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Museums in Education.

FOR many years past a number of people, approaching the question from diverse or even opposite sides, have agreed that our museums should do more for education, and that our educational establishments should be brought into closer touch with museums. The desire for mutual aid is expressed by representatives of science, art, classical studies, history, and industry. A discussion of the subject in the Education Section of the British Association at Birmingham in 1913 led to the appointment of a committee drawn from many sections "to examine, inquire into, and report on the character, work, and maintenance of museums, with a view to their organisation and development as institutions for education and research, and especially to inquire into the requirements of schools." A wide reference—and the committee, composed of university officers and professors, school inspectors and teachers, humanists and men of science, administrators and museum curators, has taken a wide sweep and a broad view. The final report, now before us,[1] was deferred owing to the difficulties and economies of wartime, and is now published with the forced omission of the detailed data on which the conclusions are based. This, however, makes it the easier reading, and read it should be by all interested in either museums or education.

1 British Association, Section L (Cardiff, 1920). "Museums in Relation to Education." Final Report of Committee (Prof. J. A. Green, chairman; Mr. H. Bolton and Dr. J. A. Clubb, secretaries; Dr. F. A. Bather, Rev H. Browne, Mr. C. A. Buckmaster, Prof. E. J. Garwood, Dr. A. C. Haddon, Dr. H. S. Harrison, Mr. M. D. Hill, Dr. W. E. Hoyle, Sir H. Miers, Prof. P. Newberry, Mr. H. R. Rathbone, Dr. W. M. Tattersall, Sir Richard Temple, Mr. H. Hamshaw Thomas, Prof. F. E. Weiss, and Dr. Jessie White). Pp. 14. Price, post free, 6*d*. Six or more copies at 2*d*. each.

Those who are to be educated by museums may be classed as the general public, the pupils of primary and secondary schools, students at universities and similar institutions, and, finally, post-graduate and other advanced students. In the past the attempt to reach these people has been subject to many difficulties. The name "museum" has diverse connotations; while some museums, of modern origin, are purely educational in aim, those of older foundation were not, and cannot be, primarily engines of education. None the less, the officials of the latter have long been anxious to enlarge this side of their work. The appeal to the general public, initiated by Flower in the Natural History Museum, has been followed and surpassed elsewhere, notably in the United States. With us the provision of guide-books and of the human guides so strenuously advocated by Lord Sudeley demands more money than is forthcoming. But the real difficulty in our larger museums has always been the conflicting aims of the exhibition galleries. This will not be overcome until the reference series for collectors and advanced students are separated from the more popular and elementary exhibits, just as the research collections are already separated. Above all, in every museum there is the difficulty of the overworked and underpaid curator.

Turning to the other side, we have found difficulties in the schools. The value of the museum and of museum material has not been appreciated by teachers. It was too much trouble. "When the ground is covered by manuals, why try to drag in pictures or objects which are a bother to look after, and which distract the pupil's attention from his book? And, as for taking the class to a museum, how are we to find either time or money?" Our great public schools have some excellent museums, but there is little or no evidence that they are used in school teaching. Our universities have museums, or collections specially designed for their students, but too often they compete rather than co-operate with the public museums of their neighbourhood. As for industries, they keep their own secrets, and (except in a few instances, as the Potteries museum) do not realise the value of museums for their purposes. Possibly curators, too, have not always realised the service they themselves might render to industry.

In these matters, as in so much else, the war has produced a change of conditions and a change of view. Museums have proved their usefulness

to the State; the public has protested in surprising fashion its affection for museums. Recent legislation has recognised this in removing the rate-limit for municipal museums, and in facilitating the promotion of museums by the education authorities of the counties and boroughs. The committee, though it welcomes this change of attitude, does not do so without warning and criticism. It recognises that municipal and national museums are not the only kinds deserving of State- or rate-aid; there are semi-private museums which need it even more. It is a little afraid of control by an "authority" that may know all about education, but certainly knows little about the governance, organisation, and financial needs of museums; and it would like to see "some national or central authority fully conversant" with such matters, to whom local museum committees might turn for advice—or perhaps something still more satisfying. Such welcome as the committee does give to the education authority seems due to its hope that the education grant will pay for the extra material and the special staff required for such desirable works as loan collections for schools or school classes in the museum. It also suggests that recent legislation may find its best fruits in establishing museums in towns as yet unprovided with them.

It is rather striking that, of the five general conclusions emphasised by the committee, the first four have reference to research. In research the universities should co-operate. To aid research, lists of contents should be published. Grants in aid should be proportioned to the research conducted by a museum, no less than to its other activities. Curators must have had a university training, fitting them for research as well as for administration. All this may not seem to have much to do with education. But the committee is right. Granted that the collection and preservation of material objects constitute the *differentia* of a museum, it is clear that the first necessity is the study of those objects. "This research must be prosecuted if museums are to fulfil their highest function, which is the advancement of Science, Art, and Industry." Research is a necessary preliminary to any and every other function of a museum, and not least to the function of education. We cannot deal here with the many practical recommendations scattered through the body of the report, and perhaps not sufficiently distinguished by type or spacing from their context. They should prove acceptable and useful to both educationists and museum officials. We would, however, reiterate our high appreciation of the committee's labours and of the firm stand that it takes on the really fundamental principles.

The chief conclusion we would ourselves draw from this report is that there is a vast body of experience relating to the proper management of museums and their use in education, and not in that alone. Much of it forms the basis of this report; much is to be found in the publications of the Museums Association and in a few books that have been published. But the local authority faced with the task of founding a museum, or of taking over and utilising one already in existence, knows nothing of all this. On this ground, then, but not on this alone, we warmly approve the suggestion that there should be a central council or board, composed of persons with knowledge and sympathy, and endowed with the requisite powers, to watch over and aid the inception of museums, to co-ordinate their work when established, and to bring them into touch with the national museums. Such a council as we have in view would certainly not wish all museums to conform to one pattern or to rigid rules, but it might save much duplication of work and expenditure and much ill-directed effort.

Scientific Methods of Design and Control in Chemical Industry.

Ministry of Munitions. Department of Explosives Supply: Preliminary Studies for H.M. Factory, Gretna, and Study for an Installation of Phosgene Manufacture. Pp. xvi+145. (London: H.M.S.O., n.d.) Price 15*s.* net.

DURING the war an enormous amount of work was done by the Department of Explosives Supply in the design of chemical plant, processes, and works, and in the construction, organisation, and control of the numerous national and other factories dealing with the manufacture of explosives and closely related substances. Lord Moulton, who was Director-General of Explosives Supply, and whose magnificent work in the cause of Great Britain and the Allies cannot be overestimated, was fortunate in having associated with him a devoted band of men of exceptional ability and knowledge. Pre-eminent amongst these on the technical and scientific side was Mr. Kenneth B. Quinan, who was responsible for the design, construction, and organisation of the works controlled by the Factories Branch. Where all worked so splendidly, it might seem invidious to single out one name. But the writer well knows that amongst the hundreds, or indeed

thousands, of men who fought the war behind the front so splendidly in the Department of Explosives Supply there is not one who did not look up to "K. B. Q." as the great inspirer and organiser, or who failed to realise what the nation owed to his genius, personality, and indefatigable labour.

Mr. Quinan was also a great educator. One cannot explain this better than by quoting from the excellent preface to the present book.

"Mr. Quinan introduced methods of studying the various problems which arose and setting out the results, which were clear and very helpful to all who were connected with the erection of the plant and works, or the subsequent manufactures carried out. . . . Mr. Quinan insisted that the steps in a calculation by which certain results were obtained should be set forth so distinctly that they could easily be followed, and that the author himself might be able to trace the line of his reasoning and action after the matter had passed from his attention, without having to rack his brains to see how he had obtained his results. He thoroughly believed in the advantage of letting all those who were engaged in directing and carrying out work have the fullest possible understanding of what they were doing, and this policy bore excellent fruit in the results obtained at the works managed by the Factories Branch, which were carried on under the initial disadvantage of staff and workers largely without expert knowledge of the work they had to do."

In pursuance of this policy, every working drawing was accompanied by a well-reasoned description of the purpose and function of the various parts of the apparatus or plant, and the technical staffs at the various factories were constantly engaged, at Mr. Quinan's instigation, in studying the working of their plant, carrying out laboratory and plant researches, and vying with each other in a continuous process of improvement in the efficiency of the plant and in their understanding of the scientific principles underlying its design and operation.

It can well be imagined that, as a result of these methods, Mr. Quinan accumulated a vast amount of material, scientific and technical, of the greatest value to the nation, and especially to the young men who are destined to become the technical workers and the leaders of the next generation. It was Mr. Quinan's earnest wish that as much as possible of this material should be edited and published after the war for the benefit of the scientific institutions of the country and for all those young men who are already engaged in the chemical industries of the British Empire. It is extremely fortunate for the successful execution of this great work that the Government has entrusted it to Mr. William Macnab, who was a member of the Department of Explosives Supply throughout its whole existence (and of the original Committee of the War Office from which the Department sprang), and very closely connected with its development and with every phase of Mr. Quinan's work.

The present volume is published under the *aegis* of the Ministry of Munitions, but the continuation of the work has been entrusted to the Department of Scientific and Industrial Research, which will publish a number of other volumes. It would be impossible to exaggerate the national importance of this work. To apply scientific principles and data to the development of industrial plant and processes requires just as much scientific method, research, and intellectual labour as the discovery of the general principles and data of science. A failure to realise this, an all-too-narrow interpretation of the words "science" and "research," accounted for many errors in the past and for much of our unpreparedness when the stress of war came so swiftly upon us. There was, however, another factor, and one of cardinal importance. There existed few, if any, examples, accessible to all, and drawn from real practice, of the methods employed by the great scientific designers and creators of industry. How does one design a plant, a process, or a works? Who was there to answer that question? How did the Glovers, Deacons, Hurters, and Monds—to mention only a few great names drawn from chemical industry—set about their work? There were plenty of books on chemical technology, but not a word on the real thing, the method of research, the way to go about it. It is a supremely difficult thing to apply science scientifically and successfully. You are not free to choose your variables, or to eliminate unpleasant ones. The whole universe is on the top of you. You cannot say that you are a chemist and, therefore, do not intend to worry about the physical and engineering aspects of the problem. Unfortunately, a chemical plant is a bit of Nature, and includes, therefore, all the sciences. And Nature is not particularly concerned with the limitations of one's education or one's particular tastes and temperament. It is no doubt perfectly true that a man can learn to be a real technical chemist only by long practical experience in works. But it is of the greatest importance for the training of young men in the later stages of their work at the universities and higher technical schools that those whose capacities and temperaments incline them to industrial work should have the possibility of studying some first-class examples of how scientific principles and data are utilised and developed in the creation of processes and plant.

For the first time in the history of chemical science this is made possible by the publication of these volumes. A close study of this and the succeeding volumes will show the young chemist how physics, physical chemistry, and engineering must be combined with exact chemical knowledge. He will find here large numbers of drawings in plan and elevation which he can utilise in his study of engineering drawing as applied to chemical plant. He will see how, step by step, leaving nothing to chance, the elaborate calculations are carried out whereby from a number of fundamental data the complete flow-sheets and precise working details of large chemical factories are quantitatively developed. He will learn how every technical chemical problem involves much knowledge of physics and engineering, and he will see how much the practical chemical designer has to do with questions of heat absorption and evolution, and the transfer and transmission of heat. Most important of all, he will learn that the object of the truly scientific designer is to guess at nothing, but, if possible, to reduce everything to fundamental principles, precise quantitative data, and systematic calculation.

In the present volume the larger part—*i.e.* that relating to the design of the great Gretna works for the production of cordite and nitroglycerine—presents to the student of chemical industry and chemical engineering a unique object for study. The plan adopted by Mr. Macnab is to set forth systematically all the calculations as to quantities and capacities to be dealt with by the various sections of the plant and works. These calculations are summarised in a complete series of flow-sheets. The various sections and the general lay-out are illustrated by a large number of engineering drawings, all of which are accompanied by detailed descriptions which add enormously to their value. The "Study for an Installation of Phosgene Manufacture" is a fine piece of work, and an excellent example of Mr. Quinan's method of utilising thermo-chemical and physical data in the solution of a technical chemical problem. This "study" is a little classic, and will undoubtedly prove a source of inspiration and instruction of the very highest value. The student can here see for himself how, given certain chemical and physical data, the trained and experienced chemical designer sets to work to decide between the claims of rival processes and to develop the technical details of the selected one.

Mr. Macnab is warmly to be congratulated on the splendid way he has carried out his work. The intellectual and manual labour involved must have been very great, but they are justified by the excellence of the result. It can be stated with certainty that the present volume and its successors will constitute a handbook of applied chemical and physical science without its equal in any language. The effects as regards the scientific training of the new generation of chemical students will be far-reaching. The Explosives Supply Department had to produce in gigantic measure the chemical weapons of destruction. In these volumes the work of the Department will live for many years to come as a great and noble contribution to the edifice of reconstruction. It is earnestly to be hoped that the Government Departments now concerned will realise the vast importance of this undertaking and so publish ample editions of the various volumes. There exists here a splendid opportunity of extracting good from the terrible waste of war, and of sowing seed which will produce a rich harvest in the years to come.

One cannot put this volume down without thinking of the great days when Mr. Quinan worked at Storey's Gate. The unique professional knowledge derived from many years of technical experience, the unremitting work of a powerful and vigorous mind, and the irradiating influence of a great, genial, and unselfish personality were unreservedly put at the disposal of the British Empire. An atmosphere of good fellowship and of equal comradeship in work pervaded every branch. Everyone who came under the influence of Mr. Quinan was stimulated to put forth his best in the general cause.

These volumes will constitute an enduring memorial to the work of one of America's greatest sons, a man who did as much as anyone to win the Great War, and in doing so won the respect and affection of all who knew him.

F. G. DONNAN.

Experimental Science in India.

The Life and Work of Sir Jagadis C. Bose: An Indian Pioneer of Science. By Prof. Patrick Geddes. Pp. xii+259. (London: Longmans, Green, and Co., 1920.) Price 16*s.* net.

THE author of this biography was fortunate in his subject: it was no hard task to write an interesting chronicle of so eventful a life and of so striking a personality. Sir J. C. Bose is equally fortunate in his biographer: his life and work are set forth with conspicuous literary skill, scientific knowledge, and sympathy with the East. The result is a singularly instructive and eminently readable book.

The story of his life shows that Sir J. C. Bose had to contend, at all stages, with difficulties of every kind. The first and most fateful was that

of securing a university education in England. It is narrated how this difficulty was overcome, so that in 1881, at the age of 23, he was able to enter the University of Cambridge as a scholar of Christ's College, the college of which his brother-in-law, Mr. A. M. Bose, the first Indian wrangler, had become a member ten years previously. It may be incidentally mentioned here that Mr. Fitzpatrick, who is mentioned as one of his college friends (p. 29), is not, as stated, Master of Emmanuel College, but President of Queens' College. Having successfully completed his university career, Bose returned to India to face the next serious difficulty—that of obtaining a suitable educational post. It is explained how impossible it seemed to the official mind that a native of India should be fitted by ability and attainments for a professorship in physical science—there was no precedent for such a claim! However, chiefly by the influence of the then Viceroy, Lord Ripon, Bose was appointed professor of physics in the Presidency College, Calcutta, a post which he held until 1915. During this period he was busily engaged, not only in maintaining and increasing the efficiency of his department by securing adequate laboratory accommodation, but also in carrying on the researches that have made his name famous.

Of these researches the author gives an attractively lucid and succinct account. The first were wholly physical, and to these three chapters (iv.–vi.) are devoted. Their main subject was that of the properties of the Hertzian electric waves, by which wireless telegraphy is effected. It is of interest to note that, so far back as 1895, Bose had demonstrated the passage of these waves from one part to another of his laboratory building. In the course of this work he observed that his metallic receivers manifested signs of "fatigue," an observation which led him to a comparison, in this respect, of metals and of animal- and plant-tissues, with the result that he found them to be essentially identical (chap. vii., "Response in Living and Non-Living"). He became so deeply interested in the study of the irritability and movements of plants that for the next twenty years he devoted himself almost exclusively to it. An adequate account of his remarkable work in this direction is given in chaps. ix.-xv. The results may be summed up in the brief statement that the phenomena of irritability of animals and plants are altogether analogous, and that the multiform movements of plants are susceptible of a simple universal explanation, depending fundamentally on the quantity of stimulus received. These great generalisations were rendered possible by the employment of recording apparatus much more delicate than any previously devised, and capable of magnifying the minute movements a thousand or even a million times. The last, and the most formidable, of the difficulties to be overcome was that of securing recognition of his work. So long as Bose's researches were confined to purely physical subjects it did not arise; but when he trespassed into the domain of physiology opposition became strong in this country, though on the Continent and in America his results were received with enthusiasm. Here the antiquated idea of "water-tight compartments" in science asserted itself to such an extent that it was not for many years that justice was done. All this is fully discussed in the author's pages, where it is also made clear that ultimate triumph was due not to ability alone, but mainly to strength of character and lofty ideals.

The sub-title of the book is "An Indian Pioneer of Science." Like all pioneers, Sir J. C. Bose has had to encounter many and great difficulties and, as has been pointed out, he has, unlike many pioneers, successfully overcome them. It is to be hoped that, now that the days of storm and stress are over, he may be able to devote all his energy to the continuance of his work in the Institute that he has founded for the purpose. The volume is well got up, and is illustrated with portraits and many figures of apparatus and records. It would have been an advantage if a full bibliography of Sir J. C. Bose's works had been appended, while the index would be more useful if it were more complete.

Elementary Geometry.

Practical Geometry. By C. Godfrey and A. W. Siddons. Pp. xv+256. *Theoretical Geometry: A Sequel to "Practical Geometry."* By C. Godfrey and A. W. Siddons. Pp. xiv+104. (Cambridge: At the University Press, 1920.) Price 7s. net. (Complete in one volume.)

THE authors of these two volumes (obtainable also as a single book) regard the teaching of geometry as divisible into four stages. The first consists of little more than instruction in the use of instruments and methods of measurement, including drawing to scale. The second is an intuitive treatment of a few fundamental propositions, and merges into the third stage, which covers the whole field of the ordinary course of elementary geometry, plane and solid, treating the various theorems in an informal fashion, and explaining the methods of constructions, often without proof, in the natural order suggested by the theorems. In these stages the pupil is led to apply the results of the theorems, whether formally proved or not, both to numerical

examples and to formal riders. The fourth stage knits all the theorems, previously considered, into a logical chain with formal proof. A few riders are interspersed, and there is a considerable amount of general discussion in this part of the text; the section closes with a collection of riders arranged under headings corresponding to suitable groups of propositions.

With the general changes of procedure adopted by the authors we are in entire agreement. There can be no question that boys are capable of making simple applications of the fundamental theorems of geometry long before they are able to appreciate the formal proofs, and the stimulus which work of this nature supplies is most beneficial to their mental development.

On its numerical side the exercises are very good, being numerous, varied, and interesting; on the formal side we do not consider the work quite so satisfactory; more riders of the "two-step" nature are needed, particularly, for example, in dealing with angle and tangent properties of the circle. We think also that much of the discussion, which at present bulks so largely in the text, might be omitted. We doubt whether any boy reads it, and there is much that we find hard to believe is really necessary for the instruction of the teacher at the present time, when modern methods are so much better understood than they were, say, fifteen years ago. Some drastic pruning of this kind would affect materially the size of the book, and, we think, leave its utility unimpaired, and at the same time appear to lighten the student's burden.

The printing is excellent, and the diagrams are clear and numerous. A set of answers and suggestions for class-work (which we have not seen) is issued separately. We regard the new form of this text-book as a definite advance in the right direction, and commend it to teachers.

The Evolution of Vertebrate Animals.

Die Stämme der Wirbeltiere. By Prof. Othenio Abel. Pp. xviii+914. (Berlin and Leipzig: Walter de Gruyter and Co., 1919.) Price 56 marks.

PROF. ABEL, of Vienna, is a most voluminous writer on extinct animals, and even the difficult circumstances of the time do not impair his energy and enthusiasm. He has now produced a most interesting volume summarising our present knowledge of the past history of the backboned animals, and his technical descriptions are illustrated by numerous up-to-date figures which are refreshing by their newness in a text-book. The work is not merely a laborious compendium, but is enlivened by many critical observations based on Prof. Abel's own researches.

Prof. Abel's classification will not in all respects prove acceptable. He avoids too many difficulties in the determination of affinities by an undue multiplication of sub-classes and orders. He also in some cases adopts the fantastic proposals of certain dabblers in scientific literature who discuss merely names without any acquaintance with the fossils to which they refer. The familiar generic name Ichthyosaurus, for example, completely disappears, while the almost equally well-known name Megalichthys is applied to the wrong fish. The work, however, is intended for advanced students who will be able to make allowance for these idiosyncrasies without much trouble.

According to Prof. Abel, the Cyclostomes are unknown among fossils, because the problematical Devonian Palæospondylus, with its suctorial mouth, is most likely the larval condition of Coccosteus. The earliest fishes are the Upper Silurian Anaspida. The earliest land-vertebrates, the Stegocephala, are treated at great length on account of the primitive character of the skeleton and its morphological importance. Among reptiles, the newly discovered Chelonia, from the Upper Trias of Germany, are especially striking. Some of them retain traces of true teeth. The Dicynodonts are described as "the Sirenians among reptiles." The Triassic Parasuchia and Pseudosuchia are separated from the Crocodilia. The marine Thalattosauria, from the Trias of California, are arranged with the Lacertilia. The birds are treated in the usual manner.

Among mammals, the Monotremata are regarded as unknown by fossils before the Pleistocene; and the Triassic Tritylodon is referred to the Marsupialia. The South American Tertiary Sparassodonta are also retained among Marsupialia. A few of the mammalian jaws of Jurassic age (*e.g.* Amphitherium and Stylodon) are regarded as belonging to Placentalia. The Insectivora follow, and the Primates, as usual, conclude the series of orders. The various groups are rather unequally treated, but students will be glad to have the preponderating sections on Cetacea and Sirenia as summarising Prof. Abel's own researches.

The volume is provided with two exhaustive indexes, one to morphology, the other to taxonomy, and is a most valuable work of reference, which should be added to every zoological library.

A. S. W.

Essays in Social Psychology.

(1) *Instincts of the Herd in Peace and War.* By W. Trotter. Second edition. Pp. 264. (London: T. Fisher Unwin, Ltd., 1919.) Price 8*s.* 6*d.* net.

(2) *The Century of Hope: A Sketch of Western Progress from* 1815 *to the Great War.* By F. S. Marvin. Second edition. Pp. vii+358. (Oxford: At the Clarendon Press, 1919.) Price 6*s.* net.

(1) DR. TROTTER has not changed anything to speak of in the body of his remarkable book, which was published in 1916, but he has added a postscript of much interest. It deals first with the discouraging fact that "in a belligerent country all opinion in any way connected with the war is subject to prejudice, either pro-national or anti-national, and is very likely in consequence to be of impaired validity." The manifestations of the herd-instinct in the German people were in accordance with the type to be seen in the predaceous social animals; the manifestations of the same instinct in the British people were of the socialised type of gregarious animal—"possessing the power of evolving under pressure a common purpose of great stability." Societies in the past have failed in stability and full functional effectiveness; these defects have been due to "the drift of power into the hands of the stable-minded class, and to the derivation of moral power and enterprise from the mechanisms of leadership and class segregation." To avoid this there must be a continually progressive absorption of the individual members of the society into the general body—a movement towards a complete moral homogeneity and integration. "The only way in which society can be made safe from disruption or decay is by the intervention of the conscious and instructed intellect as a factor among the forces ruling its development." But the unanswerable question is whether the purposive foresight of the intellect will be able, more effectively than in the past, to free itself from instinctive inhibitions.

(2) Mr. Marvin has added to his stimulating book a time-chart of developments in "thought" and "action"—or culture and politics—in the last century, and he has made a number of improvements in the body of the text. On the general thesis he stands to his guns. The hopefulness of the last century has not been exhausted; on the contrary, the sources of hope are unimpaired. In mechanical science and invention, biology and hygiene, psychology and education, sociology and statecraft, literature and religion, and in other lines of development, there have been advances in the past century which seem on the whole to have made for the fuller realisation of the higher values which the racial consciousness at its best has always cherished. What Mr. Marvin's book shows, it seems to us convincingly, is that the momentum continues in a progressive direction. There is no doubt much to discourage, but all the departments of higher human activity are full of live seeds of good pedigree, and in their promise there is progress.

Our Bookshelf.

The Assessment of Physical Fitness: By Correlation of Vital Capacity and Certain Measurements of the Body. (With Tables.) By Prof. Georges Dreyer, in collaboration with George Fulford Hanson. Pp. xi+115. (London: Cassell and Co., Ltd., 1920.) Price 10*s.* net.

ALTHOUGH various observers had made attempts to measure the respiratory capacity of the human body, the real pioneer work in spirometry was done about eighty years ago by John Hutchinson. Hutchinson worked out the vital capacity in relation to height, body weight, chest circumference, and age, attaching most importance to the first. He also made many observations as to the effect of disease upon the vital capacity, especially as regards phthisis. After the publication of his method of spirometry, considerable discussion arose both in this country and on the Continent as to its value in clinical medicine. By some clinicians it was held that the normal variations of health were so great as to preclude its extended use. The value of Hutchinson's figures in regard to height were early called in question, either as being too large or not of so great a value as figures calculated from the trunk length or sitting height. In the main, the results obtained by various observers were in favour of Hutchinson. In the little monograph by Prof. Dreyer and his colleague extensive tables are published showing the relationship of the vital capacity to sitting height, weight, and chest circumference. As Dr. F. S. Hobson has shown (NATURE, August 26), these tables will be of particular value to all those who are in any way interested in correlating the vital capacity with physical fitness. It is of interest that Prof. Dreyer and his co-workers have drawn conclusions contrary to those of Hutchinson in regard to the value of the sitting height, and also that age is looked upon as a factor of little or no importance up to about fifty years.

Handbook of Patent Law of All Countries. By W. P. Thompson. Eighteenth edition, completely revised. Pp. vii+157. (London: Stevens and Sons, Ltd., 1920.) Price 6*s.*

THE assistance that such a book as this must give to inventors and patent agents fully justifies the issue of a new edition brought up to date with

respect to British and foreign patent law and practice. The foreign section is very comprehensive—Bechuanaland and Eritrea, both of which have, we believe, issued Patent Ordinances, are the only countries we miss—though it would have been convenient if information had been given of the method of making an application in some of the smaller States that have no separate Patent Office. A very useful feature is the information given indicating the countries in which inventions relating to particular subjects should be patented. This might well be amplified in a later edition, especially with reference to the smaller States. Mr. Thompson does not refer to Luxembourg's withdrawal from the German Customs Union in December, 1918, but this is important, since, in consequence, patents granted there will presumably no longer be dependent on the corresponding patents taken out in Germany. Rumania, too, should have been included amongst those adhering to the International Convention. The British law is very well presented, though we have noticed a few errors in the statutory time limits allowed for accepting and sealing specifications. The statement on p. 14 that unless a complete specification is accepted within the statutory period it becomes public property is obviously an oversight, as such a specification is not published and remains secret. The book, however, is generally accurate, and should prove a very valuable and trustworthy guide to would-be patentees.

The Statesman's Year Book. Statistical and Historical Annual of the States of the World for 1920. Edited by Sir J. Scott Keltie and Dr. M. Epstein. Fifty-seventh annual publication. Pp. xliv+1494. (London: Macmillan and Co., Ltd., 1920.) Price 20*s.* net.

THE authors of this ever-welcome annual have conquered many difficulties in their survey of the world as it appeared in May, 1920. The maps indicate the new boundaries of South-eastern Europe and the Near East, and the new divisions of the former German colonies Togo, Kamerun, and German East Africa. In the text, however, the partitions of these ex-German territories has not been worked out. The difficulties of compilation are illustrated by the treatment of Czecho-Slovakia and Yugo-Slavia. In the first case an attempt has been made to bring together the statistics relative to the former Austrian and the former Hungarian lands, while in the second instance full details are given for Serbia only.

Mining statistics for Germany chiefly refer to 1913; there is no estimate of the probable yield of the new Germany. Hungary is incorrectly stated to have a common boundary with Germany; statistics for Croatia and Slavonia are included under Hungary, although a paragraph, which might be missed, correctly says that this area forms part of Yugo-Slavia. The list of Hungarian towns is apt to be misleading, since Arad and Temesvar have been omitted, as they are correctly included among the Rumanian towns, while Kolozsvar (Cluj), Nagyszeben (Sibiu), and Brasso (Brasov) appear in both lists. In the case of Spitsbergen it is not clearly stated that the non-Norwegian estates in Spitsbergen are not included under the sovereignty of Norway, but are extra-territorial.

These points indicate the necessarily tentative character of much of this new information. The bulk of the volume maintains the high standard of previous issues.

The Extra Pharmacopoeia of Martindale and Westcott. Revised by Dr. W. Harrison Martindale and Dr. W. Wynn Westcott. Seventeenth edition. (In two volumes.) Vol. i., pp. xxxix+1115. (London: H. K. Lewis and Co., Ltd., 1920.) Price 27*s.* net.

OFFICIAL pharmacopœias are necessarily restricted in their scope, and there are many drugs and other articles used in medicine which for good reasons find no place in them. Hence there is a recognised need for such supplementary books as the "Extra Pharmacopœia," which deal more freely than the official works do with medicinal preparations, appliances, new methods, and so forth. The fact that Martindale and Westcott's work has reached a seventeenth edition is sufficient indication that it meets a want. The single volume of the earlier editions developed into two volumes some years ago, and the most important of these (vol. i.) has become somewhat more bulky than of yore; but it can still be slipped into an overcoat pocket, in spite of its 1154 pages.

A great deal of new matter has been included in this vol. i., the requisite space having been provided in part by transferring the sections on iontophoresis, radium, thorium, and radiology to the second volume (not yet published). Among the sections which have been revised special mention may be made of those on vaccines, antitoxins, colloidal metals, and organotherapy; whilst many useful notes, particularly on the treatment of wounds, have been added to the therapeutic index of diseases. Both the medical practitioner and the pharmacist will find the volume replete with information.

White Lead: its Use in Paint. By Dr. A. H. Sabin. Pp. ix+133. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1920.) Price 7*s.* 6*d.* net.

THE information conveyed in this book is usually of a superficial character. Thus, although processes of manufacture are described, no details are given, and in the descriptions of the application of white lead in paints nothing very new comes to light. The author tells us that "it is not probable that one-thousandth of one per cent. of white lead used in paint is ever discoloured by sulphur, so it is not worth talking about." Unfortunately, however, he gives no alternative explanation of a well-known phenomenon. A similar off-hand style runs throughout the book, and cannot fail to diminish its value.

American Civil Engineers' Handbook. Editor-in-chief, Mansfield Merriman. Fourth edition, thoroughly revised and enlarged. Pp. 1955. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1920.) Price 33*s.* net.

THE seventeen sections into which the volume is divided cover the whole field of civil engineering, together with mathematical tables, mechanics, physics, meteorology, and weights and measures. The fact that there is but little overlapping indicates that the work of the editor-in-chief has been done thoroughly. Books of this kind must contain the information in a condensed form; in the present volume, however, the condensation has not been carried to the extent which sometimes obtains, making the contents a mere dictionary. On the contrary, each of the sections is presented in a readable form, and is profusely illustrated. British practice differs in many respects from American, but there is much in common, and so much of value in the latter as to make it almost essential for students of civil engineering to have some knowledge of American practice. In no other single book that we have seen can so much information be obtained regarding the practice of civil engineering in the United States, and we can confidently recommend the book as a useful addition to the British civil engineer's library.

Letters to the Editor.

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

The British Association.

WE must first tender you our best thanks for having, at this time of inevitable reconstruction, opened your columns to a discussion which has been of great value in showing the general trend of opinion concerning the future of the British Association. We have had the benefit of letters from presidents and secretaries of Sections in addition to those printed in your columns, and now beg to offer a few general comments. But we hope we shall not be regarded as attempting thus to closure the debate and dismiss it from our minds; rather do we regard the period of discussion, and, we would add, of experiment, as just beginning. It was with the full consciousness that much new enterprise and revision of old procedure were desirable that we invited the recorders and local secretaries to a friendly meeting at Oxford in the spring of this year, and we hope to continue at regular intervals the discussions then initiated and helpfully continued in your columns. We need only add here that as it is an essential function of the British Association to consider and act upon all suggestions tending in any way to the advancement of science, we hope that if you receive further communications for which you cannot find room you will do us the favour to forward them for our consideration.

Proceeding to general comments, we would first express satisfaction that the undoubted smallness of the Cardiff meeting has not been allowed undue weight, even by critics who did not attend and could not appreciate the unusually keen and businesslike quality of the proceedings. Many causes contributory to its smallness are fairly obvious, and incidental to recovery from the war. The high cost of travel and of living (the predatory attitude adopted by one or two of the Cardiff hotels by anticipation was particularly unfortunate), and ultimately the local tram strike, all played their part, and it is to be feared that some of them may continue operative beyond the Cardiff meeting. This we can only endure, reminding those who formerly urged that we should discourage "camp followers" that it is not for them to complain if the attendance is less.

But the important criticisms and suggestions have had a more general character. Some of them (fortunately) cancel out, as when Sir Ray Lankester advocates very careful pre-arrangement and Sir Oliver Lodge the throwing over of the time-table in favour of impromptu discussion. Sometimes the cancelling is kindly done in the same letter, as when Prof. Armstrong, another *laudator temporis acti*, first sings the praises of two long official reigns and then advocates a rapid change of officials. Parenthetically, we may correct a misstatement in his letter; the General Committee did not "relegate to a committee the appointment of a new treasurer"; it only adopted the universal practice of appointing a committee to suggest names to the council. We have, however, no wish to curb permanently the picturesqueness of Prof. Armstrong's exhibitions of hitting out at all and sundry.

But some of the points on which there is division of opinion cannot be simply dismissed for that reason, and chief among them is the very important question of the nature of the Sectional proceedings. Should they be made more "popular"; and can this be done without repelling some of our most regular and most useful supporters?

Now we fully agree that it is a very important function of the British Association to attract the public and impress the nation, but even from this point of view alone it may not be the best method to cater directly for them. Where a frontal attack may fail, more insidious methods may succeed.

One excellent method of attracting the public is to make sure of attracting the nearest living representatives of men like Huxley and Lord Kelvin, who always attracted the public. Now Lord Kelvin used to declare (Sir Arthur Schuster kindly allows us to quote his authority for the fact) that he came to the meetings of the British Association "to hear what everybody else was doing"; and the curtailment of "specialist" papers might easily drive away the very people who ensure the success of the meeting, and in some Sections certainly would do so. We need scarcely labour this point, on which Prof. Eddington has already written much good sense; but we will just add that, in spite of the existence of "special societies" in London, there are many people who have no other chance to hear "what everybody is doing." Thus there are many who are not near enough to London to attend meetings regularly; there is the growing army of science schoolmasters and schoolmistresses who can attend meetings only in the summer holidays, when the London societies do not meet; and there are the numerous members who are interested in more than one Section. All these would benefit by meetings of the Sections even if they were conducted on *precisely* the lines of specialist societies. No one, however, advocates this extreme ex-

pedient; undoubtedly the Sectional proceedings should be of a different type, but in trying to secure one good object we must not drop another, and we have reason to believe that the Sectional officers are well aware of the needs and wishes of the members, and are doing their best to satisfy them.

Next, as regards the number of Sections. Without rehearsing all the arguments in detail, it may be accepted as common knowledge that there are weighty considerations on both sides. Who, then, is to adjudicate between them? The people concerned or others? It would seem an almost necessary admission that in each particular case there must be particular considerations which can be truly evaluated only by the people concerned (who must at the same time be impressed, as we all are, by the general undesirability of multiplying Sections), and that a persistent and reasonable application from them must be seriously considered and liberally met. It does not advance science to boycott the younger sciences. Thus at the present time the Physiological Section, having tried a Sub-Section of Psychology for several years, having debated the alternative of a full Section for Psychology in several assemblies, and having met at least one powerful objection, came before the General Committee at Cardiff with an unopposed recommendation for an independent Psychological Section. No dissentient voice was raised in Committee, and no suggestion of further postponement was made. The officers (and staff), on whom fall many of the disadvantages of the multiplication of Sections, scarcely feel that they can oppose such a motion if no other opposition is forthcoming, and if the council concurs it will be to give effect to a preponderance of reasoned opinion.

On the other hand, there was some years ago a movement for the subdivision of Section A. It was fully considered by the Section and rejected, which may be taken as evidence that the tendency to subdivision is not automatic, and therefore to be resisted automatically. The practical requirements of Sections have always varied widely, and the plan of leaving the decision chiefly to the people concerned has much to be said in its favour.

Proposals for joint meetings between Sections and for closer co-operation between groups of related Sections—Mathematics, Physics, and Engineering; Zoology, Botany, and Physiology; Geography and Anthropology; or between any of these (and especially Engineering or Agriculture) and Economics or Education—are not new; they were carefully examined afresh by the council shortly before the war, and the informal conference last spring led to fresh efforts in this direction. Sir William Pope's suggestion of a special advisory body to assist in planning each annual meeting could be realised at any time by joint action of the actual organising committees of the Sections, which are constituted at the close of each annual meeting, and are often consulted by the council in Sectional emergencies during the year.

The presentation of a retrospect of recent advances of knowledge in each Section or in practical applications of scientific work is again a matter for Sectional arrangement. Formerly there were formal reports of this kind drawn up by responsible committees and presented in print for discussion; latterly such a summary has often been the theme of a Sectional president's address, and sometimes of one of the public discourses or the citizens' lectures. It would be easy for related Sections to arrange for such papers in turn, so as to cover the whole field in a cycle of years. In this and similar matters of procedure the policy of the Association has been to give the fullest freedom to the Sectional officers to adopt or modify suggestions coming in general terms from the council or from our friendly critics, and the Sectional officers have every encouragement to exchange suggestions and experiences with one another and with the general officers. The council does its best to select for evening discourses and other general discussions men eminent in science and accomplished exponents of its broader aspects; and the general officers and local executive spare no pains to ensure that they have every facility and convenience that experience may suggest. Occasional failures are, perhaps, inevitable in so difficult an art as public lecturing; the Association may fairly claim to be judged by those discourses which are remembered through the years, and they are not a few.

The circumstances of different localities vary so much that it has been difficult, and would probably be unwise, to insist on close adherence to any one type of programme. Only those who attend habitually know how flexible our arrangements are, how greatly one annual meeting differs from another, or how much of what some of our most outspoken critics desire is actually being done informally in the intervals of a very elastic time-table.

The annual tenure of presidents and vice-presidents of Sections and of the local secretaries introduces a large element of "fresh blood," and many of the best expedients for economy of time and effort have been contributed by annual officers. Recorders and secretaries hold office rather longer, but they are usually chosen from the younger members, and pass on to other duties quite as rapidly as is consistent with the continuity of experience necessary for the smooth working of a meeting. We are making considerable demands on the time of both classes of officers throughout the year, and gratefully acknowledge their keen and loyal co-operation in working out the proposals which we put before them or which result from their own experience.

We are very sensible of the difficulty of including, even into an eight days' meeting, all the opportunities for discussion or for exposition of scientific work which various critics desire; and we would beg that the experience of the meetings in 1919 and 1920, which were, perforce, limited to five working days, may not be regarded as typical of what the Association is trying to accomplish since the war. From these abbreviated meetings, however, and from the varied war experiences of our keenest members, we believe that we have learned some economies of procedure; and as our Edinburgh hosts promise us a normal Wednesday-to-Wednesday meeting in 1921, we have some hope of realising much that has been offered so frankly by your correspondents for our guidance.

To make the annual meeting more widely known in advance and its purpose better understood, we rely, first, on the co-operation of the Press, and especially of scientific and technical periodicals such as NATURE.

There is, we believe, a larger public than ever before for clearly written and accurately informed articles on scientific subjects, and especially on the public services rendered by scientific research, and we should welcome every opportunity of assisting competent reporters and other journalists to obtain trustworthy information on such matters, both at the annual meeting and in advance. But it has been an increasing trouble in recent years that representatives of the Press do not always display either the preliminary knowledge or the journalistic training which might enable them to forecast intelligibly or to chronicle accurately the substance of a scientific discussion, however fully apprehended by other classes of "camp followers." Shorthand, for example, is an accomplishment which we have

almost ceased to expect of a Pressman at a Sectional meeting.

We rely on the delegates from our numerous "corresponding societies" to keep those societies informed of the Association's work, to bring on their younger members to our meetings, and to assist the local secretaries in extending the area round the place of meeting from which a full attendance of scientific workers may be expected. The fulfilment of one of our primary functions—to bring provincial scientific workers into touch with specialists gathered from afar—must depend very much upon the corresponding societies of the neighbourhood.

Most of all, however, we look to our ordinary members, and especially to those who are brought into daily contact (as teachers or in business or industry) with younger or less highly trained colleagues or subordinates, to propagate that view of the value and interest of scientific work which alone makes and maintains the fellowship of workers each "doing something else," but able and keen to appreciate the discussions, whether arranged or impromptu, of scientific leaders and men of practical ability who come to our meetings with the same object in view—"to see what everybody else is doing." "Philosophy," it has been said, "begins in wonder," and intelligent wonder, if it is to work its full effect in an eight days' "parliament" or "picnic" of science, must be caught on the flitting wing by that member of ours who is lucky enough to be there when it rises.

J. L. MYRES.
H. H. TURNER.

New College, Oxford, October 24.

THE correspondence which has followed the leading article on "The British Association and National Life" in NATURE of September 16 must have been read with deep interest by everyone who cares for the advancement of science. Since in that article reference was made to some remarks of mine called forth by my experience of the Cardiff meeting, perhaps I may be allowed a few words on the subject.

It seems to me that most of your distinguished correspondents have missed the real point altogether. They have been too much concerned with discussing ways in which the scientific value of the meeting may be increased for the benefit of the scientific man taking part. From this point of view reminiscences, alterations of Sections, joint meetings, and the like are very interesting, and no doubt important. The members of the Association who visit a town have generally a good time, and if by internal reforms they can secure a better scientific holiday no one will grudge it to them. Some of the correspondents appear to think that this should be, if not the sole, at any rate the chief object of the meetings. One of them practically warns the general public off "matters which they do not understand."

The purpose of my original remarks—and, if I am not mistaken, of your article also—was to emphasise the precisely opposite opinion, namely, that whilst the Association served the cause of the advancement of science by bringing workers in it together in circumstances favourable to discussion both formal and informal, yet it also had the duty of bringing before the general public the methods and results of scientific work. There is a cumulative effect here. None of your correspondents can deny that the general public pays us to conduct scientific research. Whether that payment is direct from the rates and taxes or indirect from gifts and bequests does not matter. The public pays, and scientific men are eternally asking for more. The public has, therefore, a right to know what it is getting for its money. Further, if the word "advancement" means anything, and if science has an object at all, what other object can that be than that of making the world a better place to live in? and how can it be advanced unless the results of its progress are made known to the people who are intended to profit by them? Scientific work is either a selfish amusement (as some of your correspondents seem to think) or it is a service of public utility. If it is a service of public utility, then the more the public realises how much it owes to scientific work, the more will the public be disposed to provide money for that work, and, consequently, the more work will be done and the more the public will be benefited. This is the cumulative effect which would follow from an ably directed scientific propaganda.

Science might well consider that favourite text: "Go ye therefore, and teach all nations, baptizing them . . ." The British Association could be, and ought to be, a mighty engine for this purpose. And be it noted that the advice contained in this text is not only to preach, but also to baptise the converts, which is to bring them into the charmed circle themselves. The volumes of NATURE these fifty years are a record of scientific missionary work. They are full of finely worded appeals regarding the neglect of science, the need for money, the improvement of education, and so forth. But these sermons are not even preached to the converted; they are preached to the priests. What scientific heathen ever reads NATURE?

These considerations are on the high moral plane of duty—the duty which scientific men owe to the nation. Those of your correspondents who think that they are weird, yet beautiful, rare, and expensive, orchids kept in the public hothouses will never agree that they ought to be potatoes and show a good crop. But they will not be so satisfied with the scheme of things if the heating supply fails, and for this reason I should like to descend from the moral plane to the base one of money and to refer to a few facts. These facts would not be mentioned here if it had not already been necessary to state them very publicly in the district that had the honour of entertaining the Association at the recent meeting.

The Cardiff meeting cost the local committee about 2500*l*., and, in spite of all efforts, only about 1800*l*. has so far been forthcoming to meet this expenditure. I would ask your correspondents to consider the reason for this deficit. Cardiff is a wealthy city, and the "docksmen" are well known for their generosity. Large sums of money have been collected recently for such purposes as horse shows, flower shows, and missionary societies from people who mostly knew and cared as much about horses and flowers and cannibals as they do about Einstein. I think the reason is that they understood what these things were for, and they do not know what the British Association is for, because the Association has not seen fit to enlighten them. Another practical point is this. Owing to the decreased purchasing power of money the expenses of the meeting are necessarily two or three times what they were before the war, but the Mæcenas who gave a cheque for fifty guineas before the war does not now give you one hundred and twenty guineas; he still gives fifty.

Your correspondents who are preoccupied with that part of the Association's activities which concerns the meetings and discussions of scientific workers among themselves might perhaps indicate why, if scientific discussion is the be-all and end-all of the Association, the Association should wander all over the country, and even over the Empire, from year to year. Surely it would be more efficient and more convenient to have the annual meeting in the one place in which the Association prides itself on never having met—London.

Dare one suggest that perhaps these "orchids" rather like going to shows?

It is, of course, very easy to criticise and very difficult to construct. It would be presumption on my part to suggest how the Association should proceed to preach the good tidings to all the world, but no one can doubt that the thousand or so of scientific men who attend the meetings year by year could do a great thing for humanity if they chose, and could very soon discover the best means of doing it also. But the methods of the days when, as one of your correspondents recalls, crowds used to appear wherever Huxley was expected to speak are certainly ineffective to-day. To begin with, I am not aware that we have any Huxleys nowadays, and if we had I doubt if they would have that sort of hold on the common or British Association public of to-day. Scientific men should be the last to try to put new wine into the old bottles; it should be an easy matter for them to devise newer and better bottles.

An old member of the Association said to me during the Cardiff meeting: "Well, you may say what you like about it now, but it's a kinema compared with what it was when I first knew it!" I was reminded of this by a chance paragraph in the newspaper the other day describing "the most remarkable film which has ever been made in France," called "Les Mystères du Ciel," and there is no doubt that it made an impression on the Parisian correspondent of the *Observer*, who belongs to a profession which takes a lot of impressing. He lays stress on the fact that some of "the best-known experts have been glad to assist in the making of this remarkable and ingenious film, which has a real educative value." I suppose this will horrify some of our revered seniors, but really the British Association might do worse than kinematise itself a bit further. After all, rightly or wrongly, the kinema does attract and instruct the people more than the Association does, and it certainly collects their money.

R. V. STANFORD.

Radyr, October 23.

Testing Einstein's Shift of Spectral Lines.

I AM not aware that anyone has applied centripetal acceleration to the outstanding Einstein prediction, instead of depending on solar gravitation. It is feasible to whirl a steel disc, 1 metre in diameter, at 3000 revolutions a minute; and this gives a peripheral acceleration five thousand times earth-gravity, whereas solar-gravity is only 25*g*.

A few vacuum tubes braced to such a disc would give the effect of continuous illumination; and someone with refined spectroscopic appliances may be willing to try the experiment—unless there is a fallacy in the suggestion.

OLIVER LODGE.

Gullane, October 20.

Recapitulation and Descent.

IN NATURE of October 14 my friend and colleague, Mr. L. T. Hogben, contributes a thoughtful letter on "Recapitulation and Descent," on which you will, perhaps, allow me to make one or two comments. Mr. Hogben traverses the position taken up by Dr. Bather in his address to the Geological Section of the British Association that "recapitulation" in the development of animals is a proof of evolution. His objection is that "experimental breeding" does not justify the inference that a mutant recapitulates the characters of its ancestral type, and that "factorial omission" rather than "the perennial desire of youth to attain a semblance of maturity" is the key to "the omission of some steps in the orderly process."

Now I fully agree with Mr. Hogben that if by "experimental breeding" and "genetic investigation" we mean the endless and wearisome repetition of the crossing of "Mendelian mutants" with one another and with the parent species, we shall wait until doomsday before we obtain any light on recapitulation, or, indeed, on any of the other broader aspects of the evolution theory.

When the upholders of a theory confess, as does the leading British Mendelian, that it is totally unable to throw any light on the origin of adaptation—which is, after all, the very heart of evolution—the biologist must indeed regard it as bankrupt, at any rate if it claims to be a full exposition of heredity. Not all "genetic investigation," however, is of the Mendelian type, and quite recently some patient researchers claim to have accomplished something like evolution on a small scale experimentally, and to have found traces of recapitulation. I am aware that these results have been regarded by Mendelians with scepticism, as I think quite unfairly; but until the Mendelians have repeated the experiments and disproved the results, these results must stand as the relevant facts. They are beginning to come in from widely divergent sources, and the easy method of getting rid of them by doubting the *bona fides* of the researcher is no longer available.

The great evidence in favour of the reality of recapitulation is that in our survey of the animal kingdom we encounter facts which literally compel every naturalist who encounters them to interpret them in this way and no other. When, for instance, we find a tortoise with a soft, flexible skin devoid of the bony plates which support the carapace of all his brethren, and it transpires that this tortoise enters on his career as an ordinary tortoise with a regulation carapace, what other explanation than recapitulation can be possibly entertained? When, further, we find that Cœloplana, which looks like a flat-worm, and Tjalfjella, which resembles a Sponge or an Ascidian, both begin their free life as exquisite little Cydippid Ctenophores, does anyone consider it possible to doubt recapitulation, and therefore evolution? This may not be logical, but it is convincing, and as Huxley long ago said: "If a man chooses to maintain that a fossil oyster-shell is a concretion, and not the remains of an organism, it is impossible to drive him from his position by logic."

I differ totally from Mr. Hogben in believing that the "omission of factors" has anything to do with the shortening of the developmental process. Rather I am convinced that this shortening is akin to the greater quickness with which an habitual act is performed after countless repetitions. If, for instance, we compare the degenerate eyes met with in the pathological cripples known as Mendelian recessives with the degeneracy due to loss of function owing to changed habits, we meet with a totally different picture in the two cases, as anyone consulting the literature can see.

Nor can I agree with Mr. Hogben that much of the reasoning of the past originated in an emotional recoil excited by popular prejudice. The reasoning of the past reflected the burning impression created by the impact of myriads of new and unsuspected facts, and we owe Dr. Bather a debt for pointing out in his brilliant address that the old methods are perfectly sound *if properly applied*. At first they were applied in a wild and careless manner, and hence the reaction against the doctrine of recapitulation which set in, and of which Adam Sedgwick in his later years was a victim. But this reaction was no more justified than would be a reaction against Egyptology because some of the earlier Egyptologists drew rash conclusions from insufficient facts and sketched out

fascinating hypotheses which later proved to be baseless.

E. W. MACBRIDE.

Imperial College of Science and Technology,
South Kensington, London, S.W.7, October 22.

British Laboratory and Scientific Glassware.

THE question of the manufacture of laboratory and scientific glassware in this country is now receiving the attention of the House of Commons, together with other key industries. This matter has been the subject of considerable correspondence in NATURE, and I feel that readers of this journal will be interested to know what progress has been made in this work.

The advance made in the manufacture of laboratory and scientific glassware in Great Britain during the last five years is not only remarkable, but is also a monument to the capacity and ability of the British scientific worker. It is unnecessary to point out here the importance and necessity of scientific work or of the vessels and instruments that men of science use. That the latter must be of the finest quality and manufacture is indisputable.

At the outbreak of war men of science were absolutely dependent on supplies of German glass. They realised the danger, and at once stepped into the breach that the British manufacturer, unaided, was unable to fill. As a result of their efforts we now have the nucleus of a considerable industry in this country. While the supply is not yet equal to the demand, rapid progress has been, and is being, made.

Men of science are always critical of one another's work, and the production of these laboratory glasses has naturally led other workers to test and compare their properties with those of German and other makes. These results have been published in purely technical journals, but I feel that they have not yet had the publicity given to them that they deserve. The results of these tests are really remarkable, and prove quite conclusively that, in spite of the short time that the industry has been established, British laboratory glassware is the finest in the world. The results have never been challenged in any way, and go to show that the widely and cleverly advertised properties of German glassware are not quite so good as they have been made to appear, and that the British manufacturer has not merely equalled their best, but surpassed it.

The reports of the series of tests referred to are contained in the Journal of the Society of Glass Technology, the references being as follows:—Vol. i., p. 153: "The Attack of Chemical Reagents on Glass Surfaces, and a Comparison of Different Types of Chemical Glassware." Vol. ii., p. 219: "The Resistant Properties of some Types of Foreign Chemical Glassware." Vol. iii., p. 129: "Further Investigations of Chemical Glassware." These researches have been carried out by a department of Sheffield University.

The glasses tested have been classified (vol. ii., p. 230) under the headings "Good," "Moderate," and "Bad," and include Jena glass, Greiner and Friedrich's "R," Koln Ehrenfeld's, Swedish, Italian, French, American, and British. Of these only seven (two German, two American, and three British) remain in the "Good" class in every test. The tests include the action of (1) boiling water, (2) boiling water under pressure (autoclave), (3) 2*N*-NaOH, (4) *N*/10-NaOH, (5) 2*N*-Na_2CO_3, and (6) boiling HCl.

The action of boiling water at atmospheric pressure is so small on all seven glasses as to be, in the opinion of the authors of these researches, within experimental error, and is, therefore, negligible for comparative purposes.

An analysis of the table of results referred to above shows that for the remaining five tests the order of merit of the various glasses for general use is as follows: (1) A British glass. (2) A German glass. (3) A British and an American glass. (4) An American and a German glass. (5) A British glass.

This result speaks for itself, and it should be added that neither of the two German glasses in this list is Jena glass, which was found to occupy a comparatively low position in the table of results.

One of the great troubles which the manufacturer has had to face was that he was making this extraordinary attempt, not in normal, but in abnormal, times, when the supplies of raw materials and trained and unskilled labour were not available. Men skilled in the difficult art of "blowing" were almost unobtainable, yet these difficulties were gradually overcome and continued improvements made, until to-day the best British chemical glass bears comparison, from every point of view, with the products of the rest of the world.

In the early days many complaints were urged regarding the quality of the finish. This was only to be expected. It is obvious that skilled labour cannot be trained in a day, but I have no hesitation in saying that the finish of the majority of the best British makes of resistant glass is now as good as, if not better than, that of German glass of comparable composition.

One feels that the British manufacturer has at times been blamed for producing an inferior article. Unbranded glass has often been sent to chemists as British ware, whereas all the best makes of British glass are stamped with the name of the firm making it.

Unfortunately, those who were patriotic enough to manufacture this glass during the war are in danger of losing the result of their labours. Your readers know the heavy cost of experimental and research work, and will naturally realise that the British manufacturer is extremely anxious lest the results of this work should be permanently lost to the country. It is for this reason that the British manufacturer asks that the Key Industries Bill should be passed as soon as possible, to enable him to train more labour and to place this industry on a permanent and satisfactory footing.

S. N. JENKINSON,
President of the Society of Glass Technology.
"Rondels," Cookham Dean, Berkshire,
October 18.

The Behaviour of Time-Fuzes.

IT might appear that in my article on "The Behaviour of Time-Fuzes" in NATURE of October 14 I was describing my own researches. I wish to correct any impression of that kind. The original draft of my article was unsigned, but, unfortunately, I allowed the author's name (inserted by the Editor) to remain in the proof. The experiments described were made by a variety of people at Woolwich, at the Naticnal Physical Laboratory, at Cambridge, at University College, London, at Portsmouth, and elsewhere; and not least of the credit for the progress made in our knowledge of fuze-behaviour is due to certain officers of H.M. Army and Navy, on the Ordnance Committee, at the Ministry of Munitions, and at H.M.S. *Excellent*. My article, however, was intended not to apportion credit, certainly not to claim it, but to describe what I personally regard as the leading lines of development of a strange and interesting scientific by-product of the war.

A. V. HILL.

45 The Downs, Altrincham, Cheshire,
October 21.

The Floor of Anglesey.[1]

By PROF. GRENVILLE A. J. COLE, F.R.S.

THE thoughts of travellers across Anglesey in the Irish mail-train are usually controlled by a previous vision of the breakers rolling in on Colwyn Bay; yet many must have been attracted by glimpses of grey homesteads set on elongated mounds, farmlands alternating with strips of marsh and moor, and here and there the "desert scenery" of some sunlit groove, bounded by low terraces of ancient rock, along which the sand has drifted inwards from the sea. In 1895 Mr. Edward Greenly retired from the staff of the Geological Survey to devote himself to the geology of the island. For twenty-four years he pursued his investigations, recording his results line by line upon the six-inch maps. The antique complex, offering problems similar to those faced by him in the Scottish highlands, was his first object of research; but nothing in Anglesey proved foreign to his aim as he carried out his work. The result is a memoir presented by its author to the Geological Survey, and thus to the general public, accompanied by a map reproduced on the scale of one inch to one mile. Mr. Greenly's generosity has led him even to provide much of the cost of publishing these two handsome volumes. Geologists in many countries will associate themselves warmly with the thanks so well expressed by Sir Aubrey Strahan in his preface. May we be allowed to join also in the author's gratitude to Mrs. Greenly for her co-operation in long years of preparation?

FIG. 1.—The folding of the Mona complex, from the South Stack, Holyhead. Height seen 445 ft. From "The Geology of Anglesey," by permission of His Majesty's Stationery Office.

A comparison of the map, which is so clearly produced, in spite of all its detail, with the hand-coloured sheets issued in 1852 will best reveal the changes of view that studies in other areas have brought about. When J. F. Blake, in 1888, read his memorable paper on "The Monian System of Rocks," we were still in the grip of what may be called the pre-cambrian controversy. Lapworth had recently published his work on the north-western highlands of Scotland; the Geo-

[1] (1) "The Geology of Anglesey." By Edward Greenly. (Memoirs of the Geological Survey.) Vol. i., pp. xl+388+plates i–xxvi; Vol ii., pp 389-980+plates xxviB–lx+16 folding plates. (Southampton: Ordnance Survey Office; London: E. Stanford, Ltd., 1919.) Price, two vols., 3 guineas net.

(2) Geological Survey of England and Wales "Anglesey." Colour-printed map, one inch to one mile. (Southampton: Ordnance Survey Office, 1920.) Price 2s. 6d.

logical Survey, after a natural hesitation, had frankly accepted and developed his conclusions; but many felt that to surrender large areas of "altered Lower Silurian" on our maps to combatant claimants was a first step in the disintegration of the British Empire. On the other hand, the word "mica-schist" was reserved by others for a type of sediment that had not been repeated since pre-cambrian times. Mr. Greenly came into the field without any of these predilections, and his memoir on Anglesey represents the reasoning of an absolutely unhampered mind.

His first volume is devoted to the "Mona complex," which is regarded as probably pre-cambrian throughout. The green rocks, including the pillow-lavas of Newborough, are included in one of the earliest divisions—the Gwna "group." With J. F. Blake the author recognises (p. 896) this "group" in Howth, in eastern Ireland—a view that carries with it far wider suggestions. Gneisses underlie the Mona complex, but an unconformity has not been traced; the typical gneiss (p. 133) is composite, consisting of a granitoid element veining and permeating an originally sedimentary series, which includes even limestones. The resemblance with the gneiss of eastern Sutherlandshire and Forfarshire is close (p. 142). The details of folding and of foliation in the successive divisions of the complex, and of the spilitic lavas, with their associated red jaspers, are finely illustrated in the author's plates. Two of his broader landscapes have been selected for the present notice. The word "encarsioblast" is introduced on p. 43 for a lenticular crystalline growth in a schist, in which the cleavages and planes of intergrowth are at a high angle to the general foliation, features indicating that such growths are among the latest features of reconstruction. When a term like this is written in international Greek, cannot we get rid of "hornfels" and "augen" from British usage? The metamorphic rocks of Anglesey are admirably dealt with, and the glaucophane-schists are held (p. 120) to be modifications of the Gwna spilitic lavas.

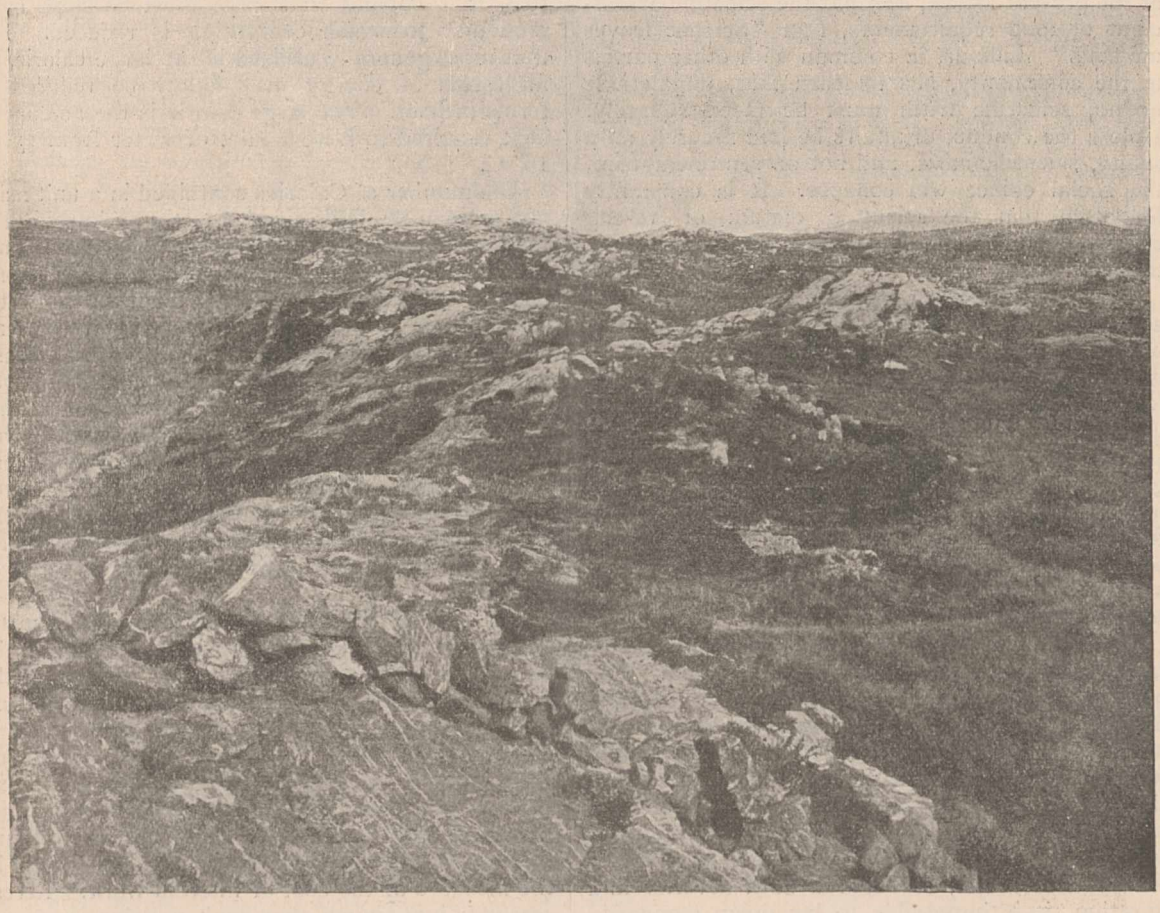

FIG. 2.—Typical scenery of the Mona complex; Amlwch Port Moor. From "The Geology of Anglesey," by permission of His Majesty's Stationery Office.

The geological systems in Anglesey range up to the Coal Measures, in which the barren red strata of Malldraeth and the Menai Strait are now included (p. 668); but we must pass on to the features impressed on the island by denudation and deposition since Cretaceous times. Mr. Greenly (p. 777) shows the probability of a large outlier of Chalk, resting on Jurassic beds, remaining in the sea between the Isle of Man and

Lancashire. The Cretaceous sea lay over Anglesey, and Cainozoic folding has carried its base (p. 895) to some 700 or 800 ft. above the present sea-level. No great warping is needed to prolong this base over Snowdon, and the excavation of the deep valleys of the highland is ascribed, like the levelling of the "Menaian platform" (p. 783), to Pliocene denudation. The contrast between Snowdonia and the lowland of Anglesey is not due to differential erosion, but to the curve of the Cainozoic anticline, rising to the east.

The details of the glaciation of the island are now for the first time adequately dealt with, and with this last hint of the additions made by Mr. Greenly to British geology, our notice must, ever gratefully, conclude.

Food Requirements and the Minimum Wage.

A WELL-KNOWN and trusted Labour leader remarked, not very long age, to the writer of the present article, *apropos* the scientific assessment of food requirements, that "Science leaves me cold." Labour, in common with other parties in the community, has to learn that, unpalatable or no, scientific truth must be faced squarely. Unless the conduct of affairs be laid securely on a sound, scientific basis, and not on sentimentalism, the social edifice will collapse. It is constantly forgotten that the scientific dictum of to-day usually becomes the hackneyed commonplace of to-morrow.

Much as the recent proposal to base wages on a sliding scale, rising and falling with the cost of living, is resented, it is an absolutely sound doctrine, and probably the only practicable base to work from without inflicting undue hardship upon the community at large. Many workers seem to resent the utilisation of this base on the ground that it would reduce them, in their opinion, to the level of animals. This is a perfectly unsound deduction, and not only is it unsound; it is unwarranted. The introduction of such a scientific assessment of wages does not reduce the status of the worker.

We all have a right to live, and life is maintained by an adequate ingestion of food. The only practicable basis for the fixation of the level of the minimum wage would seem to be the cost of living. It has been contested by many people who are unacquainted with the methods of science that as all humanity is neither of the same sex nor of equal age and size, and as the work performed by various classes of the community varies within wide limits, as regards both severity and duration, it is impossible to lay down standards which will be uniformly applicable. So far as the *minimum* wage is concerned, there is absolutely no difficulty.

It may be well to state briefly, in the first place, the methods by which science has reached its definite conclusions, as the whole question is dependent on the fact that food is consumed as a source of energy for internal and external work. The demands for internal work are fairly definitely known, and are a function of the mass of the active tissue (mainly muscle) of the body. This fraction will be considered under the terms of basal or standard metabolism—*i.e.* the energy requirements when the body is in a state of complete repose. In order to assess the amount of work done, both internal and external, and the amount of food which must be consumed in order to cover this, it is obvious that there must be some common unit to which everything is reduced. The unit most generally utilised is the large calorie, as all forms of energy may finally be reduced to terms of heat. The large calorie is the amount of heat required to raise 1 kilo. of water from 15° to 16° C.

The number of Calories contained in a unit mass of food can be determined directly by burning the food in a special small steel chamber (the bomb calorimeter) where the heat liberated by the combustion of the food material is taken up by water contained in a water-jacket, the rise of the temperature of the water being measured by a sensitive thermometer. The amount of energy given off by the body can also be determined, either directly by measuring the amount of heat given off as heat and estimating the external work done in work units, which, in turn, can also be stated in terms of heat, or indirectly by means of the exact analysis of the expired air, where each litre of oxygen consumed can be calculated in terms of Calories.

The cost of the internal work, the basal metabolism, is, as already mentioned, a function of the amount of active metabolic tissue present in the organism. It is obvious that the actual amount of such tissue cannot be directly determined in the living subject. Formerly it was assumed that the weight of the individual gave a good approximation, and that therefore the Calorie output per kilogram body weight—*i.e.* including active tissue like muscle and inactive tissue like fat—would be the measure of the cost of internal work. Recent research has shown that such a value is an approximation only; that much more uniform values can be obtained if the weight-factor is correlated with the age and the height of the individual. The basal metabolism by the use of suitable formulæ can now be stated in terms of Calories per square metre surface of the body. The mean of a large number of determinations has shown that the basal metabolism of a man between the ages of twenty and fifty on an ordinary diet is 39·7 Calories per square metre surface per hour. It is generally accepted that the "average" man has a surface of about 1·77 square metres, and, therefore, a daily basal metabolism of approximately 1700 Calories—*i.e.* as cost of internal work.

This method of assessing the basal metabolism

enables us to deal with the fact that workers vary markedly in physical condition. An objection to the use of a general average for all workers in all trades is that it is frequently found in practice that a certain type of man tends to drift into one type of occupation and a different type into another. It is a case, in the majority of instances, of the survival of the fittest; if a worker is not suited to the trade he has selected he eventually seeks another. But, in spite of this possible segregation—and nothing could be more simple than to make definite allowances if these were required—it is found that the general law of averages can be applied with success.

In order to determine the total daily output of energy by any individual, to the cost of the internal work must be added the increment due to the external work done. In spite of the widely expressed belief that it is quite impossible to correlate the daily work done by different types of workers, let us say that of a postman, a dock labourer, a bricklayer, and a trawler deck-hand, nothing is more easy, provided the appropriate tests are carried out. It is true that the amount of energy spent in the form of external work varies very markedly with the type of work performed and the conditions under which it is carried out. It may range from the low cost of sedentary work in a warm office or workshop, to the other extreme of hard manual labour under unfavourable conditions in the open air. One of the attempts at the classification of external work is given in the report on food requirements by the Food (War) Committee of the Royal Society. The figures given are net daily (eight-hour) figures to be added to the cost of the basal metabolism.

Sedentary	Less than 400 Calories
Light work	400 to 700 ,,
Moderate	700 ,, 1000 ,,
Heavy	1100 ,, 2000 ,,

In certain types of work the 2000-Calorie limit may be exceeded.

Then, finally, there is the question of sex. Experimental work has definitely shown that the basal metabolism of women is about 7 per cent. below that of men, and, further, that, except in the lightest forms of manual work, the amount of external work performed is below that of men. It is generally held that the total energy output of women for the twenty-four hours is 17 per cent. below that of men. This divergence between the male and female metabolism can ultimately be referred back to two simple factors: (1) the relative weights, and (2) the relative proportion of muscle in the two sexes. As regards the first, it is common knowledge that the average woman weighs less than the average man; and, as regards the second, it is equally well known that the average woman is not so muscular as the average man—the average muscle in the case of man forms about 45 per cent. of the total weight, whereas in the woman it forms only about 38 per cent. It therefore follows that the expenditure of energy will be greater in the case of the male, making the assumption, of course, that each worker, male and female, is working at his or her optimum rate.

It is to be regretted that in this class of investigation, although a certain amount of work has been done, Britain has not played a prominent part. Compared with the work carried out both on the Continent and in the United States, the experimental work here has been almost negligible. The special apparatus and the facilities for such research have been lacking. The Inter-Allied Scientific Food Commission, which sat during the later stages of the war, did recommend that a special institute for such research should be founded in each country, but, so far, nothing has been done here.

As regards the practical aspect of the question, the investigations of Miss Lindsay and Miss Ferguson in Glasgow have thrown considerable light on the problem. Before the war, for example, it was found that the *average family* in receipt of 1*l.* per week could obtain, expending, it is true, about 73 per cent. of the total income on food, 3163 Calories per "man"[1] per day, roughly at the rate of 453 Calories per penny. Early in 1917 an income of 1*l.* 10*s.* did not suffice. At present, in a recent Government return (*Labour Gazette*, September, 1920), it is shown that the cost of food alone is 167 per cent. above pre-war level, and if the overall expenditure be taken there is an increase of 161 per cent. The following table, from data kindly supplied by Miss Ferguson, gives a good idea of the change in the cost of living during the past six years:—

Yield of Energy in Calories per 1d. Purchasable at Glasgow: Retail Prices.

Commodity	June, 1914	June, 1915	Nov., 1915	June, 1916	May, 1917	Nov., 1917	Feb., 1920	July, 1920	Oct., 1920
Flank beef ...	132	99	99	91	79	99	74	46	66
Flank mutton	132	88	88	88	103	107	95	—	71
Bacon ...	256	203	187	179	129	100	95	90	96
Cheese ...	241	171	196	152	89	111	83	89	94
Milk ...	—	—	—	—	90	68	49	39	60
Margarine ...	659	587	587	504	298	255	298	298	277
Bread ...	810	607	607	572	405	527	495	384	405
Flour ...	1155	770	798	722	471	722	722	722	510
Oatmeal ...	1512	753	850	814	331	467	404	—	360
Barley ...	825	660	550	471	330	412	314	314	314
Split peas ...	827	552	414	325	325	297	325	325	366
Haricot beans	640	640	533	457	116	271	406	457	582
Lentils ...	648	463	216	463	217	217	271	325	271
Rice... ...	815	815	815	652	466	466	408	233	251
Sugar ...	930	531	496	372	347	317	228	133	207
Potatoes ...	542	542	723	271	244	427	299	142	375

In view of the fact that, of the weekly wage of the workers earning 50*s.* a week or less, at any rate of those with families, 50 to 60 per cent. of the income is legitimately spent in the purchase of food, it is suggested that the total

[1] A family composed of father, mother, and children can be reduced to terms of "man" by the use of appropriate and well-established factors. See Royal Society Food Requirements Report.

cost of living should be the dominant factor in the determination of the level of the minimum wage. Such a mode of assessment would also form an equitable basis for the determination of the wage of the skilled worker, in so far that the increment to be added in payment of (1) skill, (2) compensation for work carried out under unpleasant or unhygienic conditions, or (3) extra-heavy work, would be simply an addition to the minimum wage.

It is unquestionably true that there ought to be a statutory minimum wage. It is the unskilled worker who suffers most. No matter what the trade or occupation, it can be confidently asserted that, as a general rule, it will be found that the unskilled labourer is expending most energy and receiving least pay.

The assumption has been made that the purchase of food and the production of external muscular work are terms which are strictly interchangeable, and within the limits of the minimum-wage-earning class this is true. Objection to the proposal to use food consumption as the basis of wage fixation might legitimately be raised on the ground that, with the great majority of wage-earners, the purchase of food is not confined to the purchase for their own needs, but also for those of a family or other dependents. There is the further difficulty as to whether the minimum wage for men and women should be identical. There is absolutely no question about the fact that the average woman worker does not expend the same amount of energy as the average man, but this may be offset by another factor of wide application, that the majority of working women carry on at the same time housework in their own homes, where the expenditure in energy may easily compete in severity with the work done outside.

Science may seem at times to be cold and unsympathetic, even harsh, but, nevertheless, it is only when the facts are observed in a clear and unimpassioned manner that the truth can be found. Far from viewing man as a mere machine for the conversion of the latent energy of food into the potential energy of work, science is fully alive to the fact that this is only one aspect of vital activity, that there is a psychic side of life—everything that makes up the environment—which plays an equally important part in the life-history.

The purely energy side of the subject cannot be the sole criterion for the determining of wages. Food alone will not suffice to keep men going; it must be consumed under conditions which are satisfactory—conditions, it is true, which vary, at present, with the social status of the individual. There must be a sufficiency of money for a reasonable expenditure on various small luxuries, for entertainment, and for the various amenities of life, the absence of which makes life for the majority of people scarcely worth living. There is no question, then, as many Labour leaders seem to imagine, that an attempt is being made to reduce the manual worker to the level of serfdom.[2]

E. P. C.

[2] The Editor has very kindly directed the writer's attention to a footnote in Mr. H. G. Wells's "Outline of History" (p. 519; Cassell and Co., 1920) with reference to an experiment of the Oneida Silver Co. In the assessment of the weekly wage reference is made to the cost of staple commodities and common necessities, and the worker receives his wages *plus* a percentage representing the advance of the cost of food, etc., from a standard value.

Obituary.

Dr. Max Margules.

THE news of the death of Dr. Max Margules on October 4, which reached this country a fortnight ago, is rendered particularly sad by the announcement in Tuesday's *Times* that "his death was due to starvation. He had been living on a pension of 400 crowns a month (which is equivalent to 8*s*.), and he was too proud to beg for assistance." Dr. Margules was born in 1856 at Brody, in Galicia. After studying at Vienna and Berlin, he entered the Austrian Meteorological Service in 1880, and became secretary of the Institute at Vienna in 1890.

In 1882 Lord Kelvin suggested that the explanation of the regular semi-diurnal variation of the barometer, which has a range of more than two millibars in equatorial regions, might be found in the coincidence of a free period of oscillation of the atmosphere with the period of the solar gravitational tide. Lord Rayleigh in 1890 showed that *if the rotation of the earth were neglected,* a rough computation of the free periods led to values of 23·8 and 13·7 hours, so that Kelvin's hypothesis became at any rate a possibility, although the actual values obtained by Rayleigh would have indicated a bigger diurnal and a smaller semi-diurnal barometer variation. Margules, in the same year, attacked the problem of computing the pressure oscillations of the atmosphere on a *rotating* globe, and found that for an atmosphere with a temperature of 268° absolute (−5° C.) the free period was exactly twelve hours.

In 1892 and 1893 Margules contributed to the *Sitzungsberichte* of the Vienna Academy a series of masterly papers on the motion of the air on a rotating spheroid. These papers are little known to English meteorologists, as they were not included in the collection of papers and translations issued by the Smithsonian Institution in the volumes of "Mechanics of the Earth's Atmosphere."

Margules contributed to the Year Book of the Meteorological Institute of Vienna for 1903 a comprehensive discussion of the energy of storms. He showed that the atmospheric phenomena associated with storms would arise if two masses of air of different temperatures were in

juxtaposition. The situation would be unstable, and in passing from this unstable situation to a stable one the potential energy would be reduced, part of it being converted into the kinetic energy of the ensuing "storm." This paper contains the germ of the theory of line squalls, of the development of cyclones, of polar fronts, and so forth. It includes computations of the horizontal velocities which would result from various distributions of pressure and temperature, and shows that actual distributions would lead to velocities of 50 miles an hour. Margules summed up his conclusions in the sentence: "So far as I can see, the source of storms is to be sought only in the potential energy of position."

Margules retired from active participation in the work of the Austrian Meteorological Service during the directorship of the late Prof. Pernter, and applied himself to the study of chemistry. He fitted up a small laboratory in his own house, where he lived in comparative retirement. The present writer was saddened to see him there in 1909 entirely divorced from the subject of which he had made himself a master. Meteorology lost him some fifteen years ago, and is for ever the poorer for a loss which one feels might and ought to have been prevented. E. GOLD.

THE *Engineer* for October 22 records the death of MR. C. J. BOWEN COOKE on October 18 in his sixty-second year. Mr. Bowen Cooke was educated at King's College School, London, and on the Continent, and thereafter spent the whole of his life in the service of the London and North-Western Railway. After serving a pupilage under the late Mr. F. W. Webb, he was appointed assistant in the running department, and rose to be its superintendent. In 1909 he was appointed chief mechanical engineer, and thereafter was responsible for the design of several important types of locomotive engines. The chief of these was a non-compound superheater engine weighing 116 tons and having four cylinders; this engine was fitted with Walschaert's valve gear. Mr. Bowen Cooke took a very active part in the development of the manufacture of munitions of war in railway workshops, and was made C.B.E. in 1918. He was a member of both the Institutions of Civil and Mechanical Engineers, a Justice of the Peace and County Councillor for Cheshire, and a major in the Engineer and Railway Staff Corps. He was the author of two books on locomotives, and also of a paper on the mechanical handling of coal for British locomotives, read at the Institution of Civil Engineers in 1912.

PROF. HANS PEDR. STEENSBY, whose death at the early age of forty-five is announced by the *Times*, was professor of geography in the University of Copenhagen. He was chiefly known for his researches on the Eskimo in relation to their environment, most of which appeared in *Meddelelser om Grønland*, and included "Contributions to the Ethnology and Anthropogeography of the Polar Eskimos" (1910) and "An Anthropogeographical Study of the Origin of Eskimo Culture" (1917). Prof. Steensby came to the conclusion that the Eskimo were originally an inland people dwelling in the tundra, probably in the vicinity of the Great Slave Land and Coronation Gulf, and that their culture was originally an Indian hunting culture adapted later to the conditions of the Arctic shores. He also wrote on the early voyages of the Norsemen, and was returning from America, where he had been in connection with his investigations into this subject, when his sudden death at sea occurred.

Science announces that PROF. SAMUEL MILLS TRACY, agronomist of the United States Department of Agriculture, died at Laurel, Miss., on September 5, aged seventy-three years. Prof. Tracy was born at Hartford, Vermont, and graduated from Michigan State Agricultural College in 1868. From 1877 to 1887 he was professor of botany and agriculture at the University of Missouri, and from 1887 to 1897 director of the Mississippi Agricultural Experiment Station. Since that time he had been attached to the United States Department of Agriculture. He was a fellow of the American Association for the Advancement of Science, in the work of which he took an active part, and a member of the New Orleans Academy of Science and of the Botanical Society of America. Among Prof. Tracy's works are "The Flora of Missouri," "The Flora of Southern United States," and numerous bulletins issued by the Mississippi Experiment Station and the United States Department of Agriculture.

SIR CORNELIUS NEALE DALTON, whose death occurred on October 19 at seventy-eight years of age, was Comptroller-General of Patents from 1897 to 1909. When, in 1901, the Committee appointed by the Board of Trade to inquire into the working of the Patent Acts reported in favour of an examination for novelty, within certain limits, being undertaken by the office, Sir C. N. Dalton laid down the lines on which the examination has since been conducted, and recommended and carried out the necessary scheme of reorganisation. His strength lay in his tact, energy, and power of organisation, and these enabled him to carry out alterations in the law and practice of patents, though it may be doubted whether the changes were to the advantage of the inventor. He was hon. D.C.L. of Oxford, was created K.C.M.G. in 1908, and was chairman of the council of the East London College.

THE death of DR. ANTON WEICHSELBAUM, professor of pathological anatomy at Vienna University, at the age of seventy-five years, occurred on Friday, October 22.

Notes.

IMPORTANT changes are announced at the Ministry of Agriculture, the effect of which is the promotion of Mr. F. C. L. Floud to be Permanent Secretary and the liberation of Sir Daniel Hall from office work so that he will be able to keep in close personal touch with agricultural developments in this country as well as abroad, and devote his whole time to the organisation of agricultural education and research. Sir Daniel has been associated with this work throughout his whole official career. The scheme now in operation comprises four essential parts:—(1) Research institutions, where knowledge is gained and agricultural science systematically developed and put into such form that teachers and experts can use it. At first this work was distributed among a number of university departments, but of recent years there has been a tendency to concentrate it at a few institutions owing to the necessity for bringing individual workers into closer personal contact with each other and with the large-scale problems of the farmer. (2) Agricultural colleges, where experts and large farmers will be trained, receiving a three years' course of instruction of university character. Most of these colleges are associated with universities which award degrees in agriculture; for students who do not wish to take degrees there is a diploma course requiring a high standard of technical work. (3) Farm institutes for small farmers and farm-workers who cannot spare three years for college, but have some practical knowledge and are unable or unwilling to go through the ordinary college course. These institutes aim at giving sound courses of instruction on soil, manure, crops, animal husbandry, etc., but it is usually presumed that the student will take up farming in the area served by the institution, and for which the instruction is specially appropriate. (4) Advisory officers. In each county arrangements are made whereby farmers, smallholders, and others may consult the agricultural expert appointed by the county authority in regard to any difficulties they may meet with in their work. The expert is in a position somewhat similar to that of the general medical practitioner, and usually finds that he can deal with a large number of the cases presented to him. He is, however, in touch with the colleges, research institutions, etc., and can always obtain expert advice in any particular problem of special difficulty.

PROF. T. H. PEAR has been elected an honorary secretary of the Manchester Literary and Philosophical Society in succession to Prof. C. A. Edwards.

MR. J. A. BRODIE will deliver an inaugural address at the opening meeting of the one hundred and second session of the Institution of Civil Engineers on Tuesday, November 2, at 5.30 p.m.

THE *British Medical Journal* announces that the fourth congress of the Far Eastern Association of Tropical Medicine will be held in August, 1921, at Batavia, the capital of the Dutch East Indies, under the presidency of Dr. W. T. de Vogel.

THE University and the Royal Academy of Sciences of Bologna will hold a joint commemoration service for the late Prof. Righi in the lecture hall of the University on November 1. This will be the fortieth anniversary of Righi's first association with the University, and an oration will be delivered by Prof. Luigi Donati, director of the Royal School of Engineering.

A JOINT meeting organised by the Faraday Society and the Sheffield Section of the Institute of Metals will be held at the University of Sheffield on Friday, November 19, to discuss papers dealing with various aspects of electro-plating. Communications are promised from representatives of the scientific side of the electro-plating industry in London, Birmingham, and Sheffield. Anyone desirous of taking part is invited to communicate with the Sheffield local hon. secretary of the Faraday Society, Dr. F. C. Thompson, Department of Applied Science, University of Sheffield.

WE learn from the *British Medical Journal* that, through the gift of an anonymous fellow, the Royal Society of Medicine has been able to institute a triennial gold medal open to medical practitioners throughout the world. Sir Almroth Wright has been chosen as the first medallist, and the presentation will be made to him by the president of the society, Sir John Bland-Sutton, at 5 p.m., on Thursday, November 11, at 1 Wimpole Street, and Sir Almroth Wright will afterwards give an address on medical research.

AT the annual meeting of the Royal Society of Edinburgh, held on October 25, the following were elected as office-bearers and members of council:—*President:* Prof. F. O. Bower. *Vice-Presidents:* Prof. D. Noël Paton, Prof. A. Robinson, Sir G. A. Berry, Prof. W. Peddie, Sir J. A. Ewing, and Prof. J. W. Gregory. *General Secretary:* Dr. C. G. Knott. *Secretaries to Ordinary Meetings:* Prof. E. T. Whittaker and Prof. J. H. Ashworth. *Treasurer:* Dr. J. Currie. *Curator of Library and Museum:* Dr. A. Crichton Mitchell. *Councillors:* Prof. R. A. Sampson, Prof. J. Lorrain Smith, Dr. W. A. Tait, Surg.-Gen. W. B. Bannerman, Mr. H. M. Cadell, Prof. A. R. Cushny, Prof. F. G. Baily, Mr. G. J. Lidstone, Dr. R. Campbell, Prof. J. C. Irvine, the Hon. Lord Salvesen, and Prof. J. A. Thomson.

WE referred in our issue of September 2, p. 26, to a statement received from a correspondent in India that Sir Alfred Bourne was to be succeeded in the directorship of the Indian Institute of Science, Bangalore, by an administrator with no scientific experience, and we remarked that such an appointment would be greatly deprecated by scientific workers. By the statutes of the institute, the council appoints a committee at home to make nominations, and from the nominations sent out it selects a name for the approval of the Viceroy, who is patron of the institute. If the council sent home a nomination for

the office, it apparently went beyond the spirit of the statutes, but, in any event, we understand that no director has yet been appointed to succeed Sir Alfred Bourne. We trust that the post will be filled by a man who combines administrative capacity with scientific knowledge.

ONE of the most valuable contributions to the study of magic in the Malay Peninsula was the description by Mr. W. W. Skeat in his "Malay Magic" of the methods by which the soul of the rice plant was evoked in the seed grain. Our knowledge of these practices has recently been advanced by the papers contributed by Mr. R. O. Winstedt to the *Journal of the Federated States Museums* (vol. ix., part 2, July, 1920) descriptive of similar rites in Upper Perak and Negri Sembilan. In the former region the seed is washed and cleansed with limes, and the farmer makes the invocation: "Greetings be to thee, God's prophet Solomon, King of all the earth! I would sow seed rice. I pray thee, cherish it from all danger and hazard!" At harvest he says: "Greetings be to you, gnomes of the latter days, gnomes of the beginning, gnomes one hundred and ninety! Get ye back and aside! If ye turn not aside, I will curse you!" After the regular invocation the soul of the rice will come in the form of a grasshopper or other insect with the sound of a breeze. When the rice-soul is invoked at harvest the magician must wave a white cloth, so that the rice-soul shall not fall on and crush one of the party at her coming. This valuable contribution supplies additional information on the subject fully discussed by Sir James Frazer in the last edition of his "Golden Bough."

THE origin of cancer is discussed by Dr. Alexander Paine in a paper in the *Lancet* of October 2 last (p. 693). The conclusion Dr. Paine arrives at is that cancer is due, not to the action of a specific parasite, as has been suggested, but to a disordered growth of epithelium caused by various chemical or physical irritants, the most important being the toxins or poisons of micro-organisms. Dr. Paine considers that the origin of cancer lies in the degeneration of the "nobler" parts of the cell consequent on damage to its structure. The result of this damage is to disturb the balance of metabolism by impairing the special functions of the cell, thereby causing persistent overgrowth.

THE Research Defence Society has published a pamphlet by Sir Leonard Rogers on "The Value of Experiments on Animals." No one is better qualified than Sir Leonard Rogers to speak with authority on this subject. Investigations on rinderpest in cattle and surra in horses are quoted as examples of the value of animal experiments in the elucidation and prevention of diseases affecting the lower animals, whereby much suffering to the animals themselves and pecuniary loss to their owners are diminished. The action of snake-venoms and the preparation of curative sera for snake-bites, the use of permanganates in the treatment of snake-bite and of cholera, work on the dysenteries, and experiments leading to improved treatments of leprosy, tuberculosis, and kala-azar are all summarised. It is shown how much we are indebted to experiments on animals for a better knowledge of these conditions and for improved methods of dealing with them.

MR. E. H. TAYLOR gives (*Philippine Journ. Sci.*, vol. xvi., No. 3, March, 1920) an account of sixty-six species—seventeen being new—of Philippine Amphibia. These belong to the orders Apoda—represented by a new species of Ichthyophis—and Salientia, there being only one doubtful record in the order Caudata. The Salientia, which includes the frogs and toads, is represented by four families, Ranidæ, Engystomidæ, Bufonidæ, and Pelobatidæ, the first of which has by far the largest representation. A new genus of the Ranidæ—Hazelia—is described.

MESSRS. BOVING AND CHAMPLAIN (Proceedings of the U.S. National Museum, vol. lvii., No. 2323, 1920) describe the morphology and taxonomy of a number of North American species of beetle larvæ belonging to the family Cleridæ. With very few exceptions, these insects, both as larvæ and adults, prey upon destructive wood- and bark-boring beetles. This careful and very exact memoir should appeal to all coleopterists, and the classification of Clerid larvæ illustrates how much a taxonomic arrangement of the beetles can differ from that of their larvæ. A new appropriate classification of larvæ independent of the adults is necessary in this case. The second part of the paper deals with the biology and seasonal history of the Cleridæ. Information of this nature is obviously essential if the forester is ever to benefit by the preservation of the predators, and at the same time by the destruction of the injurious species upon which they prey. The authors state that, whenever practicable, the dissemination of Cleridæ, particularly of Thanasimus and Enoclerus, in quantities in badly infested regions would be a valuable additional aid to control measures.

A CERTAIN amount of romance is attached to the control of insect pests by parasites, and the Americans have specialised in this work. Those interested will find a very full illustrated account of the subject in the Monthly Bulletin of the Department of Agriculture for California (vol. ix., No. 4, April, 1920). Several parasites have been introduced as natural enemies of mealy-bugs in the hope that some might prove effective. One, a so-called mealy-bug destroyer, *Cryptolaemus Montrouzieri*, Muls., a ladybird beetle from Australia, was expected to solve the problem, but after the first few months seemed to die out except in particular localities. The reason is fairly obvious. The success of such a parasite means that its natural food becomes scarce, and therefore it starves. The problem has now, however, been solved by the Californian authorities, who found that they could feed the mealy-bug on potato-sprouts, and hence were enabled to keep the ladybird fed and breeding during the winter months. Special insectaries have been built for this purpose, and tubes of the ladybird can be supplied for release when and where necessary the following spring.

MANY entomologists will welcome an important paper by Mr. A. C. Baker on the classification of Aphidæ which has been issued lately as Bulletin No. 826 of the U.S. Bureau of Entomology. Probably no group of insects has received more attention from the economic point of view than aphides or plant-lice. Unfortunately, the classification and synonymy of aphides are in a chaotic condition, and great difficulty is often experienced in securing correct naming of specimens. Mr. Baker's paper deals with their generic classification, and was undertaken with the object of remedying this defect, to some extent at least. He regards these insects as constituting the super-family Aphidoidea, and his efforts are confined to the genera and tribes of the family Aphididæ; Phylloxera and its allies he considers to be a separate family. The genus Mindarus is regarded in some respects as the most primitive of all forms, while the Hormaphidini are considered to be the most specialised. The last-named insects are gall-formers; they lack the cornicles or honey-tubes, and have curious aleyrodiform generations. The systematist who desires to make real progress with the specific determination of many aphides will have to rear each individual species and note carefully the characters of each generation for a given food-plant. The labour involved would be great and the time demanded lengthy, but the progress made would be sure, and substantial biological knowledge would result.

THE problem of the toxic action of sulphur used as a fungicide is being investigated at the Agricultural and Horticultural Research Station, Long Ashton, Bristol, and a preliminary report on the subject by Messrs. B. T. P. Barker, C. T. Gimingham, and S. P. Wiltshire appears in the station's annual report for 1919, recently received. It has frequently been noticed that flowers of sulphur applied in paste form to the hot-water pipes in greenhouses will keep in check diseases of the mildew type on plants in the houses. Further, there are records of cases of unsprayed gooseberry bushes which have been defoliated as a result of the lime-sulphur spraying of adjacent plots of bushes. The results suggest that the toxicity of the spray is due to some gaseous compound, and if such a compound could be discovered it might be possible to surround plants with an atmosphere sufficiently antiseptic to prevent disease. The nature of the changes which follow the application of a sulphur spray were, therefore, studied, and the results showed that the active agent is the finely divided sulphur which is formed by the decomposition of the spray fluid. Several theories have been advanced to explain the action of this sulphur; the toxicity may be due to the gradual oxidation of the sulphur to sulphur dioxide, to the formation of sulphuretted hydrogen, to conversion into sulphuric acid, or, finally, the sulphur may act of itself by its own vapour. The experiments at Long Ashton show that under ordinary practical conditions none of these hypotheses meet the case. Further experiments have been made, and it is hoped that these will demonstrate the method by which sulphur at a distance from the plants under treatment is brought into contact with the fungus. It then remains to discover what happens when the sulphur comes into contact with the fungus, and for this purpose further researches must be made.

PROF. JEAN MASSART records (Bull. Acad. Roy. Belgique, Classe des Sciences, 1920, Nos. 4-5) the results of his observations on the movement of different species of littoral flagellates, and gives numerous figures of the organisms and of their paths of movement. Several of the genera and species observed are new, but the systematic descriptions will be published later. In Podomastix (a new genus) the pseudopodia—one to four in number—are long and slender, uniform in thickness, sometimes branched, and movable in an oar-like manner. They are retractile, and represent a transition between pseudopodia and flagella. The two flagella of *Cercobodo primitiva*, n.sp., are tapering prolongations of pseudopodia, but, contrary to those of Podomastix, they are permanent. One of the flagella is anterior and serves for swimming, the other is directed posteriorly. This organism can also move forward by lashing its anterior flagellum, its posterior flagellum and part of its body being applied to some object over which it is progressing, and, finally, it can move in amœboid fashion. The author remarks that many of the flagellates exhibit these three kinds of locomotion. *Clautriavia mobilis*, which has a single flagellum directed backwards, never swims freely; it becomes applied to some object by the flagellum, and pushes itself forwards obliquely, first right, then left. Dimastigamœba, n.g., forms pseudopodia while swimming freely and while creeping. In the latter condition the two flagella trail behind. The reaction —acid or alkaline—of the surrounding fluid was found to play an important part in determining change of form with Eugleninæ. In a slightly acid fluid these organisms swim in a state of extension and without modifying their contour, but if the medium is rendered alkaline the swimming is arrested and the organisms exhibit diverse changes of form.

THE latest issue of the Journal of the Marine Biological Association (No. 2, vol. xii.) contains several papers dealing in considerable detail with the life-histories and food of Teleostean fishes. Particularly noticeable is a paper (promising further contributions to the subject) on the physical conditions influencing breeding in marine organisms, breeding being defined as "fertilisation resulting in subsequent development." There is much experimental and observational work in the literature of biology, and Dr. Orton collates and discusses some of this. The breeding of a marine animal is usually seasonal, and may occur during a very limited part of the year, or it may be continuous (in some tropical and abyssal organisms). It may begin at a very early period in the life of an animal, be repeated annually, or even be delayed until almost the end of life, and may occur only once. It is very difficult to correlate the nature and abundance of food with the occurrence and dura-

tion of the breeding period, and Dr. Orton inclines to disregard this factor, assigning little or no significance to it. Salinity variations may be so capricious in relation to the distribution and habits of some animals that these, too, are difficult to correlate with spawning cycles. On the other hand, temperature variations seem to explain many facts, and the discussion deals largely with these changes. There is a temperature constant which applies to most marine species, and breeding proceeds when this condition is satisfied. Growth (and absolute dimensions) will depend to some extent upon the fraction of the lifetime of the animal occupied in breeding. One might therefore expect that a semi-sedentary or sedentary animal at the extreme northerly limit of its distribution would be generally larger than one in which the temperature of the sea remained near the constant expressing the temperature optimum. It is suggested that the approximately uniform conditions obtaining in some polar, tropical, and abyssal marine areas may be connected with prolonged, or even continuous, breeding periods. The geographical distribution of a marine animal is obviously controlled by its physiological temperature constant, and deviations from the latter may be the mode of origin of sub-species or varieties.

AMONG a number of water-supply papers issued by the United States Geological Survey special attention may be directed to several series of river plans and profiles constructed in order to determine the location of undeveloped water powers. Recent volumes include "Profile Surveys of Rivers in Wisconsin" (Paper 417), "Profile Surveys of Skagit River Basin, Washington" (Paper 419), and "Profile Surveys along the Rio Grande, Pecos River, and Mora River, New Mexico" (Paper 421). The maps show the outlines of the river-banks, islands, the position of rapids, falls, shoals, and existing dams, and the crossings of all ferries and roads, in addition to the contours of the banks to an elevation high enough to indicate the possibility of using the streams. Data concerning the volume of the flow have been published in previous papers.

THE Monthly Bulletin of the Weather Bureau of the Manila Central Observatory issued by the Government of the Philippine Islands contains detailed observations for numerous stations situated in different parts of the group. The monthly results for August, 1919, are to hand, prepared under the direction of the Rev. José Algué, S.J. Rainfall at Manila during the month was 78·10 in., which breaks all records since the foundation of the observatory in 1865; the previous highest rainfall in August was 43·15 in. in 1877, and the highest for any month of the year was 57·88 in. in September, 1867.

THE exact relations between climate and the growth of crops, and the possibilities of accurate forecasts of production, is the subject of an article by Mr. T. A. Blair in the *Scientific Monthly* for October. Mr. Blair shows in the case of maize in Ohio that the United States Weather Bureau has found that a July rainfall of less than 3 in. means an average yield of 30 bushels per acre, and that a rainfall of 5 in. or more results in 38 bushels. When the July rainfall is $3\frac{1}{4}$ in. the yield is 15,000,000 bushels greater than when it falls short of that amount by half an inch. In the four great maize-growing States of Indiana, Illinois, Iowa, and Missouri the addition of half an inch to a total of $2\frac{3}{4}$ in. adds 10 bushels per acre to the average yield. A more precise relationship is found in the idea of critical period—that is, certain short periods of time in the growth of any crop, during which its future prospects are largely determined. With some crops this is a single period; with some temperature, and with others rainfall or sunshine, are the most important factors. In the case of maize in Ohio it has been found that the first ten days of August are the critical period as regards rainfall. The application of this knowledge may be used to increase production in two ways. First, it will be possible to determine what crops are climatically suited to a particular district; and, secondly, by the use of early or late varieties and by the help of fertilisers or other means, the crop may be advanced or retarded so as to bring the critical period into coincidence with favourable weather.

Science Progress for October contains an article by Dr. Aston which summaries his work on the atomic weights of the elements as determined by his method of the "mass spectra." These spectra are obtained on a photographic plate placed *in vacuo* by deflecting positive rays on to it by passing them first through an electric, then through a magnetic, field in such a way that all the rays corresponding to an element of given mass are concentrated in a short line on the plate and those of different masses in other parallel lines. The separation of the lines is sufficient to fix the atomic weights to considerably less than a tenth of a unit. By this method it has been possible to demonstrate that boron consists of two, neon, silicon, and chlorine of two or three, bromine of two, krypton of six, and mercury of at least two isotopes—that is, elements of the same chemical properties but of different atomic weights. Dr. Aston concludes that the atoms have weights which are all integral numbers, and that observed fractional atomic weights are due to mixtures of two or more isotopes.

ELECTRIC furnaces in which the heating element consists of a metallic wire or strip are now extensively used both in the workshop and in the laboratory, and possess the advantages of cleanliness, accuracy of temperature control, and small working costs. A special form, possessing several new and useful features, and intended mainly for workshop use, is announced by Automatic and Electric Furnaces, Ltd. The furnace-chamber or muffle is flat on the top and bottom, while the sides are rounded, this shape being specially suited to secure complete contact with the heating coil wound on its exterior. In order to prevent destruction of the coil through inadvertent overheating, a cut-out consisting of a loop of wire melting at 960° C. is inserted in the furnace. The heating current passes through the loop and is cut off by the melting of the latter, a red pilot-lamp being simultaneously lit up to serve as a warning. Several sizes

are listed, ranging in power consumption from 700 to 9500 watts. The muffles are made of a new refractory material called "Ameroid," which is claimed to possess special advantages. We would suggest that intending purchasers of furnaces would prefer to know the composition of the refractory—to which the name given furnishes no clue—so as to judge of its suitability to their requirements.

Engineering for October 15 contains a description of a new 7½-ton six-wheel commercial vehicle made by Messrs. G. Scammell and Nephew, London. One obvious way of reducing costs of road transport is to increase the weight of the load which can be handled by one vehicle and one road crew, and this lorry appears to fulfil this condition admirably. It consists of a four-wheel chassis carrying the engine, and is arranged to draw a two-wheel body which pivots on a turntable at the rear of the chassis. The weight of the complete vehicle is 4½ tons, and it can carry a load of 7½ tons without exceeding an axle-load of 6 tons, which is the limit allowable for a vehicle travelling at 12 miles per hour. The vehicle is able, in addition, to draw a 6-ton trailer, so that a useful load of 13½ tons can be dealt with. Whilst the vehicle is not the first six-wheeler which has been produced, it possesses many points of novelty and interest which add to its usefulness and efficiency. The engine develops 47 brake-horse-power at 1000 revolutimes per minute.

THE presidential address to Section H (Anthropology) of the British Association, which was delivered by Prof. Karl Pearson at Cardiff in August last, has been re-issued as a separate publication by the Cambridge University Press, price 1*s.* 6*d.*

Our Astronomical Column.

BRILLIANT METEOR OF OCTOBER 19.—This fine object was observed at 8.15 G.M.T., and descriptions of its appearance have been received by Mr. Denning from Purley and Oxted, in Surrey, and from Stowmarket. Fortunately, the meteor was seen by two experienced observers, Miss A. Grace Cook and Mr. J. Edmund Clark. It was brighter than Venus and gave an intense flash, although the half-illuminated moon was in the same quarter of the sky. The motion was moderate, and a streak remained along one section of the path for about 10 seconds.

On the same date as that on which the meteor appeared the shower of Orionids is usually abundant, and the fireball from its direction of flight seems to have been a brilliant member of that system, though the radiant point was a few degrees below the horizon.

If we adopt a radiant at 88°+17°, the observations of the object indicate a height from about 61 to 69 miles along a path of 110 miles, and a velocity of about 35 miles per second. In fact, the meteor seems to have been rising in the atmosphere instead of falling, as is usually the case.

The luminous flight occurred over the English Channel, from close to Beachy Head to about 40 miles south of Bournemouth.

Over the West of England the sky was cloudy, and it is important that further accounts should be sent to Mr. Denning from the eastern counties, as the computed heights are rather exceptional and require further investigation.

THE TOTAL SOLAR ECLIPSE OF SEPTEMBER, 1922.—The track of totality in this eclipse traverses the Maldive Archipelago and Christmas Island, south of Java. It then passes right across Australia, but reasonably accessible stations are confined to the eastern portion of its track. Mr. H. A. Hunt, the Commonwealth Meteorologist, acting under instructions from his Government, has prepared a map giving much meteorological information.

A shaded area runs across Australia parallel to, but somewhat south of, the eclipse track; it is stated that this shaded region has no single well-marked wet season, but is subject to both summer and winter rain-producing influences. The map also shows the periods in which most rain falls in each region, and it is noteworthy that the month of September occurs in the wet season on the south coast only, so that the month appears to be favourable on the eclipse track. The sun's altitude on the east coast of Queensland is only 18°, but 26° may be obtained by proceeding inland by rail to Cunnamulla or Coongoola. The directors of the leading Australian observatories have expressed their hope of occupying stations in Queensland, while plans are being formed for expeditions from England to the Maldives and Christmas Island. The scheme of observations will include further verification of the gravitational deflection of light, as it is desirable to strengthen the evidence for a result of such fundamental importance.

THE CAPTURE OF COMETS BY PLANETS.—Prof. H. N. Russell contributes a second article on this subject to *Astr. Journ.*, No. 775. He shows that out of a hundred million comets that approach within an astronomical unit of the sun, 90,000 would be made periodic by Jupiter's action and 2400 by that of Saturn, while the numbers in the case of Uranus and Neptune are only 14 and 8 respectively. Hence he concludes that the two outermost planets have not played any part in such capture, with the possible exception of the comet of the November meteors by Uranus. Prof. Russell admits the curious relationship of the orbits of the comets with periods less than a century, which fall into four groups, the aphelia of which are somewhat outside the orbits of the giant planets. This point gives strong grounds for assuming some connection between these cometary groups and the corresponding planets; further, the point made by Prof. Russell, that many of the cometary orbits considered do not pass within several astronomical units of the planet with which they are associated, may be explained by the slow alteration in the cometary orbit through planetary perturbations.

Many of the facts now pointed out were noted by Mr. R. A. Proctor half a century ago. His explanation was that the origin of the comets in question took place, not by capture, but by expulsion from the giant planets. It is surprising that this suggestion has met with so little support from other astronomers; the phenomena observed in the atmospheres of Jupiter and Saturn testify to the existence of very powerful forces. Even on the earth such explosions as that of Krakatoa occur, in which cubic miles of matter are flung to a great height. Moreover, retrograde orbits would occur more readily if the motion of the parent planet were slower and its gravitation weaker, which would explain their restriction to the comet-families of Uranus and Neptune. Hence it would seem to be premature to accept the non-connection of Neptune with the comet-family that bears his name, as finally demonstrated.

Intensive Cultivation.*

By PROF. FREDERICK KEEBLE, C.B.E., Sc.D., F.R.S.

I PROPOSE to devote my address entirely to horticulture—to speak of its performance during the war and of its immediate prospects. Although that which intensive cultivators accomplished during the war is small in comparison with the great work performed by British agriculturists, nevertheless it is in itself by no means inconsiderable, and is, moreover, significant, and deserves a brief record. That work may have turned, and probably did turn, the scale between scarcity and sufficiency; for, as I am informed, a difference of 10 per cent. in food supplies is enough to convert plenty into dearth. Seen from this point of view, the war-work accomplished by the professional horticulturist—the nurseryman, the florist, the glasshouse cultivator, the fruit-grower and market gardener—and by the professional and amateur gardener and allotment holder assumes a real importance, albeit the sum total of the acres they cultivated is but a fraction of the land which agriculturists put under the plough. As a set-off against the relative smallness of the acreage brought under intensive cultivation for food purposes during the war, it is to be remembered that the yields per acre obtained by intensive cultivators are remarkably high.

The reduction of the acreage under soft fruits—strawberries, raspberries, currants, and gooseberries—which took place during the war gives some measure of the sacrifices—partly voluntary, partly involuntary—made by fruit-growers to the cause of war-food production. The total area under soft fruits was 55,560 acres in 1913, by 1918 it had become 42,415—a decrease of 13,145 acres, or about 24 per cent. But though the public lost in one direction it gained in another, and the reduction of the soft-fruit acreage meant—reckoned in terms of potatoes—an augmentation of supplies to the extent of more than 100,000 tons. Equally notable was the contribution to food production made by the florists and nurserymen in response to our appeals. An indication of their effort is supplied by figures which, as president of the British Florists' Federation, Mr. George Munro—whose invaluable work for food production deserves public recognition—caused to be collected. They relate to the amount of food production undertaken by 100 leading florists and nurserymen. These men put 1075 acres, out of a total of 1775 acres used previously for flower-growing, to the purpose of food production, and they put 142 acres of glass out of a total of 218 acres to like use. I compute that their contribution amounted to considerably more than 12,000 tons of potatoes and 5000 tons of tomatoes.

In this connection the yields of potatoes secured by Germany and this country during the war period are worthy of scrutiny. The pre-war averages were: Germany 42,450,000 tons, United Kingdom 6,950,000 tons; and the figures for 1914 were Germany 41,850,000 tons, United Kingdom 7,476,000 tons. Germany's supreme effort was made in 1915 with a yield of 49,570,000 tons, or about 17 per cent. above the average. In that year our improvement was only half as good as that of Germany, our crop of 7,540,000 tons bettering our average by only 8 per cent. In 1916 weather played havoc with the crops in both countries, but Germany suffered most. The yield fell to 20,550,000 tons, a decrease of more than 50 per cent., whilst our yield was down to 5,469,000 tons, a falling off of only 20 per cent. In the following year Germany could produce no more than 39,500,000 tons, or a 90 per cent. crop, whereas the United Kingdom raised 8,604,000 tons, or about 24 per cent. better than the average. Finally, whereas with respect to the 1918 crop in Germany no figures are available, those for the United Kingdom indicate that the 1917 crop actually exceeded that of 1918. There is much food for thought in these figures, but my immediate purpose in citing them is to claim that of the million and three-quarter tons increase in 1917 and 1918 a goodly proportion must be put to the credit of the intensive cultivator.

I regret that no statistics are available to illustrate the war-time food production by professional and amateur gardeners. That it was great I know, but how great I am unable to say. This, however, I can state: that from the day before the outbreak of hostilities, when, with the late secretary of the Royal Horticultural Society, I started the intensive food-production campaign by urging publicly the autumn sowing of vegetables—a practice both then and now insufficiently followed—the amateur and professional gardeners addressed themselves to the work of producing food with remarkable energy and success. No less remarkable and successful was the work of the old and new allotment holders, so much so indeed that at the time of the armistice there were nearly a million and a half allotment holders cultivating upwards of 125,000 acres of land—an allotment for every five households in England and Wales. It is a pathetic commentary on the Peace that Vienna should find itself obliged to do now what was done here during the war, namely, convert its parks and open spaces into allotments in order to supplement a meagre food-supply.

This brief review of war-time intensive cultivation would be incomplete were it to contain no reference to intensive cultivation by the armies at home and abroad. In 1918 the armies at home cultivated 5869 acres of vegetables. In the summer of that year the camp and other gardens of our armies in France were producing 100 tons of vegetables a day. These gardens yielded in 1918 14,000 tons of vegetables, worth, according to my estimate, a quarter of a million pounds sterling, but worth infinitely more if measured in terms of benefit to the health of the troops.

As the result of Gen. Maude's initiative, the Forces in Mesopotamia became great gardeners, and in 1918 produced 800 tons of vegetables, apart altogether from the large cultivations carried out by his Majesty's Forces in that wonderfully fertile land. In the same year the Forces at Salonika had about 7000 acres under agricultural and horticultural crops, and raised produce which effected a saving of more than 50,000 shipping tons.

Even from this brief record it will, I believe, be conceded that intensive cultivation played a useful and significant part in the war. What, it may be asked, is the part which it is destined to play in the future? So far as I am able to learn, there exist in this country two schools of thought or opinion on the subject of the prospects of intensive cultivation, the optimistic and the pessimistic schools. The former sees visions of large communities of small cultivators colonising the countryside of England, increasing and multiplying both production and themselves, a numerous, prosperous, and happy people and

* From the opening address of the President of Section M (Agriculture) delivered at the Cardiff meeting of the British Association on August 24.

a sure shield in time of war against the menace of submarines and starvation. Those, on the other hand, who take the pessimistic view point to the many examples of smallholders who "plough with pain their native lea and reap the labour of their hands" with remarkably small profit to themselves or to the community.

Before making any attempt to estimate the worth of these rival opinions, it may be observed that the war has brought a large reinforcement of strength to the ranks of the optimists. A contrast of personal experiences illustrates this fact. When in the early days of the war I felt it my duty to consult certain important county officials with the object of securing their support for schemes of intensive food production, I carried away from the conference one conclusion only: that the counties of England were of two kinds, those which were already doing much and were unable therefore to do more, and those which were doing little because there was no more to be done. In spite of this close application of the doctrine of Candide—that all is for the best in the best of all possible worlds—I was able to set up some sort of county horticultural organisation, scrappy, amateurish, but enthusiastic, and the work done by that organisation was, on the average, good; so much so, indeed, that when after the armistice I sought to build up a permanent county horticultural organisation I was met by a changed temper. The schemes which the staff of the Horticultural Division had elaborated as the result of experience during the war were received and adopted with a cordiality which I like to think was evoked no less by the excellence of the schemes themselves than by the promise of liberal financial assistance in their execution. Thus it came about that when the time arrived for me to hand over the Controllership of Horticulture to my successor, almost every county had established a strong county horticultural committee, and the chief counties from the point of view of intensive cultivation had provided themselves with a staff competent to demonstrate not only to cottagers and allotment holders, but also to smallholders and commercial growers, the best methods of intensive cultivation.

By means of county stations the local cultivator may learn how to plant and maintain his fruit plantation and how to crop his vegetable quarters, what stock to run, and what varieties to grow. Farm stations—with the research stations established previously by the Ministry: Long Ashton and East Malling for fruit investigations; the Lea Valley Growers' Association and Rothamsted for investigation of soil problems and pathology; the Imperial College of Science for research in plant physiology, together with a couple of stations, contemplated before the war, for local investigation of vegetable cultivation; an alliance with the Royal Horticultural Society's Research Station at Wisley, and with the John Innes Horticultural Institute for research in genetics; the Ormskirk Potato Trial Station; a Poultry Institute; and, most important of all from the point of view of education, the establishment at Cambridge of a School of Horticulture—constitute a horticultural organisation which, if properly co-ordinated and (dare I say it?) directed, should prove of supreme value to all classes of intensive cultivators. To achieve that result, however, something more than a permissive attitude on the part of the Ministry is required, and in completing the design of it I had hoped also to remain a part of that organisation long enough to assist in securing its functioning as a living, plastic, resourceful, directive force—a horticultural cerebrum. Thus developed, it is my conviction that this instrument is capable of bringing horticulture to a pitch of perfection undreamed of at the present time either in this country or elsewhere.

In my view, horticulture has suffered in the past because the fostering of it was only incidental to the work of the Ministry. In spite of the fact that it had not a little to be grateful for—as, for example, the research stations to which I have referred—horticulture had been regarded rather as an agricultural sideshow than as a thing in itself. My intention, in which I was encouraged by Lord Ernle, Lord Lee, and Sir Daniel Hall, was to peg out on behalf of horticulture a large and valid claim and to work that claim. The conception of horticulture which I entertained was that comprised in the "petite culture" of the French. It included crops and stock, fruit and vegetables, flower and bulb and seed crops, potatoes, and pigs and poultry and bees. I held the view, and still hold it, that the small man's interests cannot be fostered by the big man's care; that horticulture is a thing in itself, and requires constant consideration by horticulturists and not occasional help from agriculturally minded people, however distinguished and capable. I hold that education—sympathetic and systematic—is an instrument the power of which, for our purpose, is scarcely yet tried; is, in fact, of almost infinite potency.

The truth is that great skill and sure knowledge exist among small cultivators side by side with much ignorance and moderate practical ability. Herein lies the opportunity of the kind of education which I have in mind. But for any such intensive system of education to prevail the isolation both of cultivators and of Government Departments must be abolished. There is only one way to prepare the ground for the intensive cultivation of education, and that is to secure the full co-operation of officials and cultivators. If this be not done, the official must continue to bear with resignation the unconcealed hostility of those he wishes to assist. That a state of confidence and co-operation may be established is proved by the record of the Horticultural Advisory Committee which was set up by Lord Ernle during my Controllership. The Committee consisted of representatives of all the many branches of horticulture—fruit-growers, nurserymen, market gardeners, growers under glass, salesmen, researchers, and so forth. That Committee became, as it were, the Deputy-Controller of Horticulture. To it all large questions of policy were referred, and to its disinterested service horticulture owes a great debt. That its existence has been rendered permanent by Lord Lee is of good augury for the future of intensive cultivation.

It may be asked: What are the subjects in which growers require education? To answer that question fully would require an address in itself. Among those subjects, however, mention may be made of a few: the extermination or top-grafting of unthrifty fruit, the proper spacing and pruning of fruit-trees, the use of suitable stocks, systematic orchard-spraying, the use of thrifty varieties of bush fruit and the proper manuring thereof, the choice of varieties suitable to given soils and districts and for early cropping, the better grading and packing of fruit. Of all methods of instruction in this last subject the best is that provided by fruit exhibitions. Those interested in the promotion of British fruit-growing will well remember the object-lesson in good and bad packing provided by the first Eastern Counties Fruit Show, held at Cambridge in 1919. That exhibition, organised by the East Anglian fruit-growers with the assistance of the Horticultural Division of the Ministry of Agriculture, demonstrated three things—first, that fruit of the finest quality is being grown in East Anglia;

secondly, that this district may perhaps become the largest fruit-growing region in England; and, thirdly, that among many growers profound ignorance exists with respect to the preparation of fruit for market.

I believe that no administrator, save the rare genius, can direct the expert, whereas the expert with trained scientific mind and possessed of a fair measure of administrative ability can direct any but a genius for administration. If the work of a Government office is to be and remain purely administrative, no creative capacity is required, and it may be left in the sure and safe and able hands of the trained administrator; but if the work is to be creative it must be under the direction of minds turned as only research can turn them—in the direction of creativeness. To the technically initiated initiation is easy and attractive, to the uninitiated it is difficult and repugnant. The useful work that such a staff as I have indicated would find to do is well-nigh endless. It would become a bureau of information in national horticulture, and the knowledge which it acquired would be of no less use to investigators than to the industry. Diseases ravage our orchards and gardens; some are known to be remediable and yet persist, others require immediate and vigorous team-wise investigation, and yet continue to be investigated by solitary workers or single research institutions. Certain new varieties of some soft fruits are known to be better than the older varieties, and yet the latter continue to be widely cultivated. The transport and distribution of perishable fruit are often inadequate—"making a famine where abundance lies." The information gathered in during the constant survey of the progress of horticulture would serve not only to direct educational effort into useful channels, but to stimulate and assist research.

The tacit assumption which has so far underlain my address is that an extension of intensive cultivation in this country is desirable. I have indicated that areas are to be discovered where soil and climate are favourable to this form of husbandry, and that by the establishment of a proper form of research—administrative—and educational organisation the already high standard reached by intensive cultivators may be surpassed. It remains to inquire whether any large increase in the area under intensive cultivation is, in fact, either desirable or probable.

The dispassionate inquirer will find his task by no means easy. He should, as a preliminary, endeavour to discern in the present welter of cosmic disturbance what are likely to be the economic conditions of the politician's promised land—the new world which was to be created from the travail of war. In the first place, and no matter how academic he may be, he cannot fail to recognise the fact that costs of production, including labour, are at least twice, and probably two and a half times, those of pre-war days, and he must assume that the increase is permanent and not unlikely to augment. What this means to the different forms of cultivation may be judged from the following estimates of capital costs of cultivation of different kinds:

Labour and Capital for Farming and Intensive Cultivation.

—	Labour per 100 acres.	Capital per acre. Pre-war.	Present.
	Men.	£	£
Mixed Farming	3–5	10	20–25
Fruit and vegetable growing	20–30	50	100–125
Intensive cultivation in the open (French gardening)	200	750	1,500–1,875
Cultivation under glass ...	200–300	2,000	4,000–5,000

In the second place, the inquirer is bound to assume that the intensive cultivator of the future, like his predecessor in the past, will have to be prepared to face the competition of the world.

But, on the other hand, he may find some comfort in the fact that both immediately before and, still more, after the war, the standard of living both in this country and throughout the world was, and is still, rising. Hence he may perhaps expect a less severe competition from foreign growers, and also a better market at home. He may also derive comfort from the reflection that the increased cost of production which he must bear must also, perhaps in no less measure, be borne by his foreign competitors. Even before the war the cost of production of one of the chief horticultural crops—apples—was no higher in this country than in that of our main competitors. There are also certain other apparently minor, but really important, reasons for optimism with regard to the prospects of intensive cultivation. Among these is the increasing use of road in lieu of rail transport for the marketing of horticultural produce. The advantages of motor over rail transport for the carriage of perishable produce for relatively short distances—say up to 75 miles from market—lie in its greater punctuality, economy of handling, and elasticity. Fruit crops ripen rapidly and more or less simultaneously throughout a given district. They must be put on the market forthwith or are useless. A train service, no matter how well organised, does not seem able to cope with gluts, and hence it arises that a season of abundance in the country rarely means a like plenty to the consumer. Increasing knowledge of food values, together with the general rise in the standard of living, also present features of good augury to the intensive cultivator. Jam and tomatoes and primeurs may be taken as texts.

In 1914 the consumption of jam in the United Kingdom amounted to about a spoonful a day per person. The more exact figures are 2 oz. per week, or 126,000 tons per annum. It is difficult to estimate the area under jam-fruit—plums, strawberry, raspberry, currants, etc.—required to produce this tonnage, but it may be put at between 10,000 and 20,000 acres. By 1918, thanks to the wisdom of the Army authorities in insisting on a large ration of jam for the troops, and thanks also to the scarcity and quality of margarine, the consumption of jam had more than doubled. From 126,000 tons in 1914 it reached 340,000 tons in 1918. To supply this ration would require the produce of from 25,000 to 50,000 acres of orchard, which in turn would directly employ the labour of, say, from 5000 to 10,000 men. Yet even the tonnage consumed in 1918 allows only a meagre ration of little more than a couple of spoonsful a day. It may therefore be anticipated that if, as is probable, albeit only because of the immanence of margarine, the new-found public taste for jam endures, fruit-growers in this country will find a considerable and profitable extension in supplying this demand.

The remarkable increase in consumption which the tomato has achieved would seem to support this conclusion. Fifty years ago, as Mr. Robbins has mentioned in his paper on "Intensive Cultivation" (*Journal of the Board of Agriculture*, vol. xxv., No. 12, March, 1919), this fruit was all but unused as a food. To-day the production in this country amounts to upwards of 45,000 tons. Yet the demand for tomatoes has increased so rapidly—the appetite growing by what it feeds upon—that the imports in 1913 from the Channel Islands, Holland, France, Portugal,

Spain, Canary Islands, and Italy amounted to nearly double the home crop, viz. 80,000 tons, making the total annual consumption not less than 1¼ tons, or about 2 lb. per week per head of population. Is it too fanciful to discern in this rapidly growing increase in the consumption of such accessory foodstuffs as jam and tomatoes, not merely an indication of a general rise in the standard of living and a desire on the part of the community as a whole to share in the luxuries of the rich, but also a sign that in a practical, instinctive, unconscious way the public has discovered simultaneously with the physiologists that a monotonous diet means malnutrition, and that even in a dietetic sense man cannot live by bread alone? If, as I think, the increasing consumption of the accessory foods which intensive cultivation provides represents not merely a craving for luxuries, but an instinctive demand for the so-called accessory food-bodies which are essential to health, then it may be expected that, as has been illustrated in the case of jam and potatoes, consumption will continue to increase. If this be so, the demand both for fresh fruit and also for "primeurs"—early vegetables—should grow, and should be supplied, at least in part, by the intensive cultivators of this country.

If the home producer can place his wares on the market at a price that can compete with imported produce—and it is not improbable that he will be able to do so—he need not, even with increased production, apprehend more loss from lack of demand than he has had to face in the past. Seasonal and other occasional gluts he must, of course, expect.

Even when judged by pre-war values, his market, as indicated by imports, is a capacious one. Thus in 1913 the imports into the United Kingdom of products from small holdings were of the value of about 50,000,000*l.* sterling. To-day it is safe to compute them at more than 100,000,000*l.* To that sum—of 50,000,00*l.*—imported vegetables contributed 5,500,000*l.* sterling, apples 2,250,000*l.*, other fruits nearly 3,000,000*l.*, eggs and poultry more than 10,000,000*l.*, rabbits and rabbit-skins 1,500,000*l.*, and bacon and pork more than 22,000,000*l.* No one whose enthusiasm did not altogether outrun both his discretion and knowledge would suggest that the home producer could supply the whole, or even the greater part, of these commodities. But, on the other hand, few of those who have knowledge of the skill and resources of our intensive cultivators, and of the suitability of favoured parts of this country for intensive cultivation, will doubt that a modest proportion, say, for example, one-fifth, might be produced at home. This on a post-war basis would amount in value to more than 20,000,000*l.*, would require the use of several hundred thousand acres of land, and would provide employment for about 100,000 men.

The estimated acreage under fruit in England and Wales is:

	Acres.
Apples	170,000
Pears	10,000
Plums	17,000
Cherries	10,000
Strawberries	13,000
Raspberries	6,000
Currants and gooseberries ...	22,000
	248,000

exclusive of mixed orchards and plantations.

These figures are, however, well-nigh useless as indicating the areas devoted to the intensive cultivation of fruit for direct consumption. Of the 170,000 acres of apples, cider-fruit probably occupies not less than 100,000, and of this area much ground is cumbered with old and neglected trees. Of the 10,000 acres in pears some 8000 are devoted to perry production, and hence lie outside our immediate preoccupation. Having regard, however, to the reduction of acreage under fruit, to the increasing consumption of fruit and jam, and to the success which has attended intelligent planting in the past, it may be concluded that a good many thousand acres of fruit might be planted in this country with good prospects of success.

Lastly, it remains to consider what results are likely to occur if intensive cultivation comes to be more generally practised in this country.

It may, of course, be true that a chance word, a common soldier, a girl at the door of an inn, have changed, or almost changed, the fate of nations, but it is probable that the genius of peoples and the pressure of economic and social forces are more potent. Is there then, it may be asked, any indication that the people of this country will seek in intensive cultivation a means of colonising their own land rather than continue to export their surplus man-power? The problem is too complex and too subtle for me to solve, but I will conclude by citing a curious fact which may have real significance in indicating that if a nation so wills it may retain its surplus population on the land by adjusting the intensity of its cultivation to the density of its population. If a diagram be made combining the intensity of production of a given crop, *e.g.* the potato, as grown in the chief industrial countries of the world, it will be found that the curve of production coincides closely with that of density of population.

Density of Population and Intensity of Production.
Potatoes.

	Density of population square mile.	Percentage of population.	Percentage of yield	Yield in tons per acre less seed. Average 1911-13.
United States	31	10	33	1·3
France	193	62	56	2·2
Germany	311	100	100	3·9
U.K.	374	120	110	4·3
England and Wales ...	550	177	128	5
Belgium	658	212	155	6·04

From these facts we may take comfort, for they indicate that as a population increases so does the intensity of its cultivation: the tide which flows into the towns may be made to ebb again into the country. The rate of return, however, must depend on many factors: the proclivities of peoples, the relative attractiveness of urban and rural life and of life at home and abroad, but ultimately the settlement or non-settlement of the countryside must be determined by the degree of success of the average intensive cultivator. The abler man can command success; whether the man of average ability and industry can achieve it will, I believe, depend ultimately on education. He can look for no assistance in the form of restricted imports. He must be prepared to face open competition. Wherefore he should receive all the help which the State can render; and the measure of success which he, and hence the State, achieves will be determined ultimately by the quality and kind of education which he is able to obtain.

Studies in Animal Inheritance.

ALL students of modern advances in our knowledge of heredity are familiar with Prof. W. E. Castle's experiments in modifying the hooded pattern of piebald rats by continued selection. In a recent Publication of the Carnegie Institution, No. 288, "Studies of Heredity in Rabbits, Rats, and Mice," Prof. Castle describes the results of crossing his selected races with unmodified wild rats, in continuation of his previous work, and announces the conclusion to which he has come. "The same wild race, when its residual heredity is made fully effective by repeated crosses, brings both the *plus*-selected and the *minus*-selected hooded lines to a phenotype of common grade. This shows, contrary to my earlier opinion, that what has really happened in the case of the selected races was more largely due to residual heredity than to any change in the gene for the hooded character itself." In this paper further experiments on the breeding of English and Dutch white-spotted rabbits are also described, the results of which are generally comparable with those obtained from the hooded rats.

The magpie moth (*Abraxas grossulariata*) has been a favourite subject for breeding experiments since Doncaster's memorable demonstration of the sex-linked inheritance of the *lacticolor* colour-aberration. In a recent paper (*Journal of Genetics*, vol. viii., No. 4, 1919) H. Onslow describes the result of crossing with the type the variety *lutea*, in which the ground-colour of the wings is yellow or orange instead of creamy-white, the difference being due to a general deepening of the pigment of the scales. The *lutea* ground-colour is incompletely dominant over that of typical *grossulariata*, so that in the first hybrid generation the colours form a continuous series from white to deep orange, and a plotting of the frequency distribution gives an approximately even "chance" curve. "But the F_2 generation, etc., are at once seen to give curves having more than one maximum caused by the tendency of the colour factors to segregate according to the ordinary Mendelian laws."

In the same number of the *Journal of Genetics* Dr. J. W. W. Harrison continues his series of papers on the hybrid Bistonine moths, dealing especially with what he calls the "stimulus of heterozygosis." His experiments strongly confirm the general belief maintained by Darwin that "cross-fertilisation is a source of strength or of stimulus to metabolic activity"; for he found that among the moths the inheritance of which he studied "the hybrid larvæ were not only emphatically more robust than those of the weaker parent, but they also surpassed in strength and vitality those of the stronger form." Hybrid caterpillars had a very low mortality rate, and they often completed their transformations in an "amazingly short period." Besides discussing the possible intra-cellular causes of these stimuli, Dr. Harrison points out how they may affect the results of breeding experiments on the size and weight factors of such animals as poultry or rabbits. "Any attempted genetic analyses for size purposes which fail to allow for heterozygotic impulses are vitiated and useless."

On the fascinating subject of sex-linked inheritance some new light may come from an extension of Dr. E. Hindle's records of the sexes of series of families of body-lice (*Pediculus humanus corporis*) published in the same number of the *Journal of Genetics*. Three types of family occur, all males, all females, or mixed in which one sex or the other may predominate. The author believes that these results suggest the existence of two types of female and two types of male. The puzzling facts, first noted by Doncaster, respecting coat-colour and sex-inheritance in cats receive further attention and a suggested explanation in a short paper by C. C. Little (*t.c.*, pp. 279–90).

G. H. C.

The Site of the University of London.

WE note with pleasure the decision arrived at by the Senate of the University of London regarding the Government's offer of a site at Bloomsbury. At the meeting of the Senate held on October 20 the report of the Site and Accommodation Committee was adopted, as was also, after a long discussion, the resolution of which we give the full text below. The provisos attached to the acceptance of the offer evince a capacity for keen bargaining and a business mentality not conventionally associated with an academic body. It is to be hoped that they will not in the eyes of the Government constitute an obstacle to the completion of the matter, though it is obvious that some of the conditions will prove difficult in practice. It would be a matter of keen regret if a scheme which has advanced so far should come to grief over any points of detail.

The text of the resolution is as follows:

"That his Majesty's Government be informed that the Senate are prepared to accept the offer made in Mr. Fisher's letter of April 7, 1920, to the Chancellor of the site therein described, gratis and in perpetuity, on the terms as regards the maintenance, rates, etc., of the University headquarters buildings laid down in the Treasury Minutes of February 16 and July 13, 1899, and in Mr. Fisher's letters of June 26, September 24, and October 6, 1920, to the Vice-Chancellor, provided:

"(1) That such grant for maintenance, rates, etc., shall not be counted as a portion of the grants made to universities for educational purposes.

"(2) That the allocation of the site between the various buildings to be erected thereon shall be at the sole discretion of the Senate of the University.

"(3) That the University shall retain and King's College shall retain full possession of their present sites and buildings under the conditions under which they now hold them until such time as the new buildings are ready for occupation and are free from debt.

"(4) That the buildings to be erected for the University headquarters shall be, as regards dimensions and design, in accordance with plans to be agreed upon between the Senate and his Majesty's Treasury, and shall afford not less than 50 per cent. more floor-space than is now allocated in the buildings at South Kensington for the separate use of the University.

"(5) That the terms of the removal of King's College from the Strand to the Bloomsbury site shall be a matter of subsequent negotiation between his Majesty's Government, the Council of King's College, and the Senate of the University, and that an agreement shall be concluded between the said parties.

"And that the Senate, in accepting, subject to the above conditions, the Government's offer of a site in Bloomsbury, assume that the offer does not incidentally involve a policy of curtailing the development of the work of those colleges and schools of the University which are not now, nor in the future will be, situated in the neighbourhood of the Bloomsbury site, and that these institutions will not receive less favourable consideration at the hands of the Government than would otherwise have been the case."

University and Educational Intelligence.

BIRMINGHAM.—At the last meeting of the council profound regret was expressed at the death of Mr. Arthur Godlee, who since 1914 had filled the office of treasurer of the University, and whose death at the present juncture was greatly to be deplored.

The Worcestershire County Council has increased its grant to the University for the current year from 300*l.* to 500*l.*

The following appointments have recently been made:—Mr. T. G. Madgwick, assistant professor in petroleum technology; Mr. Kenneth Neville Moss, assistant professor in coal-mining; Mr. T. Spencer, demonstrator and instructor in petroleum drilling; Miss Nora I. Calderwood and Mr. T. A. Lumsden, assistant lecturers in mathematics; Mr. F. H. Boden, lecturer in machine design; Mr. T. G. Bamford, lecturer in metallurgy; Mr. H. Baker, assistant lecturer in machine design; and Mr. Harold Harris, demonstrator and instructor of assaying.

BRISTOL.—Mr. H. G. Hughes has been appointed assistant lecturer in physics, and Miss G. Gilchrist demonstrator in botany.

The number of full-time day students who have already entered the faculty of engineering this term is 223, as compared with 207 last session.

CAMBRIDGE.—Mr. W. G. Dixon, Downing College, has been re-appointed reader in pharmacology and Mr. S. W. Cole, Trinity College, lecturer in medical chemistry. Mr. T. R. Parsons, Sidney Sussex College, has been re-elected to the Michael Foster research studentship. Field-Marshal Viscount Allenby is to receive an honorary degree on October 29.

Dr. L. E. Shore, St. John's College, and Mr. W. B. Hardy, Gonville and Caius College, have been re-appointed University lecturers in physiology.

The Gedge prize has been awarded to G. E. Briggs, St. John's College, for an essay on "Photosynthesis in Plants."

The Board of Research Studies has recommended to the Senate that degrees of M.Litt. and M.Sc. be established in the University on a two years' post-graduate research course.

EDINBURGH.—The University Court has approved of the minute of the order of the proceedings at the laying of the foundation-stone of the first of the "King's Buildings" by his Majesty the King and the Laureation of her Majesty the Queen on Tuesday, July 6, and directed that it be printed and circulated among the graduates and alumni of the University throughout the Empire and elsewhere, and that an appeal be made for the financial assistance necessary to further the schemes now in progress.

The following appointments have been made to the newly instituted office of reader:—Dr. Cargill G. Knott (applied mathematics), Mr. George G. Chisholm (geography), and Dr. R. Stewart Macdougall (entomology).

The War Office has authorised the utilisation of the estate of Stobs as a forest area in connection with the department of forestry.

LONDON.—A course of three public lectures on "Present Tendencies of Philosophy in America" commences to-day at King's College with a lecture on "New Realism: Its Background and Origin," by Prof. W. P. Montague, professor of philosophy in Columbia University, New York City. The two other lectures will be "New Realism: Its Implication and Promise" (October 29), also by Prof. Montague; and on Monday, November 1, "Pragmatism: Its Right and Left Wings," by Prof. J. E. Boodin, professor in Carleton College, Minnesota. The lectures are at 5.30 p.m., and admission is free without ticket.

Dr. Edwin Deller, assistant secretary of the Royal Society, has been appointed academic registrar of the University in succession to Mr. P. J. Hartog, now Vice-Chancellor of the University of Dacca.

DR. N. MORRIS, assistant to the professor of physiology in the University of Glasgow, has been appointed to the chair of physiology at the Anderson College of Medicine, Glasgow.

A LECTURE on "Eugenics and Religion" is to be delivered at the Wigmore Hall at 5.30 on Tuesday, November 16, by Dean Inge, under the auspices of the Eugenics Education Society.

MR. F. J. HARLOW, head of the department of mathematics and physics at the Sir John Cass Technical Institute, Aldgate, has been appointed principal of the Municipal Technical College, Blackburn, in succession to Dr. R. H. Pickard, now principal of Battersea Polytechnic.

A LECTURE on "Rare Gases in the Atmosphere" will be given by Prof. J. Norman Collie at University College, Gower Street, W.C.1, on Friday, November 19, at 6 p.m., as one of the London County Council's lectures for teachers. The chair will be taken by Mr. A. Chaston Chapman.

A COURSE of twelve free Swiney lectures on geology is announced for delivery by Dr. J. D. Falconer in the geology lecture theatre, Royal School of Mines, South Kensington, on Mondays, Wednesdays, and Fridays, at 5.30, beginning on Monday, November 8. The subject will be "The Modelling of the Earth's Crust."

Societies and Academies.

PARIS.

Academy of Sciences, October 4.—M. Henri Deslandres in the chair.—E. **Picard**: The International Congress of Mathematics at Strasbourg.—The President announced the death of Sir Norman Lockyer, and described the main lines of the scientific work carried out by this distinguished astronomer and correspondant of the Academy.—A. **Lacroix**: A series of alkaline syenitic potassic rocks in sodium minerals from Madagascar.—G. **Bigourdan**: Corrections of the normal time-signals sent out by the Bureau international de l'Heure from January 1 to March 19, 1920. Two types of signal are sent out: ordinary signals for the purposes of navigation, railways, etc., and scientific or rhythmic signals for use in observatories. The corrections for the directing clock are tabulated; those for the time-signals will be given later.—C. **Sauvageau**: The membranes of some algæ (Florideæ) and the setting of the gelosic hydrosol.—M. **Gevrey**: The determination of Green's functions.—T. **Varopoulos**: Some theorems of M. Rémoundos.—J. **Soula**: Generalisation of a theorem of M. Leau relating to the determination of the singular points of a function defined by a Taylor's series.—A. **Bilimovitch**: The intrinsic equations of motion of a solid body.—V. **Vâlcovici**: The hydrodynamical forces in movements differing between themselves by a uniform rotation of space.—J. **Andrade**: The problem of the spiral cylinder.—A. **Vela**: Observations of Nova Cygni. An account of work done on the new star at the Madrid Observatory. Maximum brightness, about 1·4 magnitude, was attained on August 24. A number of spectroscopic observations were made.—J. **Bergengren**: The absorption spectrum of phosphorus for the X-rays.

The substances employed included ammonium phosphate, Bridgemann's black phosphorus, phosphoric acid, and commercial red phosphorus. It was found that the wave-lengths of the limits of absorption were different for the various kinds of phosphorus. This is the first time that the chemical state of an element has been found to have an influence on its X-ray spectrum.—M. **de Broglie** and A. **Dauvillier**: The fine structure of the absorption discontinuities in X-ray spectra. A discussion of some phenomena having a bearing on the results described in the preceding paper by M. Bergengren.—A. **Dauvillier**: The mechanism of the chemical reactions caused by the X-rays. The only mineral substances sensible to the action of the X-rays are crystals for which I. Langmuir, Born and Landé, and Debye and Sherrer have supposed and proved the existence of an ionic structure. All other sensitive substances, colloids, electrolytes, glass, etc., also contain ions. The cause of the chemical actions would thus be due to the destruction of the negative ions, which would lose their electrons under the impact of the rapid electrons constituting the corpuscular radiation. The violet coloration of alkaline glasses, the photo-electric properties of crystals, and the colour-changes in platinocyanide screens are considered from this point of view.—H. **Copaux** and C. **Philips**: The heat of oxidation of beryllium. Direct combustion of the metal in compressed oxygen in the calorimetric bomb gave unsatisfactory results; the combustion of the metal was never complete. The figure required was hence derived indirectly by measuring the heats of solution of the metal and its oxide in dilute hydrofluoric acid. The heat of oxidation, 151·5 calories, was high, and ranges beryllium with calcium (160 calories), lanthanum (148 calories), and magnesium (144 calories).—G. **Denigès**: The microchemical reactions of radium: its differentiation from barium by iodic acid. The usual reagents employed in the microchemical reactions of barium, hydrofluosilicic, oxalic, and tartaric acids, tartar emetic, potassium ferrocyanide, and tartrate give identical results with barium and radium salts. Ammonium cyanurate, ammonium phosphomolybdate in ammonia solution, and potassium bromate, which are also good reagents for barium, give similar crystals with radium compounds. Iodic acid, on the other hand, shows clear differences between the two metals, and reproductions of two microscope-slides are given to prove this. As showing the delicacy of the microchemical method, it is mentioned that all experiments on the reactions of radium were carried out with 0·2 milligram of metallic radium added as the bromide.—R. **Fosse**: The qualitative analysis of cyanic acid.—A. **Lumière** and F. **Perrin**: A new class of hypnotics: the dialkylhomophthalimides. Starting with naphthalene, this is oxidised to phthalonic acid, which reduced by hydriodic acid leads to homophthalic acid, $(CO.OH).C_6H_4.CH_2.CO.OH$, the ammonium salt of which, evaporated to dryness and gently fused, gives the homophthalimide. From this dialkyl derivatives are readily obtained. Used as hypnotics, they possess the advantages of very slight toxic power, and are practically free from unfavourable secondary reactions.—F. **Kerforne**: The tectonic of the Armorican massif.

Books Received.

Die Einsteinsche Relativitätstheorie. By Prof. U. Kopff. Pp. 24. (Leipzig: Greszner und Schramm.) 1.25 marks.

"A New Activity?" A Treatise on Mrs. Dickinson's Discovery of a "New Radio-Activity." By Frank A. Hotblack. Pp. ix+195+plates. (London: Jarrolds, Ltd.) 10*s*. 6*d*. net.

Studies in Fossil Botany. By Dr. D. H. Scott. Third edition. Vol. i., Pteridophyta. Pp. xxiii+434. (London: A. and C. Black, Ltd.) 25*s*. net.

Slide-Rules and How to Use Them. By T. Jackson. Pp. 30. (London: Chapman and Hall, Ltd.) 1*s*. 6*d*. net.

Magic in Names and in Other Things. By E. Clodd. Pp. vii+238. (London: Chapman and Hall, Ltd.) 12*s*. 6*d*. net.

Œuvres complètes de Christiaan Huygens. Tome Quatorzième. Calcul des Probabilités. Travaux de Mathématiques Pures, 1655–1666. Pp. v+557. (La Haye: M. Nijhoff.)

Practical River and Canal Engineering. By R. C. R. Minikin. Pp. vii+123+xii plates. (London: C. Griffin and Co., Ltd.) 12*s*. 6*d*.

Animal Life in South Africa. By S. H. Skaife. Pp. x+281. (Cape Town: T. Maskew Miller; Oxford: B. Blackwell.) 15*s*. net.

Mechanismus und Physiologie der Geschlechtsbestimmung. By Prof. R. Goldschmidt. Pp. viii+251. (Berlin: Gebrüder Borntraeger.) 32 marks.

Fifteenth Annual Report of the Meteorological Committee to the Lords Commissioners of His Majesty's Treasury for the Year ended March 31, 1920. (Cmd. 948.) Pp. 88. (London: H.M. Stationery Office.) 9*d*. net.

Electric Switch and Controlling Gear. By Dr. C. C. Garrard. Second edition. Pp. xxii+654. (London: Benn Bros., Ltd.) 25*s*. net.

Landscape Architecture. By Prof. H. V. Hubbard and T. Kimball. Pp. 132. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press.) 6*s*. 6*d*. net.

The Elder Edda and Ancient Scandinavian Drama. By Dr. B. S. Phillpotts. Pp. xi+216. (Cambridge: At the University Press.) 21*s*. net.

Hittite Seals. By D. G. Hogarth. Pp. xi+108+10 plates. (Oxford: Clarendon Press.) 3*l*. 13*s*. 6*d*. net.

The Flowering Plants of South Africa. Edited by Dr. I. B. Pole Evans. Vol. i., No. 1. (London: L. Reeve and Co., Ltd.) 10*s*.; hand-coloured plates, 15*s*.

Relativitätstheorie und Erkenntnis Apriori. By H. Reichenbach. Pp. v+110. (Berlin: J. Springer.) 14 marks.

The Second Danish Pamir Expedition. Conducted by Lt. O. Olufsen. Studies in the Vegetation of Pamir. By O. Paulsen. Pp. ix+132. (Copenhagen: Gyldendalske Boghandel.)

Psychologie du Raisonnement. By E. Rignano. Pp. xi+544. (Paris: F. Alcan.) 18 francs.

The Sun a Habitable Body like the Earth. A Book on Solar Physics. By Sree B. Raha Dass. Pp. xiv+130. (Calcutta: Thacker, Spink and Co.)

Medical Research Council and Department of Scientific and Industrial Research. Reports of the Industrial Fatigue Board. No. 9. A Study of Output in Silk Weaving during the Winter Months. (Textile Series, No. 3.) Pp. 69. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

The Civil Servant and his Profession. A Series of Lectures delivered to the Society of Civil Servants in March, 1920. Pp. viii+124. (London: Sir I. Pitman and Sons, Ltd.) 3*s*. 6*d*. net.

The Determination of Hydrogen Ions. By Dr. W. M. Clark. Pp. 317. (Baltimore, Md.: Williams and Wilkins Co.) 5.50 dollars.

The Groundwork of Modern Geography. By Dr. A. Wilmore. Pp. xv+396+xxvii plates. (London: G. Bell and Sons, Ltd.) 6*s*. net.

A First Course in the Calculus. By Prof. W. P. Milne and G. J. B. Westcott. Part ii.: Trigonometric

and Logarithmic Functions of X, etc. With Answers. Pp. xv+181–402+xv–xxxix. (London: G. Bell and Sons, Ltd.) 5s.

Plantation Rubber and the Testing of Rubber. By Dr. G. S. Whitby. Pp. xvi+559+viii plates. (London: Longmans, Green and Co.) 28s. net.

The Centenary Volume of Charles Griffin and Company, Ltd., Publishers, 1820–1920. With Foreword by Lord Moulton. Pp. xx+290+plates. (London: C. Griffin and Co., Ltd.)

Diary of Societies.

THURSDAY, OCTOBER 28.

CHEMICAL SOCIETY (at Institution of Mechanical Engineers), at 8.—Dr. M. O. Forster: The Emil Fischer Memorial Lecture.

ABERNETHIAN SOCIETY (at St. Bartholomew's Hospital), at 8.30.—Sir St. Clair Thomson: Recollections of Joseph Lister by one of his House-surgeons.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—Sir Thomas Horder: The Treatment of Sub-acute Nephritis by Decapsulation; with an Account of Four Cases.—V. Bonney: A New Operation for Nephroptosis.

FRIDAY, OCTOBER 29.

ROYAL GEOGRAPHICAL SOCIETY (at the Æolian Hall), at 5.—T. A. Barns: In the Land of the Okapi and the Gorilla.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Keith: Demonstration on the Contents of the Museum.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. W. Bennett: Winchester: The Cathedral, the School, and the Hospital of St. Cross.

CHEMICAL INDUSTRY CLUB (at 2 Whitehall Court), at 8.—Annual Meeting.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.30.—Dr. A. K. Chalmers: The Function of the Isolation Hospital in a General Scheme of Hospital Provision.

MONDAY, NOVEMBER 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. S. G. Shattock: Demonstration of Pathological Specimens in the Museum.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

INSTITUTE OF BREWING (at Imperial Hotel, Russell Square), at 8.—A. F. Baillie: The Use of Oil Fuel in Breweries.

SOCIETY OF CHEMICAL INDUSTRY (at Institution of Mechanical Engineers), at 8.—Sir William J. Pope: The Photography of Coloured and of Distant Objects.

TUESDAY, NOVEMBER 2.

ROYAL HORTICULTURAL SOCIETY, at 3.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Sir William B. Leishman: An Experimental Investigation of the Parasite of Tick Fever, *Spirochaeta Duttoni* (Horace Dobell Lecture).

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—J. A. Brodie: Presidential Address.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—J. H. Lloyd: Some Observations on the Structure and Life-history of the Common Nematode of the Dogfish (*Scyllium canicula*).—Mrs. O. A. Merritt Hawkes: Observations on the Life-history, Biology, and Genetics of the Lady-bird Beetle, *Adalia bipunctata*, Mulsant.—Haru Ram Mehra: The Sexual Phase in certain Indian Naididæ (Oligochæta).—E. A. Barnes: In the Land of the Gorilla and Okapi.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Capt. C. W. R. Knight: Heronry.

RÖNTGEN SOCIETY, at 8.15.

WEDNESDAY, NOVEMBER 3.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Miss M. E. J. Chandler: The Arctic Flora of the Cam Valley at Barnwell, Cambridge.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—Dr. W. R. Schoeller and E. F. Waterhouse: The Gravimetric Estimation of Bismuth as Phosphate and its applications in Ore Analysis.—P. J. Fryer: The Time Factor in Saponification.—V. Cofman: The Position of Analytical Chemistry in France.—W. T. Burgess: Apparatus for collecting Samples of Water at Great Depths.

THURSDAY, NOVEMBER 4.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Prof. H. Lamb: The Vibrations of an Elastic Plate in Contact with Water.—Prof. H. M. Macdonald: The Transmission of Electric Waves around the Earth's Surface.—Lord Rayleigh: A Re-examination of the Light scattered by Gases in respect of Polarisation. II. Experiments on Helium and Argon.—Prof. C. F. Jenkin: Dilatation and Compressibility of Liquid Carbonic Acid.—W. T. David: Radiation in Explosions of Hydrogen and Air.—Dr. R. E. Slade and G. I. Higson: Photochemical Investigations of the Photographic Plate.—Dr. E. H. Chapman: The Relationship between Pressure and Temperature at the same Level in the Free Atmosphere.—Prof. J. C. McLennan: Note on Vacuum Grating Spectroscopy.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. R. C. B. Wall: Chorea (Bradshaw Lecture).

LINNEAN SOCIETY, at 5.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Wing-Comdr. Flack: The Human Machine in Relation to Flying.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Mrs. S. S. Brierley: Discussion on Vocational Tests.

CHEMICAL SOCIETY, at 8.—L. Higginbotham and H. Stephen: The Preparation of 4-, 5-, and 6-Methyl-coumarin-2-ones, and some Derivatives of *o*-, *m*-, and *p*-Tolyloxyacetic Acids.—H. Stephen: A New Methid for the Preparation of 2:4-Dihydroxy- and 2:4:4′-Trihydroxy-benzophenone, and some Observations relating to the Hoesch Reaction.—W. J. Pope and E. E. Turner: Triphenylarsine and Diphenylarsenous Salts.—R. H. Atkinson, C. T. Heycock, and W. J. Pope: The Preparation and Physical Properties of Carbonyl Chloride.—H. W. Bausor, C. S. Gibson, and W. J. Pope: Interaction of Ethylene and Selenium Monochloride.—G. Van B. Gilmour: A Study of the Reactions of Sugars and Polyatomic Alcohols in Boric Acid and Borate Solutions, with Some Analytical Applications.—F. L. Pyman and L. A. Ravald: The Sulphonation of Glyoxalines.—F. L. Pyman and L. A. Ravald: *o*- and *p*-Tolueneazoglyoxalines.—M. E. Laing and J. W. McBain: Investigation of Sodium Oleate Solutions in the Three Physical States of Curd, Gel, and Sol.—J. C. Irvine and E. S. Steele: The Constitution of Polysaccharides. Part I. The Relationship of Inulin to Fructose.—B. E. Hunt: The Preparation of Ethyl Iodide.—R. C. Menzies: Action of Sulphur Trioxide on Aromatic Ethers.—G. T. Morgan and H. D. K. Drew: Researches on Residual Affinity and Co-ordination. Part II. Acetylacetones of Selenium and Tellurium.—R. B. Drew: The Formation of 2:3:6-Trinitrotoluene in the Nitration of Toluene.—J. N. E. Day and J. F. Thorpe: The Formation and Reactions of Imino-compounds. Part XX. The Condensation of Aldehydes with Cyanoacetamide.—O. Becker and J. F. Thorpe: The Formation and Stability of Spiro-compounds. Part III. Spiro-compounds from Cyclopentane.—H. Chattopadhyaya and P. C. Ghosh: Condensation of Dimethyldihydroresorcin with Aromatic Aldehydes.—E. B. Maxted: The Influence of Lead on the Catalytic Activity of Platinum.

FRIDAY, NOVEMBER 5.

ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science), at 2.30.—Prof. F. W. Oliver: The Reclamation of Waste Land by Botanical Means.—Dr. E. J. Russell: The Reclamation of Waste Land by Agricultural Means.

GEOPHYSICAL COMMITTEE (Royal Astronomical Society), at 5.—Discussion on the African Arc and Meridian, to be opened by Col. H. G. Lyons, and continued by Sir Charles Close, Col. E. M. Jack, A. R. Hinks, C. G. T. McCaw, and others.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Sir Richard T. Glazebrook: Limit Gauging (Thomas Hawksley Lecture).

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