° C. inside a tube 8·6 cm. internal diameter, wound with No. 15 s.w.g. nichrome wire. The makers of this material state that it is suitable for use at temperatures up to 1100° C., and while there is no doubt that the higher temperature could be attained, the author was indeed fortunate if his furnace did not burn out in a short time.

The next two sections of the book deal with current supply and transformation in electric furnace operations. These subjects are discussed very fully, commencing with the theory of alternating currents. There is a mistake in the first figure in this section (Fig. 49), both collector brushes of the diagrammatic dynamo being shown on the one slip ring.

A later section, 6, discusses the measurement of high temperatures, dealing mainly with the use of optical and radiation pyrometers. A curious statement occurs on p. 84, where reference is made to thermo-couples consisting of "two different metals such as platinum and an alloy of platinum with rhodium or ruthenium." Surely iridium, not ruthenium, is intended.

The next three sections deal with the chemical, in contradistinction to the metallurgical, manufactures carried out in the electric furnace, viz. the making of calcium carbide, the synthesis of nitrogen compounds from the atmosphere, and the ammonia oxidation process. In the section on the synthesis of nitrogen compounds it is stated that the world's production of calcium cyanamide during 1918 was estimated to be more than three-quarters of a million tons, of which nearly one-third of a million tons was made in Germany.

In sections 10 to 16 and section 18 an account is given of the use of the electric furnace for the production of metals, alloys, and refractories. The importance of these operations is shown by the fact that, in 1918, 100,000 tons of pig-iron were produced in Sweden in the electric furnace, while during the previous year one and a quarter million tons of electric steel ingots and castings were manufactured in the United States. The section dealing with the manufacture of aluminium is disappointingly short in view of the importance of this metal, about 100,000 tons of which are produced annually at the present time solely by means of the electric furnace.

Attention must be directed to a curious misstatement in this part of the book. It is said (p. 294) that in the electrical smelting of zinc there is a tendency to the formation of a grey powder "due to rapid cooling, whereby the metal passes direct from the vapour to the solid condition, the boiling-point of the metal being only slightly removed from the melting-point." Actually, the boiling-point of zinc, at atmospheric pressure, is more than 900° C., while its melting-point is 418° C. Further, the use of the word "matte" on p. 168 for the metallic product from an iron-making blast-furnace appears to be undesirable.

The remaining sections of the book deal with miscellaneous furnaces, electrolytic processes, and questions of design and power supply.

The book will doubtless be a very valuable addition to the library of the metallurgist and electrical engineer, and it is to be hoped that a second edition will be called for soon, partly to enable the numerous misprints to be corrected. To select a few at random: p. 37, "Electrical connection . . . are conveniently made"; p. 87, an x is evidently omitted from the formula; p. 290, the word "downward" appears to be displaced, presumably from the line above; p. 269, "a Belgian Compant . . ." should doubtless read "a Belgian Company . . ." Furthermore, if the author were to take to heart the dictum reiterated by Rickard in his invaluable book on "Technical Writing" and remember the reader, the demand for a second edition would give him an opportunity of rewriting some of his sentences, particularly the following: "Currents up to 6000 amps. can be lead up to the furnace walls, along two heavy bars for single phase, and three for two or three phase and connected by flexible cables to the electrodes." Or, "According to Prof. J. W. Richards, pig-iron was, in 1920, being produced in Sweden in electric furnaces from charcoal at a cost of 5 dollars per ton less than their own blast-furnace pig-iron."

J. L. H.

Chemistry after the War.

(1) *A Dictionary of Applied Chemistry.* By Sir Edward Thorpe. Assisted by eminent contributors. Vol. 1, *A–Calcium.* Revised and enlarged edition. Pp. x+752. (London: Longmans, Green, and Co., 1921.) 60*s.* net.

(2) *A Text-book of Electro-chemistry.* By Prof. Max le Blanc. Translated from the fourth enlarged German edition by Dr. Willis R. Whitney and Dr. John W. Brown. Pp. xiv+338. (New York: The Macmillan Co. London: Macmillan and Co., Ltd., 1920.) 18*s.* net.

(3) *Thermodynamics and Chemistry.* By Prof. F. H. MacDougall. Pp. v+391. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 30*s.* net.

(1) IT was almost inevitable that, when the distractions caused by the war had diminished somewhat, there should be a call for a new edition of Thorpe's Dictionary. Whilst pure chemistry may have made comparatively little progress during the war, applied chemistry has received a very great stimulus during the period that has elapsed since the former edition appeared in 1912. The first volume of the new edition has expanded from 614 to 752 pages, or rather more than one-fifth, and whilst it is difficult, without a careful comparison with the old edition, to discover where the expansion has taken place, it is easy to see that the most striking developments are adequately described in the new volume, so far as they are covered by the section from "A" to "calcium." Thus under "acetic acid" and "aldehyde" the manufacture from acetylene is described; under "amatol" there is a forward reference to an article on explosives which will appear in a later volume, and a brief account is given of the new methods used

to prepare ammonium nitrate on a large scale. The synthetic processes for the production of ammonia are described very briefly in a single column, but this is in accord with the classification of the former edition, where a full description of these processes is reserved for a later article under "nitrogen." The revision, as a whole, has been well done, and the new edition can be commended heartily as an accurate presentation of the state of applied chemistry after the vicissitudes of recent years.

(2) The publishers of le Blanc's "Text-book of Electro-chemistry" have adopted a simpler method of meeting the demand for a new edition. Although the title-page is dated 1920, the translator's preface bears no date. No references later than 1907 have been discovered by the reviewer, and the table of equivalents is certainly more than ten years old. In view of the rapid growth of the science of electro-chemistry, further comment is scarcely necessary.

(3) Prof. MacDougall's book contains an attractive and lucid account of the principal applications of thermodynamics to chemistry. The author writes as a chemist rather than as a mathematician, and, instead of giving merely an occasional numerical illustration of his equations and formulæ, has provided quantitative data even when these are scarcely needed to elucidate the text. Thus it is a pleasure to find a full list of specific heats of the solid elements, a table of the heat-capacities of gases and of the ratio of their specific heats at different temperatures, as well as useful tables of the heats of formation of metallic and non-metallic compounds and of heats of solution, combustion, and neutralisation. In the same way the later chapters contain useful tables of electrode-potentials, equivalent conductances, ionisation-coefficients, transference numbers, and ionic conductances. In dealing with the phase rule, one chapter only is devoted to theoretical considerations, whilst three chapters are required to cover the various examples which the author has selected to illustrate the applications of the rule. Another valuable feature of the book is the insertion at the end of each chapter of a large number of problems. These are of a very practical character, and illustrate clearly the many ways in which a knowledge of thermodynamics may be made use of in the study of chemical problems. Certainly no book with which the reviewer is acquainted presents the subject in a manner more likely to prove attractive to the chemist.

T. M. L.

Prices and Wages.

Prices and Wages: An Investigation of the Dynamic Forces in Social Economics. By P. Wallis and A. Wallis. Pp. xii+456. (London: P. S. King and Son, Ltd., 1921.) 25*s.* net.

THE authors of this volume are, it may be gathered from the preface, business men without much literary experience. The consequent defects of the book, it is to be feared, render it unlikely that many readers will be found with sufficient patience to attempt the whole. Four hundred and fifty pages of reasoning and criticism are at the best a heavy task; when the reasoning is often obscure and unnecessarily verbose, when the criticism seems often ill-informed or based on misunderstanding, the task is apt to become almost unendurable.

The argument appears to be as follows: (1) The value of the net annual production, per head of persons engaged in the industry, for any one commodity, tends to fluctuate in the same way as for any other commodity; this agreement is much closer than for prices. (2) These fluctuations in the value of net annual production are due to fluctuations in the value of the money standard. (3) The value of the net annual production per head, at any one time, tends to be nearly the same for all commodities, including the money standard. (4) Wages and salaries tend approximately to the same proportion of the net annual production per head. (5) It follows from (3) and (4) that the annual wage-rate in any industry tends to be equivalent to the *net* annual production of gold per head for the same grade of labour in the gold-mining industry. (6) The approximately constant proportion of wages and salaries to total net annual product is due to the competition of unemployed labour; the maintenance of this pool of unemployment is the real failure of capitalism.

It should have been obvious even to unpractised writers that ordinary terms should not be employed in senses widely divergent from common usage. This rule has not been followed. The value of the net annual production per head of any commodity is spoken of throughout as its "normal price," with the result that the argument falls at times—for the reader if not for the authors also—into the most hopeless confusion. The reader comes across some phrase about "normal commodity prices"—dissents from it —passes on—and only perhaps some time later when wearied with an argument that seems to him nonsense may it occur to him that the authors did not mean normal prices at all, in the ordinary sense, but net annual products. Nor is the reader's understanding helped by careful consistence in the use of the term. On p. 116 we read: "This normal price consists in the number of articles produced per person (labour unit) multiplied by the money price," which suggests a gross and not a net product; but on p. 142, "when we take the normal prices which are based upon the unit of labour, we find that this price, *which is the price the producer gets*. . . ."—our italics. On p. 205 we find a clear statement that it is really the net product which is wanted, but on p. 303 we read "normal price is the market price or price per unit, multiplied by the quantity produced." The authors have only themselves to thank if few readers have the patience to stand much loose writing of this sort.

Frankly, this is a pity. For to the present reviewer there seems something to be said for the constructive argument of the book, though very little for much of the criticism contained in it. The argument might have received more attention if concisely presented, with unnecessary criticism eliminated. G. U. Y.

Our Bookshelf.

The War List of the University of Cambridge, 1914–18. Pp. xiv+616. (Cambridge: At the University Press, 1921.) 20*s*. net.

IN his address to the Senate of the University of Cambridge, delivered on October 1, 1915, the retiring vice-chancellor, Dr. M. R. James, spoke of the services which members of the university were giving in their country's need. He said: "We are debtors to all. . . . Yet the university bears them upon her heart and will not, I know, neglect to perpetuate the memory of them." No public memorial has, indeed, been raised to their memory, but a noble record has been given to the world by the publication of this volume, which will carry far and wide the names of those members of the university who served with his Majesty's forces.

The volume has been prepared under the able editorship of Major G. V. Carey, of Clare College, and it is based on the lists published from time to time by the *Cambridge Review*, the materials for which came from the various college records. The syndics of the University Press took over the records in December, 1919, and since that date every name has been checked by the official Service Lists. Faced with the task of deciding which names were to be included, it was determined that residence prior to war service should be the criterion, with the exception of those who were prevented from going into residence in October, 1914, by reason of their having joined the forces; further, only those names which appeared in the various Service Lists have been included. This necessarily excludes the names of many who performed valuable and distinguished national service in other capacities, but it is obvious that to obtain an accurate record doing justice to all is almost an impossibility.

The volume concludes with an alphabetical index to the names, and a comprehensive summary—in itself a task of considerable magnitude—giving, for each college and for the whole university, the number of men who served, the number killed in action, the number of honours, etc. The first total is 13,878, and the second 2162—figures which show what a great part the university played in the war, and she has commemorated them worthily in this handsome list.

Meteorological Office—Air Ministry: British Rainfall, 1920: *The Sixtieth Annual Volume of the British Rainfall Organization*. Pp. xxviii+285. (London: H.M.S.O., 1921.) 12*s*. 6*d*. net.

RAINFALL statistics over the British Isles have in no way suffered by the transfer of the collection and discussion of the observations from private to public control. The present annual volume is the sixtieth issued, and the second published under the management of the Meteorological Office. The war occasioned some diminution in the number of observers, but a considerable recovery from this is shown, the number now being 4952, an increase of 54 on 1919. A column is added to the detailed observations, giving the number of wet days or days with 0·04 in. or more of rain, and for the present the rain days or days with 0·01 in. of rain are also given.

Standard average values for the period 1881–1915 are used for the first time in "British Rainfall," and these are in agreement with the averages in use by the Meteorological Office in its various publications. Monthly average maps are given for the new period now introduced.

The distribution of total rainfall for 1920 is shown by a map as a frontispiece. Maps of monthly and seasonal rainfall are given, and the peculiarities are well described in the letterpress. Droughts and excessive rains are discussed, and there is much valuable information on evaporation and percolation in 1920.

Special articles are given on the new averages by the Superintendent of the Rainfall Organization, and also on the presence and distribution of salt in the air over the British Isles, by Mr. Wilfred Irwen, and on the Nipher rain-gauge shield, possibly of use where over-exposure is experienced.

Rainfall for 1920 was generally in excess of the average except in the eastern districts of Great Britain. The results for the droughty year 1921 will be of great interest. C. H.

Geography: Physical, Economic, Regional. By J. F. Chamberlain. (Lippincott's School Text Series.) Pp. xviii+509. (London: J. B. Lippincott Co., 1921.) 15*s*. net.

ESSENTIALLY this book is an account of the earth, its surroundings, and its products in relation to man, but, since it is addressed particularly to citizens of the United States, nearly all its illustrations, verbal and pictorial, are taken from North America and the possessions of the United States, and all the references, with few exceptions, are to American writers. In view of the fact, admitted by the author, that "the future history of America is to be inseparably connected with that of the rest of the world," more attention might have been directed to other countries; for instance, some of the street-scenes in American cities might have yielded to views in European or Asiatic capitals. It is, however, right that geographical study should begin with the home region, and this idea frequently finds expression in the inquiries suggested at the end of each chapter—*e.g.* "Make a careful study of the influence of geographic environment in your own State or locality. What factors are the most important? Are there any national forests in your State? Locate them. Is the Federal Government aiding in road construction in your vicinity?" But other suggestions will broaden the reader's outlook—*e.g.* "How will the economic geography of France be changed by the restoration of Alsace-Lorraine? What made possible the shipping of meat and dairy products from Australia and New Zealand to the British Isles?" These questions cannot be answered from the book itself. He who succeeds in answering them all will have had to read and think much, and will have become a more valuable citizen.

Modern High-speed Influence Machines. By V. E. Johnson. Pp. viii+278. (London: E. and F. N. Spon, Ltd., 1921.) 14*s.* net.

THE author points out that electrostatic machines are used much more on the Continent and in America than in this country, where they do not appear to be held in good esteem. He proceeds to argue that this bad repute is undeserved, and proceeds to investigate the capabilities of this class of machine and the conditions upon which its efficiency and trustworthiness depend. Practically all the types which have been proposed from time to time are described and analysed, and accounts are given of the author's own experiments, resulting in a type considerably more efficient than the well-known Wimshurst machine. He claims that, as a source of high potential supply, a high-speed influence machine designed on the right lines should be as efficient as an induction coil with all its accessories, and that, principally on account of the continuity of its supply and the higher voltage available, it should give better results for Röntgen-ray work, particularly with tubes for high penetration. Other fields in which he suggests that such machines may prove useful include applications to wireless telegraphy, electro-culture, electro-therapeutics, ignition, and the testing of materials.

Although we find here and there a little looseness of expression and vagueness in quantitative statement, there is evidence of clear thinking in the construction of a consistent theory of the action of these machines from the mass of incomplete explanation which is diffused among the existing literature on the subject. There is also some thoroughly practical information as to the construction of these machines.

The Transition Spiral and its Introduction to Railway Curves. By A. L. Higgins. Pp. viii+111. (London: Constable and Co., Ltd., 1921.) 6*s.* net.

THE early part of this book is devoted to a discussion on the principles underlying transition curves. The objects of a transition curve on a railway are to provide a gradual increase in curvature from zero at the point of contact of the curve and the straight part of the line of rails to a curvature equal to that of the central circular portion of the curve, and also to provide for a corresponding increase in the superelevation. Special attention is given to the clothoid (or Glover's spiral) $\lambda=m\sqrt{\phi}$, and the mathematical work required to elucidate this curve is carefully and clearly explained. The conditions which govern the lengths of transition curves are adequately discussed. The engineer may be called upon to insert transition curves in existing lines of railway and also in new lines, and for either purpose he will find the explanations of the procedure given in this book of great service. The latter half of the book is entirely taken up with field exercises fully worked out, which include not only the ordinary problems, but also problems in compound curves and reverse curves. This part is especially valuable, and cannot fail to be of use to railway engineers. We can recommend this book with confidence both to students of surveying and to railway engineers.

The New Hazell Annual and Almanack for the Year 1922. By Dr. T. A. Ingram. Thirty-seventh year of issue. Pp. xlvi+585. (London: Henry Frowde, Hodder and Stoughton, Ltd., 1922.) 5*s.* net.

THE new volume of Hazell's Annual will receive a cordial welcome from all who have occasion to make use of reference books. It is smaller by about two hundred and thirty pages than the volume issued last year, the sections dealing specifically with the Overseas Dominions and with foreign countries having been omitted, but the omission has enabled the publishers to make a handsome reduction in the price. We also miss several of the interesting surveys of the progress in particular subjects during the previous year which have hitherto been included. Other features of past volumes, such as the calendars, astronomical and meteorological data for the current year, and a compilation of the particulars of societies and institutions, which includes most of the better-known British and foreign learned societies, have been retained. A large amount of educational information which covers the universities, colleges, and secondary schools in the British Isles has also been gathered together. The volume is a valuable book of reference on matters of general interest.

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.]*

Some Problems in Evolution.

SINCE I am not, in the ordinary meaning, a biologist, I have sometimes difficulty in understanding biological language. Doubtless, also, I am often ignorant of recent developments in knowledge and thought. But certain problems of disease and education interest me, and I cannot get on with them unless some points, essentially biological, are cleared up. In the hope of enlightenment I wrote to NATURE. Immediately the discussion became acrimonious: at least, I became acrimonious. I was told, in effect, that I had no business in the august deliberations of biologists. It is not in human nature, or my variety of it, to accept that pontifical attitude. However, there seems now some prospect of the desired lucidity, and I shall be very ready to accept it with an humble and a contrite heart.

I fear, however, that Dr. Cunningham's letter in NATURE of January 12 does not greatly help. He writes:—"Sir Archdall Reid argues, as though it were a remarkable discovery, that characters are not present as such in the fertilised ovum from which an organism develops." But is that quite fair? I argued only that if, *as all biologists are aware,* no characters as such are present in the germ, then it must follow that, in the case of any and every character, nothing but germinal potentiality (predisposition, diathesis, capacity, ability) to produce (in response to fitting nurture) can be transmitted; whence it follows further that all characters are alike as regards innateness, acquiredness, and inheritability; whence, again, it follows that if we classify characters *with respect to these qualities,* there is, as Prof. Goodrich says, only one kind of character. On the other hand, *as all biologists know* (I protest I do not claim this as a new discovery), there are two kinds of variations: (*a*) those which result from germinal, and (*b*) those which result from nurtural, differences.

Of course, we can classify characters in all sorts of ways, useful and useless—according to colour, weight, size, shape, obviousness of recapitulation, frequency of reproduction, and so on. In a classification which physiologists have found useful, characters are ranked according to the influences which cause them to develop. This tabulation has the merit of forcing the inquirer to bear in mind the plain truth that frequency of reproduction depends (except when germinal variations occur) altogether on the frequency with which fitting nurtures are experienced, and not at all on the frequency of inheritance. For example, under this scheme of classification the inquirer bears in mind that rose comb and single comb in poultry are not more inheritable than corns on oarsmen's hands, but that they are more frequently reproduced only because the proper nurture is more frequently experienced. With respect to inheritance, his mind is fixed on the nature of the individual (the germplasm); with respect to reproduction, on the nurture received. Moreover, the student is compelled to realise that when he transfers the distinguishing terms "innate," "acquired," and "inheritable" from likenesses and differences between individuals to the characters in which those likenesses and differences are revealed, he has shifted his ground. It is one thing to compare separate individuals, and quite another thing to compare characters which may occur in the same individual. The old terms may still be applicable; but that is the question which has been raised. It will be gathered that they do not seem applicable to me, and that their constant and (to me) inexplicable transference is one of the causes of my puzzlement. It may be noted also that Darwin, in all that remains permanent of his work, used these terms in relation to variations, while Lamarck and Weismann applied them especially to characters. I may be mistaken, but I believe that I am right when I say that no one (including Darwin) has ever doubted the all-sufficiency of natural selection unless he has, in his thinking, transferred the terms "innate," "acquired," and "inheritable" from variations to characters, or has confused inheritance with reproduction.

Again, we may employ our words with unusual meanings and reason on that basis. Thus "inherit" may be used in the sense of "reproduce," when, of course, the "intensity of inheritance" of combs is infinitely greater than that of corns. But now we are asking for trouble and in sight of confusion. We are in danger of using as counters in thought and discussion, not realities in nature, but mere words. Our inquiries, notwithstanding our language, relate not to the natures of individuals, but to their nurtures. Does or does not the impure dominant inherit the recessive trait which it does not reproduce? Does the pure extracted recessive which is unlike its parent inherit nothing? When a pigeon or a fowl belonging to a fancy breed reproduces the wild ancestral coloration, from whom does it inherit? From an exceedingly remote ancestor? It passes my non-biological comprehension to understand how an individual can inherit except through, and therefore from, his parent. In practice the difficulty is surmounted by using "inherit" with the usual, or with the unusual, meaning as exigencies of argument dictate. For example, Dr. Cunningham employs the word with the ordinary meaning when he declares "a character may be inherited when it is apparent only in one parent or in neither," and with the unusual meaning when he insists that combs are more inheritable than corns.

Consider the Lamarckian dictum: "Acquired as well as innate characters are inheritable"; and the neo-Darwinian: "Innate, but not acquired, characters are inheritable." What do "innate" and "acquired" mean here? No one can tell. Definitions are impossible, for none can be framed which cover the whole of common and accepted usage. What does "inherit" mean? When applied to "innate" characters it may have, as already indicated, its ordinary meaning, or it may mean "reproduce." If a cock reproduced a comb under the same conditions as those in which its parent produced it (in response to similar nurture) all biologists would regard the comb as inherited—and rightly, for reproduction *under the same conditions* implies inheritance, though inheritance does not necessarily imply reproduction. The case is different with respect to "acquired" characters. If a child reproduced an oarsman's corn under the same conditions as the parent produced it, few biologists would regard the corn as inherited. It would be regarded as inherited only if the child developed it under conditions in which the parent did not and could not have developed it. The word now means "vary," *i.e.* non-inherit, for non-inheritance *is* variation. It seems, then, that an acquired character is not inherited when it is inherited, and is inherited when it is not inherited—*i.e.* a single word in a single sentence has two contrary meanings. Biologists say they understand one another, and therefore I suppose they do; but I wish, in pity, they would enlighten me. Why do Lamarckians and neo-Darwinians say "inherit" when they mean "vary"? Why do Mendelians and biometricians say "inherit" when they mean "reproduce"? Meanwhile, I cannot help suspecting that something is wrong. Consider what has happened—Lamarck's theory and half a century of stasis; Darwin's brilliant lucidity and twenty years of progress, with biology in its splendour, a great intellectual force; Weismann's effort, and nearly half a century of controversy, with interest in the subject limited to some (not all) zoologists and botanists, and of these few a majority resentful of trespassers.

I propose in two or three letters to adopt the physiological classification when dealing with three or four biological subjects. Biologists, I hope, will be tolerant towards one who uses this classification because, admittedly, he does not understand the difficult language they speak. G. ARCHDALL REID.

9 Victoria Road South, Southsea, January 16.

Atmospheric Refraction.

DR. BALL is surely wrong in suggesting in NATURE of January 5, p. 8, that the difference between Mr. Mallock's figure for the radius of curvature of a nearly horizontal ray and that given by Dr. de Graaff Hunter is accounted for by any consideration of the curvature of the wave-front. If such were the case, then an observer looking towards the sea horizon would see a ray of light in different directions for different initial curvatures of the wave-front. Suppose an observer from the bridge of a ship were looking at a searchlight placed at sea-level at the extreme limit of visibility. The rays of the searchlight beam would be plane waves, those coming from the barrel of the searchlight spherical. Does Dr. Ball wish us to infer that in such circumstances the visible beam would appear to the observer to issue from a point *above* the projector?—for that is what his suggestion leads to.

To my mind, a great deal of the confusion between refraction figures given by different authorities lies in their attempt to connect refraction with variations of temperature before they have properly considered the subject from the point of view of variations in refractive index. If we assume that, over the sea at all events, the refractive index stratification is one which is spherical and concentric with the earth, then the general equation of any ray of light is

$$pn = \text{constant},$$

where n is the refractive index and p the perpendicular upon the tangent to the ray from the earth's centre (see Herman, "Geometrical Optics," p. 305, or Heath, "Geometrical Optics," p. 329).

If r is the distance of any point upon the ray from the earth's centre, h the height of the point above the earth's surface, and R the earth's radius, then $r = \mathrm{R} + h$.

Now n must be some function of the height $= f(h) = f(r - \mathrm{R})$, and hence the "$p, r$" equation of the ray is

$$pf(r-\mathrm{R}) = \text{constant} = \mathrm{C}.$$

The radius of curvature of the ray is thus

$$\sigma = r\frac{dr}{dp},$$

$$= -\frac{r\{f(r-\mathrm{R})\}^2}{\mathrm{C}} \bigg/ \frac{df}{dr},$$

or

$$= -\frac{rn^2}{\mathrm{C}} \bigg/ \frac{dn}{dh}.$$

As we are dealing with a ray which is nearly horizontal, variations in r and n^2 cannot have large effects upon σ. The variations in r might amount to 1 part in 200,000 if the ray never gets above 100 ft. above the surface of the sea; the refractive index, which at the sea-level is 1·00029, could scarcely be reduced below 1·00027 in the same height, so that variations in n^2 could not exceed 4 parts in 100,000. It follows that the curvature of such rays is essentially proportional to the refractive index gradient. Since by Dale and Gladstone's law $n - 1$ is proportional to ρ, the density, the curvature of the ray-path becomes immediately proportional to the density-gradient. If we attempt to translate density-gradient into temperature-gradient, I see no means of doing so other than by making the assumption that the atmosphere is statically in equilibrium, in which case the formulæ given in my letter in NATURE of January 5 result immediately. But I have the gravest doubts of the legitimacy of such an assumption for the lower levels of the air. A steady motion leading to a dynamical relationship between pressure, density, and temperature is much more likely, but is, from the mathematician's point of view, a hopeless thing to try to set down owing to the impossibility of dealing with all the factors of the problem, such as rate of radiation of heat-energy from the earth or sea, rate of thermal conduction in the air, nature of the upward air-currents, and so on.

If however, we leave all such considerations aside and deal only with the established connections between curvature of the ray-path and the density-gradient, then we can only admit uniform curvature if we are prepared to admit that the density of the air in its lower levels is a linear function of the height. To such an admission I take the strongest exception. It is quite insufficient to account for a refraction of the visible sea horizon above the true horizontal—a phenomenon which, as every seaman knows, is by no means uncommon. T. Y. BAKER.

Admiralty Research Laboratory, Teddington, Middlesex, January 7.

The Colours of Tempered Steel.

THE well-known and characteristic tints that appear on the surface of a tarnishable metal when it is heated in contact with air have been usually regarded as interference colours due to the formation of a thin film of oxide on the surface of the metal. The correctness of this explanation has, however, recently been questioned (A. Mallock, Proc. Roy. Soc., 1918), and rightly so, as a continuous film on a strongly reflected surface cannot on optical principles be expected to exhibit such vivid colours as those observed.

I have recently made some observations which shed a new light on this subject. It is found that the *missing colours* complementary to the tints seen by reflected light appear as light *scattered* or *diffracted* from the surface of the metal. In other words, if a plate of blue-tempered steel be held in a beam of light and viewed in such a direction that the regularly reflected light does not reach the eye, the metal shows a straw-yellow colour, and not the usual blue. It will be understood that the scattered light, being distributed over a large solid angle, appears much feebler than the regularly reflected colour, and in order to observe the effect satisfactorily the metal should have a smoothly polished surface before being heated up. Scratches and other irregularities show the ordinary colour of the film, and not the complementary tint. The most attractive effects are those exhibited by a heated copper plate, both on account of the vividness of the colours and on account of the ease with which the surface can be given a satisfactory polish.

It is clear from the observations mentioned above that the colours under discussion are in the nature of *diffraction effects* arising from a film which is not continuous, but has a close-grained structure. Interesting effects are observed when the surface of the illuminated plate is viewed through a nicol, the colour and intensity of the scattered, as well as of the regularly reflected, beams varying as the nicol is rotated about its axis. The most striking effect is obtained when the direction of observation is nearly parallel to the surface of the plate. The scattered light in this case is nearly completely polarised, and the colour of the regularly reflected light changes nearly to its complementary when the nicol is turned through 90°. The phenomena strongly recall to mind the observations of R. W. Wood on the colours of a frilled collodion film on a silvered surface, which have been discussed by the late Lord Rayleigh (*Phil. Mag.*, November, 1917), and it seems probable that the explanation of the phenomena will ultimately be found to be somewhat similar in the two cases.

C. V. RAMAN.

210 Bowbazaar Street, Calcutta, India,
October 11.

MR. MALLOCK has shown that the colour of the oxide film is an *intrinsic* property of the material of which it is composed and the material retains this property as it is gradually ground down from its original thickness to the vanishing point. Sir George Beilby's observations have confirmed this, and have further shown that the film is an aggregate *in open formation* through which oxygen molecules can penetrate to the metallic surface. For each temperature above the tempering range the thickness of the film is determined by the porosity of the aggregate to the oxygen molecules at that temperature. Direct experimental observations have shown the part played by *time of heating* at any given temperature. For example, at 275° C. a deep purple was reached in ten minutes, and this changed to blue from the margin inwards during a further period of twenty minutes. It was thus shown that the watchspring-blue, which could immediately be produced by a temperature of 300° C., could also be produced by heating at 275° for thirty minutes. Sir George Beilby's view is that the *intrinsic* colours of the films which are produced at different temperatures result from changes in molecular aggregation in relatively open formation of a similar nature to those which have been shown to occur in thin metal films, *e.g.* gold. This is referred to in his recently published volume entitled "Aggregation and Flow of Solids," sections 3 and 10.—ED. NATURE.

Some Terrestrial Experiments on Gravitation and Einstein's Theory.

THE object of this letter is to direct the attention of writers on Einstein's theory of gravitation to some recent experiments on the terrestrial aspects of gravitation which seem to have been overlooked, although they appear to be of great importance for the purpose of forming a just estimate of the correctness of Einstein's theory.

The first investigation referred to is that of Dr. P. E. Shaw on the effect of temperature on gravitative force (Phil. Trans., 1916, A, vol. 216, pp. 349–92). On p. 390 Dr. Shaw writes:—"When a large mass attracts a small one, the gravitative force between them increases by about 1/500 as the temperature of the large mass rises from, say, 15° C. to 215° C." The only cause capable of producing this effect on the relativity theory seems to me to be the absorption of heat by the large mass (lead), amounting to 6 calories, or $2{\cdot}5\times10^8$ ergs per gram, and resulting in a fractional increase of inertial mass of about $2{\cdot}8\times10^{-13}$. We require 7000 million times this amount in order to account for Dr. Shaw's result on the hypothesis of the proportionality of the gravitative and inertial masses, which is one of the basal assumptions of Einstein's theory.

Another investigation is that of Majorana on the absorption of the gravitational flux (*Phil. Mag.*, vol. 6, No. 39, pp. 488–504, 1920), in which he finds, *inter alia*, that a lead ball weighed *in vacuo* loses $7{\cdot}7\times10^{-10}$ of its weight when it is surrounded symmetrically by 104 kg. of mercury. If the gravitational flux be assumed to be absorbed by the mercury according to an exponential law of density and thickness, the *quenching constant*, or factor of absorption, is found to be $6{\cdot}73\times10^{-13}$ per unit density and length. A possible interpretation is that the gravitational mass of a homogeneous sphere at an outside point is only a fraction of its inertial mass; according to Majorana, it is about one-third for the sun. If this interpretation be legitimate, the results of Majorana, like those of Shaw, lead to the conclusion that the gravitational and inertial masses are not proportional to one another in all circumstances.

G. A. SCHOTT.

University College of Wales, Aberystwyth,
January 5.

British Scientific Instruments.

IN the timely and encouraging leader in NATURE of January 19, with which my experience is in entire agreement, there is a point of some importance to which reference is omitted. This is the practical question of cost. I would ask permission to draw a moral for application at the present time. Without expressing any opinion as to whether this cost could be reduced by improved methods of manufacture, I would direct attention to the fact that in the impoverished state of the finances of universities and similar bodies it is impossible adequately to equip their laboratories with costly apparatus.

The moral is this: *The most effective way in which Government intervention can assist British makers of scientific apparatus is to increase the grants to universities and to research in general.* It is impossible for individual workers to purchase expensive British instruments out of their own incomes, and until the resources of the laboratories in which they work are sufficiently increased it is an unjustifiable and foolish restriction to prevent their obtaining from abroad apparatus often admittedly inferior, but capable of good use. How many laboratories can afford to obtain Hilger optical apparatus or the Cambridge string galvanometer? It is further to be remembered that as science advances the instrumental equipment for continued pushing forward tends to become more elaborate, sensitive, and accurate, and necessarily of greater cost

W. M. BAYLISS.

University College, London.

Globular Lightning Discharge.

THE following is an account of what appears to have been a genuine case of globular electrical discharge observed by the sisters of one of my colleagues, the Misses Pitman, at Eastbourne on August 17 last. Authentic instances of this phenomenon are rare, and as the conditions which accompanied this particular ball were observed with some care it seems desirable to put the case on record.

The two ladies were sitting at table about 8 p.m., with the window open. It was raining heavily at the time, and there was no wind. Stormy clouds were about, but it was not unusually hot. Thunder and lightning at the same time were afterwards reported from London—a distance of, say, 50 miles—but there was no thunderstorm at Eastbourne. There had been no rain during the few preceding days. As one of the ladies took up a knife to cut bread the ball of light was seen to flash past the knife (without touching it) on to the table, travelling a distance of about 9 in. at an average height of about 3 in. from the table, but moving towards the latter.

When the ball touched the tablecloth it "went out with a spitting sound," leaving no mark or trace of any sort. Until it touched the cloth there was no sound, and the whole thing was over in such a "flash of time" that it was impossible to say how fast the ball travelled. There seems to have been an impression that the ball came from the direction of the open window, but it was only under dependable observation during its 9-in. path from the bread-knife to the tablecloth.

As to the appearance of the ball itself, it was "about the size of a pea, the light encircling it being about the size of a golf ball. The light was white and intensely bright, like electricity." "Too dazzling to see through." A. P. CHATTOCK.

The University, Bristol.

Where did Terrestrial Life Begin?

FOR a long time now the idea has prevailed that life began in the sea or in the mud of the seashore, and many interesting articles have been written to describe the emigration of sea-creatures and water-creatures to the land, but there are some difficulties in the way of this theory which do not seem to have been noticed, and on broad general grounds it is, perhaps, more probable that life began on mountain-tops.

Life became possible on the earth only after it had cooled to a certain point, and surely that point was reached much sooner on hilltops than in the sea or on the seashore. It must be remembered that the sea when first formed would have a temperature of more than 100° C., since the condensation of volcanic steam must have taken place under a massive atmosphere of carbon dioxide. This heavy atmosphere would not only raise the boiling point of the sea, but would greatly retard its cooling, which would in any case be a very slow process, since the sea-bed would be hot and the sea deep, and a bad conductor. Would not the mountain-tops have become cool and habitable centuries before the temperature of the sea fell to 111° F. and became a fit abode of life? Further, it is almost certain that the first life was green chlorophyll-carrying cells which would require sunlight, and sunlight would pierce the heavy and cloudy atmosphere of steam and carbon dioxide, and would reach the hill-tops long before it reached sea-level.

For these reasons it seems that life is more likely to have made its first appearance on the mountain-top of the Polar regions than in sea-mud or sea-water. RONALD CAMPBELL MACFIE.

DR. MACFIE's suggestion that life originated on the mountain summits is new, and entitled to careful consideration. If the early earth, when its atmosphere was laden with carbon dioxide and steam, had been windless, then the mountain summits would have stood like islands above a sea of hot mist, and they would have been the only situations possible for the development of life; but as any wind would have at times submerged the mountain summits beneath the lower atmosphere, they would have been subject to violent fluctuations in temperature and moisture which would have been unfavourable to primitive life. It may be doubted whether life could have appeared on the earth until later, when the temperature and the atmosphere were more similar to those which have existed throughout all the time of which there are contemporary geological records as to climate and geographical conditions.

In the discussion on this question in a chapter of "The Making of the Earth" I laid stress on an equable environment as an essential condition for the development of Protobion, the most primitive form of life. If that view be sound, then life was not likely to have developed until a considerably later stage on the earth than that at which the conditions stated by Dr. Macfie would have held. His letter involves the issue whether the first life was semi-aquatic or terrestrial. On his assumption that it is "almost certain" that the first life consisted of cells containing chlorophyll it would certainly have begun on land. But such an organism would be more complex, and, therefore, probably later in development than some simple form of amœboid or mycetozoon, to which strong sunlight would have been less beneficial, and for which the unchanging environment on the muddy shores of a primeval lagoon would appear to be a more suitable medium than a mountain summit.

J. W. GREGORY.

Rainfall and Drainage at Rothamsted in 1921.

IN view of warnings that are being issued by various water companies that waste of water should be avoided, the rain and drainage figures of the Rothamsted Experimental Station for 1921 are of considerable interest and significance. The drainage gauges were built in Barnfield in 1870 by Lawes and Gilbert, and contain undisturbed soil which is kept bare; each gauge measures 1/1000 acre. The soil is a rather heavy loam with a reddish subsoil over chalk.

	Rainfall	Percolation.		
	1/1000 acre gauge. Inches.	Through 20 inches of soil. Inches.	Through 40 inches of soil. Inches.	Through 60 inches of soil. Inches.
For year 1921	16·093	5·766	5·984	5·479
Average for 50 years ...	28·692	14·834	15·482	14·659

The significance of these figures is that not merely is the rainfall and drainage the lowest since the records started, but that whereas in a normal year about 50 per cent. of the rainfall evaporates, during the past twelve months as much as 63 to 65 per cent. evaporated. This is partly accounted for by the excess of sunshine, which at this station amounted to 159 hours above the average, or about 26 minutes a day.

The number of days on which rain fell (0·01 in. or more) during the past twelve months is 119; this compares with an average for sixty-eight years of 174.

It is interesting to recall the fact that the year 1902, which hitherto gave the lowest percolation figures, was followed by the wettest year on our records, when the heavy rain-showers gave a drainage of 24 in. W. D. CHRISTMAS.

Rothamsted Experimental Station, Harpenden, January 16.

Tribal Name of the Raninidæ.

IN the report of the Linnean Society's meeting on December 15 last the abstract of an elaborate and highly important essay by Prof. G. C. Bourne on "The Raninidæ: A Study in Carcinology" contains a proposal to place the family "in a separate tribe, Gymnopleura."

It would seem, however, that the name for such a tribe has been anticipated by Latreille, who, under date 1831, in his "Cours d'Entomologie," p. 368, institutes the tribe Notopterygia expressly for the genus Ranina. Attention has been directed to this in the comparatively recent year 1908 in the Annals of the South African Museum, vol. 6, p. 17. The same page explains that the specific name in *Ranina dentata* is founded on a mistake, and the preceding page, while giving a wrong date to the Mantissa of Fabricius, will by its synonymy justify the substitution of *Ranina raninus*, Linn., in preference alike to *R. scabra* and *R. dentata*.

THOMAS R. R. STEBBING.

Tunbridge Wells, December 22.

I AM far from a scientific library and unable to verify Mr. Stebbing's reference to Latreille's classification of the Raninidæ, but have not the least doubt that the reference is correct. There is no reference to Latreille's tribe Notopterygia either in Milne Edward's "Histoire Naturelle des Crustacés" or in de Haan's "Crustacea" in Siebold's "Fauna Japonica," and as I was concerned rather with the correction of existing schemes of classification than with the work of earlier authors, Latreille's "Cours d'Entomologie" escaped my attention. Had I read it I should have suggested the restoration of Latreille's tribe, giving to it the new definition set forth in my memoir communicated to the Linnean Society, and it seems that my proper course will be to withdraw the name "Gymnopleura" and substitute that of "Notopterygia, Latreille," in an addendum to the printed paper.

G. C. BOURNE.

Twyning Manor, Tewkesbury, December 30.

The Depth of Earthquake Focus.

IN the Philosophical Transactions of the Royal Society, Series A, vol. 222, pp. 45–56 (1921), Mr. G. W. Walker, relying on certain observations of the emergence-angle of P waves at Pulkovo, makes the somewhat startling suggestion that the depth of focus is of the order one-fifth of the earth's radius, or about 1250 km. This is a much larger estimate of depth than that hitherto suggested, viz. of order less than 100 km. Mr. Walker's estimate of depth is a consequence of accepting the Pulkovo numbers as correct. It appears that the values of the apparent angle of emergence calculated from Zöppritz's curve do not agree with its value directly measured at Pulkovo. This discrepancy is so marked that either the time-curve or the Pulkovo values must be seriously in error, and Mr. Walker proceeds on the assumption that within the limits of possible error in the time-curve we can modify it so as to agree with the direct measure of the apparent angle of emergence.

It appeared to me that in a matter so important independent proofs would be desirable, and an attempt has been made to obtain an estimate of depth from the following considerations:—For a very deep focus, the long-wave phase in the seismogram or the "main strock" identified with the arrival of Rayleigh's two-dimensional surface-waves would be of diminished importance compared to the P and S phases which are due to the three-dimensional longitudinal and transverse waves travelling by brachistochronic paths from focus to station, in view of the fact that the surface-waves are originated by the shocks in the epicentral region. These shocks in their turn are due to the arrival of the longitudinal and transverse waves from focus to the epicentral region, and these waves, varying as they do as the inverse powers of the distance, make the shock in that region of lesser and lesser intensity the greater the depth of the focus. Consequently, the depth to be chosen for the focus must be of such a magnitude that the observed relationship between the principal phases in the seismogram is maintained. It has been found possible to calculate the effects of various focal depths on the relative importance of the different phases in the seismogram by an extension of the procedure adopted by Lamb in determining the propagation of tremors on the surface of an elastic solid (Phil. Trans., A, vol. 203, 1904). The investigation suggests that the hitherto accepted estimate of depth of focus is much nearer the truth than Mr. Walker's estimate. The detailed calculations will be published in due course.

S. K. BANERJI.

University College of Science, Calcutta,
December 22.

Energy Changes Involved in Transmutation.

IN some recent discussions concerning the possibility of the transmutability of large amounts of one element into others—and particularly that of lead into gold—no mention has been made of the energy changes involved. Studies in radio-activity and the work of Sir Ernest Rutherford have shown that whenever an element breaks up a relatively enormous quantity of energy is liberated.

Should it ever become possible to control the breaking up of elements, the advantages to be gained will lie in two main directions. First, the manufacture of elements now scarce from those more plentiful will be of the utmost value to industry. Secondly, the fact that intra-atomic energy will then be available should provide a satisfactory solution to the problems raised by the world's dwindling sources of power.

But if the energy available in this way is ever extensively used, all the heavier elements will be destroyed and gradually replaced by lighter; at the same time their available energy will be lost. So it appears possible that after countless ages the earth may become a mass of light elements, possibly in the condition of a nebula.

It has been assumed above that it would be possible to control the decomposition of elements so that only a limited amount of energy was liberated at a time. It is of some interest to contemplate what will happen should this evolution of energy get out of hand.

Let us suppose that someone has succeeded in starting the rapid decomposition of a block of a heavy element by the use of some accelerating influence. If the energy liberated during the action can escape faster than it is set free, no violent action is to be expected; but if, on the other hand, it is liberated faster than it can escape, an action of explosive violence may occur. The accumulation of energy will certainly increase the rate of decomposition of surrounding atoms, which in their turn will add still more energy, and the change will go on with ever-increasing velocity until the whole block of the element is destroyed. Should the surrounding elements be unable to stand up against the enormous quantity of free energy at their surfaces, it seems that nothing could save the earth from complete destruction. Thus inadvertently the world might be reduced by some enterprising chemist or physicist to a white-hot nebulous mass.

I. W. WARK.

43 Vincent Square, S.W.1.

The Theory of the South-West Monsoon.

By L. C. W. BONACINA.

IN the widest sense the term "monsoon" in climatology is applicable to those seasonal modifications, or subversions, of the planetary circulation which are established by the differences of temperature due to the irregular distribution of land and water, especially as seen in such regions as Eastern and Southern Asia, where a definite continental outflow of air in winter, and inflow in summer, characterise the surface circulation.

In relation to India the expression "south-west monsoon" is nowadays quite a commonplace, but it cannot be said that the theory of the phenomenon has hitherto been properly elaborated. The text-books commonly describe the monsoon as a kind of magnified sea-breeze action, an explanation of a complex phenomenon which can stand only as a first approximation. It must be emphasised, indeed, that the south-west monsoon of India is not in the main a special local effect of the heated condition of India at all, but is part of a general circulation of air with respect to a system of low barometric pressure originating primarily in the heated condition of the vast Asiatic continent as a whole. It is when one abandons a merely qualitative conception of the monsoonal circulation and considers the latter in the form which it actually takes as a wind-system of particular direction, speed, and structure that the mechanism is realised to be much more complex than is suggested by the above simple statement. For, just as one cannot understand the many puzzling peculiarities of the small-scale diurnal sea-breeze effect familiar round the English coast in summertime without referring to the general barometric-gradient wind of which it is often nothing more important than a coastal modification in direction and speed, so one cannot properly deal with the large-scale seasonal sea-breeze effect in monsoon countries otherwise than as an item in a wider system of circulation. This outlook is the key to the problem, and has enabled Dr. G. C. Simpson[1] to present meteorologists with the most effective analysis that has yet appeared. He shows the futility of trying to explain the monsoon in terms of a single cause, and the necessity of seeing in the phenomenon the final result of a number of interacting factors.

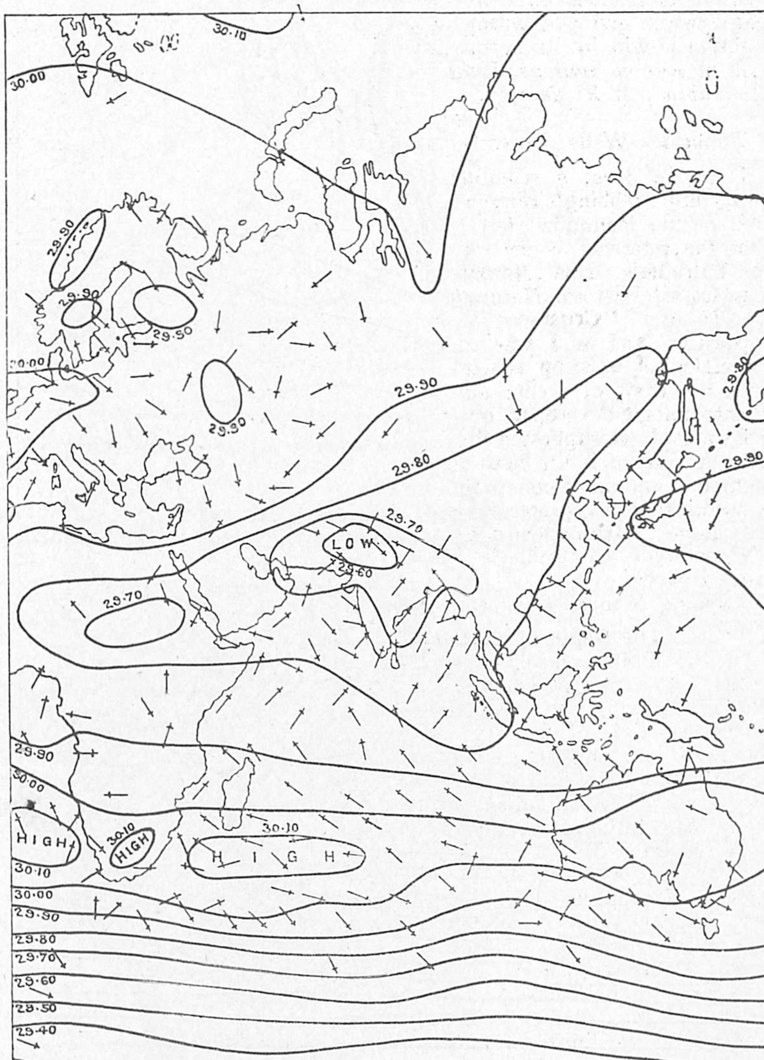

FIG. 1.—Average wind and pressure distribution around India in May. Pressure in inches.

Before stating Dr. Simpson's theory, it may be well to review the main seasonal divisions of the Indian year. These are: (1) a cool, dry season, November to February, definitely dominated by the north-east monsoon, which really belongs to the north-east trade system as regulated at this season by high barometric pressure in Central Asia; (2) a hot, dry season, March to May, characterised by light air-currents gradually changing round from north-east to south-west,

[1] "The South-West Monsoon. Lecture delivered to the Royal Meteorological Society, March 16, 1921, and published in the Society's Journal for July, 1921.

culminating in unstable conditions productive of violent thunderstorms; (3) a wet season, June to September, dominated by the south-west monsoon, a powerful current bringing heavy rainfall everywhere in India except the north-west corner and those parts situated on the lee side of the mountain ranges; (4) a short transition period embracing the month of October, during which the south-west monsoon is retreating with belated rains on the Madras coast.

Now, in order to strike at the root of the prevalent misconception that the south-west monsoon current is due essentially to the heated surface of India itself, Dr. Simpson points to the outstanding seasonal anomaly in the climate of India. The anomaly in question is the fact that the hottest month of the year in India as a whole is not July, but May, coming, that is to say, just before the high solstice, instead of just after, as in England and most countries. The mean day and night temperature for the whole of India in May is 88·7° F., with a large part of the northern central region more than 90°, whereas in July the mean is only 83·5°, with the area more than 90° relegated to the Thar Desert in the north-west.

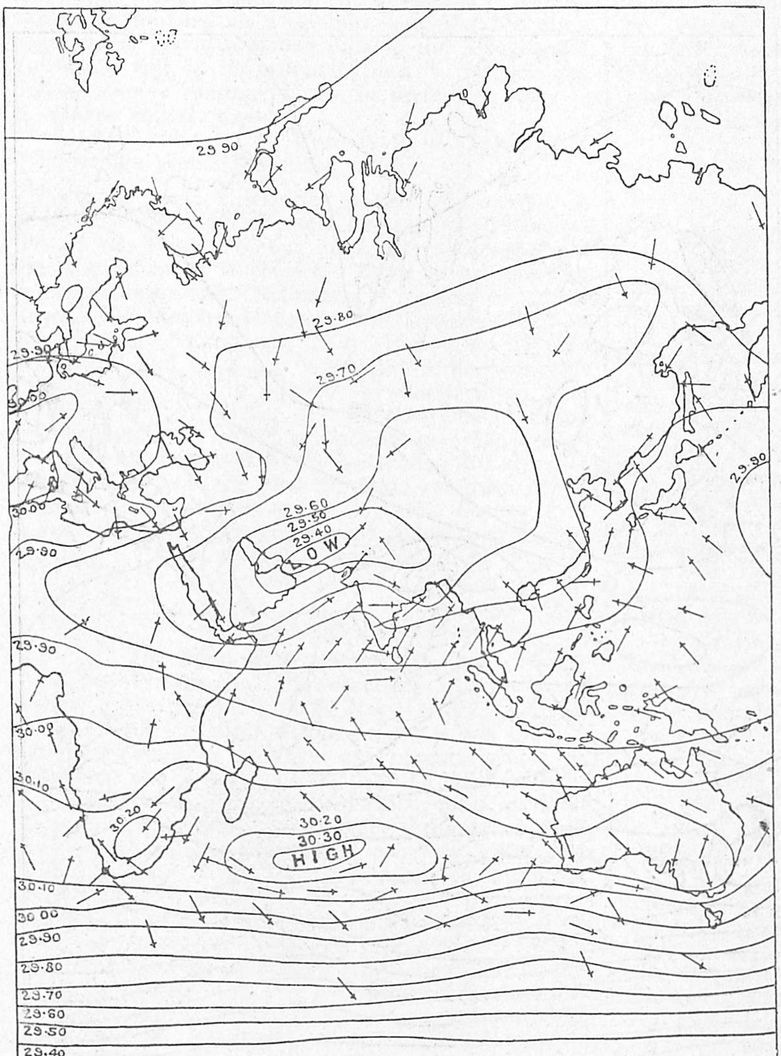

FIG. 2.—Average wind and pressure distribution around India in July. Pressure in inches.

Clearly, in all the more northern portions of India which lie away from the nearly non-seasonal equatorial regimen controlling the climate of Ceylon and the extreme south of the peninsula, the temperature ought to continue rising until July, and the fact that after May it appreciably declines is evidently the result of the cutting off of sunshine by the dense canopy of cloud and rain rolled in by the south-west monsoon. Why, then, does not the south-west monsoon burst in May? Because in that month the summer low-pressure system to the north-west of India is not in a sufficiently advanced stage of development. It is not until June that this low-pressure area and, contemporaneously, the high-pressure area in the South Indian Ocean become pronounced enough to induce the south-east trade wind to cross the equator, thereby to become deflected by the rotation of the earth into the current which feeds the south-west monsoon. The difference is illustrated in Figs. 1 and 2, which show the average distribution of wind and pressure over a large area surrounding India in May and July. The difference between the two maps will be brought out more fully in relation to the monsoon rainfall. Meanwhile, let there be noted what is exhibited with much greater distinctness in maps[2] of wind and pressure for India alone, that in both months, but more conspicuously in May, the isobars, with corresponding deflection of the wind arrows, bend southward in crossing the Indian land-mass—away, that is to say, from the centre of low pressure in the north—signifying that there actually is some indraught due to India itself, though it is only a superposed secondary feature, giving the isobars their precise trend—a local modification of the general Asiatic circulation.

Now to explain the great meteorological characteristic of the south-west monsoon, viz. the heavy rainfall. The diagram Fig. 3 was devised by Dr. Simpson to represent the chief alignments of mountains in and around India (thick-lettered lines), and the chief air-stream lines of the south-

[2] See Dr. Simpson's original paper, and Sir John Eliot's "Climatological Atlas of India."

west monsoon current (numbered arrows). It should be studied in relation to Fig. 4, showing the mean rainfall over the same area in July, the typical monsoon month. The disposition of the mountain ranges is such as very effectively to entrap in a kind of box the humid air brought into the Indian area by the south-west monsoon, with the consequence that the air is mechanically forced to ascend with copious condensation of moisture as a result of cooling by adiabatic expansion. Where the ranges obstruct the air-currents at right angles, as in the case of the Western Ghats, KL, or the Khasi Hills, HI, enormous falls of rain occur during the four or five months of the wet season. The Khasi Hills, moreover, contain a spot, Cherrapunji, so peculiarly favourable to orographic precipitation that the average annual rainfall is as high as 424 in., nearly all of which falls during the monsoon period. In the Gangetic Plains the heavy rainfall is largely due to the convergence of air-streams III., IV., V., and VII., assisted by the Himalayan wall, CD, at the base of which the forced ascent of air causes another specially wet submontane strip of country.

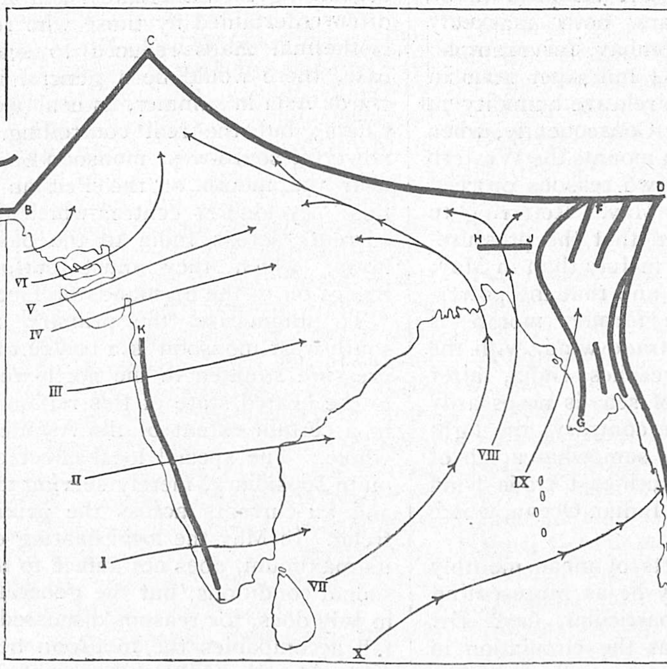

FIG. 3.—Chief alignments of mountains, and air-stream lines of south-west monsoon, in and around India. (After G. C. Simpson.)

The dry areas in July are mostly in the "rain-shadow" of the mountains, but the desert region in the north-west of India is nearly rainless for a complexity of reasons—partly because the trend of the neighbouring mountains is not such as to force upward the comparatively small amount of air which flows into this corner of the country; partly because, with the initial conditions thus unfavourable to cloud production, what little air does arrive there from the sea is heated up so that its relative humidity is lowered and the tendency to drought consequently increased; and partly because over this part of India the upper-air current from the north-west, as revealed by direct kite observations, is warm and dry, a condition most unfavourable to condensation of moisture in any surface air that may be caused to rise. In the burning-hot Thar Desert a number of interacting factors thus conspire to maintain intense drought during what in India generally is the rainy season.

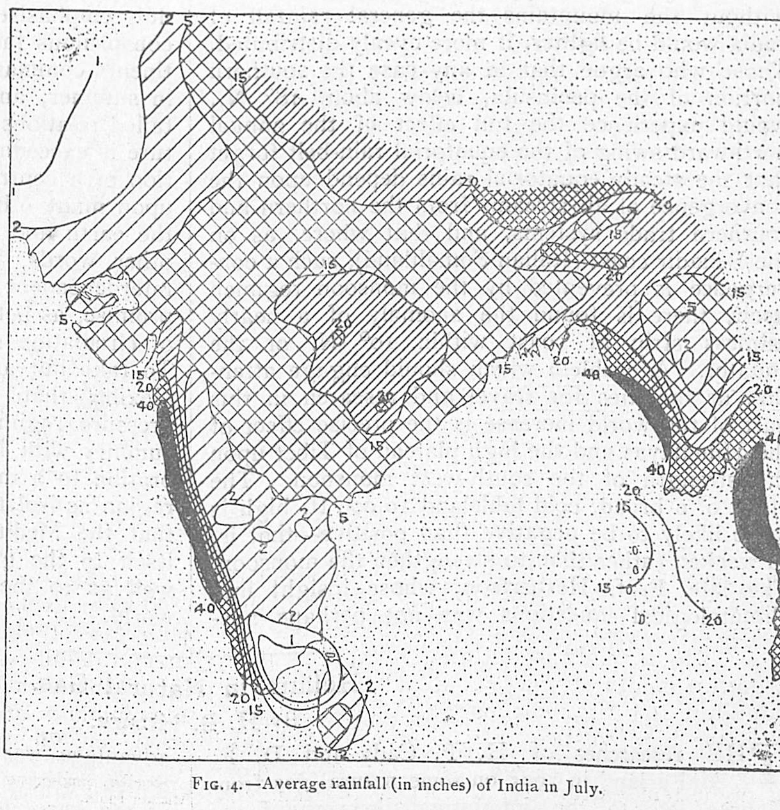

FIG. 4.—Average rainfall (in inches) of India in July.

The reason why the mountains provoke so enormous a rainfall out of the monsoon current of July, and scarcely any out of the indefinite sea-winds of May, is shown by Dr. Simpson to be twofold—the July winds are both markedly stronger and damper. At Bombay, for example, the mean wind velocity is 7·4 miles per hour in May and 14·2 in July, and the relative humidity 74 and 86 per cent. respectively. Consequently, when a wind from the Arabian Sea mounts the Western Ghats, condensation will for two reasons proceed more actively in July than in May. Referring to Figs. 1 and 2, it will be seen that the pressure-gradient over India is steeper in July than in May, which means stronger winds, and that the powerful monsoon current of the former month is supplied from the south-east trade wind, with the result that the air which reaches India, after traversing some 2000 miles of sea, is necessarily very humid. In May, on the contrary, the light winds on the west coast blow somewhat north of west and conflict with the south-east trade wind over the equatorial part of the Indian Ocean, where rain falls instead of in India.

Realising how illusory charts of mean monthly meteorological conditions may be as representing actual conditions on any particular day, Dr. Simpson is able to show that the circulation in the Indian area rarely differs essentially from the mean, and that breaks in the monsoon are associated with temporary reversions to the conditions typical of May, when clear skies and fierce sunshine are broken only by violent local thunderstorms.

One cannot but support his conclusion that without the mountains the general rainfall of India would be lighter, if more evenly distributed. Those who argue that in any case the southern portion of the peninsula, below about 18° N., would experience the full effect of the annual northward swing of the equatorial rain-belt forget that the steady equatorial rains depend upon the convergence of air-streams from the northern and southern trade systems, and that where, as on the Benadir coast (Italian Somaliland), such a convergence is prevented by the monsoon regimen itself, there is found the anomaly of a nearly rainless strip of coast within 10° N. of the equator. A problem which should engage attention as facilities for travel and research in this part of the world increase is the precise effect of the Himalayas and the high plateau of Tibet upon the strength of the south-west monsoon. The effect of a broad, cold tableland 10,000 ft. high is more likely to be negative than positive—that is, to weaken rather than to strengthen the monsoon. The late Prof. Herbertson, whose insight into climatological questions was not perhaps adequately appreciated by meteorologists, used repeatedly to discountenance exaggerated notions concerning the "flue-like" action of Central Asia often entertained by those who rely too much on isothermal maps reduced to sea-level. In any case, there would be a general inflow of air towards Asia in summer, as is so well exemplified in China; but the real controlling centre of the powerful south-west monsoon of India is situated near the mouth of the Persian Gulf, and it is this "cyclonic" centre which guides the air-currents across India to the base of the Himalayas, which they must perforce mount, and thence on to the highlands of Tibet.

To summarise, the primary condition of the south-west monsoon is a centre of low barometric pressure situated to the north-west of India, due to the heated state of this region in summer, and to a certain extent of the Asiatic land-mass as a whole. The special local effect of India itself is quite subsidiary, merely serving to give the isobars and air-currents across the peninsula their final trend. In May the local heating of India, then at its maximum, does not suffice to bring about monsoonal conditions, but the general Asiatic heating in July does, for reasons discussed. A heavy rainfall accompanies the monsoon because it is both a humid and a powerful current, and is met more or less at right angles by various high mountain ranges.

Finally, it is advisable to refer to certain general principles in connection with the theory of the monsoonal circulation, the importance of which is duly emphasised by Dr. Simpson. Whilst it is a conspicuous fact that, broadly speaking, the continents command high pressure in winter and low in summer, and the oceans *vice versa*, the more detailed relationship between pressure and temperature is exceedingly complex, and the precise location of a centre of high or low pressure depends upon many other factors, such as the rotation of the earth and the configuration of the land. In other words, the atmosphere being a unity of interdependent parts, it is largely a matter of compromise, as between region and region, what type of circulation shall prevail here and what there. To take but an instance. Nothing is more perplexing than the drought-producing wind and pressure regimen of the Mediterranean basin in summer with intense insolation and active evaporation to a meteorologist who conceives of this region as isolated from other regions, and forgets that the Mediterranean circulation has to adapt itself to the great monsoon system of Asia, as well as to the conditions in other parts of the world.

Helium in Natural Gas.

By H. B. MILNER.

THE researches of H. P. Cady and D. F. McFarland in 1905 on some natural gas from Kansas led to the interesting discovery of the presence of helium in that gas, a fact of which advantage was taken afterwards by the United States military authorities during the later stages of the war. In 1915 the natural gas resources of this country were investigated for a similar purpose under the direction of the late Sir William Ramsay, and those of Canada were also examined, but in both cases the efforts were unsuccessful. The dangers attending hydrogen-filled aircraft were obvious from the fate of many of the German Zeppelins, so that the possibility of extracting sufficient quantities of an incombustible gas such as helium (admirably suited in every way to the peculiar requirements of lighter-than-air machines) was too important to be ignored.

In the United States the help of certain commercial firms, employing the Linde and Claude processes of gas liquefaction for the treatment of air, was solicited, and in 1918 two plants were in operation at Fort Worth, Texas, ultimately giving an average production of 5000 cb. ft. of gas per day, yielding on purification up to 93 per cent. of helium. Although the effect of the armistice was to check military requirements, the development of commercial aviation keeps this use of helium very much in the foreground, and in view of this and also of the far-reaching scientific problems involved the United States Geological Survey has just published, from the pen of G. Sherburne Rogers, a most valuable monograph on "Helium-bearing Natural Gas" (Professional Paper 121, 1921).

The chief region from which commercial supplies of helium are obtained is that of the Mid-Continent oilfields, more especially from two areas, one in North Texas and the other in North Oklahoma and South Kansas; gas in both these areas yielded up to 0·5 per cent. of helium, in some cases the amount being as much as 2 per cent. One would naturally expect helium-rich gas to show a high nitrogen content with consequent low calorific value; generally speaking this is found to be so, though in one instance a gas with 14 per cent. of nitrogen yielded 0·35 per cent. of helium. On the other hand, a high nitrogen content is not necessarily a criterion of a high helium yield, and Rogers cites several examples of this. The nitrogen–helium ratio in natural gas in thirteen samples quoted ranges from 114 to 20; the conclusion to be drawn from this, and also from a careful study of several other available analyses, is that a low (N_2He) ratio implies a low helium content.

The richest helium-bearing gas in America is obtained from comparatively shallow depths in the Pennsylvanian beds, and it is interesting to note that gas emanating from younger beds, such as the Cretaceous or Tertiary of Texas and Louisiana, is low in helium content. Bearing in mind Czakó's contention that the radio-activity of a gas is an index of its helium content, and also Holmes's work on radio-activity as a measurement of geological time, it is thus not difficult to appreciate the reason of the low helium content of European natural gas, derived for the most part from Tertiary strata. Evidence is not forthcoming as to the radio-activity of the gas from the Pennsylvanian beds, but McLennan's researches in Ontario (NATURE, vol. 70, p. 151, 1904) demonstrated the tendency of decreased radio-activity with increased depth, and this may reasonably be correlated with the marked decrease in helium yield with increase in depth from which the gas is obtained in the present case.

The origin of the helium in the gas affords a wide ground for speculation, though in the present state of our knowledge it would be very unsafe to dogmatise. Rogers discusses this at some length, but of the several possible theories he favours two, more particularly the first—that the helium is generated from uranium or thorium deposits disseminated through the beds proximate to the natural gas horizons, or that it is primordial and comes from abyssal sources. His arguments in favour of the former theory are very sound, though, as he admits, it assumes the occurrence of radio-active deposits of which we have no knowledge, more particularly in the upper palæozoic rocks of the Mid-Continent region, or in some of the buried igneous masses occurring as subterranean uplifts.

It is interesting to note that in the case of the three principal occurrences of natural gas in this country, at Calvert, Buckinghamshire, at Middlesbrough, Durham, and at Heathfield, Sussex, the nitrogen contents were 19·5 per cent., 16·8 per cent., and 0·9 per cent. respectively; in the first case the source of the gas is doubtful, but it is presumably from pre-Liassic beds; in the second case it is obtained from the Magnesian Limestone, and at Heathfield it is unquestionably derived from the Kimmeridge Clay. If the nitrogen evaluation is any indication of helium-bearing gas, as it would seem to be in the United States, it is extremely unlikely that helium occurs in those gases in amount greater than 0·5 per cent. (if as much as that) at Calvert and Middlesbrough, while at Heathfield it is probably absent altogether.

Obituary.

LORD BRYCE, O.M., F.R.S.

IT can be but seldom, when a man's life has been prolonged to well over eighty years, that his death is generally felt as a serious public loss. Lord Bryce's sudden, if happy, death on January 22, in his eighty-fourth year, is a shock which will be felt equally here and in the United States, where only last summer he had been engaged both by lecturing and in social intercourse in spreading a better understanding of the problems of Great Britain and Europe. Years ago, by his great work on "The American Commonwealth," and at a later date by his tact and manifold activities while our Ambassador at Washington (he was reputed to have visited every State in the Union), Lord Bryce had made himself a living link between the two peoples. In the United States he was not only trusted by statesmen and appreciated by the leading men in thought and literature, but he was also an idol of the crowd. When he came into a popular assembly the proceedings were apt to be interrupted and the whole audience would stand up and give three cheers for "good old Bryce." Among themselves the Americans to the last habitually called him "our Mr. Bryce." American citizens of all classes believed in his thorough goodwill towards their country, and he thus achieved what seemed almost the impossible in inducing them to bear kindly with criticism they felt to be both honest and friendly. For if Lord Bryce knew no better form of government than democracy, he was, as his recent work has shown, keenly alive to its imperfections and crudities both in the States and in Australia.

Politics, historical and literary studies, and travel were the main occupation of Lord Bryce's life. His career in the two former branches of activity has been fully dealt with in the general Press. Here we may more appropriately confine ourselves to the last. Lord Bryce, without being in any strict sense a man of science, though he was elected a fellow of the Royal Society, under the special rule, in 1893, took the keenest interest in several branches of natural science. His father had been a geologist, and he himself was apt to record the geological features of the countries he passed through. In botany he was an eager student, with a keen eye for rarities. In his walks near his home at Ashdown Forest he would frequently stop to recognise some relatively rare growth, and so long ago as 1859 he wrote a manual on "The Flora of the Island of Arran."

When he visited Pekin the attachés at the British Legation, who were prepared to give information on Chinese politics, were dismayed to find themselves called on to answer questions as to the local flora. In his "Impressions of South Africa" he discusses at some length the vegetation of the country, and records that he brought home fifty-four plant specimens, eleven of which were pronounced at Kew to be new to science. Wherever he went he was as keenly interested in the natural aspects and features of the country visited as in its inhabitants and their politics, and he delighted to trace the interaction between the two. His descriptive talent was exceptional, and was aided by the almost unique opportunities for comparison given him by the extent of his travels. Take at hazard this vivid sketch of Lake Titicaca :—

"The blue of Titicaca is peculiar, not deep and dark, as that of the tropical ocean, nor opaque, like the blue-green of Lake Leman, nor like that warm purple of the Ægean which Homer compares to dark red wine, but a clear, cold, crystalline blue, even as is that of the cold sky vaulted over it. Even in this blazing sunlight it had that sort of chilly glitter one sees in the crevasses of a glacier; and the wavelets sparkled like diamonds."

The shortest way to indicate the extent of Lord Bryce's travels might possibly be to give a list of the regions he had *not* visited. During the three years (1899–1901) when he was president of the Alpine Club it was noted that whatever distant range might be under discussion the ubiquitous chairman was sure to begin his remarks with, "When I was out there." I believe "The Mountains of the Moon" was one of the few places where the author of the paper had the advantage of him.

Of these many years' wanderings and holidays in a busy life (continued until last spring by a trip to Morocco) the public have had the results in three solid works. Of these, the first, "Transcaucasia and Ararat" (1877) was in the main not a mountaineering record, but a study of the Caucasian isthmus and its peoples, as seen by a passing visitor. But the account of an ascent of Mount Ararat, in which Lord Bryce reached the top without his companions, fixed public attention and had some singular consequences. In a rash moment he wrote of a piece of wood he picked up near the top, a relic of a previous Russian ascent, that he was not able to state it might not be gopherwood. When in the United States he had frequent applications from out-of-the-way local museums for the smallest fragment of this invaluable relic of Noah's Ark!

Lord Bryce's two solid volumes on South Africa and South America are, apart from their political importance, admirable pictures of the regions described. In their pages he unites the power of observation which makes a good traveller with that of generalisation which is called for in a geographer. And he carries his readers on from one topic to another by a lively style which reflects the quickness and versatility of the author's mind. Lord Bryce was engaged at the time of his death in a collection of "Memories of Travel," which we trust will be found in a state sufficiently advanced to admit of publication.

It must be added that if Lord Bryce had one hobby, or taste, stronger than another, it was for mountains and mountain climbing. He habitually found time to attend the meetings of the Alpine Club, and to take a share in its discussions. He followed the doings of its members with the keenest interest. The chief ornament of a study which was usually a chaos of proofs, letters, and presentation volumes, was a photograph of the most beautiful of snowpeaks, the Himalayan Siniolchum.

DOUGLAS W. FRESHFIELD.

SIR JOHN KIRK, G.C.M.G., K.C.B., F.R.S.

BY the death of Sir John Kirk at the advanced age of ninety, the world has lost the last survivor of the heroic pioneers of African exploration, the founder of the British position in Eastern Equatorial Africa, and a botanist whose contributions to African natural history were of first-rate importance.

Sir John Kirk was born in the Manse of Barry, near Arbroath, in 1832. He entered Edinburgh University at the age of fifteen, and obtained the degree of M.D. in 1854. In 1855 he went to Turkey with the Volunteer Medical Corps in connection with the Crimean War and served in a hospital on the Dardanelles. In 1857 he was recommended by "Woody Fibre" Balfour as physician and naturalist to Livingstone's second expedition, in which he served from 1858 until he was invalided home in 1863. On that expedition, which was the least successful of Livingstone's three, Kirk gained a higher reputation than any other of its members. His unfailing good humour, tact, and great gift of sympathy must have been invaluable, and in spite of internal dissensions in that expedition, Livingstone afterwards wrote that he had never had any difference with Kirk. Livingstone has borne warm testimony to Kirk's untiring zeal, energy, and courage. He collected 4000 species of plants, in addition to zoological specimens, making careful studies of the economic products. In gratitude for his help Livingstone named the western wall of the Rift Valley along the Shire River and Lake Nyasa, the Kirk Range.

Kirk returned to East Africa in 1866 as physician to the Consulate at Zanzibar. He was fortunately soon entrusted with political work, and became Vice-Consul in 1867 and Consul in 1873. In 1870 Said Barghash succeeded to the Sultanate, and the general impression of his character is summed up in Kipling's "from Said Barghash in a tantrum," but he was never in that condition with Kirk. Both men had a keen sense of humour, and Kirk soon gained an immense influence over Said Barghash, who was a loyal friend. When the Sultan was visiting this country in 1875 he threatened to return at once because he felt that Kirk had been treated rudely by the Duke of Cambridge. In 1873 the combined influence of Sir Bartle Frere's mission and of Sir John Kirk secured the abolition of the slave trade in the Dominion of Zanzibar. Sir Frederick Lugard has testified to the efficiency with which Kirk ensured the enforcement of that edict by the Slave Court at Zanzibar, while insisting on the missionaries taking no illegal premature steps in reference to domestic slavery. In 1877 the Sultan offered a British syndicate a lease of his dominion on the mainland; but the British Government would not accept the offer, and it was not until after Germany had secured the southern part of those territories that a concession of the rest was accepted, and the British East Africa Company founded to administer them. Kirk was one of the founders and original directors to whom the Royal Charter of that company was awarded. Its ultimate failure was one of his most bitter disappointments. The company was incorporated in 1888, and Sir John Kirk thenceforward lived in England. He served for many years as foreign secretary of the Geographical Society, which gave him its Patron's Medal in 1882. He was elected fellow of the Royal Society in 1887; he was also a D.C.L. of Oxford and Sc.D. of Cambridge.

Kirk's scientific work was mainly botanical. He was a most indefatigable collector; he described some of his new plants, and wrote many articles for the *Kew Bulletin* and other scientific journals. His collections have greatly enriched the Kew Herbarium, and have been described as amongst the most important materials for its "Flora of Tropical Africa." His main interest was in economic botany. He established at his own expense at Mbweni, near Zanzibar, an experimental plantation of which the results were of the highest value, and introduced many trees and plants, and some of the extensive eucalyptus plantations in East Africa came from seeds raised from his trees. He wrote reports on olive culture and on fibres, one of the valuable local supplies of which comes from *Sansevieria Kirkii*.

Kirk founded the East African trade in wild rubber, the best of which came from *Landolphia Kirkii*, and his name is also commemorated in many other important East African plants. He introduced through Kew a considerable series of new plants to British gardens.

After his return to this country he was regarded, until blindness lessened his usefulness, as one of the most trustworthy referees from the Foreign Office on African questions. In 1889–90 he was a plenipotentiary to the Brussels Conference, and for his services there was made K.C.B. His K.C.M.G. was awarded in 1881, and his G.C.M.G. in 1886. He was Vice-Chairman of the Uganda Railway Committee, and was sent to Nigeria to inquire into the famous case of sacrificial cannibalism when forty prisoners were eaten at Akassa.

The beautiful little antelope, "Kirk's Gazelle" (*Madoqua Kirkii*), will help to preserve his memory among settlers in the lands he secured to the Empire. To the explorers of that area Kirk was a friend who will always be remembered with most sincere affection and respect.

PROF. J. H. COTTERILL, F.R.S.

ON January 8 Prof. James Henry Cotterill died at Parkstone, near Bournemouth. Prof. Cotterill was the youngest son of the Rev. Joseph Cotterill, of Blakeney, Norfolk. Educated at Brighton College, he was afterwards apprenticed in the works of Sir William Fairbairn, at Manchester. Later he went to St. John's College, Cambridge, and took a fair place in the mathematical tripos. In 1866 he became lecturer and in 1870 vice-principal at the Royal School of Naval Architecture and Marine Engineering at South Kensington. In 1873 the school was moved to Greenwich, and became part of the Royal Naval College, in which Prof. Cotterill was professor of applied mathematics until his retirement in 1897. He was elected hon. vice-president of the Institution of Naval Architects in 1905.

In 1806 a commission had recorded the opinion that the highest officers then responsible for the design and construction of vessels of the Royal Navy were sadly ignorant of the theory of naval architecture, and, in fact, in the early nineteenth century the best ships in the Navy were those captured or copied from the French. In 1811 the first Admiralty School of Naval Architecture was opened at Portsmouth for training expert advisers, under Dr. Inman. It lasted twenty years, but trained only forty students, some of whom, like Isaac Watts, chief constructor, attained distinction. In 1848 a second school was opened at Portsmouth, under the principalship of the Rev. Dr. Woolley, and entry from the dockyard schools was made dependent on merit. It lasted only five years. Mr. E. J. Reed (chief constructor) and Mr. Barnaby (chief naval architect) were among its students on whom devolved the responsibility of the transition to ironclad construction. Chiefly at the instance of the Institution of Naval Architects, the third Admiralty school was established at South Kensington, and this continues its good work as part of the Royal Naval College.

This institution had the great advantage that the Admiralty students from the dockyard schools were well prepared for advanced instruction. It has, through the distinguished careers of many of its students, exercised an important influence on the shipbuilding industry in this country, and on the development of the great Navy which commanded the seas in the late war. The organisation of the theoretical part of the instruction was mainly due to the ability, industry, and originality of Prof. Cotterill. An account of the courses of study is given in the later editions of his "Applied Mechanics." The school was open to private students, and some of these obtained important positions in private shipyards and in the constructive departments of foreign navies.

Prof. Cotterill's earliest papers were on least action, on the theory of propellers, and on the reaction of an elastic fluid escaping from an orifice. In 1878 he published a treatise on "The Steam Engine considered as a Thermodynamic Machine"; and in 1884, a treatise on "Applied Mechanics." Both these have passed through several editions, are still in use, and have much influenced the teaching of the subjects in engineering schools in this country and in America.

WE record with much regret the death on January 22, at seventy-six years of age, of Sir William Christie, K.C.B., F.R.S., Astronomer-Royal from 1881 to 1910.

Notes.

IN a letter to the *Times* of January 23 Mr. F. P. Mennell recalls his description of the bone-cave at Broken Hill, Rhodesia, published in the *Geological Magazine* in 1907, and adds some further details in reference to the recent discovery of *Homo rhodesiensis* in a deeper extension of the cave. He emphasises the fact that all the stone and bone implements found with this extinct cave man are such as are used to-day by the Bushmen and Hottentots in outlying places, while all the mammalian bones, evidently broken for food, belong either to living species or to species closely allied to those still existing in the neighbourhood. The Rhodesian man is therefore probably not so old as the primitive types of man who wielded the Palæolithic implement in western Europe. We may add that Mr. Mennell's original paper was referred to in NATURE of November 17 last by Dr. Smith Woodward, who also expressed the opinion that Rhodesian man would prove to be of comparatively recent date.

IT was resolved by the General Committee of Subscribers to the Rayleigh Memorial, after arranging for the erection of the tablet in Westminster Abbey, which was unveiled recently, "that the executive committee be empowered to use the balance for the establishment of a library fund at the Cavendish Laboratory." The amount subscribed to the memorial fund was 1575*l*., and after defraying all expenses connected with the tablet the balance was 687*l*. 15*s*. 8*d*. In accordance with the resolution of the general committee, Sir Richard Glazebrook and Sir Arthur Schuster, secretaries of the fund, have now sent a cheque for this amount to the Vice-Chancellor of the University of Cambridge. The committee desires that of this sum 600*l*. should be treated as capital, the interest upon which is to be at the disposal of the Cavendish professor annually for the purposes of the library; the balance of the capital, namely, 87*l*. 15*s*. 8*d*., may be drawn upon at once in order to bring the library up to date. It is suggested that a book-plate should be prepared connecting the books purchased out of the fund with Lord Rayleigh.

THE Père Lachaise cemetery in Paris, which has during the last few days witnessed several acts of homage to the memory of the great dramatist Molière, contains a large number of tombs and monuments of remarkable interest. Among these are many to the men of science of last century. The cemetery was laid out in 1804, and the monument to Molière was one of the first erected in it. Walking round the paths familiar names of statesmen, poets, musicians, writers, soldiers, and painters catch the eye at every turn. Science is represented by the mathematicians Poinsot, Monge, Hachette, and Charles; the astronomers Arago and Delambre; and the chemists Dulong, Gay Lussac, Chaptal, Boussingault, and Raspail. Comte, Cuvier, Bichat, Claude Bernard, and Geoffrey St. Hilaire are also commemorated. Quite close together will be found the tombs of Madame Lavoisier who made such an unhappy alliance with Rumford, and Madame Blanchard, the intrepid aeronaut who perished in 1819. Other pioneers in the conquest of the air whose names are perpetuated in the cemetery are Robertson, Charles, Croce-Spinelli, Gaston, and Tissandier.

FROM the *Daily Telegraph* we learn that the Paris Academy of Sciences has received an invitation, through Prof. Kriloff, a specialist in naval construction, to send representatives to Moscow to the celebration of the bicentenary of the Russian Academy of Sciences, to be held in 1925. Prof. Kriloff, in his speech, expressed the hope that science would throw solid bridges over the chasms made by war, and that the relations of all the peoples would be re-established with the same cordiality as before. The initiation of the Russian Imperial Academy of Sciences was due to Peter the Great, though its actual inauguration was carried out by his widow, Catherine I. It was she who invited the great mathematician, Leonhard Euler, to her capital, but her death occurred on the day Euler set foot on Russian soil. Joined by Daniel Bernoulli and the astronomer Delisle, Euler continued to work at Petrograd until 1741. His surroundings, however, were not always congenial, and afterwards when a princess at the Court in Berlin asked him why he spoke so little, he replied: "Madame, parce que je viens d'un pays où quand on parle on est perdu." Euler continued to send memoirs to the Academy, and in 1766 he accepted the invitation of Catherine II. to return to Petrograd, and he died there in September, 1783. Some of his sons entered the Russian service, while his son-in-law, Nicolas von Fuss, became permanent secretary to the Academy.

ONE of the largest telescopes in the world, hitherto unused, is likely to be brought into service shortly, according to an announcement made at a recent meeting of the American Astronomical Society. It is a 60-in. reflector constructed by the late Dr. A. A. Common about thirty years ago and bought by the Harvard Observatory in 1902. It is exceeded in size by two telescopes only, both of them on the Pacific coast—the 100-in. reflector at Mount Wilson, in California, and the 72-in. reflector, the property of the Dominion Government, at Victoria, in British Columbia. A second reflector at Mount Wilson is of the same size as that at Harvard. The Harvard instrument was purchased for visual and photographic star measurements, but when set up and tested was found unsatisfactory for that purpose. It was therefore abandoned, and has ever since been stored away in the observatory grounds. Meanwhile, the science of astrophysics has provided an increasingly large number of problems, in which the light and heat from a star, rather than the size of a photographic image, are the things measured. It is for such problems as these that the Harvard telescope, with its 5-ft. mirror—once considered useless because it would not produce perfect images—is now to be employed.

AT the annual general meeting of the Royal Society of Arts, on June 30, 1920, it was announced that unless the society succeeded in purchasing the freehold of its house in John Street, Adelphi, it would be obliged to find new quarters after March, 1922. The matter was referred to again in the annual meeting on June 29 last, and the sum of 50,000*l*. was mentioned as the cost of buying and renovating the property. An appeal for subscriptions was therefore made in order to obtain funds to secure permanent possession of the historic house built for the society by the brothers Adam about 1775. So far, two lists of subscribers have been issued in the society's journal, from which it appears that the sum of 40,678*l*. has already been raised. Of this total no less than 30,000*l*. is due to the generosity of one anonymous benefactor. Other noteworthy subscriptions are 2,500*l*. from Sir Charles A. Parsons, and 1000*l*. each from Lord Bearsted, Sir Dugald Clerk, the Earl of Iveagh, Lord Leverhulme, and Mr. A. A. Campbell Swinton. The sum already subscribed should be sufficient to secure the continuity of tenure of the John Street house, which has been the scene of the society's labours for the past 147 years, but it is to be hoped that further contributions will be forthcoming, so that the whole of the purchase-money may be available, and also means for making desirable alterations in the meeting-room and other parts of the building.

AT the annual general meeting of the Royal Meteorological Society on January 18 the Symons gold medal, which is awarded biennially for distinguished work in connection with meteorological science, was presented to Col. H. G. Lyons. Dr. Charles Chree was elected president of the society for the year 1922.

DR. G. CLARIDGE DRUCE has recently been elected a corresponding member of the Botanical Society of Czecho-Slovakia "for his inestimable services to botanical science." The diploma is signed by the president of the society, Prof. Karel Domin, professor of systematic botany in the University of Prague.

ON Tuesday next, January 31, Prof. H. H. Turner begins a course of three lectures at the Royal Institution on "Variable Stars," and on Thursday, February 2, Sir Napier Shaw delivers the first of two lectures on "Droughts and Floods." The Friday evening discourse on February 3 will be delivered by Sir Francis Younghusband on "The Mount Everest Expedition," and on February 10 by Dr. Halliburton on "The Teeth of the Nation."

THE Civil Service Commissioners announce that an open competitive examination for not fewer than fifteen situations as assistant engineer in the Engineer-in-Chief's Department of the General Post Office will be held in London, Edinburgh, and Manchester in April next, commencing on April 20. The limits of age are twenty and twenty-five, with certain extensions. Regulations and forms of application will be sent in response to requests by letter addressed to the Secretary, Civil Service Commission, Burlington Gardens, London, W.1.

HAVING regard to the confusion which now exists, especially in overseas trade, due to the difference between the American gallon and the Imperial gallon, the Decimal Association urges that it is desirable for an agreement to be reached between the Governments of Great Britain and the United States to the effect that as an alternative to either of the above gallons being adopted by both countries as a common standard, each of them should forthwith adopt the litre, which could be described as the "metric gallon." It is obvious that uniformity of practice in a matter of this kind is most desirable, and the adoption of the metric gallon would not only standardise practice between Great Britain and America, but also with practically all other countries engaged in international trade.

A PORTRAIT of Sir Patrick Manson was unveiled by Sir James Michelli at the London School of Tropical Medicine on January 20. The portrait was subscribed for by a large number of past and present students and other friends at home and abroad. The painting was entrusted to Mr. E. Webster, and is a most pleasing likeness. It hangs in the vestibule of the school, where it will be seen by the large number of students attending the classes. Reproductions of the portrait will be made by Mr. Malcolm Osborne, and will soon be ready for distribution. In recognition of Sir Patrick Manson's services as a clinician, money has also been subscribed for a medal, which will be awarded annually to those who distinguish themselves in clinical work. The medal will bear a portrait of Sir Patrick Manson by Mr. John Pinches.

THE programme for the Air Conference to be held at the Guildhall on February 7–8 has now been issued. During the morning of the first day of the meeting papers will be read by Lord Gorell on civil aviation, and Lt.-Col. W. A. Bristow on aerial transport of to-day and to-morrow. Papers on research work from the points of view of designers, constructors, and users by Major F. M. Green, on the progress of research by Brig.-Gen. R. K. Bagnall-Wild, and on airships by Major G. H. Scott will occupy the afternoon session. The whole of the second day of the meeting will be devoted to general discussions. In the morning Capt. F. E. Guest will preside, and civil aviation papers read during the previous morning will be dealt with; in the afternoon the chair will be taken by Lord Weir of Eastwood, and the technical papers of the previous afternoon will be discussed.

INFLUENZA had materially increased in severity, according to the Registrar-General's return for the week ending January 14. Deaths due to the epidemic numbered 1240 for the ninety-six great towns of England and Wales, an increase of 433 on the preceding week. In London the deaths were 551 for the week, an increase of 197 on the preceding week. During the great epidemic of 1918–19 the deaths from influenza in London amounted to 2458 in the week ending November 2 and to 2433 in the week ending November 9, but with the exception of the 1918–19 epidemic the death-rate is now higher than in any other epidemic of influenza since 1890, the nearest approach occurring in the epidemic of 1892, when for the week ending January 23 the deaths in London numbered 506. During the week ending January 14 the deaths between the ages of sixty-five and seventy-five were 21 per cent. of the total. Deaths from pneumonia and bronchitis have also considerably increased.

A SUMMARY of weather results for 1921 is given in the *Weekly Weather Report* of the Meteorological Office for the closing week of December, showing the mean and aggregate values for the several districts of the British Isles. There was a general deficiency of rain, the only districts with an excess being the north and west of Scotland, these districts having respectively 106 and 104 per cent. of the average fall. In the east of Scotland the rainfall for the year was 87 per cent. of the average, and in the north of Ireland 89 per cent., whilst in the north-west of England it was 86 per cent. In the north-east of England the rainfall was 73 per cent. of the average, and in the Midland Counties 69 per cent. The rainfall was only 48 per cent. of the average in the east of England, followed by 50 per cent. in the south-east of England, 54 per cent. in the English Channel district, and 60 per cent. in the south-west of England. The district having the largest amount of rain during the year was the north of Scotland with 54·34 in., while in the east of England the total measurement was 13·45 in., and in the south-east of England 13·84 in. The mean temperature for the year was above the normal in all districts; the greatest excess was 2·7° F. in the English Channel district and 2·5° F. in the north-east and east of England and the Midland Counties. The duration of bright sunshine was in excess of the average in all districts over Great Britain; the greatest excess was 0·7 hour per day, amounting to 250 hours for the year in the east of England and 0·6 hour per day in the Midland Counties and the south-east of England.

THE problem of the conservation of the coal resources of Great Britain involves the study and classification of the coal seams which are at present being worked or developed, and also of seams above or below ground which are being left unworked or are thrown aside. On its directly practical side this work must deal primarily with the suitability of each particular coal for those purposes for which its individual qualities render it most appropriate, and the Fuel Research Board believes that the most effective way of achieving this end is by the co-operation in local committees of colliery owners, managers, and consumers with the representatives of the Fuel Research Board and the Geological Survey. By this combination local knowledge and experience, as well as the initiative of those most deeply interested in the practical aspects of the survey, will be secured. Thus from the outset the survey will assume a practical character. The selected seams will be submitted to physical and chemical examination by the local experts, and as a result of this examination a further selection will be made of those which appear to justify experiments on a practical scale to test their suitability for particular uses or methods of treatment. This experimental work will be carried out either at H.M. Fuel Research Station or at other works, as may be found most convenient. A start has already been made in the Lancashire and Cheshire district, where the local research association has been recognised by the Fuel Research Board as its representative body for the purpose of dealing with the physical and chemical survey of the coal seams in this area. The chairman of the new committee is Mr. R. Burrows, and the director of research Mr. F. S. Sinnatt.

A LEADING article in the *Museums Journal* for December suggests as a remedy for the alleged overcrowding of the national museums that their redundant specimens should be transferred to the provincial museums, and asks for a Commission to consider the limits of our national museums and how far it is possible for them to assist the provincial and "Colonial" museums. In the January issue Mr. Williamson, of the Derby Museum, while admitting past help, would welcome gifts or long loans on a more systematic plan and with more reference to local needs. Dr. F. A. Bather, while in agreement with the proposal, maintains that such transference is the policy of the British Museum, which is only prevented from carrying it out fully by inadequacy of staff. He also points out that the interests of scientific students demand the accumulation of large collections in as few centres as possible, and that the bulk of such material is not really redundant. Sir Frederick Kenyon in his presidential address to the Museums Association in July last expressed a wish to meet the needs of provincial museums if they would make them known.

DR. RAPHAEL KARSTEN, lecturer in the University of Helsingfors, Finland, has made an important contribution to anthropology in the first part of his "Studies in South American Anthropology." He deals more particularly with personal ornamentation, ceremonial mutilation, and kindred customs. The savage man's love for self-decoration has been discussed by many anthropologists. Darwin believed that the object of these decorations was to make man beautiful, and especially attractive to the other sex; W. Joest, while admitting that body-painting has a practical value in protecting the body from insects, heat, or cold, admits that the principal motive, besides inspiring enemies with fear in battle, is sexual desire, a view generally accepted by Westermarck in his "History of Human Marriage." Dr. Karsten believes that the part which magic has played in originating primitive customs has, up to recent times, been much underrated, owing to our defective knowledge of the psychology of savage man. This side of the subject is pursued in this monograph, which, though principally devoted to South America, discusses the question from other points of view, and, with its careful citation of authorities, deserves the attention of anthropologists.

NATIONAL laboratories for the cleaning, restoration, and preservation of antiquities have for some years existed at Berlin, Copenhagen, and Stockholm. Well-known books on the subject have been published by Dr. Rathgen (ed. 2, 1914) and Dr. Rosenberg (1917), the latter dealing with iron and bronze objects only. In our own country there was no laboratory for the purpose until 1920, when Dr. Alexander Scott was induced by the Department of Scientific and Industrial Research to direct the work of a small laboratory temporarily equipped at the British Museum (Bloomsbury). So far as the English language was concerned, G. A. and H. A. Auden's translation of Rathgen's first edition (1905), a chapter in Prof. Flinders Petrie's "Methods and Aims in Archæology" (1904), and a few articles in the *Museums Journal*, notably a well-illustrated one by Dr. Rathgen (1913), were about all the museum curator had to guide him. Now the Department just mentioned has issued a first report by Dr. Scott (Bulletin No. 5, 1921, 2*s*.). It deals with prints, enamels, silver, lead, iron, copper and copper alloys, and rock-paintings. Dr. Scott has attacked the problems *de novo*, and has evolved some new and ingenious methods. Their success is illustrated by some photographs "before" and "after."

A VERY complete summary on the subject of anthrax infection in man appears in the Bulletin Mensuel for November last of the Office International d'Hygiène Publique, Paris (t. 13, No. 11, 1921, pp. 1135–1239). Anthrax infection in man is most commonly seen as a cutaneous manifestion, the characteristic malignant pustule, which is caused by local inoculation. Internal anthrax also occurs in the lungs, intestine, and brain, and is caused by inhaling or swallowing the spores of the anthrax bacillus. Internal anthrax is always fatal, but the malignant pustule is fairly amenable to treatment, if taken in time, by anthrax serum or by excision. The disease is always transmitted from an affected animal, living or dead, or from the commercial products derived from an affected animal, such as skins and hides, goat, camel, or horse hair, and wool. Between 1915 and 1920 a number of cases of human anthrax due to shaving-brushes has been reported in England (49), United States (40), Holland, Italy, and Egypt, the brushes having been made with infected hair. In Holland few cases of human anthrax occur, less than a dozen per annum. The same is the case in Norway, in spite of the frequent occurrence of the disease in domestic animals, though among these the frequency of the disease is diminishing, from 686 animals affected in 1906 to 33 in 1920.

THE last report of the Grain Pests (War) Committee established by the Royal Society has now made its appearance. It required the conflagration of a European war and the threat of starvation to Britain to stir us to investigate some of the problems connected with the destruction of grain by insects. Though the committee set up by the Royal Society was purely a war one, it seems a pity that it should cease to act just when the fringe of the subject has been touched. Could the Royal Society not be induced to continue the investigations? The present report (No. 9) contains a short note by Prof. Goodrich on the parasitisation of certain grain beetles by Hymenoptera. It is shown that these parasites are not likely to prove of value as a means of controlling the beetles, as the chalcids are themselves kept in check by carnivorous acarids. The second part is by Dr. J. Waterston, who deals with the systematics of the parasitic Hymenoptera. These parasites are, like their hosts, cosmopolitan, and many of the species previously described were certain to fall as synonyms. This comprehensive and beautifully illustrated paper should prove the basis of future work. The last report is that by Mr. J. H. Durrant on the species of insects found in grain; hundreds of samples of grain were examined from different parts of the world. These are all tabulated, showing the species found in each. We note that several species of beetles are new to our lists of grain pests. Altogether, much useful information is contained in the report.

IN the November issue of the Journal of the Franklin Institute Dr. Carl Hering brings together some of the phenomena produced by the flow of heavy currents in conductors which have been observed in recent times, and points out that in many cases they violate some of the laws of electromagnetism as stated in current text-books. He therefore pleads for a restatement of these laws in such form that there shall be no apparent exceptions to them. In the first instance, he points out that it is not sufficient for the production of electromotive force by magnetic induction that lines of magnetic force shall cut through a *circuit*, but that the lines must cut through a *conductor*. Further, he contends that the existence of the "pinch" effect, contracting the section of a conductor carrying current, of the "stretch" effect, lengthening the conductor, and of what he has named the "corner" effect, when a conductor changes its direction, render it advisable to modify the dictum that the forces on a conductor "can never have a resultant in the direction of the axis."

THE firm of Messrs. Barr and Stroud, which grew out of the remarkable inventive work of the partners, was from 1888 until 1918 mainly occupied with the manufacture of range-finders and other instruments relating to the gunnery requirements of many different countries. They have since turned their attention also to the small type of internal-combustion engine used on motor-cycles, and, as a consequence, have now put on the market an engine of 349 c.c. capacity working on the four-stroke cycle and having a sleeve-valve and air-cooling. The engine is made under the well-known Burt and McCollum patents and has several attractive features. The absence of all external valve mechanism makes for cleanliness and greatly lessens engine noise. It is a light engine, since its weight to horse-power ratio is, it appears, but 7 lb. per h.p. when giving the maximum power of 7 h.p. The sleeve has a double motion, both horizontal and vertical, so combined that any point in it moves in an elliptical orbit. It has five curiously shaped ports, two for inlet, two for exhaust, and one for the double purpose, serving each in turn. The general design is very attractive, and the claim for a special degree of ease in dismantling and adjusting appears to be substantiated by an examination of the details of the design. Tests on the road have shown a satisfactory degree of fuel economy.

DURING the past forty years many proposals have been considered by the authorities in New South Wales for providing suitable means of communication across Sydney Harbour to accommodate the growth and development of Sydney. Tenders and designs have now been invited for the construction and erection of a cantilever bridge. Some particulars of this project are given in an illustrated article in *Engineering* for December 30 last. The bridge will carry four lines of railway, a main roadway 35 ft. wide, a motor roadway 18 ft. wide, and a footway 15 ft. wide. The total length, including the approach spans, will be 3816 ft.; the headway required for shipping will be 170 ft. at high water for the central 600 ft. of the bridge. The bridge is to consist of steel cantilevers with shore and harbour arms each 500 ft. long and a central suspended span of 600 ft. The clear span from centre to centre of the main piers will be 1600 ft. For the information of tenderers a number of interesting tables is given, showing the range of temperatures and intensities of prevailing winds and the extreme velocities and pressures recorded during the severest storms in Sydney. Full particulars are also given regarding the loads to be employed in estimating and the stresses to be used. The specification has been prepared by the chief engineer, Mr. J. J. C. Bradfield.

THE council of the Chemical Society has issued a pamphlet of eleven pages dealing with the furnishing and equipment (so far as fixed fittings are concerned) of chemical laboratories as the result of a conference of various bodies interested called by the society eighteen months ago at, we believe, the suggestion of the Royal Institute of British Architects, though this is not mentioned. The object in view was to ascertain whether, in view of the high prices of labour and materials, economies could be effected in laboratory fittings. A small committee of the society was appointed and decided to investigate present practice, and the report gives information collected from various institutions. Though necessarily but a slight contribution to a very large subject, the report contains a useful epitome of the methods in use for forming and treating bench-tops, reagent shelves, fume cupboards, sinks, and waste channels, while notes on ventilation, supply services and floor and wall surfaces are added. Finally, a short bibliography is given on the subject of laboratories, upon which, however, there is very little literature. Laboratory fittings are always costly, and at the present time, when so much educational work is held up owing to lack of funds for its material development, any information which will enable those responsible for designing laboratory fittings to cheapen and simplify requirements is bound to be of service. As regards the use of wood particularly, it seems much to be desired that experiments be undertaken in order to ascertain whether many of the cheaper soft woods cannot, by impregnation or other suitable treatment, be made to serve in place of imported hard woods.

THE August issue of the Journal of the American Chemical Society contains an account of the separation of the isotopes of chlorine by diffusion, contributed by W. D. Harkins and A. Hayes. The work was begun in 1915, and has been carried out in the chemical laboratories of the University of Chicago. A preliminary account of the separation of a heavier fraction from hydrogen chloride by diffusion through the stems of tobacco-pipes was given in NATURE of April 22, 1920, p. 230. Calculations by Rayleigh's formula show that to produce an increase of 0·2 in the atomic weight would require the diffusion of 130 tons of hydrogen chloride gas. The relative amounts of the different isotopes are as important as the atomic weight differences, and it is shown that, contrary to what has been supposed, it is easier to produce a small increase in the atomic weight of chlorine than to produce the same increase in the atomic weight of neon. The diffusion was carried out through clay pipe-stems or tubes at atmospheric pressure. Low pressures would be more advantageous. The increase in atomic weight amounted in different experiments to from slightly less than to considerably more than one part in a thousand. A considerable amount of the isotopic acid has been produced. These experiments seem to confirm beyond doubt the existence of the isotopes of chlorine first announced by Dr. Aston on the basis of positive-ray analysis. The latter method gives, in addition, the atomic weights of the two isotopes.

MESSRS. BENN BROS., LTD., announce for publication in March a work which should be of interest and value to many readers, viz. "The Early Ceramic Wares of China," by A. L. Hetherington, in which will be described the main characteristics of the products of the Chinese factories before 1368. The same publishers also promise a new series entitled "The Chemical Engineering Library," the first nine volumes of which will be The General Principles of Chemical Engineering Design; The Layout of Chemical Works, H. Griffiths; Materials of Construction: I., Non-Metals, H. Griffiths; Materials of Construction: II., Metals, H. Griffiths; Mechanical Handling, A. Reid; Weighing and Measuring Chemical Products, Malan and Robinson; Flow of Liquid Chemicals in Pipes, N. Swindin; Chemical Works Pumping, N. Swindin; and Factory Wastes as Fuels, A. Reid.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, London, have just issued an up-to-date list of "College Text-books and Works of Reference in Science and Technology." The titles are arranged under authors' names, and are classified under eighteen subjects, some of which, such as chemistry, engineering, etc., are again divided. The subjects are arranged alphabetically, whilst a contents-list on the first pages makes reference to any subject quick and easy. The list will be sent post free to any address on application.

Our Astronomical Column.

DEDUCTION OF STAR-DISTANCES FROM PROPER MOTIONS.—The proper motions are almost our sole guides in estimating the distances of the more remote stars. Hence any method that affords a check on the results is of value. Prof. H. N. Russell points out in the *Astrophysical Journal* for September last that we can estimate the distance either (1) by correlating the motion away from the solar apex with the sun's velocity, or (2) by correlating the cross-motion with the line-of-sight velocity. As a test he has divided the 180 stars of type B_0 to B_5, the radial velocities of which were found by Campbell, into eighteen groups, the mean position of each group being nearly the same. He finds for the general mean parallax 0·0083″ from (1) and 0·0058″ from (2). One reason given for the smaller value from method (2) is that some of the stars may be undetected spectroscopic binaries, in which case the adopted line-of-sight velocity is presumably too great. The probable error of result (1) is 0·0010″, of (2) 0·0014″. In general, method (1) gives the best results for objects of small average velocity like the B stars, while (2) is better for quick movers like the planetary nebulæ. The apparent close connection between period and absolute magnitude in the Cepheid variables was originally deduced from results obtained by method (1), and later obtained considerable confirmation from a study of the variables in the globular clusters, which appear to be mainly Cepheids.

METEORIC SHOWER OF DECEMBER 4–5, 1921.—Mr. W. F. Denning writes that he has received a communication from the Tokyo Astronomical Observatory, Japan, stating that an abundant display of meteors was observed there on the morning of December 5. Watching 55 minutes between 4.15 and 5.10 G.S.T. of Japan (December 4 between 7.15 and 8.10 G.M.T.), Mr. S. Inouye saw fifty or sixty meteors, and recorded the paths of forty-six meteors, among which forty-four radiated from about 156°+37° near β Leonis Minoris. The meteors were rather rapid, and the magnitudes ranged nearly from 2·0 to 4·5.

On the next morning Mr. Inouye watched 15 minutes, but no meteors belonging to the same radiant were observed.

Mr. S. Kanda calculated the following elements from the above radiant point, assuming the orbit to be parabolic:

$$\Omega=252{\cdot}1°,\ w=232{\cdot}6°,\ i=133{\cdot}3°,\ q=0{\cdot}791.$$

No comet is identified with these elements.

Mr. Denning adds that this shower in Leo Minor was well observed at Bristol on November 25–28, 1876, when he observed 26 meteors from the point 155°+36°. The observation was reported in NATURE of December 21, 1876, p. 158. The shower was also seen by him on December 2, 5, 7, and 10, 1885, when the radiant point was redetermined at 152°+40°.

The display witnessed at Tokyo on the night following December 4 last could scarcely have been well observed in England, for when the maximum occurred at 7.35 p.m. G.M.T. the radiant point was close to the north-north-east horizon, whereas at Tokyo it was situated only a few degrees east of the zenith, and splendidly placed for the abundant distribution of its meteors.

POPULAR ASTRONOMY IN SWEDEN.—The Stockholm periodical *Populär Astronomisk Tidskrift* continues to produce articles of much interest and practical value. Häfte 3 and 4, 1921, contain a useful illustrated article by Edv. Jäderin on the graphical prediction of eclipses and occultations. The methods are easy to follow and capable of an accuracy that is amply sufficient.

O. A. Åkesson discusses the periodicity and motion of sun-spots. The daily amounts of rotation for different latitudes are plotted for the two periods 1886–97 and 1898–1909. The values for the second period show a diminution of nearly 1 per cent. compared with the former. H. v. Zeipel contributes a study of the cluster M 37, near θ Aurigæ. He finds the colour-indices by comparison of photographic with photo-visual magnitudes, and deduces a distance of 1500 parsecs. There is also an illustrated article on the Babelsberg Observatory and its new refractor (aperture 65 cm.) and reflector (aperture 120 cm.), both made by Zeiss.

The approaching series of occultations of Aldebaran are the subject of a useful note. Accurate observations of the bright-limb phases of these phenomena will serve to test the conjecture that there may be a sensible atmosphere on the moon's sunlit face.

Physiology at the British Association.

THE outstanding features of this most successful meeting at Edinburgh were the large number of discussions and the giving of an official semi-popular lecture. Before the beginning of the latter a very pleasant interlude was furnished by Prof. Halliburton announcing a presentation to Sir Edward Sharpey Schafer on his seventieth birthday by his former students and co-workers.

The address of the president of the section was followed by a debate. Sir E. Sharpey Schafer discussed three points in connection with physiology, namely, the position of histology, physiology as a pure science, and physiology in relation to clinical medicine. He stated that anatomy is not a dead subject without histology, as it can be developed along the lines of morphology and embryology, but that histology is essential for the proper understanding of physiology. He further pointed out that, although it can be called microscopic anatomy, histology has developed as a branch of physiology. The study of physiology as a pure science is necessary, because it is in the pursuit of knowledge that discoveries are made. It is not always known what practical applications may arise for new knowledge, but by confining one's attention to purely practical applications the reserve of knowledge to be applied will become exhausted. The application of physiology to clinical medicine should come by the clinical teacher having held a position in the physiological laboratory. The physiologist has sufficient work to accomplish in his laboratory without attempting to become a clinician. By the proper training of clinical teachers in physiology it is hoped that invaluable applications will arise in medical practice.

A number of other speakers took part, all of whom enforced the views of Sir Walter Fletcher that physiology must be studied as a pure science in a university; that the physiologist should study the organism as a whole, so that histology, chemistry, and physics all may be applied to explain the behaviour of living organisms; and that it is only by a combination of all these that one can appreciate to what extent the chemical and physical processes may be regulated in the living cells.

Prof. A. R. Cushny opened a discussion on the relation of tests for studying the efficiency of the kidney to the views as to the function of the kidney. Various tests have been used to test the functional activity of the kidneys without a proper consideration of the conditions of its activity. The excretable substances must be distinguished from the non-excretable. The threshold substances are those which are excreted when their concentration rises above a certain threshold, and the no-threshold substances are those which are completely excreted, *i.e.* they are of no further use to the organism. Of the various substances used, water, chlorides, and urea are not satisfactory, as they are not completely excreted. By comparing the amount of urea and sulphate in blood and urine it has been found that sulphate is concentrated twice as much as urea, so that the functional activity as judged by the sulphate excretion would be twice as great as when judged by the urea excretion. Sulphate, phosphate, and creatinine were concentrated to equal degrees; therefore, the concentration of any of these in plasma and in urine might be measured as a test for functional activity.

Prof. J. Meakins commenced by agreeing that urea is not a toxic substance. He quoted cases where chronic incomplete obstruction of the ureter gave rise to a large volume of dilute urine. If temporary removal of the obstruction causes the kidney function to become normal, this is an indication for surgical interference; but if the excretion does not become normal, surgical interference is contra-indicated. Sometimes one finds that a no-threshold substance (*e.g.* creatinine) is being retained. Retention of urea by itself is not important, because along with this retention one may find such conditions as an excessive excretion of phosphates or a retention of chlorides, which are more responsible for the symptoms. The kidney does not function as a whole under abnormal conditions, and if one adheres too rigidly to one criterion of functional efficiency abnormalities may be overlooked.

Dr. J. S. Haldane expressed the view that under normal conditions the kidney regulates the diffusion pressure of water, but that under some abnormal conditions the level set by the kidney is not that required by the tissues.

Prof. P. T. Herring showed some slides of the skate's kidney, which demonstrated the direct excretion of substances into the kidney tubule. He stated that normally the kidney has a constant function, but in disease the function is variable, being influenced by other organs. A study of the comparative structure of the kidney in various animals may help to show how various parts of the kidney tubule function; part may be absorptive and part excretive.

Prof. A. Krogh (Copenhagen) pointed out that the concentration of urea is the same throughout the tissues, but that it may be present in different concentrations in the various secretions.

Prof. T. H. Milroy re-emphasised the uniformity in concentration of urea in blood and muscle. He added that an increase in concentration of urea in the blood is followed by a latent period before the extra urea is eliminated. The concentration in blood and muscle falls slowly to the former level.

Dr. C. L. Evans thought that local circulatory changes in different parts of the kidney might affect the excretion of different substances by different parts of the tubule. The circulatory changes in arterio-sclerosis is a case in point.

Dr. E. P. Poulton stated that in the arterio-sclerotic kidney there is a marked difference between the two parts of the kidney and slight urea retention. In azotoic nephritis urea excretion is damaged, but the chlorides are not retained.

Sir James Mackenzie desired that more attention should be paid to the interrelation of kidneys and other excretory organs, such as the skin and bowels.

Prof. E. P. Cathcart opened a discussion on "Heavy Muscular Work." Heavy muscular work requires a co-ordination of the muscular, circulatory, respiratory, and nervous systems. In carrying out heavy work rest periods are important, but the data concerning the number and duration of them are not yet satisfactory. Overwork is prevented by two factors of safety, namely, fatigue, which is slow in onset and may be produced by any degree of work, and collapse, which is sudden in onset, probably due to heart failure, and not to lack of oxygen-supply to muscles. The former is hastened by monotony, such as in marching, and the latter occurs sooner if the work involves a static or maintained element. The effects of training and of diet are important in determining the power to carry on work. All movements are mixed, but some recent experiments may be quoted as indicating a division into three varieties of work, namely, positive, such as lifting a weight; negative, such as lowering a weight; and static, such as maintaining a weight. The first two correspond to isotonic conditions of contraction, and the last to isometric contraction. As a measurement of the expenditure of energy in these forms of work a subject was given the task of lifting a weight on his hand, lowering the same weight and holding it steady both in the prone and supine positions, the rate of movement being controlled by a metronome:—

Form of work	Calories per sq. m. per hour
Positive	150·9
Negative	124·5
Positive and negative	180·5
Movements without weight	60·1
Static	94·6

In spite of the apparent severity of static work in producing fatigue the metabolism is not excessive, and the fatigue may be due to interference with the circulation.

Prof. A. V. Hill showed curves founded on the heat production of isolated frog's muscles, indicating that maintenance of a contraction is expensive, requiring ten times as much energy expenditure. He also gave results obtained by moving a flywheel at different rates of speed. The rapid rates of movement waste energy because the change of form of muscle requires work to be done in overcoming the viscosity of muscle, whilst slower rate of movement allows a larger proportion of energy to appear as external work. It is important to find out the most efficient relation between the work to be done and the rate at which it should be carried out.

Prof. H. Briggs described the physical endurance tests used during the war. He showed curves relating the variation of energy expended with the work done. A normal load is one which can be continued indefinitely. It was found that well-trained men get assistance from breathing oxygen only when doing excessive work, whilst a man in poor condition is helped by breathing oxygen with smaller loads. Stamina is the ability to maintain work. It appears that habitual hard work may maintain a man's stamina to greater ages than is found in sedentary individuals.

Dr. J. S. Haldane quoted experiments on the circulatory side of work. These experiments were made on man, the lungs being used as an aerotonometer. With increasing severity of work the blood-flow increases exponentially, whilst the percentage of oxygen desaturation of the blood rises logarithmically, and the output per heart-beat remains almost uniform. Therefore, the pulse-rate varies with the blood-flow. In a few individuals in whom the percentage of oxygen utilisation is already high the output of the heart increases as well as the rate of beat. Acapnia decreases circulation-rate, and is thus unfavourable to work.

Prof. A. V. Hill reported some results on pulse conduction in relation to blood-pressure, using the hot-wire sphygmograph. The pulse conduction can be expressed by

$$3{\cdot}57/\sqrt{\text{per cent. increase of arterial volume per mm. Hg increase in pressure.}}$$

By measuring systolic and diastolic pressures and the rate of pulse conduction it is possible to estimate the increase in volume of the arterial reservoir at each heart-beat.

Prof. A. D. Waller described the simplified method for the estimation of physiological cost of work done under various industrial conditions. He suggested that, instead of the various arbitrary terms such as sedentary, light, medium, and heavy work, one should use the energy expenditures of 100, 200, 300, and 400 kilogram metres respectively.

Prof. A. Krogh laid emphasis on the effect of diet on the respiratory quotient and on efficiency. For short experiments a diet containing plenty of carbohydrate is better for maintained exertion. He criticised Prof. Waller's technique, but said that it was probably satisfactory for the investigation of energy expenditure under working conditions in industry. Prof. Waller's methods were criticised by several others. Some criticisms were on technical points, such as the accuracy of dry meters, temperature and pressure measurements or the size of bag used in collecting the expired air, and some were on the results, namely, the low carbon dioxide output in his published work. As Prof. Briggs pointed out, there may be greater sources of error neglected by both sets of workers than those due to the errors of analysis.

The discussion terminated by a paper on "The Economy of Human Effort in Industry" by Mr. E. Farmer. The aim of his study was to find more rapid methods of carrying out industrial processes. One must see the effect on output without the stimulus of special pay. The principles to be used in devising new methods are to encourage smooth movements without marked change in direction and to avoid the intervention of discrimination. He gave examples of increased output in packing chocolates and in metal polishing. Further points requiring study are: What is monotony, what is the influence of noise, and what is the influence of vibration on the workers?

A few individual papers were given.

Prof. A. Krogh described a simple apparatus, consisting of a volume recorder containing soda lime, for measuring oxygen consumption. The soda lime absorbs all carbon dioxide and the volume decrease as recorded on a kymograph gives a measure of the oxygen absorption.

Dr. J. C. Drummond gave an interesting account of some recent work in connection with vitamins and their relation to public health. Green plants and fruits are the main source of vitamins. Dairy products are good in furnishing the vitamins provided that the cows have been fed on green food containing them. The plankton in the sea by the presence of green plants is a source of vitamins which we obtain in fish and fish-oils. It is important that industrial populations should obtain a proper supply of vitamins, because a relative deficiency in them may cause ill-health without the appearance of such diseases as scurvy or beri-beri.

Dr. F. W. Edridge-Green reported experiments on mixing white light with spectral colours. He was followed by Dr. Shaxby, who described a useful instrument consisting of a grating spectroscope with two collimators by which the spectra are formed in reversed order. By a shutter in the eye-piece it is possible to compare monochromatic patches in reversed order.

Dr. R. J. S. McDowall read a paper on "The Independence of the Pulmonary Circulation as shown by the Action of Pituitary Extract." Tracings were shown in which the pulmonary pressure was seen to vary independently of the systemic circulation.

Dr. E. P. Poulton and Dr. W. W. Payne read a paper on "Epigastric Pain." They consider that epigastric pain is not necessarily referred pain, but that it may be due to spasmodic contractions of the œsophagus, stomach, or duodenum.

A number of demonstrations were given, and one afternoon was spent seeing some of these at the Clinical Laboratory, Royal Infirmary. Amongst these demonstrations were Dr. R. K. S. Lim, demonstration of the mucoid cells of the stomach; Dr. E. P. Poulton and Dr. W. W. Payne, peristalsis of the human œsophagus; Mr. McClure, psychogalvanic reflex; and Prof. J. Meakins, respiration with decreased volume per respiration, with and without oxygen, and effect of resistance to breathing on respiration at rest and whilst working.

The Week in West Africa

AT a meeting of the Royal Anthropological Institute held on December 13 Mr. Northcote W. Thomas read a paper on "The Week in West Africa." He said there were in West Africa a number of sub-divisions of the lunar month, such as 16-day periods, 10-day periods, and the like, the origin of which was either in the market or in some religious belief. There were, in addition, a number of shorter units, comparable to our week, of more uncertain origin; they ranged in length from two to eight days. They were very rarely sub-divisions of the month, and there was reason, where the week is synchronised with the month, to suspect foreign influence. Generally speaking, the month in West Africa was of small importance and played no part in economic or religious life; it was reckoned from the day on which the new moon was first seen, but the native can only very rarely say of how many days it consists. There was no less uncertainty as to the length of the year; few, if any, tribes had any exact knowledge of its length. The calendar was sometimes adjusted by the recognition of two years of different length, as in Benin, where the female year seems to have been about 340 days in length.

The week has been traced to a religious origin. Webster has regarded the "rest day" as its germ, but the rest day is an institution of agricultural people, and there are many such peoples in Africa who have no week. On the other hand, the distribution of the market is practically conterminous with that of the week, and it is probable that the calendar first came into existence as a means of indicating the market day. We have, however, little or no evidence to show why the different units were chosen. A certain number of day-names are derived from names of deities, notably on the Gold Coast, but, generally speaking, the kind of work done on a given day or the market attended is the decisive factor, and consequently they are used only in a small area. To this there is one striking exception; the Ibo day-names, used also in a different order in Benin City, are found everywhere from the Niger to the Cross River, but we are ignorant of their meaning.

The four-day week of the Lower Niger, which appears to be independent of the week of the Congo, seems to occupy the largest area; but we know too little of the distribution of the five- and six-day weeks, especially in French territory, to make any very definite assertion. There is good reason to suppose that a non-Mohammedan seven-day week was known; some of these weeks are clearly expanded from an earlier four-day week, but they have native, not Arabic, names.

Scientific Research and Industrial Development.

IN a lecture on "The Benefits of Research to Corporations" (No. 18, R. and C. Series of Nat. Res. Council, U.S.A., 1921) Dr. Charles L. Reese, chemical director of the de Pont de Nemours Explosives Co., U.S.A., gives examples of the advantages which accrue when a large industrial concern is equipped with a staff capable of applying scientific knowledge to the improvement of materials and processes.

Before the war this important company had already systematised its procedure by developing a system of records and costing, and had completed a number of investigations which had been the means of saving money, resulting, for example, in methods for shortening the time of separation of nitroglycerine from its acids, increasing its yield, preventing its freezing in dynamites, and for nitrating cellulose by the use of the mechanical dipper. Studies from the company's laboratories on the nitration of toluene and of the characteristics of nitrocellulose propellants became of great importance when war broke out, as did also a process for the recovery of a considerable proportion of the alcohol used in gelatinising the propellant, this leading to a direct saving in corn—estimated at ten million bushels—which thus escaped being fermented.

During the war enormous extensions were made by the company for the production of nitrocellulose powder, trinitrotoluene, picric acid, amatol, and tetryl, and in this connection it is stated that the staff of the chemical and mechanical research departments of the firm was increased in number from 212 to 987, with an expenditure on experiment and research of 3,360,000 dollars for four years of the war, the output of military explosives being seven million tons.

Since the war the company has transferred its research organisation with success to the production of dyes, and is spending, and is prepared to spend, many millions of dollars on research to meet German competition, but protection is considered to be essential at present to the existence of the industry.

The address is interesting as giving an idea of the scope and the methods of a large chemical concern in utilising the services of scientific men for the investigation of new processes and the conservation of materials. A custom obtains with the company of recompensing inventors by means of a bonus in the form of the company's stock, in some cases sufficient to make them independent.

Little mention is made, however, of research on the theory of explosives, on which doubtless much work has been done by the staff. A few remarks may be made as to some subject-matter of the claims. Thus, while the mechanical dipper was undoubtedly an advance for obtaining output on the old pot-process of making nitrocellulose, the Thomson displacement process as used in this country and in France also greatly reduces handling of the material and eliminates fuming off, which appears still to occur occasionally with the mechanical dipper. Much is made of the "work found necessary to develop satisfactory methods for loading that very successful high explosive developed in England known as amatol, a mixture of trinitrotoluene and ammonium nitrate," but it is understood that an enormous number of shell was filled with amatol by the methods supplied from this country. Again, tetryl, trinitrophenylmethylnitroamine, not "tetranitro-dimethylaniline," as stated, was not used exclusively in Germany before the war, but was made here also on the manufacturing scale.

The address, however, is of interest as showing a practical appreciation of the need for the application of scientific method in the development of old, and the acquisition of new, industries.

University and Educational Intelligence.

BIRMINGHAM.—The reports of the Council and of the Principal to be presented to the Court of Governors at the annual meeting on February 9 have been issued. The Principal appeals for more liberal provision of both undergraduate and post-graduate scholarships, and lays stress upon the difficulties which financial stringency imposes on the advancement of research. He reminds the Governors that "the war revealed the obvious, but often forgotten, truth that trained minds cannot be improvised, and that success in international competition will go to the nation which, by laborious and patient organisation, provides, through its universities, disciplined workers."

The extension of the University library is reported with satisfaction as a step in the direction of a more complete provision of that vital need of research workers. The overcrowding of the Mason College buildings is regarded as a grave menace to the continued expansion of the departments of medicine, biology, arts, and education. The obvious remedy is to transfer the biological departments to new buildings at Edgbaston, but as this would involve great expenditure of money the alternative of restricting entries to all the departments at present housed in Mason College may have to be faced in the near future.

The Principal appeals especially for more support from the districts surrounding the city, which send a large proportion of the students at present in the University, reminding them that "we cannot have it both ways: unrestricted admission of all the fully qualified and the withholding of a substantial contribution towards the financial cost of a university education."

Reference is made to the problem of adult education and the way in which the University is trying to do its share of this important work. "All who keep closely in touch with the main currents of educational opinion are impressed with the increasing insistence of the demand as well as with the complexity of the task involved in an 'educated democracy.' It would be disastrous if the handling of the problem became political; the provincial universities by sympathy and wise statesmanship, perhaps more than any other organisations, can avert this danger."

The Court of Governors is to be asked to confer the title of emeritus professor on Prof. J. H. Muirhead.

The assistance of the Birmingham Chamber of Commerce in completing the fund for a chair of Italian (which was started by Mr. Arthur Serena's gift of 5000*l.*) is gratefully acknowledged by the Council.

The appointment of Mr. Maurice Nicoll to the lectureship in psychotherapy, endowed by Sir Charles Hyde, is reported.

In commemoration of the work of Prof. P. F. Frankland, a fund has been subscribed for providing a Frankland medal and a prize of books to be given annually to the best student in practical chemistry.

A bequest of 2000*l.* under the will of the late Richard Peyton becomes available, by the death of his widow, "for the advancement of music."

Calendar of Industrial Pioneers.

January 26, 1891. Nicolas August Otto died.—Originally a commercial traveller, Otto began work on the gas engine in 1854. In 1867 with Langen he brought out the Langen and Otto atmospheric engine, and in 1876 he introduced the engine working on the Otto cycle, which proved to be the turning point in the history of gas motors.

January 27, 1848. Josiah Christopher Gamble died.—A pioneer among alkali manufacturers, Gamble was born in Ireland in 1776. He graduated at Glasgow University and became a Presbyterian minister. After a few years he abandoned the Church, started small works at Dublin for the manufacture of sulphuric acid, bleaching powder, and alum, and in 1828 with Muspratt founded the first chemical works at St. Helens.

January 27, 1885. Edward Davy died.—A contemporary of Wheatstone and Cooke, Davy invented an electric telegraph, experimented with a mile of wire in Regent's Park, and in 1837 at Exeter Hall exhibited his needle telegraph. In 1839 he sailed for Australia, where he became medical officer of health and Mayor of Malmesbury.

January 28, 1829. Thomas Tredgold died.—Known for his valuable writings on carpentry, the strength of materials, and the steam engine. Tredgold began life in the North of England as a journeyman carpenter. He studied mathematics, chemistry, and architecture, contributed to the "Encyclopædia Britannica" and the *Philosophical Magazine*, and made original investigations. He died in London at the age of forty, worn out by his labours.

January 28, 1864. Benoit Paule Emile Clapeyron died.—From the Ecole Polytechnique Clapeyron entered the mining service, taught in the School of Public Works at St. Petersburg, and on his return to France took part in the construction of some of the earliest French railways. He wrote on the mechanical theory of heat, and it was through his work that Kelvin was led to the study of Carnot's famous memoir. Clapeyron in 1858 succeeded Cauchy as a member of the Paris Academy of Sciences.

January 29, 1882. Alexander Lyman Holley died.—A graduate of the Brown University, Providence, Holley engaged in practical engineering, and in 1860 published an important work on American and European railway practice. He afterwards became a great ironmaster. The inscription on his monument in Washington Square, New York, states that he was "foremost among those whose genius and energy established in America and improved throughout the world the manufacture of Bessemer steel."

February 1, 1885. Stanislas Charles Henri Laurent Dupuy de Lôme died.—In 1848–52 Dupuy de Lôme built the *Napoléon*, the first steam line of battleship. About five years later he converted the finest two-decker in the French Navy, also called the *Napoléon*, into the *Gloire*, the first fully armoured sea-going ship ever seen. She was 256 ft. long, of 900 h.p., carried thirty-six guns, and was protected by 5 in. of iron and 26 in. of timber. Dupuy de Lôme was for some years Chief Constructor of the French Navy.

February 1, 1885. Sidney Gilchrist Thomas died.—A clerk in a London police court, Thomas studied chemistry and in 1870 attacked the problem of the dephosphorisation of pig-iron in the Bessemer converter. By 1875 he had solved the problem, and with the assistance of his cousin, Percy Gilchrist, and others, the commercial triumph of his important discovery was assured. His grave is in the Passy Cemetery in Paris.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, January 19.—Sir Charles Sherrington, president, in the chair.—L. **Hill**, H. M. **Vernon**, and D. H. **Ash**: The kata-thermometer—a measure of ventilation. The kata-thermometer is used in ventilation inquiries to estimate (1) the cooling, (2) the evaporative power of the air on a surface at body-temperature, and (3) as an anemometer to indicate the velocity of air-currents. Certain discrepancies having arisen, the "kata" formulæ have been re-investigated, using the large wind-channels at the National Physical Laboratory, and for low velocities the method of moving the "kata" through the air in a whirling arm, taking count of the effect of "swirl."—Lt.-Col. C. B. **Heald** and Major W. S. **Tucker**: Recoil curves as shown by the hot-wire microphone. The hot-wire microphone has been employed to measure body recoil as the result of heart action, and the records measure quantities proportional to the kinetic energy imparted to the body by motions of the blood. Thus slow-moving displacements, such as those of breathing, are not recorded. The apparatus can be standardised, giving the same responses from day to day for the same body recoils, and the kinetic energy of the body can be expressed in C.G.S. units. The results are consistent with physiological data.—E. W. A. **Walker**: Studies in bacterial variability: The occurrence and development of dys-, eu-, and hyper-agglutinable forms of certain bacteria. In the enteric and dysenteric groups of bacteria dys- and hyper-agglutinable forms occur. Both may be obtained from one eu-agglutinable strain of a bacillus. In agglutination tests a highly dys-agglutinable bacillus may fail to agglutinate with a serum that agglutinates the culture from which it was derived up to 1 in 1000. It may also fail to absorb from the serum the agglutinins specific to that culture. Noteworthy differences in behaviour thus exist between different individuals of a single culture. These facts may help to throw light on the problem of seriological strains.—Marjory **Stephenson** and Margaret **Whetham**: Studies in the fat metabolism of the timothy grass bacillus. During the growth of the timothy grass bacillus on a medium of inorganic salts, including ammonia as the sole source of nitrogen, glucose, and sodium acetate, the formation of protein, nitrogen, and fat was followed and correlated with the disappearance of glucose and acetate. No intermediate decomposition products of glucose were found. The growth of the organism on possible intermediate products of the breakdown of glucose was then studied. The growth on lactic acid was very similar to that on glucose alone. Growth on acetic acid was negligible. Growth on acetic and lactic acid showed that lactic acid enabled the organism to utilise the acetic acid. The acetic acid utilised in the presence of lactic acid or glucose served to increase the proportion of lipoid material formed, and not to increase the general growth of the organism. Growth on propionic and butyric acids was like that on lactic acid.—J. A. **Gardner** and F. W. **Fox**: The origin and destiny of cholesterol in the animal organism. Pt. 12: The excretion of sterols in man. Measurements of the intake and output of sterols in twenty-six cases on known diet show that in every case, except one, there was an excess of output over intake. The average daily negative balance was 0·3 gram, but individual balances were very variable. A considerable portion of the cholesterol of the food and of the bile is re-absorbed in the intestine along with the bile salts, but this process appears to be limited by the reduction of cholesterol to bi-hydrocholesterol in the intestine, a process especially characteristic of the adult human subject. The excess of output of cholesterol over intake leads to the conclusion that there is some organ in the body capable of synthesising cholesterol. The intake of unsaponifiable matter not precipitable by digitonin is much larger than the output.—S. J. **Lewis**: The ultra-violet absorption spectra and the optical rotation of the proteins of the blood sera. The absorption curve of pseudo-globulin is constant and the same for both the horse and human varieties. The curve for euglobulin differs considerably from that for pseudo-globulin in extinction coefficients, but not in general form. The absorption curves for the horse and human varieties of albumin are similar, except for a constant ratio in their magnitudes, and this difference may be due to the association of an aggregate possessing little or no selective absorptive power, *e.g.* an aliphatic amino-acid or a polypeptide, with the principal aggregate. The close similarity in form of all the curves when corrected to a common amplitude, and the fact that the amplitudes are nearly all simple multiples of a common factor, point to similarity of constitution amongst these proteins and to a variable "concentration" of the active group. Processes for the separation and purification of the proteins have been elaborated.

Mineralogical Society, January 10.—Mr. A. Hutchinson, president, in the chair.—C. E. **Tilley**: Density, refractivity, and composition relations of some natural glasses. The glasses investigated fall into two groups, (*a*) tektite glasses and (*b*) volcanic glasses. The characteristics of the former confirm their divergence from volcanic glasses, and support the theory of their meteoritic origin. The specific refractivities of five analysed glasses are compared with the values calculated from the specific refractivities of their component oxides, and a notable correspondence is revealed. The influence of contained water on the specific refractivity is discussed and some figures bearing on the volume-change accompanying the passage from the vitreous to the crystalline state are given.—H. H. **Thomas** and E. G. **Radley**: The so-called "avanturine" from India, with an analysis of the contained mica. The stone is a quartz-schist, and owes its colour to plates of green fuchsite arranged parallel to the planes of foliation. The mica contains 1·77 per cent. Cr_2O_3 and a little vanadium; its optical characters are described. The probable source of the stone is discussed and the deterioration of the stone by heat and other causes is explained.—A. **Russell** and A. **Hutchinson**: Laurionite and paralaurionite from Cornwall. Laurionite associated with phosgenite and anglesite in a cavity in limonite is described in a specimen obtained from the collection of John Hawkins, of Trewithin, Cornwall. The locality is probably Wheal Rose, Sithney. Paralaurionite occurs with phosgenite in a very similar specimen in the collection of the late H. J. Brooke, said to come from Wheal Confidence, Newquay.—A. **Russell**: A discovery of pitchblende at Kingswood Mine, Buckfastleigh, North Devon. Pitchblende, occurring in a north and south lode associated with chloanthite, and native bismuth is described. The discovery shows promise of being of some economic importance.—W. A. **Richardson**: The distribution of oxides in Washington's collected analyses of igneous rocks. Frequency curves are given for all the oxides, and show considerable differences from those previously published. The silica curve is the most interesting, and shows two maxima, one at 52 per cent. and the other at 72 per cent. SiO_2. The frequency curve for SiO_2 can be matched by a combination of two normal curves of error with origins on the 52 and 72 per cent. lines.—W. A. **Richardson**: A simplification of the Rosiwal method of micro-analysis. A method by which, using a drawing apparatus, the lengths of component minerals of a rock can be projected on to separate strips of paper and directly summed is described.—Dr. A. **Schoep**: The absence of cobalt in cornetite from Katanga, Belgian Congo. Microchemical tests made on carefully selected crystals from the original locality (Star of the Congo Mine) prove that cobalt is present only in associated black spots of heterogenite. The mineral is thus a hydrated phosphate of copper, agreeing completely with that recently described from Northern Rhodesia.

PARIS.

Academy of Sciences, January 9.—M. Emile Bertin in the chair.—C. **Lallemand**: The genesis and present state of the science of the abacus.—T. **Varopoulos**: A class of increasing functions.—P. **Humbert**: The product of Laplace relative to certain hypercylinders.—G. **Dumas**: A normal table relating to unilateral surfaces.—A. **Denjoy**: Functions defined by series of rational fractions.—B. **Gambier**: Surfaces and varieties of translation of Sophus Lie.—C. **Nordmann** and M. **Le Morvan**: Observation of an abnormal star by the heterochrome photometer of the Paris Observatory. The star 13 Cepheus presents some singular anomalies. It belongs to the spectral type A (hydrogen stars), but has a yellow coloration. The colour photometer shows that the light intensity is distributed in the spectrum in such a manner that the more refrangible rays are proportionally less intense than in any of the stars hitherto studied, not only of this type, but also of types F and G. It is possible that the atmosphere surrounding this star possesses exceptional absorbing power.—E. **de Martonne**: The massif of Poïana Ruska and the correlation of the erosion cycles of the southern Carpathians.—E. **Carvallo**: The principle of relativity in dielectrics.—P. **Chevenard**: The expansion of chromium and the chrome-nickel alloys over a wide temperature interval. A differential dilatometer was employed in which the standard bar was a nichrome (with 10 per cent. of chromium), the law of expansion of which had been carefully determined by direct methods. A diagram is given of the results on commercially pure chromium (98·3 per cent.) and five chrome-nickel alloys. The diagram gives the coefficients of expansions as functions of the temperature over the range 0° C. to 900° C.—M. **Faillebin**: A mixed organo-metallic compound of aluminium. Aluminium and methylene iodide in dry ether in the presence of a little iodine react in two ways, the principal reaction giving $CH_2{\cdot}AlI$ and AlI_3, the subsidiary reaction AlI_3 and ethylene.—J. **Barlot** and Mlle. M. T. **Brenet**: The determination of fatty acids by the formation of complex compounds with uranyl and sodium. Streng's reagent (acid solution of uranyl nitrate) is known to give a precipitate of a double salt with sodium acetate. Similar precipitates are obtained with the sodium salts of higher fatty acids, but only if the acid contains an even number of consecutive carbon atoms. Thus formates, propionates, *iso*butyrate, and normal valerates give no precipitate, but the reaction is obtained with acetic, normal butyric, fermentative valeric and normal caproic acids.—Y. **Milon** and L. **Dangeard**: A Redonian formation (Upper Miocene) forming ravines with the Eocene clays to the south of Rennes (Ille-et-Vilaine) containing iron minerals.—E. **Zaepffel**: The mechanism of the orientation of leaves. The movements of the leaf are connected with the distribution of water, and this distribution is influenced by the mobile starch.—C. **Douin**: The gametophyte of the Marchantiæ.—L. **Plantefol**: The toxicity of various nitrophenols for *Sterigmatocystis nigra*. Experiments were carried out with three isomeric nitrophenols, dinitrophenol, and trinitrophenol. All these proved more toxic to the mould than phenol itself. The three mononitrophenols differed in toxicity, the para-compounds being the most toxic. The dinitrophenol had the greatest effect in inhibiting the growth of the mould of any of the substances tried; it is nearly 300 times more toxic than phenol.—E. **Chatton**: Polymorphism and maturation of the spores of Syndinium.—R. **Sazerac** and C. **Levaditi**: The use of bismuth in the prophylaxy of syphilis. Sodium potassium tartarobismuthate, administered in intramuscular injection, acts preventively against syphilitic infection, and the same salt applied locally in the form of salve acts preventively even after infection. The conclusions were arrived at after experiments on rabbits.

Diary of Societies.

THURSDAY, JANUARY 26.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—S. Gordon: Sea Birds and Seals.

ROYAL SOCIETY, at 4.30.—W. B. Hardy and Ida Doubleday: Boundary Lubrication: The Paraffin Series.—Prof. W. A. Bone, A. R. Pearson, E. Sinkinson, and W. E. Stockings: Researches on the Chemistry of Coal. Part 2: The Resinic Constituents and Coking Propensities of Coals.—Dr. J. A. Crowther and B. J. Schonland: The Scattering of β-rays.—Ann C. Davies: The Minimum Electron Energies associated with the Excitation of the Spectra of Helium.—C. N. Hinshelwood, H. Hartley, and B. Topley: The Influence of Temperature on Two Alternative Modes of Decomposition of Formic Acid.—Prof. C. V. Raman: The Molecular Scattering of Light in Water and the Colour of the Sea.

ROYAL AERONAUTICAL SOCIETY (Students' Meeting) (at Royal Society of Arts), at 7.—C. Daniel: Practical Points in Fuselage Construction.

INSTITUTION OF LOCOMOTIVE ENGINEERS (London) (at Caxton Hall), at 7.15.—C. J. Allen: The Influence of Design on Express Locomotive Performance.

CONCRETE INSTITUTE, at 7.30.—E. B. Moullin: Capillary Canals in Concrete, and the Percolation of Water through Them.

ROYAL MICROSCOPICAL SOCIETY (Metallurgical Section), at 7.30.—H. Wrighton: Demonstration of Polishing Metal Specimens.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, JANUARY 27.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science and Technology), at 2.30.—Prof. E. P. Stebbing and others: Discussion: The Importance of Scientific Research in Forestry and its Position in the Empire.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—A. L. Howard: The Timbers of India and Burma.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—T. H. Littlewood: The Diffusion of Solutions.—H. R. Nettleton: A Special Apparatus for the Measurement at Various Temperatures of the Thomson Effect in Metals.—J. J. Manley: A Defect in the Sprengel Pump: its Cause and the Remedy.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Hunterian Lecture: The Facial Characteristics of the Races native to India.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children Section), at 5.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—L. M. Jockel: Fuels and the Boiler-house.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.—Dr. S. M. Copeman, Dr. R. A. O'Brien, Dr. A. J. Eagleton, and A. T. Glenny: Experiences with the Schick Test, and Active Immunisation against Diphtheria.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Viscount Burnham: Journalism

SATURDAY, JANUARY 28.

ESSEX FIELD CLUB (in Physical Lecture Theatre, West Ham Municipal College), at 3.—C. Nicholson: The Rosy-Marbled Moth (*Erastria venustula*) in Britain (with special reference to Essex).—G. Morris: Some Neolithic Sites in the Valley of the Essex Cam.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. C. Macpherson: The Evolution of Organ Music (2).

MONDAY, JANUARY 30.

INSTITUTE OF ACTUARIES, at 5.—G. King: A Short Method of Constructing Select Mortality Tables: Further Developments.

ROYAL SOCIETY OF ARTS, at 8.—C. Ainsworth Mitchell: Inks (Cantor Lectures) (2).

MEDICAL SOCIETY OF LONDON, at 9.—Sir Leonard Rogers: Amœbic Liver Abscess: Its Pathology, Prevention, and Cure (Lettsomian Lectures) (1).

TUESDAY, JANUARY 31.

ROYAL HORTICULTURAL SOCIETY, at 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. H. H. Turner: Variable Stars (1); Short Period Variables.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. H. Wrench: Our Old Village Churches and their Story.
ILLUMINATING ENGINEERING SOCIETY (Joint meeting with the Royal Aeronautical Society) (at Royal Society of Arts), at 8.—Lt.-Col. L. F. Blandy and others: Discussion: The Use of Light as an Aid to Aerial Navigation.

WEDNESDAY, FEBRUARY 1.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—C. E. N. Bromehead: Some Notes on the New 6-inch Geological Survey of London and the Influence of the Geology on the History of the Area.
ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30.—Major H. D. Gillies: Demonstration of Plastic Surgery.
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Major J. Erskine-Murray: (*a*) The Determination of the Decrement of a Distant Sending Station; (*b*) Some New Methods of Radio-Navigation.
ENTOMOLOGICAL SOCIETY OF LONDON, at 8.
ROYAL SOCIETY OF ARTS, at 8.—A. Wilcock: Surface Printing by Rollers in the Cotton Industries: A Comparison with other Processes of Printing Patterns for Cretonnes, Dress Materials, Wallpapers, etc.
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—J. L. Lizius and N. Evers: Studies in the Titration of Acids and Bases.—Dr. J. C. Drummond and A. F. Watson: The Sulphuric Acid Reaction for Liver Oils and its Significance.—W. Dickson and W. C. Easterbrook: The Quantitative Separation of Nitrobody Mixtures from Nitro-glycerine.

THURSDAY, FEBRUARY 2.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Napier Shaw: Droughts and Floods (1).
ROYAL SOCIETY, at 4.30.—*Probable Papers*.—C. Shearer: The Oxidation Processes of the Echinoderm Egg during Fertilisation.—J. Schmidt: The Breeding Places of the Eel.—J. Gray: The Mechanism of Ciliary Movement.—J. Gray: The Mechanism of Ciliary Movement. II. The Effect of Ions on the Cell Membrane.—J. S. Huxley and L. T. Hogben: Experiments on Amphibian Metamorphosis and Pigment Responses in Relation to Internal Secretions.
LINNEAN SOCIETY OF LONDON, at 5.—F. Johanssen: The Canadian Arctic Expedition.—Dr. J. C. Willis and U. Yule: Some Statistics of Evolution and Distribution in Plants and Animals, and their Significance.—Mrs. E. M. Reid: Note on Fossil Floras.
ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Discussion on the Treatment of Gastric Ulcer. Speakers: Sir William Hale-White, Sir William Willcox, Sir Berkeley Moynihan, and Mr. Sherren.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—L. J. Romero and J. B. Palmer: The Interconnection of A.C. Power Stations.
CHEMICAL SOCIETY, at 8.—E. J. Hartung: The Action of Light on Silver Bromide.—C. K. Ingold: The Structure of the Benzine Nucleus. Part I. Intra-nuclear Tautomerism.—C. K. Ingold: The Structure of the Benzine Nucleus. Part II. Synthetic Formation of the Bridged Modification of the Nucleus.—C. K. Ingold and H. A. Piggott: The Structure of the Benzine Nucleus. Part III. The Suppression of Intra-nuclear Change.

FRIDAY, FEBRUARY 3.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.45.
ROYAL ASTRONOMICAL SOCIETY, at 5.—Geophysical Discussion on the Depth of Origin of Earthquakes. Prof. Love in chair. Speakers: Prof. Turner, Prof. Lamb, R. D. Oldham, Dr. H. Jeffreys, Prof. Knott, Dr. C. Davison, and Major Taylor.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. K. M. Walker: The Nature and Cause of Old Age Enlargement of the Prostate (Hunterian Lecture).
EUGENICS EDUCATION SOCIETY (at Royal Society), at 8.—Prof. H. J. Fleure: Some Social Bearings of Race Study.
JUNIOR INSTITUTION OF ENGINEERS, at 8.—Major W. Gregson: Utilisation of Waste Heat from Internal Combustion Engines.
ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30.—Discussion on the Uses and Limitations of N_2O and O_2 Anæsthesia. Speakers: Dr. A. L. Flemming and others.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Francis Younghusband: The Mount Everest Expedition.

PUBLIC LECTURES.

(*A number in brackets indicates the number of a lecture in a series.*)

THURSDAY, JANUARY 26.

UNIVERSITY COLLEGE, at 5.15.—B. S. Rowntree: Industrial Unrest.
KING'S COLLEGE, at 5.30.—Dr. O. Faber: Reinforced Concrete (2).
GRESHAM COLLEGE, at 6.—A. R. Hinks: Astronomy in Daily Use (3).
ST. JOHN'S HOSPITAL FOR DISEASES OF THE SKIN, at 6.—Dr. W. K. Sibley: Alopecia and its Treatment (Chesterfield Lecture).

FRIDAY, JANUARY 27.

METEOROLOGICAL OFFICE (South Kensington), at 3.—Sir Napier Shaw: The Structure of the Atmosphere and the Meteorology of the Globe (2).
KING'S COLLEGE, at 5.30.—Dr. H. W. Williams: The Peoples of the Caucasus (2); at 6.—Prof. G. Young: Brazil.
TAVISTOCK CLINIC FOR FUNCTIONAL NERVE CASES (at the Mary Ward Settlement, Tavistock Place), at 5.30.—Dr. H. Crichton Miller: The New Psychology and its Bearing on Education (1).
GRESHAM COLLEGE, at 6.—A. R. Hinks: Astronomy in Daily Use (4).

SATURDAY, JANUARY 28.

LONDON DAY TRAINING COLLEGE, at 11 a.m.—Prof. J. Adams: The School Class (2).
HORNIMAN MUSEUM (Forest Hill), at 3.30.—F. Balfour-Browne: The Life and Habits of Mason Bees.

MONDAY, JANUARY 30.

UNIVERSITY COLLEGE, at 5.—A. T. Walmisley: The Bridges over the River Thames at London.
KING'S COLLEGE, at 5.30.—Dr. J. Steppat: Recent Developments in German Education and Student Life.—Prof. L. L. Fortescue: Wireless Transmitting Valves (2).

WEDNESDAY, FEBRUARY 1.

HORNIMAN MUSEUM (Forest Hill), at 6.—W. W. Skeat: The Living Past in Britain (2).

THURSDAY, FEBRUARY 2.

KING'S COLLEGE, at 5.30.—Dr. O. Faber: Reinforced Concrete (3).
ST. JOHN'S HOSPITAL FOR DISEASES OF THE SKIN (Leicester Square, W.C.2), at 6.—Dr. J. L. Bunch: Drug Eruptions (Chesterfield Lecture).
CIVIC EDUCATION LEAGUE (at Leplay House, 65 Belgrave Road, S.W.1), at 8.15.—Miss Barbara Low: Psycho-analysis in relation to Civics.

FRIDAY, FEBRUARY 3.

METEOROLOGICAL OFFICE (South Kensington), at 3.—Sir Napier Shaw: The Structure of the Atmosphere and the Meteorology of the Globe (3).
UNIVERSITY COLLEGE, at 5.—Prof. G. Elliot Smith: The Evolution of Man (1).
KING'S COLLEGE, at 5.30.—Rev. Dr. F. A. P. Aveling: Matter, Mind, and Man.—Dr. H. W. Williams: The Peoples of the Caucasus (3).
TAVISTOCK CLINIC FOR FUNCTIONAL NERVE CASES (at the Mary Ward Settlement, Tavistock Place, W.C.1), at 5.30.—Dr. H. Crichton Miller: The New Psychology and its Bearing on Education (2).

SATURDAY, FEBRUARY 4.

SALTERS' HALL (St. Swithin's Lane, E.C.4), at 10.30 a.m.—Dr. M. O. Forster: The Relation between Pure and Applied Chemistry.
LONDON DAY TRAINING COLLEGE, at 11 a.m.—Prof. J. Adams: The School Class (3).
HORNIMAN MUSEUM (Forest Hill), at 3.30.—E. Lovett: The Folk-lore of Natural History.

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