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The Research Department.

THE sixth Report of the Committee for Scientific and Industrial Research,[1] which was recently issued, deals with a number of matters of scientific importance. It seems but a short time since the establishment of the Department, described in the pages of NATURE for May 20 and July 29, 1915, or the deputation to Lord Crewe, at which the promise of the million fund for the endowment of industrial research was made, and Sir J. J. Thomson pointed out the importance of fostering research in pure science, which, as he said, might lead to a revolution of methods, while from industrial research we could only hope for a reformation of details in method or procedure.

The Report before us naturally falls into three sections: (1) The report to his Majesty in Council of the Committee of Council; (2) the report to the Committee of Council of their Advisory Council; (3) details of the work of the various research boards and committees established under the scheme, including a list of publications both of the Department and of individuals in receipt of grants.

The Committee of Council, like the Board of Trade, has a somewhat shadowy existence. The only names which appear in the Report are those of Mr. A. J. Balfour, the Lord President, and Sir Frank Heath, the secretary. A list of the original Committee is given in the White Papers issued by Mr. Arthur Henderson when President of the Board of Education in 1915 (NATURE, vol. 95, p. 604). Since that date the direct connection between the Committee and the Board of Education has been severed.

The Report to his Majesty is naturally a somewhat formal document; it gives details of the expenditure in various directions—*e.g.* there are now twenty-six research associations, and the total expenditure in grants to these was 74,557*l.* 1*s.* 2*d.*; the balance of the million fund unexpended at March 31 was 903,205*l.* 8*s.* 10*d.*, but it is stated that "of this sum a large percentage has already been earmarked for prospective commitments to associations already formed." In view of the financial stringency, it was arranged last year that a considerable portion of the income from this fund should be appropriated in aid of the vote of the Department. The amount so utilised was about 38,000*l.* This is an arrangement which, in present circumstances, may be necessary, but is not desirable.

Turning now to (2), the Report of the Advisory Council, it is of interest to repeat from the White Paper already quoted the primary functions of the Council. They are to advise the Committee of Council on:

(i) Proposals for instituting specific researches.
(ii) Proposals for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades.
(iii) The establishment and award of research studentships and fellowships.

To these must be added another important matter, outlined in last year's Report, which has taken effect during the year under review, viz. the establishment of co-ordinating boards to organise work which is of common interest to the fighting Services of the Crown. In addition to co-ordinating the work in the various Departments, it is the duty of the boards "to arrange for researches for which inadequate provision is made."

Four boards have been appointed to deal respectively with chemistry research, engineering research, physics research, and radio research. They comprise representatives of the Services and independent men of science, and an interesting account is given of their work, "which, up to the present, has been that of preparation rather than

[1] Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1920-21.

of achievement." The task before the boards is not an easy one; in most cases they can only give advice, though where a research is financed by a board they have more power, and success depends on the friendly co-operation established between the board and those in charge of the work at the various departmental laboratories. The officers of the boards are fully aware of this, and the relations which have been established are thoroughly satisfactory.

Turning now to the research associations established under clause (ii) of the original scheme as special institutions "for the scientific study of problems affecting industries and trades," there are, as has already been stated, twenty-six of these. The Report gives an account of the work of some, and of these perhaps the most important is the British Cotton Industry Research Association shortly to find a permanent home at Didsbury, near Manchester. Its programme of research directs attention to two possible lines of advance:

"(1) To attack problems directly by methods based on past experience without seeking to investigate the fundamental nature of the process.

"(2) To try to understand the chemical and physical changes produced during manufacture, and so to establish gradually a broad roadway along which future advances may be made."

The Cotton Association proposes to seek the advance of the industry mainly by the second line. Its directors have realised the necessity of fundamental research, a matter to which we return below, but this recognition is apparently not shared by all the associations, for a warning given in the last Report against the short-sighted policy of confining research associations to the search for results of immediate commercial value is repeated.

The actual results achieved by the twenty-six associations are somewhat meagre, but three years, the time which has elapsed since the first was founded, is too short a period in which to expect much of fundamental value. The Council point out that it is premature to look to the research associations yet for convincing proof of the effectiveness of co-operative industrial research, and with this view there will probably be general agreement. Still, there are difficulties to be surmounted. Among them one discussed at one of the conferences of associations held at the Department is of great importance: To what extent may an association undertake for its members work of a kind hitherto carried out by the professional analyst or testing engineer? The view was urged by some that consulting work was of definite value to the progress of research, while another association felt that research should only be carried to the initial stage of practical application, the individual firms being left to work out the method of applying the new knowledge to their own particular problems. On this point one may ask the question, Can they do it? Much depends, no doubt, on the problem; in any industry there are probably a number of large firms with their own scientific staffs who have ample opportunity for working out the details of a new process, and it is likely that this can be done to greater advantage in the works than in the research association laboratory. But this does not apply to the small firms to be found in large numbers in any industry, which, if the association is to benefit the trade, must be brought in and given the means of utilising the results. Experience shows that a process has to be carried a long way before it can be usefully applied by such firms, and while this is not the same as undertaking consulting work, it must be carried out at the laboratory of the association. It will be found, no doubt, in the long run, that no rigid rule can be laid down. Each association must work out for itself the problem of combining pure research with industrial practice.

This naturally leads to a consideration of the steps the Council is taking to encourage pure research dealt with under (i) and (iii) of the original scheme, though, did space permit, much more might be written about the work of the other committees and boards of the Department. Encouragement is given (*a*) by financing specific researches carried out by competent men, and (*b*) by research studentships. The applications for grants are divided into those (1) for students in training, (2) for research workers or research assistants, (3) for laboratory or clerical assistants, and (4) for equipment.

The applications numbered 333 in all, of which 245 were granted, 36 refused, and 52 referred elsewhere. Of the 245 granted, 132 went to students in training and 70 to research workers or assistants; of the 132 students in training, 95 are engaged in chemical work, but comparatively few of these, we may surmise, are doing fundamental research; they have not yet reached the stage at which this is possible, being still "in training"; some few may in time become research workers and add to the

stock of fundamental knowledge. Further details are given in appendix 2, while in appendix 3 we have a list of aided researches; scarcely one of these deals with work in pure science; they include glass technology, the corrosion of condenser tubes, the flow of steam through nozzles, and other similar investigations of an industrial character. An exception should be made in the case of the work on tides now in active progress at Liverpool University, but here, too, the results have a direct industrial bearing. On the other hand, appendix 4—publications by individuals in receipt of grants—does contain a number of papers of the greatest importance to pure science—*e.g.* Dr. F. W. Aston on "Mass Spectra and Atomic Weights"; Sir Ernest Rutherford, "The Nuclear Constitution of Atoms" and "The Mass of the Long-range Particles from Thorium-C," with many others of less striking merits—while an interesting list is given on p. 73 showing the wide range of science covered by the papers. It appears that during the year under review a sum of 40,850*l.* was spent on these grants, while provision is made for the expenditure of 50,000*l.* during the current year, but by no means all of this was for the advancement of pure research, and the criticism may be made that, compared with the amounts available for industry, the sum devoted to pure research is but small.

Yet it is difficult to see how it could be greatly different. The men capable of original research in pure science are limited in number. We have long known that *Poeta nascitur non fit* and poetry and original discovery have much in common. Imagination of a high order, combined with skilled training and a real grasp of essential principles, the love of knowledge for its own sake, the readiness to pursue it whithersoever it may lead, and the opportunity to do this when the exceptional man is found, are all required. The opportunity implies freedom from too much pure routine and financial worries. The best course the Advisory Council can adopt is to see that all those who have shown the incipient signs of this ability should have the opportunity and the freedom. The Council realises this in theory; it was pointed out in the Report for last year that "no conditions are attached to the grants made to workers whose sole aim is the extension of knowledge either as to the line of their work or as to the use to be made of their results." If a discovery is to be made use of commercially, application must be made to the Department.

This is as it should be, but it is almost equally important that the same principle should apply to work done for the research associations or in the various laboratories controlled or aided by the Department. It is impossible to evaluate pure research on principles which apply to a works, or even to a works laboratory engaged mainly on routine testing and the examination of products. There is a real danger lest the time of men thoroughly competent to carry out fundamental investigations of high value should be absorbed in serving tables, in compiling details of the hours and minutes spent on this or that job, or in writing minutes in reply to official inquiries. It is difficult, no doubt, for a Government Department to avoid this; there are Treasury rules to be followed, but the error comes in the attempt to apply these rules to conditions for which they were never intended.

It should be noted, however, as the Council itself points out, that the funds which it administers in grants to workers mainly at the universities are only a small portion of the sum contributed by the State through other agencies to university education and research. It is not the business of the Council to pay professors and teachers. It can make grants only for individual pieces of work, and this function we may fairly hope it will discharge when once convinced of the importance of the work and the capacity of the worker, with a broad faith and without too narrow an inspection of details.

The Report covers much ground, and much more could be written about it, but space forbids. One matter, however, mentioned at the end, must be noticed. The results of research become known through the publications of the scientific societies, and many societies are in a difficult position financially, and find it impossible to make both ends meet. The matter has been considered by the Conjoint Board of Scientific Societies, but it moves slowly; still, it is intended that a statement of the case should be presented in the near future to the Treasury. The Council had referred to the matter in the Report for last year, and it now states:

"We have learned with satisfaction that action has already been taken by the scientific societies on the lines suggested in our Report of last year, and should they apply for, and receive, Government aid through the Treasury under a well-thought-out scheme, we should welcome the removal of a serious obstacle to the progress of science in this country."

Gas Warfare.

Chemical Warfare. By Brig.-Gen. Amos A. Fries and Major C. J. West. Pp. xi+445. (New York and London: McGraw-Hill Book Co., Inc., 1921.)

IT is earnestly to be hoped that every British man of science will take the opportunity of studying this account of chemical warfare prepared by Brig.-Gen. Fries and Major West, of the United States Army. He will then be able to make up his mind, knowing the facts, as to the possibility of eliminating gas warfare by edict or mutual consent while war itself remains a possibility as before. Having answered this implied question, he must needs ask himself what is his own particular responsibility in the matter.

The need for propounding these questions is undoubted. Recent protests by certain eminent chemists, directed against the organisation of research for chemical warfare purposes, make it clear that considerable divergence of opinion exists as to the *rôle* which should be adopted by men of science in maintaining international peace. On one hand is the desire to withdraw all semblance of support from the perpetuation of what is regarded as a peculiarly inhumane method of waging war. On the other is the belief that, whatever we do, chemical warfare has come to stay; that peace and our national security will best be safeguarded by placing ourselves at least on an equality with our neighbours as regards the new warfare; and that, since, if we wish peace, we must be ready to fight for it, the man of science must shoulder his burden and prepare to become the military arbiter of the future. It is the old political battle of armaments transferred to the scientific arena.

In these circumstances, therefore, we are exceedingly fortunate in having the facts of chemical warfare placed before us so completely and clearly from an outside source. In Fries and West's book there is little of special pleading beyond that of military exigency. It supplies a full—indeed, a most astonishingly full—account of gas warfare in general, and, in particular, the part played by the United States in building up what was eventually the largest chemical warfare service of any of the belligerent nations.

It is highly significant, too, of the present position in America that the veil is withdrawn for the first time from many of the most carefully guarded chemical warfare secrets of the past. For example, a whole chapter is devoted to the thermal production of particulate clouds. Side by side with these frank disclosures are the following statements—the first, in the foreword, by Major-Gen. W. S. Sibert, General Fries's distinguished predecessor as Chief of the Chemical Warfare Service in America; the other in the body of the book:—

"There is no field in which the future possibilities are greater than in chemical warfare, and no field in which neglect to keep abreast of the times in research and training would be more disastrous."

"Poison gas in the World War proved to be one of the most powerful of all weapons of war. For that reason alone it will never be abandoned. It cannot be stopped by agreement. . . ."

From the considered inclusion of such opinions in a book redolent with disclosure only one conclusion can be drawn.

The United States Chemical Warfare Service was built up almost wholly on the foundations of British practice and experience. To this fact and to the subsequent intimate relations between the two services Fries and West pay generous tribute. As to the magnitude of the American organisation, its success in every branch and its clear-sighted vision, facts are allowed to speak for themselves. Owing to the cessation of hostilities the full extent of the American chemists' great effort was probably never generally realised in England, and only partially, perhaps, even in the inner circles of the War Office and the Ministry of Munitions. Yet it was unquestionably one of the greatest achievements of the war. Starting literally from nothing, the Americans within nine months elaborated a service in which research, manufacture, training, and field organisation were brought to the highest pitch of efficiency. In Washington the research department under Burrell mustered a chemical *personnel* of 1200, which included men of international reputation such as Wilder Bancroft, Hulett, W. K. Lewis, and Tolman. It is small wonder, therefore, that some very fine work was accomplished.

It is, however, by a consideration of Edgewood Arsenal that the full extent of the American chemical warfare effort can best be gauged. Built on an isolated tract of country in Maryland, this poison-gas factory attained a magnitude which is simply staggering. By October, 1918, it employed 10,247 men, and was successfully making chloropicrin, phosgene, mustard gas, bromobenzylcyanide, and other accessory chemicals, and was in a position to turn out 100 tons of liquefied chlorine a day. As a feat of chemical engineering alone it must be almost unique. As an indication of what can be accomplished without recourse to

existing plant it gives one food for considerable thought.

The success of Edgewood Arsenal and the gas mask factories was due in no small measure to the inauguration of a development division intermediate between the Research Department and the manufacturing plants. The difficulties attending large-scale production were overcome in the single-unit plants of the development section, and the results obtained immediately transferred to Edgewood and the subsidiary factories spread up and down the country. Only in this way was it possible to maintain throughput at its maximum and avoid the time- and labour-consuming hindrances notoriously attendant on the alteration of existing plant or the installation of new. It is a procedure heartily to be commended to many of our own industrial concerns, where much good research is wasted by inability of the works to cope with difficulties which could well be overcome by experimentation on full-sized units.

Of course, even in America, the enormous chemical warfare organisation did not come into being without attendant inefficiencies. General Fries points out the difficulties he encountered in having his cabled demands from the Expeditionary Force attended to (did he but know it, he was no worse off in this way than the British, who were fighting almost at their own door). This was due to a lack of co-ordination between the numerous extensive divisions of the service, each of which had grown up separately. Eventually a Chief of the Chemical Warfare Service was appointed, but in the interim the various separate activities were held together only by the personal efforts of William H. Walker, of the Massachusetts Institute of Technology. General Fries and Major West are not sufficiently appreciative of Walker's efforts during this disquieting period. In service to his country Walker accomplished in this unofficial co-ordination something even greater than his subsequent organisation and control of Edgewood Arsenal. Without him General Fries and the American Expeditionary Force would have had to remain dependent for supplies on Britain for many months longer than they did.

The book is full of information of a technical nature previously denied to the average man of science, and even without its clarity and illuminating illustrations would hold the reader enthralled from start to finish. It is a fine compilation and a great tribute to American chemists. Its publication can do nothing but good in throwing light on a subject of ever-increasing international importance. Its extensive sections, dealing with the legitimacy of gas warfare and its possibilities in the future, are highly stimulating, but must be read in conjunction with the remainder properly to be appreciated. Sufficient has been quoted above to indicate the authors' views on the subject.

No British notice of "Chemical Warfare" would be complete without reference to the now notorious "Lewisite." Whatever the British views as to the war value of chlorovinyldichloroarsine, the fact remains that the Americans rated, and still rate, it very highly indeed. It was under the strictest pledges of official secrecy that its nature and mode of preparation were imparted to the British Government. It is therefore most disquieting to find it made the subject of a communication to a scientific society without express permission being obtained from the real owners of the secret. As the communication was sanctioned by the War Office, there would appear to be two explanations required—one from the military authorities, and the other from the authors of the paper referred to. Doubtless some satisfactory explanation can be given of this "unfortunate, or otherwise" (Fries and West), occurrence, but the Official Secrets Act, our friendly relations with foreign Governments, and respected procedure regarding scientific publication, all appear to be involved. S. J. M. A.

Zoology for Medical Students.

Zoology for Medical Students. By Prof. J. Graham Kerr. Pp. x+485. (London: Macmillan and Co., Ltd., 1921.) 25*s*. net.

SUCH a title challenges attention not merely as a scientific work but as a confession of faith. It is the *credo* of one of our younger men on education at this moment when there is nothing else of such importance. A huge and undigested heap of students has been shovelled into our universities by the combined pressure of war arrears and Government subsidies (8,000,000*l*. sterling is to be spent first and last by the Treasury alone on University courses for ex-officers). These men are our inevitable masters in the decade to come. Thus vital are the principles on which Prof. Graham Kerr decides to cultivate his garden.

The professor of zoology in Scotland has a dreadful task. In ten short weeks he has to expound and classify all the innumerable combinations of living matter. In addition he has to break in to the life of a university a class of many scores—sometimes of hundreds—of last year's secondary schoolboys. The biology of the first-year medical student has to unfold its

broadest sweep when he is least capable of receiving it.

The 485 pages of reading matter and line drawings give the conspectus of the animal kingdom which it is hoped such a one may carry away. Prof. Graham Kerr in his preface sets himself three tasks: (1) To awaken and develop . . . interest in biological science. (2) To lay an adequate foundation for the superstructure of detailed knowledge of the animal body. (3) To provide a reasonably up-to-date account of the more important animal parasites, especially of the pathogenic microbes of animal origin.

The course represented by this book is preponderatingly morphological. The writer holds not only that our knowledge of the morphological features of the lower types of animal is much more advanced than our knowledge of their physiology, but also that morphological study affords a better intellectual discipline than physiological:

"The student observes structural features in the laboratory . . . and he is able to compare what he observes with what he is told or reads. When he tries to make physiological observations he finds even in the case of the simplest phenomena that behind these phenomena are at work factors, so far as he is concerned, transcendental and as far beyond his powers of criticism and comprehension as if they were the direct result of supernatural agency."

The only quarrel a student could have with the book is one which it shares with so many scientific works—that it is all so true. Few things are more devastating to the unformed mind than first contact with the vast mass of knowledge which the ant-like industry of man has piled up through the last three centuries. When the process of selection is also hidden, and the innumerable errors by which we have arrived at truth, the student is apt to think that those who have taught him so much can teach him all. His faculty of scepticism, before the brute mass of all this verity, lies down baffled, and his powers of disbelief are not reawakened for years, or for ever. The intellectual stimulus of finding a great clinician out-faced and routed at a post-mortem should not, even for the earliest years, be neglected if in any fashion it can be reproduced in zoological lecture-room or laboratory.

Therefore, although the anatomy of the higher vertebrates has been excluded from the course and the mass of detail pruned vigorously, one would plead for still further selection. By a glance at the countless mistakes of the past the investigator of the future will be encouraged. One would beg the teacher, in delivering that cataract of certainty which batters on the head of the first-year student, to remind him not only of the rightness but of the wrongness of the theories of the past, that he may pluck up heart to question those which now are current.

The book is well printed, and the line drawings are numerous and comprehensible. For examination purposes the summaries ending each chapter will prove of great value. The chapter on the Flagellata and that on the Crossopterygii are of special interest in view of the work done in these two fields by the Glasgow school.

The Study of Rocks.

Petrographic Methods and Calculations, with some Examples of Results Achieved. By Dr. A. Holmes. Pp. xix+515+4 plates. (London: Thomas Murby and Co., 1921.) 31*s.* 6*d.* net.

DR. HOLMES has produced a text-book that is likely to have a far-reaching and beneficial effect in promoting the intelligent study of rocks. Some scientific treatises are patient compilations of the common stock of theories and facts current among specialists in the subject treated. If they are at least fairly accurate and reasonably up-to-date and complete they may be of great use to the student and research worker, even if they contain little or nothing that is original or novel. Others strike out a new and independent line of their own, and deal only with certain aspects of the subject on which the author feels he has a message to deliver. These, of course, have a value of their own, though they are not available as text-books or as works of reference.

The special characteristic of the work under review is the keenness of Dr. Holmes's outlook for fresh ideas in every department of his subject. Sometimes he has evolved them for himself, sometimes he has added new developments of his own to the methods that he has met with in his unusually wide reading. He even succeeds in making the well-worn subject of specific gravity interesting, and embodies much American work that has recently been published, as well as his own experience in the investigation of building stones. In dealing with the procedure for the separation of rock minerals, he does full justice to the advances that have been made in this country in the last few years. His novel diagrams showing at a glance the refractive indices and bi-refringence of minerals are remarkably successful in giving an idea of their relations to one another and the variations that occur. The chapter on microchemistry should prove very useful, and

his advice on the examination of thin sections and the description of rocks is excellent.

We cannot agree with his adoption of the meanings attached by Prof. Shand to the terms "saturated" and "unsaturated" as applied to minerals and rocks, meaning saturated or unsaturated with silica. It is always undesirable, we think, to take a recognised word, especially one with a definite scientific meaning already attached to it, and employ it in a more restricted sense. Perhaps the most valuable chapters in the book are those on the interpretation of analyses and their representation by diagrams. We could have wished, perhaps, that greater space could have been given to the subject of the crystallisation of magmas, but this could have been effected only by an increase in the size and cost of the book.

It is to be regretted that this work was completed before the issue of the report of the Joint Committee of the Geological and Mineralogical Societies on Petrological Nomenclature, to which Dr. Holmes, who was a member of the committee, gave most valuable assistance. It is very desirable that the use of technical terms in petrology should be standardised, at any rate so far as this country is concerned.

J. W. EVANS.

Our Bookshelf.

Insect Pests of Farm, Garden and Orchard. By E. Dwight Sanderson. Second Edition. Revised and enlarged. By Prof. L. M. Peairs. Pp. vi+707. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 26*s.* net.

THE first edition of the author's "Insects Injurious to Staple Crops" was published ten years ago. The advances made during the past decade have been such that it was considered necessary to rewrite practically the whole book. In its present form it covers all the more important insects affecting the crops of the farm, garden and orchard, besides including two final chapters on household insects and the pests of domestic animals. The work aims at giving a clear idea of the life-history and habits of every species concerned and the best methods of control. There are also chapters on insecticides and spraying and dusting apparatus. It is profusely illustrated, the text-figures numbering more than 600, and with few exceptions they are of a uniform level of excellence. References in the form of footnotes guide the more inquisitive reader to many of the separate bulletins and articles on individual pests.

Notwithstanding the number of text-books on economic entomology which have appeared in America, the present work will undoubtedly occupy a high place in their ranks. Its comprehensiveness is truly remarkable and, in fact, it is difficult to quote any similar work which compresses so much well-sifted information, and so many good illustrations, within an equally convenient compass. Chap. 3, however, which deals with the structure and development of insects, is rather inadequate. In the first place it should have preceded chap. 2, which treats of beneficial insects. As it stands, the practical grower will have to read chap. 3 first if he is to understand properly the remarks in the preceding chapter. In the second place, a brief account of the principal orders of insects might have been added with advantage, even if at the expense of an additional page. But these points are comparatively trivial in what can be regarded unhesitatingly as an all-round first-rate practical book on insect pests. A. D. IMMS.

Department of Applied Statistics (Computing Section), University of London, University College: Tracts for Computers. Edited by Karl Pearson. No. 6, *Smoothing.* By E. C. Rhodes. Pp. 60+3 diagrams. (London: Cambridge University Press, 1921.) 3*s.* 9*d.* net.

THE methods of graduating or "smoothing" a series of more or less irregular data affected by errors of observation or of sampling have of recent years received a good deal of attention; the present tract is a very valuable contribution to the subject. New methods are developed, which may be described as combinations of tangential or osculatory interpolation with the least-square method of Dr. Sheppard, and these and older methods are compared, both graphically and by finding the sum of the squares of the departures from the graduated curve. The results of this test are rather surprising. The osculating methods used give distinctly worse results than the other four methods employed. By grouping the observations it is possible to estimate what order of differences is negligible; if a higher order of differences is employed, the resultant curve tends to bring out something that is not inherent in the data, with very unsatisfactory consequences to the fit obtained.

North England: An Economic Geography. By L. R. Jones. Pp. viii+256. (London: G. Routledge and Sons, Ltd., 1921.) 6*s.* net.

THERE is a distinct need for sound regional text-books of the more intensive type exemplified by this work. It deals with the coal-fields north of the Trent and the Midland Gate, and discusses the industries which have arisen upon and about them, the communications between them, and their great centres of industry and trade. The basis of discussion is very largely geological. Here there is room for broadening of both foundation and fabric. The book needs an index, and is disfigured by a number of typographical errors, but it is well illustrated with maps which, for the most part, are clear and illuminating. It makes a very useful book for secondary schools and first-year college courses.

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 Action of Sunlight.

REFERRING to Dr. Saleeby's letter in NATURE of December 8, p. 466, I may report that, in conjunction with the late Marshall Ward, professor of botany at Cooper's Hill, I carried out a number of experiments at Liverpool near the end of last century on the effect of light in slaughtering anthrax bacilli. Prof. Ward prepared the cultures, covered them seriatim with a quartz plate which I lent him, and then sent them to me to be exposed to a suitably arranged arc light through quartz lenses and a quartz prism, discriminating the kind of light by its effect on fluorescent paper pasted at the side. The experiments were never properly published, though they are partly described in Prof. Ward's memoir on the subject in the Phil. Trans. Unfortunately, I do not possess the B series to refer to, but Dr. Saleeby could easily find the paper, and I think it would interest him.

The general outcome, to my mind, was that the arc light was more efficient than Liverpool sunlight, but that the most effective parts of the spectrum were two strongly phosphorescing bands in the ultra-violet, not far from the visible portion, and not of such short wave-length that clean air would be opaque to them. Their wave-lengths were, in fact, about 3830 and 3250 tenth-metres.

The unpolluted atmosphere seems well adapted to screen us from the really deleterious rays of exceedingly short wave-length, while still allowing the microbe-destroying rays to come through and do their beneficent work. OLIVER LODGE.

Microscope Illumination and Fatigue.

IT is interesting to note from Mr. J. E. Barnard's letter in NATURE of December 8, p. 468, that other workers have taken up the problem of variable illumination for the microscope. But in criticising the method outlined in these columns on November 17 Mr. Barnard seems to have overlooked the important fact that a monochromatic light-filter is used, so that the question created by the shift of the dominant radiation does not arise. This shift—which in its simplest expression amounts to a reddening of the light as the temperature of the source is decreased—was fully recognised when the method of regulation was originated, and in practice is a distinct advantage, since the apparent decrease of illumination of the field, when a filter is used which passes only a small band of the spectrum, is greater than that of the light source alone, where the full spectrum is present. Hence any increase of the resistance of the circuit doubly decreases the light in the field.

The neutral wedge device described by Mr. Barnard is very ingenious, and if it can be controlled from the front of the working bench by a long actuating spindle should be of the greatest use when monochromatic light is not desired. It is not easy to put an arm round to the front of the microscope to make an adjustment without moving the eye from the eye-piece, especially when a drawing-table and other accessories are in use. The adjustable resistance can, of course, be put wherever it is most convenient to the hand, and its use in a short time becomes almost subconscious.

It would be of interest to know whether in Mr. Barnard's experience he finds that there is any increased visibility of the finer details when variable illumination is used. This is markedly the case in cytological preparations and in the examination of cotton hairs.

The use of monochromatic light, so strongly advocated by Dr. Spitta, raises several questions, and is open to criticism where double staining methods are used, though with two filters all details can usually be made out. There was a half-promise in Zeiss's 1913 catalogue of monochromat objectives. These were put on the market some years before the war, corrected for monochromatic ultra-violet light, and an admirable description of their use was given by Mr. Barnard in NATURE of November 28, 1920, but there would be a real use for monochromats for visible light of a definite short wave-length if the attention now given to apochromatism could be transferred to flatness of field. H. J. DENHAM.

Shirley Institute, Didsbury, Manchester,
December 9.

Tin Plague and Scott's Antarctic Expedition.

IT will be recalled that a chief contributing cause of the failure of Scott's party to get back to their base was the "leakage" of the fuel oil that was stored in tin cans at the depôts along the line of the return march from the Pole. The oil-cans as found were apparently intact and "without hole of any kind," and it was therefore thought by some that the oil had evaporated through the "stoppers." Scott himself, however, wrote in his last message: "We should have got through in spite of the weather but for . . . and a shortage of fuel in our depôts, for which I cannot account, and . . ."

Now it has been clearly understood since 1899, by reason, chiefly, of the continued investigations of the Dutch chemist, Prof. Ernst Cohen, and his collaborators, that ordinary tenacious white tin is no longer stable below 18° C., but may change into a modification that appears grey and pulverulent. This change, long since observed in organ-pipes and other articles in very cold climates, is referred to by Prof. Cohen as tin plague, and spreads fastest, according to him, at about −50° C. Ever since reading Scott's diary in 1913 the present writer has in his teaching been in the habit of suggesting that certain of Scott's paraffin cans contracted tin disease, thus exposing the underlying iron, in spots at least, to the danger of chemical action and so of becoming "pin-holed," with the possible aid of electrolytes present in traces from the process of refining the oil. This rather obvious suggestion has, however, not appeared in your columns, nor was it known to Prof. Cohen, who was lecturing here a few days ago, as he has lectured elsewhere in this country and in Europe, on tin plague and related matters. It was interesting to learn from Prof. Cohen that he had experience of precisely the same phenomenon in the case of canned foods stored at rather low temperatures.

ALAN W. C. MENZIES.

Princeton University, Princeton, N.J., U.S.A.,
November 25.

The Dispersal of Snails by Birds.

I WAS present at a meeting of the Malacological Society last May when Dr. Boycott read a very interesting paper, in which he showed how the small snail *Balea perversa* occurred on trees, walls, and rocks, but not on the ground. The question arose

how it got from tree to tree; and in the resulting discussion the fact was brought out that it had exceptionally tenacious slime. There appears to be no doubt that it is carried by birds, to which it may become attached at night while they are asleep. The Island of Porto Santo possesses a large number of endemic snails, and also a certain number of species, such as *Euparypha pisana* and *Cochlicella acuta* (the latter, new to the island, I found abundant locally north of the Villa Baleira), which have been introduced by man. But there is one species, *Balea perversa*, which was found by Wollaston only on the isolated summit of the highest mountain in the island, the Pico do Facho. This is far from human habitation, and it is nearly certain that the snail was not brought there by man. It is equally improbable that it is a member of the ancient fauna, remaining unchanged while all the other species have diverged in various directions. The strong probability is that it was carried by birds, which could reach the Madeiras in a short time, while the snails remained dormant attached to their legs. Mr. J. Y. Johnson many years ago cited no less than seventy species of birds which had been observed as visitors or stragglers to the Madeira Islands.

The indications are, nevertheless, that few species of snails can be carried long distances in this manner. Balea is exceptional on account of its arboreal habitat and tenacious mucus. There is, however, a small species common in Porto Santo, the *Heterostoma paupercula*, Lowe, which is also found in Madeira, all three Desertas, and in the Azores. I have observed that it adheres very tightly to rocks or other objects, and is very tenacious of life. Specimens which I collected in Porto Santo last January came to life and crawled about the other day on being moved from their positions. There can be little doubt, I believe, that this little snail has been distributed by birds.

It is even probable that certain species of Coccidæ (scale-insects) are dispersed in the same manner. On the top of the Portello Pass, Madeira, I found a strange little Coccid at roots of native grasses, and expected it would prove undescribed. Mr. E. E. Green, however, recognised it as *Ortheziola Vejdovskyi*, described from Central Europe. The larvæ of this insect could very well be carried on the feathers of birds, and, escaping at almost any point on the island, would be likely to find the necessary grass.

T. D. A. COCKERELL.
University of Colorado, Boulder, Colorado,
November 22.

The Distribution of Brightness in the Penumbra during an Eclipse of the Moon.

ON the day after the eclipse of October 16, Mr. C. E. P. Brooks mentioned to me that the edge of the umbra had seemed much more sharply defined when the eclipse was nearly total than at an early stage. This observation suggested to me that it might be worth while to work out the theoretical distribution of light over the lunar disc and gain some information about the relation between umbra and penumbra. The diagrams which commonly illustrate the theory of umbra and penumbra in the text-books are shaded in such a way as to suggest that there is a sharp discontinuity in the illumination, the umbra being indicated by one uniform shading, the penumbra by another.

A little consideration shows however that the transition from bright to dark must be gradual. From the point of view of a spectator on the moon and within the umbra the sun would be entirely hidden by the earth. To a spectator in the penumbra but close to the edge of the umbra the sun would be nearly obscured, but to a spectator near the outer edge of the penumbra almost the whole of the sun would be visible. In traversing the penumbra the proportion of the sun visible would increase slowly at first, then more rapidly, the rate of increase would reach a maximum with the sun about half obscured, and finally the proportion would change but slowly when the spectator neared the outer edge of the penumbra.

The illumination received by various parts of the moon is proportional to the area of the sun as seen by the imaginary spectator, and if the local differences in reflecting power could be ignored the apparent brightness of the disc as seen from the earth would follow the same rule.

In Fig. 1 the small and large circles represent sun and earth as seen from some point on the moon, SP ($=r$) is the apparent radius of the sun, EP ($=R$) is the apparent radius of the earth, and the angles PES, PSE are denoted by β and $\pi-\alpha$ respectively. The ratio of I, the illumination of the moon at the point in question, to I_0, the illumination where there is no eclipse, is determined by the fraction of the sun that is not hidden, so that

$$\frac{I}{I_0}=\frac{1}{2\pi}\left[\left(2\alpha-\sin 2\alpha\right)-\frac{R^2}{r^2}\left(2\beta-\sin 2\beta\right)\right].$$

The angles α and β which occur in this formula are related to x, the angular distance between the

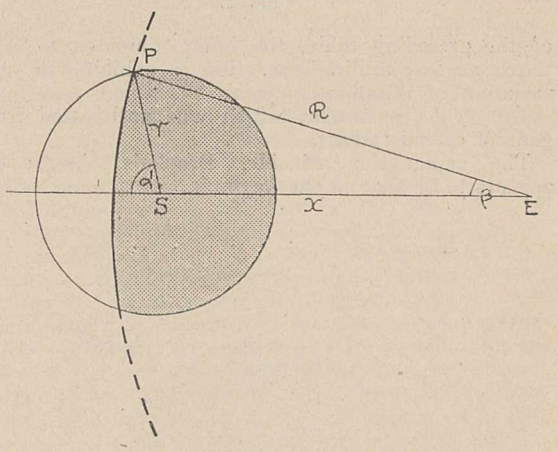

FIG. 1.

centres of sun and earth as seen from the moon, by the equations

$$\frac{R}{\sin\alpha}=\frac{r}{\sin\beta}=\frac{x}{\sin(\alpha-\beta)}.$$

For R and r the mean values 16·60 milliradians and 4·64 milliradians may be adopted. On this basis I/I_0 has been plotted as a function of x in Fig. 2.

From this figure the values of x corresponding with specified values of the ratio I/I_0 have been read off; these are shown in the following table, the unit for x being the milliradian :—

I/I_0	0	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9	1·0
x	12·0	13·3	14·2	14·9	15·6	16·4	17·1	17·9	18·7	19·6	21·2
$(x-R+r)/2\rho$	0·00	0·14	0·24	0·33	0·41	0·49	0·57	0·66	0·74	0·85	1·03

The angle x, which was defined as the distance between the centres of sun and earth as seen from a certain point on the moon, is to a very close approximation the same as the distance of the same point of the moon from the centre of the shadow as seen from the earth.

In Fig. 3, which shows umbra and penumbra in proportion, isopleths for each multiple of 20 per cent. of full illumination have been drawn. The ratio to the lunar diameter of the distance of each isopleth from the edge of the umbra is given in the last line

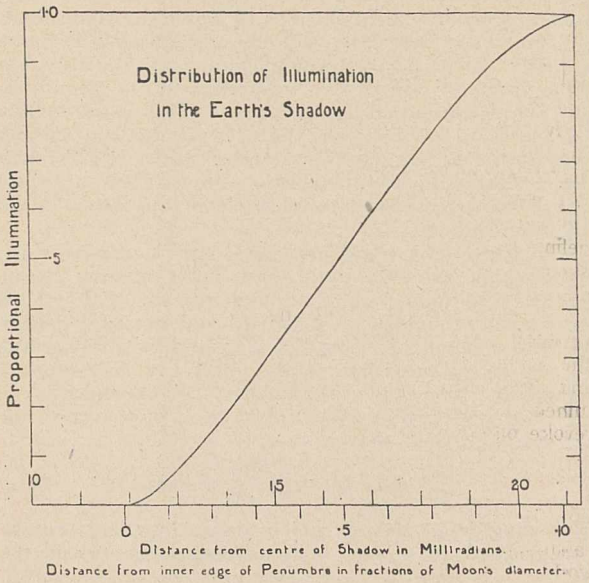

FIG. 2.

of the preceding table, the lunar diameter 2ρ being taken as 9·04 milliradians. Fig. 2 exhibits the slow variation of illumination near the inner and outer edges of the penumbra which was anticipated from general considerations.

The explanation of Mr. Brooks's observations appears to be that at the beginning of a lunar eclipse

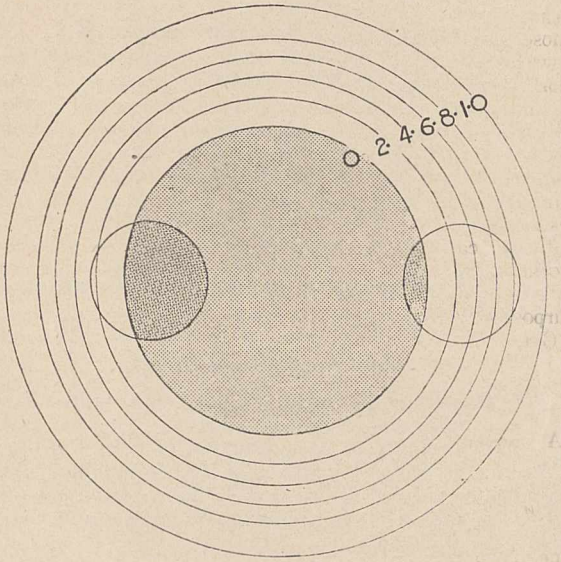

FIG. 3.—The small circles represent the moon in two positions, the shaded circle the umbra thrown by the earth, and the outermost circle the edge of the penumbra.

the range of the brightness I is from zero nearly to I_0. The dull region, say from $I=0$ to $I=\frac{1}{5}I_0$, has a width equal to 0·24 of the lunar diameter. With the eclipse approaching totality, say when the width outside the umbra is one quarter of the diameter, the maximum illumination is only $0{\cdot}21I_0$, and the dull strip, which in this case extends from $I=0$ to $I=\frac{1}{5}\times 0{\cdot}21I_0$, has a width 0·08 of a diameter. The width of the dull or fuzzy region is therefore reduced in the ratio 3 : 1. If this explanation be sound the phenomenon is physiological rather than physical.

A lunar eclipse presents another and much more difficult photometric problem: the umbra is not perfectly black, and as is well known the slight illumination it receives is due to light refracted in passing through the earth's atmosphere. It would be of interest to compare the strength of this illumination with that in the penumbra, and hence determine the fraction of sunlight which passes through our atmosphere without loss by diffraction and absorption.

Though it is hardly relevant to the subject of eclipses, it may be mentioned that a measurement of equal delicacy and greater value would be that of the brightness of the "old moon in the arms of the new," from which measurement the mean albedo of the earth could be deduced. One may even speculate on the possibility of variation in this albedo being detected, as the earth as seen from the moon is covered mostly by land or by sea or by cloud. Such knowledge would be of considerable value in the theory of the economy of the earth's thermal energy.

The new moon is observed from England after sunset when the western hemisphere mostly covered by water is facing the moon, whereas at the end of the lunar month we see the old moon in the early morning when the eastern hemisphere with the larger proportion of land is opposite to the moon. Conditions are therefore favourable for detecting the contrast in question.

F. J. W. WHIPPLE.
Meteorological Office, South Kensington,
S.W.7, November 15.

Awards to Discoverers.

IN view of the Government having enforced reductions in State funds available for research, it may be of interest to refer to the subject of awards to discoverers as means of effecting economy in, and increasing incentives to, research.

In a leading article in NATURE of March 31 last on "Inventions and Grants-in-Aid," special consideration was given to the first Report of the Royal Commission on Awards to Inventors, and also my scheme for the administration of grants for scientific discoveries and memoranda which were submitted by me to the Department of Scientific and Industrial Research. The scheme and memoranda were referred to in the article above mentioned in relation to rewards for future inventions and discoveries. In this connection I wish to direct attention to certain rulings of the Commission in respect of rewards for unpatented inventions and discoveries, particularly as the impression has been formed in certain quarters that the procedure of the Commission in respect of rewards for unpatented inventions might be made available in regard to rewards for discoveries such as those which contribute to the advancement of knowledge which it is desirable in the national interest to increase.

The discoveries for which grants may be obtained in accordance with the provisions of my scheme may be scientific or medical or surgical discoveries, and they may be described in an allocation or allocations of grants. A fund out of which grants may be allocated may be created by the State, or by means of donations and bequests, or both these sources may be made available.

I observed in my Memorandum G that "grants may be allocated to discoveries which are unremunerative,

but which have effected or contributed to the attainment of any medical or surgical purpose (specified or not as may be prescribed) of general utility or advantage which it is deemed desirable, in the national interest, to subserve."

Paragraph 29 of the Report of the Commission above referred to commences as follows:—"In a previous paragraph dealing primarily with patented inventions, it has been stated that, in the case of unpatented inventions also, the general principle has been adopted that rewards are not recommended in respect of inventions publicly proclaimed and thrown open to all the world to use." And after reference to the case of medical or surgical discoveries it is stated in this paragraph:—"Suggestions have recently been made elsewhere that a fund should be created for the pecuniary reward of investigators who have conferred great benefits on the public by such discoveries as those, for instance, which have resulted in the prevention of disease by inoculation and the like. But we have taken the view that all such matters as these lie entirely outside our province."

I may mention that in his letter appearing in the *Times* of July 13 last Sir Ronald Ross referred to a conjoint committee of the British Science Guild and the British Medical Association having written to the Prime Minister "suggesting that the powers of the Royal Commission on Awards to Inventors might be enlarged so as to include medical and sanitary discoveries and inventions." Replying in the *Times* of July 15 to this letter, Mr. Tindal-Robertson, the secretary of the Commission, in explanation of the general practice of the Commission, quoted the paragraph of the Report of the Commission which I have mentioned above.

In the case of unpatented inventions the Commission, it appears from reference to paragraph 27 of the Report, attached more importance to "priority of communication" than to "priority of discovery." And as showing that even these considerations may be outweighed by other counteracting considerations, the following statements are made in paragraph 28 of the Report:—

"It was found by the Commission that the credit of designing and producing the weapon of warfare known as the 'Tanks,' as actually used, was to be attributed to Sir William Tritton and Major Wilson, who, in fact, carried out their work in the latter part of the year 1915 and the early part of the year 1916; and it was recommended that a large award of 15,000*l.* should be made to them. On the other hand, it was found that Mr. L. E. de Mole, an Australian engineer, had made and reduced to practical shape, as far back as the year 1912, a brilliant invention which anticipated, and in some respects surpassed, that actually put into use in the year 1916; and that this invention was, in fact, communicated at the time to the proper Government Department, but was not then appreciated and was put aside and forgotten. The result in this case was expressed as follows:—'We regret that we are unable to recommend any award to him. But we are bound to adhere to the general rule in such cases that a claimant must show a causal connection between the making of his invention and the user of any similar invention by the Government.' It need hardly be said that, had Mr. Mole's invention been brought either directly or indirectly to the notice of Major Wilson or Sir William Tritton, as was clearly not the case, a very different result would probably have been arrived at by the Commission."

From the foregoing remarks I think it will be apparent that the conditions affecting priority and validity of claims to discoveries in the case of unpatented inventions for war purposes are unsuitable for adoption in the case of any future provision for awards, not only in regard to medical and surgical, but also scientific, discoveries the publication of which is desirable in the national interest.

Mr. Tindal-Robertson's letter, to which reference is made above, concluded with the following statement: "I need hardly say that this letter in no way touches the broader question raised by the first paragraph of Sir Ronald Ross's letter—namely, whether some new body should be constituted for the purpose of recognising and rewarding discoveries or services such as are there referred to."

I venture to say that, as a condition precedent to the constitution of such a body, it is necessary to define the principles upon which priority in discovery should be established and the validity of claims to discoveries should be determined. I have suggested such principles in my scheme, and they resemble in certain respects the principles upon which priority in the invention of patentable inventions is established and the validity of claims to such inventions is determined on application for patents or on proceedings to revoke patents.

In my Memorandum G (p. 18) I observed: "Another potent deterrent to research is the absence of any trustworthy means of establishing claims to discoveries, and the contentions that frequently arise as to the validity of such claims must tend to make research workers less disposed to attempt to solve problems of fundamental importance."

In exemplification of this I referred to letters appearing in the *Times* that succeeded and had relation to the insertion in the issue of the *Times* of May 22, 1918, of an article from a correspondent on the subject of trench-fever research, and reference was made in the correspondence to the Commissions on Malta fever, sleeping sickness, and trench fever.

I may mention that trench-fever research might have been promoted during the war by the allocation of grants (to be administered under conditions similar to those specified in my scheme) to unremunerative discoveries which advance the knowledge of the causation, prevention, or treatment of trench fever.

I may add that co-operative research, as well as the research of individuals working independently, can be promoted in accordance with the principles of my scheme. Priority in discovery could be established on similar conditions in both these kinds of research, and research by a co-operative body might be encouraged, without causing jealousy among the co-operative workers, by their agreeing to assign prospective grants to a nominee empowered to hold such grants for the purposes of the research. WALTER B. PRIEST.

Gresford, Wrexham, November 28.

The Smoke-veil.

A curious instance of atmospheric pollution came to my notice on November 26 while walking from Hayfield into Edale over the central watershed of England in the Peak of Derbyshire. Below 1500 ft. on the western side there was hazy sunshine with a rime frost, but at this level we entered a thin cloud, with a temperature scarcely below freezing point, formed by a steady easterly wind blowing over the Peak plateau from the east. Friends in Edale informed us that these conditions had obtained since the morning of the previous day, and the hoar-frost thus formed was peculiar; the stream-lines of air-flow round stones were clearly mapped by curling lines of ice, while every blade of grass and stem of Juncus bore a deposit of ice-crystals which resembled the

blade of a knife, the knife-edge pointing up-wind and the parent leaf forming the back.

On the largest of the ice-knives, which approached an inch in width, a regular striped pattern was evident, even from a distance of two or three yards, and closer inspection showed the same stripes on every one. These stripes were three in number, pale grey near the leaf, and again grey towards the edge of the knife, with an intervening zone of clear or yellowish ice. The grey stripes were evidently due to the presence of smoke in the cloud-mist during the daytime on November 25 and 26, while the clear zone between had been formed from the cleaner night-wind.

At Edale Cross, 1750 ft. above sea-level, the undamaged knives pointed their edges due east magnetic or directly to the centre of Sheffield. The intervening distance is more than sixteen miles, of which the first fourteen miles traverse some of the wildest moorland in England. Though I became familiar with the fouling effect of our industrial towns even on this lonely hill-country during nearly two years' residence there, yet this particular example seemed strange enough to be recorded.

W. LAWRENCE BALLS.

The Orchard House, Bollington Cross,
near Macclesfield, December 1.

An Oyster Spat (1921) with Mature Male Sexual Products.

IN the course of experiments carried out this year (1921) on the rate of growth of the slipper-limpet in the River Blackwater, Essex, I obtained a number of oyster spat on shells put in a floating raft and on clean scallop shells which were put in the water on June 9. These clean scallop shells were strung out on tarred rope at low water and kept suspended above the ground by tying the rope to stout branches of trees driven vertically into the ground. On November 16 the shells were taken out of the raft and from the shore and the new summer growth, including young oysters, examined and measured. Many of the young oyster spat measured about an inch in diameter (length anatomically) and an inch in depth (height anatomically). Some of these living spat were examined microscopically on the beds, and a few were taken back to the Plymouth Laboratory for careful examination in the living state.

In one of the spat examined at Plymouth a few ripe sperm-morulæ were found, which disintegrated into active separate sperm while under observation under the microscope. In order to confirm this interesting observation microscopic sections were prepared, and some ripe sperm-morulæ found actually in the gonadial tubes. It is therefore established that oyster spat may produce ripe sexual products in the year in which they are born. In the experiment described here the oyster which gave mature male products had a *maximum* age of twenty-three weeks; it was probably younger than this, but there is no means of determining how much younger it actually was. In a paper by the present writer ("Sea-temperature, Breeding, and Distribution of Marine Animals," Journ. Marine Biol. Assoc., vol. 12, No. 2, p. 352, 1020) it was predicted that "young specimens of the European oyster (*O. edulis*) will be found to be sexually mature in the summer in which they are spawned in those situations where high temperatures obtain for a few months." The exceptionally warm summer of 1921 resulted in an unusually long breeding period for oysters and in "high temperatures" prevailing over English oyster-beds for several months. In 1921, therefore, the conditions over English oyster-beds compared with normal conditions in such oyster-breeding places as Arcachon, Taranto (Italy), and the spatting pools in Norway.

The observation here recorded is of considerable academic interest, and might become of practical interest when confirmed—as I have no doubt it can be—in a large number of specimens. Between September and November this year I have been able to examine only eight large 1921 spat, including those mentioned above. Most of them gave indications of developing sperm, but in such small quantity that microscopic sections are required of them all for confirmation. The young oyster containing ripe male sexual products was not ripe in the sense that all the gonadial tubes at the surface of the body were crammed with tailed sperm-morulæ; and although there can be no doubt that the sperm from this young oyster were mature and were capable of effecting fertilisation under suitable conditions, it is not thought probable that ripe sperm are actually extruded by such small forms. There can be no doubt, however, that similar spat would be fully mature in the following summer, and would certainly breed at least as males. This experiment, which was made possible by a grant from the Royal Society, is being continued, and should yield—together with a large amount of spat now isolated from other localities—further useful material for investigating the sex of oysters at first maturity. The gonad of the young oysters examined in all cases indicated maleness, but the number examined is far too few to be of any value statistically. It is desirable to know the sex at first maturity of 1000 young oysters, and as young oysters have been more plentiful in most localities this year than for a good many years, it is probable that spat born this year can be identified with certainty now and isolated for examination next year. The sex of 1921 spat could be more easily determined in a large number of individuals next summer, and if results were recorded with accuracy from many different localities we should obtain a total of information which would help to clear up the doubtful question of the sex of the European oyster at its first maturity.

J. H. ORTON.

Marine Biological Laboratory, The Hoe,
Plymouth, December 5.

The Flight of Thistledown.

MY attention has been directed to the letters in NATURE of October 20 and November 10 on the flight of thistledown. The explanation of the phenomenon observed seems to me to lie in the very slow air-currents which are sufficient to raise the pappose structures of many Compositæ, especially when it is only the pappus which is raised, the fruit having fallen off.

Interested readers will find the hydrodynamics of fruit dispersal by wind discussed in some detail in my "Origin and Development of the Compositæ" (Wheldon and Wesley, London, 1919), and more briefly in my "Text-book of Botany" (Churchill, London, 1921). Some of the results given may be of general interest, *e.g.* the minimum winds which will raise the following pappose fruits (with fruit attached) are: dandelion, 1 m.p.h., groundsel, ⅔ m.p.h. The pappus alone would be lifted by a much slower wind, as is shown by the fact that a current of air moving at 0·59 m.p.h. is sufficient to blow the complete fruit of coltsfoot for a considerable distance horizontally.

JAMES SMALL.

Department of Botany, Queen's University,
Belfast, December 2.

The Study of Agricultural Economics.[1]

By C. S. ORWIN, M.A.

IT is now about five and twenty years since research and educational work in agriculture began to be developed seriously in this country. Since that date a very great deal of effort has been expended in investigating the forces by which plant and animal life are controlled, and in bringing natural science to bear in every way upon the problems of food production. Work along these lines has been productive of most valuable results to the farmer; but at the same time the fact has been overlooked that, when all is said, farming is a business, and if it is to succeed as such it must be carried on with a clear regard for the economic forces which control the industry. So, whilst desiring nothing but the fullest recognition of work in the fields of natural science applied to the investigation of farming problems, I must express without any qualification the view that the equal importance of the study of these economic forces has never been adequately recognised.

Educational and research work in agriculture which takes no account of the dominant importance of economics must always be ill-balanced and incomplete, for farming business requires for its proper control a consideration of human relationships, of markets, of transport, and of many other matters which should come within the purview of the economist, as well as, or even more than, a consideration of questions regarding the control of plant and animal growth with which the man of science, in the limited sense of the name, is concerned. No one could wish to deny the need for the close and continual study of the soil and the means by which it can be made to produce more abundantly; no one could deny the need for research work in problems of animal and plant life. But the main concern of the farmer is to know not so much that which he can *grow* and how best to grow it as that which he can *sell* and how to sell it at a profit. Given the necessary capital and labour, conditions may be contrived under which any soil may be made to produce any crop; but the wisdom or otherwise of embarking upon any particular form of production can be determined only by a study of economic forces. In Bedfordshire, for example, considerable areas of very moderate land are met with given up to a most intensive form of agriculture; but land equally suitable for a similar form of farming may be met with in many other parts of the country which is producing not a tenth part of the value in food products nor employing a tenth part of the capital and labour, whilst at the same time the systems under which it is farmed are fully justified by the results.

The reason of the difference, as doubtless everyone realises, is that the land in the former case is so situated that it has access, in the first place, to supplies of organic manures on an abundant scale and at a cheap price, and, in the second place, to markets crying out for its produce, whilst one or both of these facilities are denied to the other areas. In the Chilterns district of Oxfordshire farming a generation ago was mainly directed to the production of corn and meat, and nothing that has arisen out of the work of the investigators along lines of natural science would have called for any radical changes in agricultural policy on these soils. But economic forces, inexorable in their effect, have brought about a revolution, and arable land previously under corn and sheep is now laid down to grass or occupied with fodder crops for the maintenance of the dairy herds which have replaced sheep throughout the area. Again, in the hill districts of England and Wales there occur combes and valleys admirably adapted by soil and climate to the production of potatoes, and the highlands of Devonshire and Somerset may be cited in illustration. In these places, however, in the majority of cases, even though good markets may exist—Somerset, for example, imports potatoes—the lack of transport facilities makes it impossible for the farmers to produce anything which does not go to market on four legs.

Coming last to the question of human relationships, we find that it is possible to organise much more intensive forms of agriculture than any of our own, which would be an enormous advantage to a consuming nation like Britain; examples of such are to be met with in varying degrees of intensity in many countries. The Chinese, one reads, have increased production per unit area to an almost incredible extent, and in a lesser degree a similar state of affairs exists in parts of France and in Belgium (so often held up to us in this country as a model of productive capacity which we should strive to emulate). But in all these places the results are achieved only by a prodigal use of labour. The nation gains, no doubt, in the volume of produce available for its consumption, but the individual producer, deprived under this system of the opportunity to apply his manual effort in conjunction with an adequate amount of capital and land, is sacrificed to the consumer's advantage, and is driven to spend himself, year in and year out, for a reward for his toil to which the British worker, with so many alternative openings in more profitable directions available for him under our industrial system, would never for one moment submit.

These few illustrations may serve to indicate the over-riding importance of the economic factor in farming just as in any other business. It is a common experience in industry that many scientific and technical processes are possible which are not profitable, and it is in the light of the profit that they leave that all of them must be judged.

[1] Abridged from the presidential address delivered to Section M (Agriculture) of the British Association at Edinburgh on September 12.

Economic conditions are subject to continual change, and the variations may be both sudden and extreme. This makes it the more needful to be continually recording experience and to examine it for the facts that emerge from which to obtain guidance for future policy. Much information is required both for national and individual guidance. Of late years, for example, there has been much advocacy of more intensive cultivation of the soil; it is said that by closer settlement and more intensive methods the production from the land could be much increased. On the other hand, there are those who advocate a development of extensive farming as being the only means by which to attract capital to the land and to pay the highest wage to the worker. Both sides to this controversy can and do produce evidence in support of their views, and some figures derived from a survey made by my colleague, Mr. J. Pryse Howell, will serve to illustrate both. The total area surveyed was 9,390 acres, divided into fifty-two farms of various sizes, and the region was selected by reason of the uniformity of the general conditions. All available data for each holding were collected, and after grouping the farms according to acreage the figures were thrown together and averaged for each group, with the following result:—

Production per Unit of Land and per Unit of Labour from Holdings of Various Sizes.

Group.	No. of farms in each group.	Average size of farms.	Average arable land per cent.	Altitude.	Average rent per acre.	Average men per 100 acres.	Sales per acre.	Sales per man.
Acres.				Feet.	s. d.		£ s. d.	£ s. d.
I. 0–50	5	39	17	341–369	32 10	7·1	11 19 11	168 19 0
II. 50–100	10	78	22	319–384	33 0	6·4	9 19 2	156 2 0
III. 100–150	14	138	21	370–453	27 2	4·2	7 19 1	189 0 0
IV. 150–250	11	201	11·7	330–411	28 4	3·3	7 5 8	222 12 1
V. over 250	12	356	18·0	286–435	26 5	2·6	8 4 4	316 19 0

It will be noted that the conditions under which the farming is carried on in the various groups show no material differences as between one group and another, except in the matter of area. There is a tendency for rent to fall as the size of the holdings increases, but it is not pronounced, and in one case (Group IV.) the percentage of grassland to arable land is considerably higher than in the rest; but, considering the variations which must be expected in the conditions prevailing over any area of fifteen square miles, it may be claimed that in respect of altitude, quality of land, and proportion of arable to grass the holdings in these five groups are fairly comparable. Taking the results as they stand, the fact emerges that employment and production vary inversely with the size of the holding, but that the production per man employed varies directly with the size of the holding. Thus, on one hand, the advocates of closer settlement and the intensive methods which must necessarily follow if men are to live by the cultivation of small areas of land would seem to be justified in that the results shown by the survey indicate the highest amount of employment and the greatest product-value in the smaller groups. On the other hand, the advocates of more extensive methods of farming can point to their justification in that it is clear that the efficiency of management is greatest in the larger groups if the standard of measurement be that of product-value per man employed.

However, it is clear that either party is drawing conclusions from incomplete data. The efficiency of any farming system can be judged only by an examination of the extent to which all the factors of production are utilised and balanced under it. Each of the assumptions made from the figures above ignores entirely the factor of capital. Land, labour, and capital are all required for production, and the *optimum* system of farm management is that which utilises all three together so as to secure the maximum result from each. If information were available as to the capital utilised in each of the five groups in the survey it might be found that in the smaller groups labour was being wastefully employed, and that an equal number of men working on a larger area of land with more capital, in the form of machinery equipment, would produce an equal product-value per unit of land with a higher rate of output per man employed. Equally it might be found that in the larger groups the use of more labour, or a reduction in the area of land, might produce the same product-value per man with a higher rate of output per unit of land. Obviously there can be no absolute answer to the question of what constitutes the most economical unit of land for farm production. The quality of land in certain cases, and market, transport, and climatic conditions in many more, make it impossible to determine even within wide limits the size of the holding on which the principal factors of production can be employed with maximum effect. Within similar areas, however, and in limited districts, much work can and should be done by agricultural economists to collect evidence on this point for the information of all concerned with the administration of land.

Another matter of the utmost importance to the farmer and to the public alike, and one which is crying out for investigation on a large scale, is the distribution and marketing of farm produce. Attention has been directed many times to the discrepancy between the price realised by the producer and the price paid by the consumer for the same article. In connection with market-garden produce, for example, the Departmental Committee on the Settlement or Employment on the Land of Discharged Sailors and Soldiers stated in their Report (Cd. 8182, 1916) that "the disparity between the retail prices paid for market-garden produce in the big towns and the small portion of those prices received by the growers is utterly indefensible. It demonstrates a degree of economic waste which would ruin any other industry." No evidence was published by the Committee as to the facts upon which this conclusion was based, but a recent inquiry made by the Ministry of Agri-

culture into the prices prevailing at various stages in the distribution of vegetables in London may be quoted in confirmation of it. Figures were collected to show the amount received by the producer, the wholesaler, and the retailers for various classes of everyday garden stuff, with results as shown below.

Producer's, Wholesaler's, and Retailers' Prices for Market-garden Produce, January, 1921.

	Cabbages, medium grade, per doz.	Cabbages, bottom grade, per doz.	Cauliflowers, top grade, per doz.	Sprouts, top grade, per 28 lbs.	Turnips, medium grade, per cwt.
	s. d.	s. d.	s. d.	s. d.	s. d.
Producer...	0 3	0 2½	3 0	3 6	3 0
Wholesaler	1 0	0 9	5 0	—	5 6
Retailers—					
(*a*) Stalls and barrows	2 6	2 0	6 0	—	14 0
(*b*) Suburban shops ...	3 0	2 6	8 0	—	14 0
(*c*) Stores and high-class shops ...	4 0	3 0	10 0	14 0	18 8

One has only to glance at the prevailing methods of distribution to realise their wastefulness. The street in which I live contains ten houses, and each day four milk-carts, three bakers' carts, three grocers' carts, and two butchers' carts deliver food to them. Twelve men, horses, and carts, not to mention a host of errand-boys on foot and on cycles, to deliver food to ten families!

At the present time labour problems afford a useful example of the need for further investigation of the economic problems of agriculture. The labourer is often blamed for results which are due to the inefficiency of the farmer as a manager. When wages were low it may have been that the labourer was the cheapest machine, but in proportion as his remuneration approaches more nearly to the standard of reward in competing industries, so will the necessity for making his work more productive be intensified. The value of the output from the farm per man employed is not the only measure by which to gauge the efficiency of the management, but is certainly one of primary importance. A man with a spade can dig an acre of land in about two weeks at a cost to-day of about 4*l.* 10*s.*; a horseman and a pair of horses can plough an acre in about a day and a half at a cost of about 1*l.* 15*s.*; a farm mechanic on a tractor can break up an acre in about a quarter of a day, and although in the absence of sufficient data the comparison cannot yet be completed by reference to the cost of motor ploughing, it is fairly safe to suggest that when all the factors are considered—speed, less dependence upon atmospheric and soil conditions, as well as actual cost—there will be a still further advantage to be derived by investing the manual worker with the control of mechanical power. Thus it may be that high labour costs to-day are due in many cases less to the inefficiency of labour and more to the inefficiency of management.

In a recent issue of the *Times* an agricultural writer expressed the view that if the means existed for determining the proportion of the net returns of agriculture accruing to-day to labour, it would be found that labour was taking an excessive toll of farming results. This view is probably very generally held, and it affords a good example of the misconceptions which may and do arise in people's minds in the absence of exact information upon which to base their assertions. This happens to be one of the questions which have been the subject of investigation at Oxford, though only on the small scale that the means at the disposal of the University have admitted. An investigation was made before the war of the distribution of the net returns of agriculture as between landlord, farmer, and labour. It was found that the proportions accruing to each of the three interests varied hardly at all, and that it would be safe to say that 20 per cent. of the total was going to the landlord, 40 per cent. to the farmer, and 40 per cent. to labour before 1914. Taking the above proportions, and calling each of these shares 100, the proportion of distribution between the three interests varied during the following six years as shown below:—

Distribution of the Net Returns from Farming between Landlord, Farmer, and Labour during the years 1913–14—1919–20.

Year.	Landlord.	Farmer.	Labour.
1913–14 (standard)	100	100	100
1914–15...	97	104	99
1915–16...	94	108	98
1916–17...	91	115	94
1917–18...	90	111	99
1918–19...	87	115	98
1919–20...	89	109	102

The figures are interesting in several ways. In the first place they seem to disprove the suggestion referred to above, that labour has been taking an undue share of the net returns from farming, for an examination of the figures in the "Labour" column shows that until the institution of the Agricultural Wages Board in 1917 the tendency was in the direction of a slight but steady reduction in the proportion coming to the workers; the effect of the Wages Board Orders was to steady this tendency and, ultimately, to bring labour back approximately to the position it occupied in 1913–14. If the figures could have been continued for another year it is likely that they would show a material increase in the workers' share, but, even so, it would be found that this increase had been achieved without reducing the farmer's share below his pre-war proportion. In the second place, the figures confirm the experience of landowners in that the landlord has received no part of the increased prosperity of farming, whilst, as everyone knows, his expenses of maintenance have enormously increased. Briefly, the situation is that, thanks to the Agricultural Wages Board (and its appointed members may take heart from the fact), the workers have been maintained in the same position as regards their share in the net returns as that in which they were before the war, whilst the farmer has received his share in the increase realised during the past few years, together with that which would have gone to the

landlord had the pre-war scale of distribution been maintained. Rents and wages under normal conditions are slow to adjust themselves to changes in farming fortune, and, except in a time of violent economic upheaval, it is right that this should be so, for if the landlord may be regarded as a debenture holder, and labour as a preference shareholder, then the farmer, as the ordinary or deferred shareholder, has to bear the brunt, and if he must take the kicks so also is he entitled to the halfpence.

Turning now from problems in which either the nation generally or whole classes of the industry are concerned, it may be stated that there are many economic problems arising on the farm itself in the solution of which the individual farmer should be able to derive help from the economist. Some of these problems are so simple that their solution should be obvious, but the fact remains that waste in its most easily eliminated forms is constantly to be met with on the farm. The need for the study of the economic use of manual labour has already been referred to in another connection, but, granted that the balance between the employment of land, capital, and labour on any farm has been established, cases are continually met with where labour is being mismanaged. It is a not uncommon practice at threshing-time to take the horsemen from their work to assist at threshing, and as this operation can be performed only in dry weather, it may be assumed that the horses might usually be employed on threshing days. With manual labour costing about 7*s.* 6*d.* a day and horses about 5*s.* a day, the advantage of hiring casual labour for threshing, even at high rates of pay, will be obvious when it is remembered that the horseman whose horses are standing idle represents a daily cost for the manual work performed by him of some 18*s.* On a Midland counties farm, where the maximum possible horse-hours in a certain week in November last were 238, the time actually worked by horses was found to be eighty-seven, owing to threshing operations, and the wastefulness of the labour-management in such a case is obvious. Again, employers in certain cases object to paying Saturday overtime to men willing to work, because overtime payments are at a higher rate than those for ordinary time, but they overlook entirely the fact that the Agricultural Wages Board provides no overtime payments to the horses, and thus the cheapest horse-labour on the farm is that performed on Saturday afternoon at overtime rates of pay to the horsemen.

Everyone realises, of course, the importance of keeping horses busy, but not everyone thinks how heavily the cost of manual labour is increased by idle horses. The maximum number of working days in a year is 312, a total obviously impossible of attainment in practice. Such records as are available show that the days actually worked by horses on the farm will not usually exceed four-fifths of the maximum. More time may be lost in summer than in winter, a fact not generally realised, and the period of maximum unemployment falls between haymaking and harvest. The busy seasons are, of course, the autumn and the spring, when the preparation of the ground for winter and spring corn is going actively forward. In the year 1918 figures were collected to show the percentage of days worked compared with "possible days" in each month on four farms distributed pretty evenly over England, and the results, thrown together, are as follows:—

Percentage of Days Worked to Possible Horse-days on Four Farms in 1918.

	Per cent.		Per cent.
January	67	July	38
February	82	August	65
March	77	September	78
April	74	October	80
May	70	November	67
June	56	December	64

Although the figures represent an average of four farms, it is noteworthy that the results on the individual holdings varied one from another in degree only, and that the months of maximum and minimum employment were the same in every case. The loss of time is far more serious than many people realise. The maximum possible horse-days in the year are 312, and the cost per day of the horses on the above four farms on this basis was 2*s.* 7*d.*, whereas, owing to the time lost, the cost on the basis of days worked was 3*s.* 7*d.* Whilst some difference is inevitable, so great a discrepancy as these figures reveal can be avoided by skilful management, and one of the tests of the farmer's efficiency is provided by an examination of the distribution of horse-labour throughout the year on his farm. His cropping and other work should be so contrived as to provide for the uniform utilisation of horse-labour month by month. Under skilful management the differences in the number of days worked by horses from year to year are extraordinarily slight. On an East Midlands farm, employing twenty-three horses, the days worked per horse during the past six years have been as follows:—

Year	1913–14	1914–15	1915–16	1916–17	1917–18	1918–19
Days worked per horse	250·25	247	243	236	243	244·5

It may be noted, in passing that figures such as those given for the seasonal employment of horse-labour emphasise the need for a study of the place of the agricultural tractor in farm management, for the busiest times of the year synchronise, more or less, with the seasons when the weather is more uncertain and suggest that the application of speedier mechanical power to field operations, in substitution for slower horse-power, would result in economic advantages in certain cases.

In connection with the study of economics on the farm the question of agricultural costings naturally suggests itself. Farmers, as a class, are not accountants and much less are they cost accountants, but this has not deterred many of them from taking part in discussions of farming costs which have been going on in the Press and

in the Food Controller's offices for some time past, and the confusion of thought on the question of what cost of production really is which these discussions have revealed is evidence of the need for study and education in costing processes. Few things can be of greater service to the farmer than scientific book-keeping carried out and interpreted with proper understanding, but few things can deceive him more than costing wrongly conducted or misinterpreted.

Lastly, I want to urge, and particularly before a gathering such as this, the importance of agricultural economics in agricultural education. The fact is realised, no doubt, by many teachers, but until a sufficient body of data bearing on the study of farm management can be made available to them it is impossible for them to give to the teaching of practical agriculture that solid economic basis which is fundamental, and the teacher is driven to include in his instruction much to which the economic test has never been applied and to exclude more for which no basis for teaching exists at all. Given the requisite body of information it would not only be possible but also necessary to recast the whole foundations upon which the teaching of practical agriculture rests.

Black Coral as a Charm for Rheumatism.

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

MR. C. H. POWNALL, of Banjoewangi, Java, has sent to NATURE office a letter accompanying three bracelets made from the horny skeletal substance of a soft coral or Gorgonian, known to science as Plexaura. This forms great branched growths which are abundant on the outer or seaward sides of coral reefs at from 10 to 40 fathoms, but in protected situations almost reaching the surface. All corals are formed by anemones, and the one in question here possesses eight feathered tentacles round the central mouth. The original anemone of a "colony," as the whole animal is termed, settles on the bottom and buds off other anemones from its sides, these in turn giving birth to further children. All remain attached to one another by canals, so that the whole growth forms a single, many-mouthed animal. It takes the form of long branches, the whole simulating a broom-like shrub growing upon the bottom of the sea. The skeleton is in the centre of the stems, and consists of an axis of black, horny substance in each branch, surrounded by the living tissues of the anemones, these further strengthened by scattered spicules of carbonate of lime. Generally, the branches are regarded as belonging to some form of submarine plant, to which the name Akar Bahar is given in the Malay Archipelago.

The bracelets, which are the cleaned, horny axes of stems twisted into rings, are "credited with the virtue of curing rheumatism." "There are," says Mr. Pownall, "many doctors in the Malay Archipelago who advise their patients to make use of them. They acknowledge that the bracelets do good, although they cannot account for it. It has been suggested that the substance is radio-active. Personally, I can testify that, during a residence of forty-seven years in this part of the world, I have never met a person who has used one of these bracelets without deriving benefit from it. The bracelets are usually worn on the left arm. All natives are firmly convinced of their efficacy, and all seamen and others who are much exposed to the wet make use of them. They maintain that they must be used quite plain; any ornamentation of gold or silver renders them useless."

Rheumatism is, of course, one of those diseases which can have as many causes as there are weeks in the year. Any concretions in any part of the body, however caused, may give the regular symptoms. The close association of rheumatism with malaria is well known to every tropical traveller, and malaria is particularly rife among coast-dwelling people. In some cases the symptoms described by the malarial patient are such as are usually associated with rheumatism. The present writer, while living in a small tropical island, Rotuma, ran out of quinine, which he had found quite effective. His reputation, however, had been established by that time, and he then found a mixture of cascara, brown sugar, and methylated spirit equally good. Probably these bracelets, if he had had them, would have been quite effective to produce similar faith cures. They exhibit absolutely no trace of radio-activity, and are not composed of a substance which could produce any direct effect. A lady who is a victim to rheumatism has worn one of these bracelets for a month, with considerable comfort and a satisfaction which she herself laughs at.

The association of the bracelets with rheumatism in the Malay Archipelago is interesting, because the use of similar bracelets merely as articles of adornment seems to be widely spread among fisherfolk from Suez to the most distant islands of the Pacific. They are made either of the stems of some Gorgonian such as the above, or of the true black coral (Antipatharia), in which the central horny rod is slightly hollowed. In the Maldives, growths dredged up by the present writer, after he had taken what he required, were eagerly divided up by his native crew, and a large piece was taken by the Sultan's representative to be presented on his return to court. The ornaments made were exclusively used by the women. Other coloured Gorgonians obtained at the same time were quite neglected. One of the black sailors, originally recruited at Zanzibar, on

H.M.S. *Sealark* in 1905 always wore a pendant of black coral under his blouse, and all the black "boys" on board begged pieces from us "to keep them from drowning." Inquiries show, too, that black ornaments, bracelets, rings, and pieces strung into necklets are common on all coasts from Zanzibar to Singapore. They are usually described as wood, but, as it is stated that the ends overlap or that the bracelets or rings are spiral, they are probably of coral. A Japanese professor says that black coral is much valued in China and Japan, and largely used by coastal people for jewelry. Branched growths are not infrequently brought up on the hook when fishing outside coral reefs, but, while there are frequent indications of local use, there is no regular fishery for such as an article of commerce.

Rheumatism would seem to be particularly a "charm" disease. All over England a potato is carried in the pocket as a remedy, and several ladies residing in Cambridge derive great benefit from the permanent presence of horse chestnuts below their couches. Rings of metal—tin in many parts of the West—are a regular specific. One of the black bracelets in question has a decorative value of its own. We wonder, however, whether the ladies might not find Chinese jade a still better specific.

Obituary.

J. M. Dodds.

BY the death of John Macalister Dodds on November 13 last Cambridge has lost a great gentleman, while many people, both inside his college and outside, have lost a most kindly, helpful, and amusing friend. He took his degree as fifth wrangler in 1881, and returned from Glasgow to Peterhouse as bursar and mathematical lecturer in 1884, since when he had resided in college continuously. He lectured, as usual, on November 12, and was found dead in his chair the following morning. Apparently the only published paper he was connected with was one on the value of the B.A. unit of resistance (R. T. Glazebrook and J. M. Dodds, Phil. Trans., 1883).

On returning to Cambridge Mr. Dodds gave advanced lectures on the theory of sound for some years, in addition to his routine work, but henceforth his main interest lay in the theory of numbers, the theory of groups, and kindred topics. Particularly was he interested in the theory of numbers, and he worked at it incessantly. I have heard him say that he tended to lose interest when the continuous variable was introduced into that beautiful subject. Indications are not lacking that such feelings were shared by Gauss himself, but in reality the leaning of Mr. Dodds was towards ancient, simply stated, and difficult problems of a pre-Gaussian kind. He was extraordinarily astute, for example, in the application of Fermat's famous principle of infinite descent. Formal algebra, too, had a great fascination for him.

A word must be said of his generosity in working at a problem with a colleague; the algebraical avenue being left to him, Mr. Dodds was untiring in his efforts until the inquiry became hopeless or the question was determined. One habit of his is probably now obsolete; each long vacation he made a complete set of solutions of the Tripos papers that had just appeared. Younger generations do not, I think, regard that as being any longer a task that provides mental exhilaration, even supposing the problems come out.

This is not the place to dilate on the wide knowledge of books and human beings that vast reading and irresistible social powers had given Mr. Dodds, yet no account of him can be complete without an allusion to what was, it may be, the most marked feature in his attitude on general questions. He was an intense and innate conservative; the smallest suggestion of change always seemed to arouse his instant opposition. As he was an acute dialectician, this might easily have become exasperating, but he was so big, so strong, and so laughingly good-natured that the almost inevitable did not happen. If he sometimes laughed at others, he often laughed at himself. J. H. G.

WE regret to announce the deaths, on December 9, of LORD LINDLEY at the age of ninety-three years, and, on December 11, of LORD HALSBURY at the age of ninety-eight years. Both were elected fellows of the Royal Society under the special clause which permits the admission of members of the Privy Council—Lord Lindley on January 20, 1898, and Lord Halsbury on January 13, 1887. It may be recalled that Lord Lindley was the son of the late Dr. John Lindley, professor of botany in University College, London.

Notes.

ON Saturday, December 10, the Official Referee under Part I. of the Safeguarding of Industries Act gave his decision on the complaint that santonin has been improperly included in the list of goods upon which import duty must be paid. The drug is derived from flowers grown almost exclusively in Southern Russia and Turkestan, and is extracted by a simple process which does not appear to demand professional skill; its application is medicinal as distinguished from chemical, but the evidence on the question whether it should be regarded as a "fine chemical" was most conflicting, and emphasised the difficulty which may be experienced in defining a "synthetic organic chemical" within the meaning of the Act. After two hearings Mr. Cyril Atkinson, K.C., expressed the view that the word "chemical" is not a scientific term, but implies a

distinctive substance which is, generally speaking, brought into being by a chemical reaction, or primarily used for taking part in a chemical reaction; whilst "fine" chemicals are those which are manufactured by processes involving chemical skill. Furthermore, he ruled that santonin be removed from the list, on the ground that it is not brought into existence by processes of chemical action, and is not applied in chemical changes; thus its inclusion would not benefit the industry, but would only tend to raise the price of a useful drug.

WE regret to note that the *Irish Naturalist* has reached a very critical stage in its existence, and unless a practical scheme is forthcoming which will place the magazine in a better financial position, publication will cease at the end of the year. At present costs the annual loss is estimated at 50*l.* per annum. The *Irish Naturalist* has served for thirty years with conspicuous success under the able guidance of the present editors as the mouthpiece of students of natural history in Ireland, and we hope that a workable scheme will be evolved to save the periodical for future workers. But the general question is a much larger one. All magazines of this kind, with a special appeal and a limited circulation, are labouring under similar difficulties, and unless something is done many will be forced to cease publication. Raising the price only results in a reduction of the number of subscribers. It would be a thousand pities if they have to be abandoned. They perform a useful and valuable service in the stimulation of interest in natural history, and by the publication of the results obtained by local workers. We feel that the whole question is one which demands sympathetic consideration by one or other of the national scientific societies, such as the Royal Society, the British Association, or the Conjoint Board of Scientific Societies, or even by the Government itself through the Board of Education.

A CHADWICK public lecture on "The History of the Doctrine of Infection" was delivered by Dr. Charles Singer on December 8 in the Barnes Hall, Royal Society of Medicine. Dr. Singer pointed out that primitive folk regard everything as being "infectious"—that is, communicable—and believe that, by a process of "sympathetic magic," moral qualities and powers pass from person to person, and that physical attributes are similarly conveyed from object to object. Sanitary legislation among many primitive peoples is based on this doctrine of "sympathy." The classical writers of antiquity who deal with medical topics for the most part regarded epidemic diseases as being conveyed by an atmospheric element, or "miasma," and only a few diseases as being transmitted from person to person, while the laymen of the same period laid more stress on conveyance from person to person. From the twelfth to the sixteenth centuries medical teaching was mainly derived from Arabian writers, who adopted much the same view as the classical writers. In 1543 Hieronymo Fracastoro, of Verona, published a work, "De Contagionibus," in which infection was regarded as being due to small seeds or *semina*, too minute to be seen, but capable of multiplication, and specific for each infectious disease. These views became widely adopted, and the general phenomena of epidemics were closely studied, so that by the commencement of the eighteenth century the materials for a theoretical solution of the problem of the nature of infection were well-nigh complete.

THE Air Ministry has announced that the second Air Conference will be held at the Guildhall, London, on February 7–8 next. The conference, which will be opened by the Lord Mayor of London, will deal chiefly with the future of aviation, with special reference to its development as a regular and speedy form of commercial transport. The papers presented will be divided into two main groups, the one dealing with civil aviation in general and the other with technical problems. The whole of the second day will be devoted to discussions arising out of the previous day's papers. The Secretary of State for Air will preside during the civil aviation portion of the proceedings, and Lord Weir of Eastwood during the technical sessions. The principal paper on civil aviation will be read by Lord Gorell, Under-Secretary of State for Air, who will give a general account of progress at home and abroad, and will direct attention to the ways and means whereby the development of civil aviation may be best furthered; in this connection Lord Gorell will endeavour to enlist the practical co-operation of business and other interests. The chief technical paper will be read by Mr. F. M. Green, of Sir W. G. Armstrong, Whitworth Aircraft, Ltd. The London terminal aerodrome at Croydon will be open for inspection on February 6, and demonstrations of amphibian aircraft alighting on the Thames will also take place during the period of the Conference.

THE library of the Chemical Society will be closed for the Christmas holidays at 1 p.m. on Friday, December 23, and will reopen at 10 a.m. on Thursday, December 29.

ACCORDING to the *Times*, a report has reached Norway from Moscow that a Russian expedition, at present exploring in Siberia, has found the bodies of the two lost men of Capt. R. Amundsen's expedition near the mouth of the Yenisei river. These two men left the *Maud* in October, 1918, in the vicinity of Cape Chelyaskin in the hope of making their way to the fishing settlements on the Lower Yenisei, a distance of some 700 miles across the barren tundra. They carried dispatches from Capt. Amundsen. A Norwegian search expedition looked unsuccessfully for traces of the two men along the coast of north-western Siberia in the autumn of 1920, as soon as news from Amundsen reached Norway reporting their departure.

THE Massachusetts Institute of Technology is again without a president. Dr. Ernest Fox Nichols, who was inaugurated last June to succeed the late Dr. R. C. Maclaurin in that office, was taken ill immediately after the ceremony. The illness has resulted, his physicians report, in "certain physical limitations, some of them probably permanent," which would make it unwise for him to assume the responsibilities of the position. He has therefore sent in his resigna-

tion, which has been regretfully accepted by the executive committee. Dr. Elihu Thomson, chief engineer of the General Electric Co., who served as acting president after Dr. Maclaurin's death, has again been appointed temporary head of the institute. The physical disqualifications under which Dr. Nichols labours will not restrict his activities in the simpler life of scientific investigation, and he hopes accordingly to return to the research laboratory and to resume the work, connected with certain problems of lighting, which he interrupted to accept the offer of the presidency.

AN account is given in the *Times* of a recent ascent of Mount Kilimanjaro, the extinct volcano in the Tanganyika territory of East Africa. Discovered by German explorers in 1848, the summit was first reached in 1889 by Dr. H. Meyer, and since then it has been scaled several times. The last ascent, which took place in October this year, was made by Messrs. C. Gillman and P. Nason. No great difficulty was encountered in reaching the Saddle Plateau, which, at a height of some 15,000 ft., separates the two peaks of the mountain, Mawenzi, the rocky one rising to 17,570 ft., and Kibo, the ice-capped one, rising to 19,720 ft. The rarefied atmosphere forced two of the party and several native carriers to give up the attempt at altitudes varying from 16,000 ft. to 18,500 ft. The top was reached only with difficulty on this account. Many photographs were secured. Mr. Gillman notes that a comparison of the actual extent of the ice with that indicated on Dr. Meyer's photographs proves a considerable shrinkage of the glaciers, especially on the south-east, east, and north side of the peak of Kibo.

THE following are among the lecture arrangements at the Royal Institution before Easter:—Prof. J. A. Fleming, six lectures adapted to a juvenile auditory on electric waves and wireless telephony, beginning on Thursday, December 29. On Tuesday afternoons, commencing on January 17, there will be two lectures on "Physiology as Applied to Agriculture," by Dr. F. H. A. Marshall; three by Prof. H. H. Turner on "Variable Stars"; five by Sir Arthur Keith on "Anthropological Problems of the British Empire—Series I.: Racial Problems in Asia and Australasia"; and two by Dr. J. W. Evans on "Earth Movements." On Thursday afternoons Mr. Seton Gordon will give two lectures on "Mountain Birds of Scotland and Sea Birds and Seals"; Sir Napier Shaw, two on "Droughts and Floods"; Prof. A. G. Perkin, two on "Dyeing: Ancient and Modern"; Prof. H. Maxwell Lefroy, two on "The Menace of the Insect Pest: The Balance of Life in Relation to Insect Pest Control"; Dr. P. Chalmers Mitchell, two on "The Cinema as a Zoological Method"; and Prof. A. M. Hind, two on "Landscape Etchers: New and Old." On Saturdays there will be six lectures by Sir Ernest Rutherford on "Radio-activity." The first Friday evening discourse will be given on January 20 by Sir James Dewar on "Soap Films and Molecular Forces." Succeeding discourses will probably be given by Viscount Burnham, Sir Francis Younghusband, Prof. W. D. Halliburton, Dr. R. S. Watson, Prof. J. Joly, Dr. C. M. Wenyon, Prof. T. R. Merton, Dr. A. P. Laurie, Prof. F. G. Donnan, Mr. A. B. Walkley, and others.

THE Report of the Committee on Ancient Earthworks and Fortified Enclosures issued by the Congress of Archæological Societies for 1920 indicates that the damage anticipated from military entrenchments and other activities during the war has not been serious. Attention is directed to the rapid destruction of the hill-fort at Penmaenmawr by a quarrying company, and it is pointed out that the Act contains no provision for the payment of compensation to the owners of any ancient monument who would suffer pecuniarily if it were taken over by the public. Bokerly Dyke, on the borders of Dorsetshire and Hampshire, is suffering greatly from the burrowing of rabbits, but it is not clear that this constitutes the "neglect" which would justify the Ancient Monuments Board in taking action for its preservation.

THE seventh Scientific Report of the Investigations of the Imperial Cancer Research Fund, which has recently been issued, cannot be said to throw much further light on the problem of the causation and prevention of malignant disease, although its contents have much scientific value and represent a considerable volume of research work which may be preliminary to more important later results. Long-continued study of transplantable tumours in the mouse and rat has shown that many of the characteristics of these tumours are consequent on slight biological differences subsisting between the cells of the organism in which the propagable tumour arises, and the cells and fluids of the successive hosts of the same species in which it is growing. The minute and painstaking investigations detailed in this report on the fundamental physiological processes of normal and cancerous cells, although not completed, have great value. The experiments by Drs. Murray and Woglom described in the report are important as throwing light on the means by which cancer can be artificially produced and on the cell changes occurring in the affected parts. It may be hoped that continuation of this investigation will throw new light on the origin of cancer not artificially produced.

THE Department of Public Health of the Ministry of the Interior (Egypt) have recently published an instructive report by Prof. W. H. Wilson on the nutritive values of rations issued to officials and other public employees. Owing to the fact that a considerable proportion of the protein is supplied as vegetable protein, it was necessary to estimate its biological value, and to this end the author has utilised the results of K. Thomas, although, as he remarks, these can be regarded as only approximately correct. Prof. Wilson bases his conclusions as to the sufficiency of a diet upon the following considerations. He holds that the daily intake of available animal protein should not be less than 40 gm., that the fat intake should not fall below 30 gm., and the gross Calories should vary from 2600 for sedentary to 3450 for moderate or "hard" labour. It appears that several

of the Ministry of Education's ration scales are defective, and all those of the Ministry of War. Respecting the latter he writes: "Presumably the men are able to supply themselves from a canteen; this, however, can hardly account for the low level of what is stated to be the active service ration." This latter is defective to the extent of 543 Calories in respect of available energy, 14 gm. on the fat account and 5·5 gm. of protein. The following remark is of interest: "In February, 1919, the writer recommended that, in view of the number of relapses and high mortality from pellagra among the patients at the 'Abbâsîya Asylum on a diet the protein biological value of which was 49·5 (the diet being satisfactory in other respects), that this should be raised to 60. The result has confirmed the correctness of the assumption upon which the suggestion was made, a very remarkable diminution having taken place in the incidence and mortality from pellagra."

THE Proceedings of the South London Entomological and Natural History Society for 1920–21 record a successful year's activities. The finances of the society are in a healthy condition, owing partly to the generosity of friends and to the fact that the membership has increased from 162 to 184. The present issue includes three papers of general interest to entomologists. In his presidential address Mr. K. G. Blair gives an interesting summary of the more elementary facts concerning hibernation in insects. Mr. G. E. Frisby contributes a short paper on the habits of the British Aculeata, and succeeds in compressing a large amount of information within a small compass. Dr. F. A. Dixey, in a paper entitled "Sexual Dimorphism," illustrates his remarks with reference to butterflies, in which the phenomenon is more evident as colour differences than as divergence of form.

THE report of the director of the New York Aquarium for 1920 is a record of useful work done and continued progress made by this excellent institution. The addition of a collecting boat to its equipment has made possible a great improvement in the exhibits, and increased facilities for maintaining and adding to the collections. Arrangements are already in hand for increasing the number of tanks and for enlarging several of the existing ones. The total number of species on exhibition now reaches 191, comprising mammals, reptiles, amphibia, fishes, and invertebrates. The most important of the recent additions are specimens of the alligator garfish and two female Californian sea-lions. The number of visitors during the year reached almost two millions, and the value of the institution for educational purposes may be gauged by the fact that nearly eight thousand school children visited the aquarium with their teachers. In addition to the work of maintaining its own collections, the aquarium also supplied more than eight hundred animals to thirty-four school aquaria, and sent a number of specimens of Limulus to the Zoological Society of Berlin, about half of which arrived in healthy condition.

THE Report of the Geological Survey Board and of the Director for 1920 (1921, price 1s.) shows the remarkable progress made by this national service under the care of the Department of Scientific and Industrial Research. Though the retirement of Sir Aubrey Strahan and of Mr. G. W. Lamplugh will be keenly felt, the staff, under the directorship of Dr. J. S. Flett, has been strengthened by the addition of two district geologists, six geologists, and three other officials. The importance of a revision of the mapping of the coalfields, and the renewed attention given to deposits of minerals of economic value, are responsible for this satisfactory development, which was fortunately secured before the claims of external trade and internal unemployment became so painfully urgent in the present year. A scientific branch with the traditions of the Geological Survey of Great Britain does much to justify itself among educated producers, whether they own the land or toil beneath its surface. The age has gone by when William Smith had to direct attention to the attractions and advantages of geology by remarking that "the search for a fossil may be considered at least as rational as the pursuit of a hare."

THE British Association has issued the twentieth report of its Committee on Photographs of Geological Interest. Prof. S. H. Reynolds, of the University of Bristol, as secretary of the committee, is glad to receive unmounted copies of any photographs recording noteworthy sections or exposures, or illlustrating the relations of geological structure to scenery in the British Isles, and the prints so sent are registered and preserved for reference at the Museum of Practical Geology, 28 Jermyn Street, London. The inquirer who desires a copy for his own use is referred to the author of the photograph. The list attached to the twentieth report includes a large series of half-plate and quarter-plate pictures from Gloucestershire by Prof. Reynolds, mainly illustrating the famous Carboniferous sequence in the Avon gorge, and forty-five half-plate views of glacial deposits in Suffolk by that keen worker, the late W. Jerome Harrison. Mr. J. Ritchie contributes a series illustrating the erosion due to a cloud-burst in Aberdeenshire in 1891. It is much to be desired that funds would allow of the issue with such lists of small photographic reproductions from the registered views; but this would, of course, be impossible at the present time. Geologists near London, at any rate, have the advantage of consulting a very valuable series of records in an institution which has always been a bureau of scientific information.

THE rainfall of Southern Rhodesia is the subject of a communication by Mr. A. H. Wallis, reprinted from the *South African Railways and Harbours Magazine*, September, 1921. A map gives the seasonal, or annual, rainfall for several districts, obtained from the average of all observation stations in each district, for the period of six years ending June 30, 1919. The rains fall generally between October of one year and April of the following year. There are 239 rainfall observation stations in the country, all with voluntary observers, although, as it is pointed out, Rhodesia has been only thirty years under white occupation. Mashonaland, with an area of 114,000

square miles, is divided into sixteen rainfall districts and has 151 observing stations. Matabeleland, with an area of 60,728 square miles, is divided into thirteen rainfall districts with a total of 88 observing stations. The average seasonal, or annual, rainfall, ending June, for the whole of Southern Rhodesia is 30·38 in., that for Mashonaland 34·07 in., and for Matabeleland 26·69 in. The heavier rainfall in Mashonaland is accounted for by its being closer to the sea coast, where it has more favourable opportunity of catching the precipitation from the moisture-laden winds which blow from the eastward. The average amounts of rain for the several districts given in the map do not appear very divergent, but the falls in the several seasons are said to be sometimes very different.

IN No. 17 of the Geophysical Memoirs of the Meteorological Office Dr. Chree discusses "Simultaneous Values of Magnetic Declination at Different British Stations." Of recent years the Meteorological Office has issued two-hourly readings of the magnetic declination at Kew, which are published during the ensuing week for the benefit of mining engineers and surveyors. The question has arisen as to how far the values and changes thus recorded are applicable as standards at distant stations in the British Isles. In order to throw light on the subject, Dr. Chree has made a large number of detailed comparisons between the daily magnetic changes at Kew, Falmouth, Eskdalemuir, and Stonyhurst. It appears that the irregular movements in declination recorded at any two British stations show a general similarity, and certain general relationships of a not very definite kind are found between the variations at the different observatories. There are, however, differences which are of importance where accuracy in surveying is required to within 10′ of arc. In any case, surveyors' observations taken during a time of short-period oscillations, as indicated by reference to observatory records, should be repeated.

IN the November issue of the Dutch periodical, *de Natuur*, Mr. J. W. Giltay, of Delft, describes an instrument, the "optaphé," intended to enable blind persons who cannot use the optophone (owing to their not having an ear for musical differences), to read common printed matter by *feeling*. Five selenium cells are mounted on a screen, and the enlarged image of the letter to be read slides over the cells. Each cell is connected with a relay and a battery. So long as the cell is illuminated, the armature is drawn towards the electromagnet, and a contact is open. As soon as the cell, or part of it, is darkened by a part of the (black) image of a letter, the magnet lets go the armature, and the contact is closed. This contact shuts the secondary of a small induction-coil, in the primary of which an interrupted current is circulating. A box receiver is connected with the secondary; so long as this secondary is shut by the relay the diaphragm vibrates. The tips of the five fingers of, say, the right hand are touching lightly on the diaphragms of five receivers. The combinations of the vibrations of those five telephones play the same *rôle* as the five tones of the optophone. The diaphragms are not circular; part of them has been cut off, as the usual diaphragm of a small receiver does not give sufficiently strong vibrations. For further particulars and illustrations reference should be made to the Dutch periodical.

A NEW light alloy bearing the name of "Silumin" has been placed on the market in Germany. According to the *Zeitschrift des Vereines deutscher Ingenieure* of November 5, this alloy, which was exhibited at the recent motor show in Berlin, contains 14 per cent. silicon and the remainder is aluminium. It has a specific gravity of 2·5–2·65, *i.e.* 10 per cent. lower than the usual alloys of aluminium–copper–zinc. The tensile strength is 12·7 tons per sq. in., which is 25–30 per cent. higher than that of the alloys mentioned, while the elongation (5–10 per cent.) is double that of the common alloys. The tensile strength decreases slowly with rise in temperature. At room temperature, silumin has a hardness figure of 60 kg. per sq. mm. (38 tons per sq. in.) with a load of 500 kg. and a 10 mm. ball, and at 350° C. 20–25 kg. per sq. mm. (12·6–15·7 tons per sq. in.). It remains impervious to saturated steam, while dilute (25 per cent.) nitric acid, and even concentrated acid do not attack it as much as they do pure aluminium. In the presence of other acids and alkalies, it behaves much the same as pure aluminium. The thermal conductivity of silumin is to that of pure aluminium as 4 : 4·7, while the thermal expansion coefficient is 0·88, taking that of pure aluminium as 1. Silumin is produced by combining the two constituents, with certain additions, but it can also be manufactured electrolytically in the same way as pure aluminium. After manufacture it is "refined" by appropriate treatment.

A PAPER read by Dr. James W. French before the Optical Society on November 10 contained data relating to the interocular distance of 409 individuals tested. For men over eighteen years of age the average interocular distance recorded was 63 mm.; the smallest value was 56 mm., and the largest 72 mm. For women the mean value was 61 mm., *i.e.* 2 mm. less than the average interocular distance of the men. The smallest separation recorded was 54 mm., 2 mm. smaller than the smallest male value. The maximum separation was 67·5 mm., *i.e.* 4·5 mm. smaller than the highest male value. For adults of both sexes the average interocular distance was 62 mm. After seventeen years of age there does not seem to be any definite change in the average interocular distance of male adults. At fifteen the average was found to be 59·6 mm., and at sixteen, 61·4 mm. From these measurements it is seen that binocular instruments adjustable between the limits of 56 mm. and 72 mm. would suit most users. Prismatic binoculars are usually made adjustable between the limits of 57 and 70 mm. This higher limit of 70 only excludes about ½ per cent. of the total number of individuals tested. The lower limit of 57 excludes a larger proportion, namely 1¼ per cent., the total excluded by these extreme limits being, therefore, only about 1¾ per cent.

It would not seem desirable to prejudice the design of a prismatic binocular by attempting to suit this small proportion of extreme cases.

A PAPER on sea casualties and loss of life, read by Sir Westcott S. Abell before the North-East Coast Institution of Engineers and Shipbuilders on November 4, gives a very interesting analysis for the period of twenty-three years immediately preceding the war (1890–1913). From the results of this analysis, which are displayed both in tabular and graph form, it appears that the chance of loss of life of a passenger by reason of marine accident is about 0·02 per cent. Further, if it were possible to attain absolute perfection in the ship herself, then the reduction in loss of passenger life would amount to 70 per million passengers carried per annum. If, however, the location of casualty and the fact that technical ship and machinery regulations cannot provide against strandings and certain miscellaneous risks be considered, it would be possible to reduce loss of life to 30 per million per annum. Taking the whole twenty-three-year period, the number of deaths of passengers at sea from disease is nearly four times the number arising from marine accidents. The average death-rate from all causes for European seamen engaged in foreign trade in British vessels is about 4·0 per thousand, and the occupational risk is about 2·0 per thousand. The risk to underground workers in mines was about 1·7 per thousand in 1913, and averaged 1·5 per thousand from 1890–1900.

MR. D. E. PYE-SMITH, of Gonville and Caius College, has become a partner in the firm of Messrs. Bowes and Bowes, booksellers, Cambridge, which will continue to be carried on under the present title.

THE latest catalogue (No. 90) of second-hand books issued by Messrs. Dulau and Co., Ltd., 34 Margaret Street, W.1, gives particulars of upwards of 1600 works on botany, fossil plants, and agriculture, many formerly the property of the late Prof. Ph. van Tieghem, Paris. The list should be useful to librarians and others. We notice that, in addition to the foregoing, Messrs. Dulau are offering for sale many autograph letters of eminent men of science collected by the late Dr. Henry Woodward and Prof. Rupert Jones.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, W.C.1, have just published a short illustrated account of the establishment and progress of their seventy-seven years' (1844–1921) work as medical and scientific publishers and booksellers. Though the pamphlet refers particularly to the medical aspects of the business and the technical and scientific sides of the bookselling and library departments are referred to only briefly, for many years books on all kinds of manufactures have come within the scope of the firm's activities.

Our Astronomical Column.

FIREBALLS.—Mr. W. F. Denning writes:—"On Sunday, December 4, a large fireball was observed by Mr. E. H. Collinson from Ipswich at 10h. 10m. p.m. It was estimated to be several times brighter than Venus, and its path was from 288+67° to 279+51°; it moved swiftly, and left a silvery streak along its flight.

"A large and very brilliant meteor was viewed from Eastbourne and other places on Wednesday, December 7, at 9.30 p.m. It illuminated the sky with a strong glare, and many persons mistook it for ball lightning. Exact particulars of the path of this object have not yet come to hand.

"Observations of the Geminid meteor shower were commenced from Bristol on the morning of December 10 at about 3 a.m. In one hour's watch sixteen meteors were recorded, of which eight belonged to the Geminid stream, the radiant point being well defined at 108+32½°. Bright meteors were seen at 3.4 and 3.56 a.m., but these belonged to other showers."

OBSERVERS' HANDBOOK, 1922 (BRITISH ASTRONOMICAL ASSOCIATION).—When it became known that the "Companion to the Observatory" was being discontinued, the British Astronomical Association decided to fill the gap, entrusting the work to the Computing Section, of which Mr. L. J. Comrie is director. The Handbook has just been issued at the price (to non-members) of 2*s*. Its aim is not to supersede, but to supplement, the use of the *Nautical Almanac*, very little space being given to matter contained there.

The conditions of visibility of the planets in the different months are exhibited graphically in a diagram. Phenomena of Saturn's satellites are given, having been computed by Major Levin.

Other subjects included are periodic comets, variable stars (the ephemeris of Algol is corrected by recent observations), double stars, of which a series of test objects is given, graduated for apertures from 1 in. to 10 in., meteors, occultations, etc.

There are also descriptive notes on objects of special interest in the stellar heavens, and extensive tables of elements and constants. In short, the handbook promises to be of great utility to observers of almost every class.

PERTURBATIONS OF SATURN'S RINGS.—Dr. G. R. Goldsbrough (Phil. Trans., A, vol. 222) examines the perturbations of the ring particles produced by Saturn's satellites. He neglects the oblateness of Saturn and the mutual actions of the ring particles, and then finds boundaries of the zones of instability produced by the separate satellites. The action of Mimas is predominant, owing to its nearness; he find that it should produce a division from radius 16·9″ to 17·64″ (heliocentric distances from Saturn's centre), the figures agreeing exactly with the edges of the great Cassini division. It should also produce a clearance from radius 20·2″ to its own orbit; the actual outer edge of the ring is at 20·0″. Dione should produce a clearance from Saturn's surface to 9·34″; the actual inner edge of the crêpe ring is at 10·83″. Lowell reported a black band between ring B and the crêpe ring, which the author ascribes to the action of Rhea. It is shown that the dissipative action in each case is most effective in the outer portion of the unstable zone. The author thus explains the failure of Titan to dissipate the whole of the bright rings, which lie in Titan's zone of clearance (extending from the planet to radius 29·94″), but in the portion where the dissipative action is weakest. The author concludes, however, that this action will eventually dissipate the whole ring.

The Mound-builders of Dunstable.

AT a meeting of the Royal Anthropological Institute, held on November 8, Dr. W. H. R. Rivers, president, in the chair, Prof. G. Elliot Smith and Capt. Guy Crowden read a paper on "The Mound Builders of Dunstable." After describing the results of excavations on one of the Five Knolls on Dunstable Downs, in which the remains of three cremated bodies were interred, probably in the Bronze age, the authors directed attention to the association of the tumuli with cultivation terraces, huts, and ancient roads, and suggested that the presence of flint suitable for implement making was the determining cause of the settlement of the people who built the huts and made the cultivation terraces on the Dunstable Downs. The convergence of the main roadways at this spot is also to be explained by the transport of the most valuable economic product of the Neolithic—and even also of the Bronze—age to places where such material could not be obtained locally. Attention was directed to the geographical distribution of cultivation terraces in Britain, and their remarkable association in so many places with the edge of the chalk; and the attempt was made to correlate these facts with the observations of Mr. W. J. Perry as to the causal relationship between the distribution of the megalithic monuments of Wiltshire, etc., and the flint-bearing edge of the same chalk zone further south. The plea was made for the fuller investigation of the relationship existing between ancient monuments and geological formations that produced substances valued by man in ancient times, and also for the investigation of the effects of the admixture of cultures revealed in the round barrows in different parts of the country.

The discussion which followed the reading of the paper dealt mainly with the question of terrace cultivation. The authors in the course of their paper had suggested that the employment of terrace cultivation on this site was due to a conservative instinct which continued to employ a traditional system of cultivation, originating elsewhere, and not necessitated by the conditions of the present site. Mr. Peake, however, suggested that terrace cultivation was a natural consequence of ploughing or hoeing on the side of a hill; these operations, in course of years, would be bound to produce terraces such as those known on the Downs as "shepherds' steps." Col. Hodson, on the other hand, pointed out that in Assam, also an area in which megalithic monuments occurred, terrace cultivation was practised by the Nagas, and the terraces, so far from being the result of the method of cultivation, were built up of set purpose when land was brought under cultivation. Mr. Mills also stated that the Sema Nagas, when urged by the administration to follow the terrace system, had stated that they were unable to do so, as they did not know the sacrifices for terrace cultivation. Mr. Strong said that in China terrace cultivation had been brought about by climatic changes. Owing to deforestation the climate had changed, and it had been necessary to introduce terraces with shale retaining walls.

Mr. Peake, in the course of his remarks, also dealt with the question of the roads which meet at or near Dunstable. He pointed out that the Icknield Way followed the junction of the chalk and the greensand, and suggested that while its course was determined by the position of the springs which were found at that junction, the course of Watling Street was determined by purely geographical conditions, and depended upon the position of the Dunstable gap. The site of the Dunstable settlement had been determined by the roads rather than *vice versa*. As regards the origin of megalithic buildings, he had begun to think we must look further east than Egypt, possibly in the Persian Gulf. A note recently published by Prof. Sayce in *Man* showed that the people of Akkad were interested in a tin-land at a very early date. It was possible, therefore, that the megalithic people were not Armenoids. The second stream of broad-headed invaders of this country were the "Beaker-folk," the centre of distribution of whose culture appeared to be Bohemia, or possibly Southern Russia, but it showed no trace of Ægean influence. He did not regard the authors' correlation of chalk and megaliths as convincing if the distribution in this country were taken as a whole. Mr. Crawford had suggested a more reasonable explanation of early settlement in pointing out that it depended upon the distribution of grassland and forest area. Chalk and limestone gave grassland areas, and were, therefore, the earliest to be peopled. Mr. Garfitt pointed out that the stone circles of Derbyshire did not comply with conditions suggested by the authors.

Prof. Elliot Smith replied briefly to his critics. He maintained that the position of the roads was determined by the occurrence of *suitable* flint, which was not found at any and every point; he failed to understand how a people such as the Elamites, who used brick and built no megalithic monuments, could have been responsible for the diffusion of the megalith; and pointed out that the Derbyshire stone circles were associated with copper.

Norwegian Meteorology.

(1) A PUBLICATION entitled "Nedbøriakttagelser i Norge," recently received from the Norwegian Meteorological Institute, contains information relative to precipitation at about five hundred Norwegian stations over periods of from 10 to 40 years ending 1915. The tables give mean and extreme monthly and annual values, as well as frequencies of occurrence of the various types of precipitation, while the charts show the geographical distribution of some of the tabulated elements. It will be seen that the days on which precipitation of 1/10 mm. or more is measured have a frequency of from 50 to 60 per cent. (per annum) in the western coastal regions, falling to 30–40 per cent. in the more easterly districts of the south and inland districts of the north. Great variability occurs, however, over comparatively small areas. Whereas Osland (Bergen) reports 1 mm. or more on an average of 197 days in the year, Ulstad, which is also in South Norway, but further east, records this amount on only 54 days.

The introduction to "Nedbøriakttagelser i Norge" is devoted mainly to a discussion of wind screens for rain gauges. The results of experiments show a general increase in the amount of precipitation measured when screens are in use, especially in winter.

(2) "Om veir og vind i Trondhjem." In this paper, which runs to about seventy pages, M. K. Håkonson Hansen summarises and discusses meteorological observations at Trondhjem during 30½ years (1885–1915), and presents numerous tables of mean and extreme values, including, among other things, an

analysis of precipitation in relation to wind direction. Southerly and south-easterly winds have the highest relative frequency, while south-south-westerly and west-north-westerly winds are the wettest; easterly winds are the driest. The mean annual temperature at Trondhjem for the 30½ years is 4·8° C. (=41° F.). The average for January and February is about −2½° C. (=27½° F.), and for July, the warmest month, 13·8° C. (=57° F.). There is a good range of variability, −26·1° C. (=−15° F.), having been recorded in February, 1899, and +35° C. (=95° F.) in July, 1901, the latter a remarkable value for the latitude.

(3) "Oversigt over Luftens Temperatur og Nedbøren i Norge (1918)." This paper contains mean temperature and rainfall tables for the year 1918 for Norway. January is shown to have been abnormally cold, especially in the North, where Karasjok was 8·8° C. and Alten 7·2° C. on the average below normal. June, except in the North, and September, were also cool, but temperatures for other months and also for the whole year, were generally above normal. The rainfall at Florø amounted to 2617 mm. (=103 in.) during the year, 481 mm. in excess of normal. Karasjok, however, with a total of only 224 mm. (=9 in.) was 161 mm. below the normal.

(4) "Om betydningen av, at der i Skandinavien oprettes aerologiske stationer," by Th. Hesselberg. In this paper the director of the Norwegian Meteorological Institute gives a brief survey of the present position and importance of aerological research, and urges the need for the establishment of aerological research stations in Scandinavia to take part in international investigations. He advocates a departure, however, from the present custom of observing on certain fixed days in the year, and proposes to make ascents only during the prevalence of interesting types of pressure distribution. Such an arrangement is certainly desirable, but likely to be difficult in practice.

(5) "Aarsberetning (1919–1920)." Much of the information contained in this annual report relates to purely administrative work. There is an account of the opening of a geophysical observatory on Spitsbergen and of the destruction caused by a severe storm. There is also a note on a comparison which was made at the end of 1919 between spectro-heliograph observations at Meudon (near Paris), and simultaneous magnetic observations at Haldde (N. Norway), and it appears that a connection was traced between calcium flocculi and the electric radiation occurring in aurora borealis and magnetic storms. Although the general cause of these phenomena remains unknown, the writer of the report expresses the view that terrestrial magnetic storms are a far more delicate test of solar activity than any solar phenomenon which can be studied by direct observation of the sun. J. W.

The Preservation of our Fauna.[1]

By T. A. COWARD.

THE preservation of a fauna or flora is a national and international duty. The main arguments for protection are: (*a*) economic—the argument of the commercial mind and of the Board of Agriculture; (*b*) æsthetic—mainly used in support of bird protection; (*c*) humanitarian—the argument against cruelty and the wastage of life; and (*d*) scientific—the desire to preserve all species or forms rather than individuals from extinction. The last, though the most difficult position to demonstrate logically, is the one which should carry most weight with the biologist.

Man is a competing animal, and in that aspect is justified in interfering with natural laws so far as is necessary for his welfare. But all such influence should be ordered by scientific and unprejudiced investigation of the inter-relation of animal life. Legislation and personal influence are the best methods of retarding or stopping the destruction of the fauna, but either without the other fails in its purpose. Public opinion, the aggregate of personal influences, is the creator and upholder of legislation. Protective measures have in the past frequently been framed for selfish ends, not for the sake of the object to be protected, hence the confusion in the legislation of to-day.

Normally, without the influence of man, a natural numerical ratio of individuals and species is maintained, for convenience termed the balance; famine or other causes adjust this balance in time of over- or under-population. Man by cultivation and domestication has so dislocated natural conditions that such balance is impossible. But there is, especially in civilised lands, an artificial "natural balance," in which man is one of the competing factors. This balance is constantly overthrown by man or his competitors; it should be readjusted whenever possible in so far as readjustment is in accordance with advance. Unwise or over-cultivation, as exemplified during the food shortage, caused certain unexpected results; the temporary cessation of checks to the natural increase of certain species, as shown during the absence of many men during the war, produces a surprising alteration in the status of many forms.

Man, by his very abundance, encourages the increase of such forms as depend upon him; many of these are inimical to his welfare and therefore must be combated. In his attitude towards the larger animals, especially where he treats them as legitimate objects for the increase of wealth or for the enjoyment of sport, he may easily destroy the very creatures he wishes to exploit. The artificial introduction of animals alien to any country is always dangerous, and has in the past been the cause of the crowding out or destruction of native forms; in the interests of a fauna this practice should be stopped. The unintentional introduction of many "pests" is almost entirely due to commerce; these hangers-on of civilisation should, so far as is possible, be controlled, as their presence is alike a danger to the human race and to other creatures.

[1] Abstract of the presidential address delivered to the Manchester Literary and Philosophical Society on October 4.

Researches on Food.

THE Report of the Food Investigation Board for 1920 [1] records a considerable amount of research work of scientific interest and immediate practical value. The Engineering Committee of the Board has shown that of the two channels of heat loss through an insulator, the solid itself and the air enclosed in the spaces of the solid, the latter is far the more important. The specific conductivity of any particular substance, *e.g.* cork, depends much more upon the form and size of its air spaces than upon the specific con-

[1] Report of the Food Investigation Board for 1920. (H.M.S.O., 1921.) 1*s*.

ductivity of the material considered as a continuous solid. It has also been demonstrated that the chief source of escape of heat from the surface of a wall is by convection currents. The Meat Committee has devoted particular attention to the conditions under which "black spot," caused by the fungus *Cladosporium herbarum*, develops in cold stores. Its prevalence on meat coming from the southern hemisphere during 1918–19 was correlated with the unusually prolonged period of cold storage due to war conditions. Apart from its unsightly appearance, no harmful effect could be traced to the growth. The Fruit and Vegetables Committee has carried out a great deal of research. Amongst other results we may mention the observation that only those fruits which lack the complete systems of ferments causing post-mortem changes in flavour and colour (strawberries, raspberries, black currants, red currants, and gooseberries) can be kept in a satisfactory condition for jam-making when frozen in contact with air.

Under the Oils and Fats Committee Dr. and Mrs. Robinson have continued their investigation of the synthesis of isomeric oleic acids. A synthesis of oleic acid is being attempted, and the ground has been cleared by the preparation of quantities of the starting materials. The preparation of suberic acid from ricinoleic acid has been improved, and the diethyl ester of this acid has been reduced with the production of octomethylene glycol and a small yield of hydroxyoctoic acid. Miss Gilchrist has continued an investigation of the constitution of the synthetic fats derived from mannitol and methylglucoside. In connection with the Canned Foods Committee, the work of Dr. Savage, recently published in the *Journal of Hygiene*, on the effects of putrefying meat upon the health of animals fed with it deserves mention. Very little obvious effect upon health was produced.

University and Educational Intelligence.

BRISTOL.—There was a large attendance in the council room at the University on Friday, December 2, when Dr. Lloyd Morgan was presented with his portrait, a gift from friends, colleagues, and students both past and present. The portrait was executed by Mr. Anning-Bell, A.R.A.

CAMBRIDGE.—The event of scientific importance in the term just completed was the opening of the Molteno Institute for Parasitology by Viscount Buxton. This is a research institute equipped and presented by Mr. and Mrs. P. H. Molteno, where Prof. Nuttall (unfortunately too unwell to attend the opening ceremony), his assistants, research students, and trained investigators from all parts will attack the many problems connected with the life-history of parasites and their reactions on their hosts. In addition to the regular facilities for experimental research, there is a good museum included in the institute.

MANCHESTER.—Prof. H. B. Dixon has intimated to the Council and Senate that it is his intention to retire from the Sir Samuel Hall chair of chemistry at the end of the present session. Prof. Dixon was appointed in 1886 to the chair rendered vacant by the resignation of Sir Henry Roscoe, and he has maintained ably the reputation of the chemistry department of the college now known as Manchester University. His special line of research has been the investigation of the rate of explosion in gases. It was his knowledge and experience of this branch of investigation which led to his appointment in 1891 to the Royal Commission charged to report on the explosion of coal-dust in mines, and also to the post of Deputy Inspector of High Explosives for the Manchester Area during the recent war. The scientific importance of his researches was recognised by the Royal Society in its invitation to deliver the Bakerian lecture in 1893 and by the award of a Royal medal in 1912. His wholehearted devotion to the Owens College, and later to the University, led him to take a prominent part on its academic boards, where the many-sidedness of his attainments were of invaluable assistance, particularly at the time of the establishment of an independent university in Manchester. Prof. Dixon intends to continue his researches in the chemical department of the University, where the elaborate equipment necessary for his investigations has been built up.

THE Salters' Institute of Industrial Chemistry has awarded forty-seven grants in aid to chemical assistants occupied in factory or other laboratories in or near London to facilitate their further studies.

APPLICATIONS are invited for the Gull studentship in pathology and allied subjects at Guy's Hospital Medical School. The studentship, value 250*l.* yearly, tenable for three years, is open to candidates under thirty years of age who have studied at the Medical School of Guy's Hospital. The latest date for the receipt of applications, which should be addressed to the Dean of the School, is Tuesday next, December 20.

THE Grocers' Company, with the view of encouraging original research in sanitary science, is offering three scholarships, each of the value of 300*l.*, *plus* an allowance for expenses, tenable for one year, but renewable for a second or third year under certain conditions. The election will take place in May next, and applications must be sent before April 1 to the Clerk of the Grocers' Company, Grocers' Hall, E.C.2, upon a form obtainable from the Clerk.

THE Institution of Naval Architects announces that the following scholarships will be open for competition in 1922:—Naval Architecture: Elgar (130*l.* per annum), Cammell Laird (150*l.* per annum), and Armstrong (150*l.* per annum). Marine Engineering: Parsons (150*l.* per annum) and John Brown (150*l.* per annum). The scholarships are open to British apprentices or students, and are tenable (subject to the regulations governing each scholarship) for three years at particular educational establishments. Full particulars may be obtained from the Secretary, Institution of Naval Architects, 5 Adelphi Terrace, London, W.C.2.

THE tenth annual Conference of Educational Associations will be held at University College, Gower Street, W.C.1, on December 28–January 7. A preliminary programme has been issued, and the following are among the papers which will be presented:—Education as a Mission, by Principal L. P. Jacks, at the inaugural meeting (to be held at Bedford College for Women, Regent's Park) presided over by the president of the conference, Lord Gorell, on December 28; Secondary Education through Handwork, by Mr. B. S. Gott, on December 31; Mental Tests and Mentality, by Prof. T. H. Pear, on January 2; The Effects of Competition on Plant Life, by Dr. Winifred Brenchley, and The Soil and Plant Growth, by Dr. E. J. Russell, on January 3; and Needs of the Modern University, by Prof. H. Laski, on January 4. The papers to be read to the Geographical Association have already been announced in NATURE of December 8, p. 483. On December 31 "Education as a Science" will be the subject of a joint conference at University College; Dr. J. C. Maxwell Garnett and Prof. J. Strong will take part in the discussion.

Calendar of Scientific Pioneers.

December 15, 1890. James Croll died.—Known for his writings on physical geology, such as his "Climate and Time," 1875, Croll was successively a joiner, an insurance agent, an assistant at the Andersonian College, Glasgow, and keeper of maps in the Geological Survey of Scotland.

December 16, 1798. Thomas Pennant died.—The author of "British Zoology" (1766), "British Quadrupeds" (1781), and "Arctic Zoology" (1785), Pennant, who was the friend of Linnæus, Buffon, and Voltaire, was one of the leading British zoologists of his time.

December 16, 1809. Antoine François Comte de Fourcroy died.—A teacher and organiser with a talent for oratory, Fourcroy did much to popularise the doctrines of Lavoisier among his countrymen, and with Lavoisier, Guyton de Morveau, and Berthollet published the "Méthode de Nomenclature Chimique," 1787.

December 17, 1907. Sir William Thomson, Baron Kelvin of Largs, died.—The son of James Thomson, professor of mathematics at Belfast and Glasgow, Kelvin was born in Belfast, June 26, 1824. After studying at Glasgow and Cambridge, and at Paris, where he came under the influence of Liouville and Regnault, in 1846 he was appointed to the chair of natural philosophy at Glasgow, a post he held with great distinction until 1899. Kelvin was pre-eminent in the realm not only of theory, but also of practical application. In pure science he did important work in thermodynamics, magnetism and electricity, hydrodynamics, and the theory of the æther. Besides co-operating with Tait in their famous treatise on natural philosophy, he wrote several hundred papers. As an inventor of delicate scientific instruments he was unrivalled. To him are due electrical measuring instruments of all kinds, the mirror galvanometer, siphon recorder, standard compass, and sounding and tide-predicting machines. He was president of the Royal Society from 1890 to 1894 and in 1892 was raised to the peerage. He is buried beside Newton in Westminster Abbey.

December 18, 1829. Jean Baptiste Pierre Antoine Monet de Lamarck died.—Lamarck is regarded as the founder of invertebrate zoology. His "Philosophie Zoologique" appeared in 1809, his "Histoire des Animaux Sans Vertèbres" in 1815–22. He put forward views on evolution and enunciated the doctrine of the transmission of acquired characters.

December 18, 1892. Sir Richard Owen died.—The first Hunterian professor of comparative anatomy, and later superintendent of the natural history collection of the British Museum, Owen was one of the greatest contemporaries of Darwin and Huxley. His anatomical and palæontological researches refer to every class of animal from protozoa to man.

December 19, 1887. Balfour Stewart died.—A meteorologist and magnetician, Balfour Stewart made important researches on radiant heat and spectrum analysis. He was director of Kew Observatory and then professor of natural philosophy in Owen's College, Manchester.

December 20, 1913. Julius Scheiner died.—An assistant to Schönfeld at Bonn, Scheiner, in 1887, joined Vogel at Potsdam, where he carried out a great variety of investigations in astrophysics.

December 21, 1912. Paul A. Gordan died.—A contributor to the study of the calculus of invariants and co-invariants, Gordan for many years held the chair of mathematics at Erlangen. E. C. S.

Societies and Academies.

LONDON.

Association of Economic Biologists, November 18.—Sir David Prain, president, in the chair.—E. J. **Butler**: Meteorological conditions and disease. The meteorological conditions known to influence diseases of plants are chiefly temperature, humidity, and radiation. The influences are most marked in Continental climates, as the amplitude and duration of the variations are greater than in countries like England. They act both on the host-plant and the parasite, but to judge of their full effect it is often necessary to test them on the host-parasite complex, since the influence on either host or parasite alone may not give a true picture of what occurs in the interaction of the two which constitutes disease. Small variations, amounting to not more than 5 per cent. in relative humidity or 10° C. in temperature, if prolonged, may be sufficient to determine whether a parasite will cause nearly 100 per cent. infection or none at all. In India the author has found that several diseases are so sharply restricted in their distribution by these factors that it is possible to demarcate the areas in which they cannot occur, and also those in which they occur only in special conditions arising in exceptional years, from those in which they normally occur every year. The same is true in the United States. Exact evaluation of the factors concerned is possible by rigidly controlled experimental methods, but not by field observation alone.

Faraday Society, November 28.—Prof. A. W. Porter, president, in the chair.—J. N. **Greenwood**: The effect of cold work on commercial cadmium. Chill-cast commercial cadmium undergoes spontaneous recrystallisation at the ordinary temperature without the application of cold work. Deformation hastens this change. Deformation at 20° C. softens chill-cast cadmium, and during the subsequent annealing further softening occurs. It is concluded that two forms of cadmium are being dealt with, and that the quick cooling has suppressed the transformation. Recrystallisation and hardness experiments indicate the position of the allotropic change to be in the neighbourhood of 60° C. This accords with Cohen's transformation $Cd_\alpha \rightarrow Cd_\beta$. Spontaneous recrystallisation of cast unworked cadmium takes place suddenly after about twelve days, and the hardness falls continuously during the same period. This would appear to indicate a gradual change from Cd_β to Cd_α. A third modification has sometimes been obtained, but its range of existence has not been determined.—J. N. **Pring** and E. O. **Ransome**: Reaction between cathodic hydrogen and nitrogen at high pressures. The electrode potentials with metals during electrolysis indicate that an accumulation of gas at very high pressures occurs at, or immediately within, the surface of the electrode. When cathodic hydrogen is liberated in contact with nitrogen, particularly at high pressures, the conditions appear to be favourable to the synthesis of ammonia. With nitrogen at atmospheric pressure the mean percentage current yield of ammonia by direct union of the elements amounted to 0·04 per cent. At pressures of from 60 to 104 atmospheres it was 0·09 per cent. Experiments at from 300 to 500 atmospheres showed a loss of acidity, but no ammonia was indicated. The small quantity of ammonia formed at lower pressures is ascribed to a thermal action of the heated conductors. The results indicate that no reaction takes place between nitrogen and hydrogen liberated at the cathode.—F. H

Jeffery: The electrolysis of aqueous solutions of alkaline nitrites with a lead anode and an electrometric determination of the constitution of the complex anion formed. The plumbo-nitrite complex is $(Pb(NO_2)_4)''$ for small concentrations of lead in alkali nitrite solutions. Probably this is the only complex formed. The solid in equilibrium with solutions obtained from anolytes of certain concentrations is lead nitrite crystals, $Pb(NO_2)_2,H_2O$. The colour of these crystals is approximately the same as that of the solutions from which they are derived, showing that the plumbo-nitrite complex probably maintains its identity in the crystals. A direct way of testing this hypothesis would be by an X-ray analysis of the crystals; the $(Pb(NO_2)_4)$ group should form a pattern regularly repeated in three dimensions relative to the cationic Pb atoms.—T. C. **Nugent**: An inhibition period in the separation of an emulsion. The system investigated was a fairly concentrated emulsion of benzine in water containing known amounts of stabiliser, *i.e.* gelatin or gum arabic. If caustic soda solution is added immediately, then the separation of the benzine commences immediately; but if the emulsion is left undisturbed for some time before the caustic soda solution is added, the separation of the benzine is retarded. This time lag may be termed the "inhibition period." Probably after an emulsion is produced, the gelatin slowly forms protecting layers about the benzine particles, and therefore the stability of an emulsion increases with its age.—N. R. **Dhar** and N. N. **Mittra**: Induced reactions and negative catalysis. Induced reaction is proved to be of general occurrence. In oxidation reactions, negative catalysis takes place when the catalyst is readily oxidisable. The explanation offered is the hypothesis of the formation of intermediate compounds. Experimental evidence supports the view that one chemical change will either promote or induce another chemical change of the same nature.

Linnean Society, December 1.—Dr. A. Smith Woodward, president, in the chair.—W. Neilson **Jones**: Note on the occurrence of Brachiomonas. This alga, which appeared last year in rain-water pools at Regent's Park College, had previously been reported only from brackish water at Sheerness, Stockholm, and the Black Sea.—J. **Burtt-Davy**: The distribution of Salix in South Africa. In South Africa ten species or varieties are known, and in tropical Africa twelve, only one being common to both areas. Usually each species occupies limited areas in one particular drainage-basin, so that cross-pollination is practically impossible. *S. Woodii* may be the connecting-link by way of Pondoland, the Transkei, and Eastern Cape with *S. safsaf* in Rhodesia. Although the Orange River is isolated from Angola by the wastes of the Kalahari, it is possible that these species, or a common ancestor, came from the north when the Cunene discharged into the Orange by way of the Molopo.—M. **Christy**: The problem of the pollination of our British Primulas. Some thirty species of insect visit or frequent the flowers of the three British Primulas (*P. vulgaris, P. veris,* and *P. elatior*). A small proportion have long tongues and are able to effect pollination, but their visits to the flowers are comparatively rare, and inadequate for the perpetuation of these Primulas. Most other insect visitors are short-tongued bees, totally unable to effect pollination. Some Coleoptera frequented the flowers, and seem capable of pollinating them, though in an irregular manner. Night-flying moths were suggested as the agents of normal pollination—a surmise advanced by Darwin.

PARIS.

Academy of Sciences, November 28.—M. Georges Lemoine in the chair.—P. **Termier** and L. **Joleaud**: New observations on the "nappe de Suzette" formed of Triassic strata, issued from the Alps, and having covered at the Aquitanian period a part of the region of the Rhône.—P. A. **Dangeard**: The nature of the spherome in the plant-cell. Reply to a recent communication by M. Guilliermond.—G. **Mittag-Leffler**: Cauchy's theorem on the integral of a function between imaginary limits.—M. **de Sparre**: The yield of reaction turbines working under a variable load. Turbines are usually constructed to work under full load. Calculations are given for determining the efficiency under a reduced load, and also for modifying the design of the turbine, so that while sacrificing a small percentage of efficiency at full load the efficiency varies only slightly under large variations of load.—C. **Sauvageau** and G. **Denigès**: The efflorescence of marine algæ of the genus Cystoseira.—G. **Cerf**: The systems of Pfaff and the transformations of partial differential equations.—J. **Wolff**: The series $\Sigma\frac{A_k}{z-a_k}$. —E. **Borel**: Remarks on the preceding note.—G. **Valiron**: Integral functions and their inverse functions. C. **Camichel**: Hydraulic states of flow.—D. **Eydoux**: The variation of energy round a point of a rotating hydraulic machine.—G. **Fontené**: The two Lorentz coefficients of inertia for movements at high velocities. —E. **Belot**: The minor planets of the Saturn family.— Mrs. Isaac **Roberts**: A star which may have appeared in the sky since 1892.—J. **Le Roux**: Time in classical mechanics and in the theory of relativity.—A. **Dauvillier**: Analysis of the atomic structure. The author summarises the conclusions derived from his theory of atomic structure in a form of the periodic table of the elements, showing the number of the superficial electrons, the number of electrons, and the quanta.—E. **Rengade**: The resolution of a salt in the course of the isothermal evaporation of a solution. Reply to a criticism of M. Raveau.—A. **Kling** and A. **Lassieur**: The separation and estimation of copper, lead, antimony, and tin. The analysis of white metals. The method is based on the conversion of the tin into a complex stanni-fluoride, from which the sulphide is not precipitated by sulphuretted hydrogen, with later application of rapid electrolytic methods.— P. **Thomas** and G. **Carpentier**: A very sensitive reagent for copper: the Kastle-Meyer reagent. This reagent, an alkaline solution of phenolphthalein, originally proposed as a test for blood, is an extremely sensitive reagent for copper, and will show one part of copper in a hundred millions of water, and as ordinary distilled made with a copper still may contain one part of copper in a million, special precautions are necessary in applying the test. In a solution free from organic compounds the reaction is distinctive, and is given by no other metal.—P. **Robin**: The action of nitrogen iodide and cyanogen iodide on benzamidine.—C. **Mariller**: A method of fractionating liquid mixtures and its application to the preparation of a home-produced fuel.—P. **Gaubert**: The recrystallisation produced by annealing. The theories which have been put forward to explain the recrystallisation of metals have been applied to interpret the results of experiments on organic compounds, vanillin, paraffin wax, beeswax, and cetin. It was found that recrystallisation is, in general, only possible when the crystals are sufficiently malleable for mechanical actions to modify their crystalline network.—P. **Glangeaud**: The architecture of the three principal volcanic centres of the Cantal massif.—P. **Corbin**: The tectonic of the eastern edge of the

Vercors massif.—P. **Loisel**: The existence of a new radio-active emanation in the springs of Bagnoles-de-l'Orne and its neighbourhood. The experiments described can be best explained on the assumption of the presence of a new simple radio-active element, provisionally named emilium.—L. **Dunoyer**: The graphical determination of average wind velocities.—L. **Besson** and H. **Dutheil**: Relations between the direction of the cirrus clouds at Paris and the barometric situation in Europe. The results of an examination of ten years' statistics.—Miss Ethel **Mellor**: The lichens which attack glass and their mechanical action on stained glass windows of churches. The immediate cause of the corrosion of stained glass windows is the mechanical action of the lichens; this action follows on the chemical weathering of the glass, itself accelerated by the growth and life of the lichens. The remedy suggested is annual window cleaning.—L. **Plantefol**: The teratological spikes of *Plantago lanceolata*.—A. **Dauphiné**: The experimental production of acceleration in the evolution of the conducting apparatus. Experiments on the growth of the root of the lupin, from which certain parts have been removed.—F. **Obaton**: The comparative structure of leaves of the same age and different dimensions. In small and large leaves from the same branch and of the same age the histological elements are practically the same magnitude for the parenchymatous part, and are also nearly identical in the composition of the structure of the physiologically comparable veins.—P. **Freundler** and Mlles. Y. **Menager** and Y. **Laurent**: The composition of the Laminaria. The maximum proportions of iodine, carbohydrates, and brown pigments coincide with the period of maximum insolation.—G. **Bertrand** and Mme. M. **Rosenblatt**: The distribution of manganese in the organisms of the higher plants. A detailed study has been made of two plants, *Nicotiana rustica* and *Lilium lancefolium rubrum*, at different stages of growth. The maximum proportion of manganese is usually found in the organs where the chemical transformations are the most active. The seeds also contain a high proportion of manganese.—M. **Doyon**: The utilisation of the frog for the demonstration of the anti-coagulating action of the nucleic acids.—A. **Michel**: The fibrillary tissue and nerve tissue of the elytron and dorsal cirrus of the Aphroditian Annelids.—C. **Julin** and A. **Robert**: New observations on the formation of the cardio-pericardic organ and of the epicardium in the oozoid of Distaplia.—E. **Roubaud**: Fertility and longevity of the domestic fly. A minimum of 600 eggs is estimated as the average production of a normal fly, and taking the period of evolution from egg to egg-laying as eighteen days, and it may be as low as thirteen days, from May 1 to September 30 a single fly may give rise to 4000 billions (4×10^{15}).—A. **Gruvel**: Pearl oysters on the coast of Madagascar.—R. **Kœhler**: The services which radiography may render in the study of Clypeaster.—H. **Heldt**: The co-operation of the dirigible balloon in sea-fishing. The dirigible balloon has proved useful in rapidly sketching out the nature of the sea-floor, knowledge of use to the fisherman. Shoals of fish are also readily seen; the balloon can hover over the spot and send signals to the fishing fleet.—C. **Noiszewski**: Glaucoma and the relations between intra-ocular and intra-cranial pressure.—G. **Bourguignon**: The localisation of poisons and infections on the neuro-muscular systems of man according to their chronaxy.

MELBOURNE.

Royal Society of Victoria, September 8.—Prof. A. J. Ewart, president, in the chair.—J. **Shephard**: The Rotifera of Australia and their distribution. Two hundred and thirty species have been recorded as the result of the work of seven or eight observers. The wide distribution of rotifers may be regarded as due to man's agencies.—E. T. **Quayle**: Local rain-producing influences in South Australia. The greatest rain improvement area in South Australia owes its origin to Lake Torrens, while Lake Frome is the source of another area of probably equal improvement. The full plotting of this rainfall departure on a map showed marked rainfall deficiency both to northward and southward of the improved area, but ending abruptly at the lake, showing that it was not due to any specially favoured storm tracks. Several other lakes showed slighter effects of the same kind, proving that evaporation from the lakes was a very effective factor in rain production inland. Lakes Torrens and Frome were considered together. The probable run-off rainfalls and the percentage of rainfall finding its way into the lakes were considered to be increasing. The rainfall is not retained, as formerly, in numberless small reservoirs in the uplands, but is hurried down to the lower levels, and finally into lakes or swamps, which tend to improve rainfall locally. It is considered that the filling of Lakes Torrens and Eyre from the sea would make the whole area south-east of them capable of close settlement, especially when aided by proper use of the waters of the Murray and its great northern tributaries. One cause of Australian aridity is the growth of drought-resistant perennial vegetation which regulates evaporation adversely to storm demands for rain production, and prevents accumulation of water in inland lakes by its own moisture requirements and by its prevention of the formation by erosion of defined stream channels. Human occupation tends to improve climate by reason of forest destruction and the substitution of grass and crops for drought-resistant vegetation, by water storage, and the tapping of underground water supplies.—T. H. **Laby**: A new type of barometer.—T. H. **Laby**: A gravity metre.

SYDNEY.

Linnean Society of New South Wales, September 28.—Mr. G. A. Waterhouse, president, in the chair.—T. G. **Sloane**: Description of a new tiger beetle from the Wyndham district. A new species of Cicindela was described.—L. **Harrison**: Note on the pigmentation of frogs' eggs. Results are recorded of observations on the pigmentation of the eggs in some Australian species of the genera Limnodynastes, Pseudophryne, and Hyla.—E. W. **Ferguson**: Revision of the Amycterides. Part vii.: Hyborrhynchus and allied genera. A small group of genera having affinities both with the Acantholophus-Cubicorrhynchus and the Euomid complexes are dealt with.—C. T. **White**: Notes on the genus Flindersia (fam. Rutaceæ). The genus Flindersia, founded by Robert Brown in 1814 on *F. australis*, the common "crow's ash" of Queensland or "teak" of New South Wales, consists of eighteen species, fifteen of which are found in eastern Australia. The genus includes some of the most valuable timber trees of Australia.—A. B. **Walkom**: A specimen of Nœggerathiopsis from the Lower Coal Measures of New South Wales. A large specimen of Nœggerathiopsis showing radiate arrangement of the leaves was described. All specimens previously described with this arrangement have been obtained from the Upper (Newcastle) Coal Measures.—Marjorie I. **Collins**: The mangrove and saltmarsh vegetation near Sydney, with special reference to Cabbage Tree Creek, Port Hacking. The mangrove formation—the outermost—is characterised by the two species, *Avicennia officinalis* and *Aegiceras majus*; in the salt-

marsh—the inner—two plant associations, (*a*) Salicornietum and (*b*) Juncetum, are recognised. At Cabbage Tree Creek drift sand has been raising the level of the marsh for some years, and Juncetum, the marginal association of the saltmarsh, is invading Salicornietum.—A. M. **Lea**: Description of new species of Australian Coleoptera. Part xvii. Thirty-nine species are described as new, belonging to sixteen genera in the families Nitidulidæ, Malacodermidæ, Chrysomelidæ, Erotylidæ, Endomychidæ, and Corylophidæ.

Royal Society of New South Wales, October 5.—Mr. E. C. Andrews, president, in the chair.—A. R. **Penfold**: The essential oil of *Leptospermum flavescens* (Smith). This tea-tree grows extensively in the coastal and mountainous districts around Sydney. The average yield of oil is about 0·8 per cent. from the distillation of ½ ton of material. The principal constituents are α- and β-pinene, aromadendrene, eudesmene, dextro-rotatory eudesmol, leptospermol (new liquid phenol), small amounts of citral, and unidentified alcoholic bodies.—J. K. **Taylor**: A note on chemistry of Kurrajong seeds. A syrupy red oil was extracted from the seeds with a solvent; some could be obtained by subjecting them to pressure. The oil belongs to the semi-drying group of vegetable oils. The oilcake remaining after pressure treatment is comparable with other cakes.—C. W. **Mann**: Preliminary note on the occurrence of porphyritic intrusions at Yass, New South Wales. It was thought that these beds were flows of volcanic material which had issued contemporaneously with the formation of the interbedded sedimentary rocks. New evidence indicates that after the deposition of the sedimentary material the beds of porphyry were intruded into their present positions. The rocks occurring in the upper side of the shelf of porphyry are thin beds of breccia formed by the inclusion of fragments of sedimentary rocks while the molten magma was in process of intrusion towards the surface.

Cape Town.

Royal Society of South Africa, October 19.—Dr. J. D. F. Gilchrist, president, in the chair.—Miss M. R. **Michell**: Some observations on the effect of fire on the vegetation of Signal Hill. Within three weeks of a bush fire in February, 1919, which killed the aerial parts of plants, some had put up vigorous shoots, notably *Asparagus capensis*. They were perpetuated by regeneration from the underground parts or by seed. The fire stimulated erosion. It was favourable to the spread of the Rhenoster bush; no evidence of eradication of species by burning was obtained.—Miss A. V. **Duthie**: The morphology of *Selaginella pumila*. The species is an annual occurring in abundance near Stellenbosch. The base of the vegetative leaf contains well-defined aerenchyma communicating with the atmosphere by stomata which are confined to the aligular surface of the leaf and the leaf-margin. The roots are destitute of root-hairs, and contain an endophytic fungus.—A. R. E. **Walker**: Note on a specimen of *Phacops africanus*, Lake. A nodule containing an internal cast and a mould of the external surface of the thorax and tail of the trilobite *Phacops africanus*, Lake, was described. Each segment of the axis of the thorax bore a strong medium spine, and the thorax was composed of eleven segments.—J. W. C. **Gunn**, M. **Goldberg**, and J. H. **Ferguson**: A note on the pharmacological action of *Scilla Cooperi*, Hook. Fil., *S. Rogersii*, Baker, and *S. lanceaefolia*, Baker. Extracts of these South African species of squill have similar effects on frogs and mammals to the extracts made from the digitalis group, such as *S. maritima*, though they are less poisonous. They all contain glucosides.—C. S. **Grobbelaar**: I. Some South African Paramphistomidæ, Fisch. The conditions favouring natural infection of stock, the effects of infection, and the general distribution of the family in South Africa are noted. *Isidora* (*Physa*) *tropica*, Krauss, is the intermediate host of *Paramphistomum caticophorum*, Fisch. II. Some trematodes in the South African anura and the relationships and distribution of their hosts.—C. **Pijper** and H. **Zwarenstein**: The "Account Book" of Jan Haszing. Jan Haszing practised as a surgeon at Cape Town; his "Account Book" starts at 1736 and runs on continuously until 1767; it throws light on the life of Cape Town at that epoch.—J. **Moir**: Colour and chemical constitution. Pt. 16: Further miscellaneous observations. The position of the absorption band is given for ten further derivatives of benzhydrol, twelve further derivatives of phenolphthalein, five derivatives of quinolinic acid, eleven further triphenyl-carbinol dyes, and ten other substances connected with colour and fluorescence.

Books Received.

Obras Completas y Correspondencia Cientifica de Florentino Ameghino. Dirigida por Alfredo J. Torcelli. Volumen 1: Vida y Obras del Sabio. Pp. 399. Volumen 2: Permanos Trabajos Cientificos. Pp. 773. (La Plata: Ministère des Travaux Publics.)

A Treatise on Probability. By J. M. Keynes. Pp. xi+466. (London: Macmillan and Co., Ltd.) 18*s*. net.

Rays of Positive Electricity and their Application to Chemical Analyses. By Sir J. J. Thomson. (Monographs on Physics.) Second edition. Pp. x+237+9 plates. (London: Longmans, Green and Co.) 16*s*. net.

The Elements of Social Justice. By Prof. L. T. Hobhouse. Pp. 208. (London: G. Allen and Unwin, Ltd.) 10*s*. 6*d*. net.

British Astronomical Association: Observer's Handbook for 1922. Pp. 36. (London: Eyre and Spottiswoode, Ltd.) Members, 1*s*. 6*d*.; non-members, 2*s*.

A Handbook of some South Indian Grasses. By Rai Bahadur K. Ranga Achariyar. Pp. vi+318. (Calcutta: Butterworth and Co., Ltd.; London: Constable and Co., Ltd.) 4.8 rupees.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. 5, Part 9. (Part 49 of the complete work.) Pp. ii+261–290+plates 200–203. (Sydney: W. A. Gullick.) 3*s*. 6*d*.

Physikalische Rundblicke. Gesammelte Reden und Aufsätze. By Max Planck. Pp. iv+168. (Leipzig: S. Hirzel.) 60 marks.

Nutrition de la Plante. By M. Molliard. I.: Echanges d'Eau et de Substances Minérales. Pp. xiv+305. II.: Formation des Substances Tenaires. Pp. vi+438. (Encyclopédie scientifique: Bibliothèque de Physiologie et de Pathologie Végétales.) (Paris: Gaston Doin.) 2 vols., 14 francs.

Chemical Reactions and their Equations: A Guide and Reference Book for Students of Chemistry. By Prof. I. W. D. Hackh. Pp. viii+138. (Philadelphia: P. Blakiston's Son and Co.)

Philosophy and the New Physics: An Essay on the Relativity Theory and the Theory of Quanta. By Prof. L. Rougier. Authorised translation from the author's corrected text of "La Matérialisation de l'Energie" by Prof. M. Masius. Pp. vi+159. (Philadelphia: P. Blakiston's Son and Co.)

Western Australia. Astrographic Catalogue 1900·0. Perth Section, Dec. −31° to −41°, from Photographs

taken and measured at the Perth Observatory under the direction of H. B. Curlewis. Vol. 13: Measures of Rectangular Co-ordinates and Magnitudes of 6879 Star Images R.A. 0^h to 6^h on Plates with Centres in Dec. $-35°$. Pp. 51. Vol. 14: Measures of Rectangular Co-ordinates and Magnitudes of 24,753 Star Images R.A. 6^h to 12^h on Plates with Centres in Dec. $-35°$. Pp. 113. Vol. 15: Measures of Rectangular Co-ordinates and Magnitudes of 22,139 Star Images R.A. 12^h to 18^h, on Plates with Centres in Dec. $-35°$. Pp. 107. Vol. 16: Measures of Rectangular Co-ordinates and Magnitudes of 19,277 Star Images R.A. 18^h to 24^h, on Plates with Centres in Dec. $-35°$. Pp. 94. (Perth: Observatory.)

The Tragic Sense of Life in Men and in Peoples. By Miguel de Unamuno. Translated by J. E. Crawford Flitch. Pp. xxxvi+332. (London: Macmillan and Co., Ltd.) 17*s*. net.

The War List of the University of Cambridge, 1914–1918. By G. V. Carey. Pp. xiv+616. (Cambridge: At the University Press.) 20*s*. net.

The Distribution of Gas. By Walter Hole. Fourth edition, rewritten and enlarged. Pp. xvi+699. (London: Benn Bros., Ltd.) 50*s*. net.

Traité d'Embryologie des Vertébrés. By Prof. A. Brachet. Pp. xvi+602. (Paris: Masson et Cie.) 60 francs net.

Notes sur les Propriétés fondamentales de la Matière. By Prof. J. Lemaire. Pp. 55. (Liège: Société Industrielle d'Arts et Métiers.)

Directive Wireless Telegraphy: Direction and Position Finding, etc. By L. H. Walter. (Technical Primer Series.) Pp. xii+124. (London: Sir I. Pitman and Sons, Ltd.) 2*s*. 6*d*. net.

Everyday Life in the Old Stone Age. Written and illustrated by M. and C. H. B. Quennell. (Everyday Life Series, I.) Pp. x+109. (London: B. T. Batsford, Ltd.) 5*s*. net.

Homework and Hobby Horses. Edited by H. Caldwell Cook. (Perse Playbooks, No. 6.) Pp. xii+58. (London: B. T. Batsford, Ltd.) 2*s*. 6*d*. net.

Iron-Founding. By B. Whiteley. (Common Commodities and Industries Series.) Pp. x+131. (London: Sir I. Pitman and Sons, Ltd.) 3*s*. net.

Applied Calculus: An Introductory Text-book. By F. F. P. Bisacre. Pp. xvi+446. (London: Blackie and Son, Ltd.) 10*s*. 6*d*. net.

Problemi di Filosofia Botanica. By Antonino Borzi. Pp. 344. (Rome: G. Bardi.) 60 lire.

Organic Syntheses: An Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Vol. 1. Pp. viii+84. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

The Passing of the Great Race; or, the Racial Basis of European History. By Madison Grant. Fourth revised edition, with a Documentary Supplement. Pp. xxiv+476+maps and charts. (London: G. Bell and Sons, Ltd.) 14*s*. net.

New Mathematical Pastimes. By Major P. A. MacMahon. Pp. x+116. (Cambridge: At the University Press.) 12*s*. net.

Elementary Analysis. By Prof. C. M. Jessop. Pp. viii+175. (Cambridge: At the University Press.) 6*s*. 6*d*. net.

Sammlung Vieweg. Tagesfragen aus den Gebieten der Naturwissenschaften und der Technik, Heft 59. Denken und Darstellung: Logik und Werte Dingliches und Menschliches in Mathematik und Naturwissenschaften. By E. Study. Pp. iv+43. (Braunschweig: F. Vieweg & Sohn.) 8 marks.

Die Wissenschaft. Sammlung von Einzeldarstellungen aus den Gebieten der Naturwissenschaft und der Technik, Band 66. Die Entstehung der Kontinente und Ozeane. By Prof. Dr. A. Wegener. Zweite auflage. Pp. viii+135. (Braunschweig: F. Vieweg & Sohn.) 30 marks.

Air Ministry: Meteorological Office. British Meteorological and Magnetic Year Book, 1914. Part 5: Réseau Mondial, 1914. Monthly and Annual Summaries of Pressure, Temperature, and Precipitation at Land Stations; generally Two for each Ten-Degree Square of Latitude and Longitude. Pp. xx+112. (London: H.M. Stationery Office.) 18*s*. net.

Webbia: Raccolta di Scritti Botanici. Edita da Prof. U. Martelli. Vol. Quinto, Parte 1. Pp. 355+13 plates and maps. (Firenze: M. Ricci.)

Patents and Chemical Research. By H. E. Potts. Pp. x+198. (Liverpool: University Press.) 8*s*. 6*d*. net.

Considérations sur l'Etre Vivant. By Charles Janet. Deuxième Partie: L'Individu, la Sexualité, la Parthénogénèse et la Mort au Point de Vue Orthobiontique. Pp. 196. (Beauvais: Dumontier et Hague.)

La Géographie de l'Histoire: Géographie de la Paix et de la Guerre sur Terre et sur Mer. By Jean Brunhes et Camille Vallaux. Pp. vi+716. (Paris: F. Alcan.) 40 francs net.

The Haunts of Life: Being Six Lectures delivered at the Royal Institution, Christmas Holidays, 1920–1921. By Prof. J. A. Thomson. Pp. xvi+272+16 plates. (London: A. Melrose, Ltd.) 9*s*. net.

The Year-book of the Scientific and Learned Societies of Great Britain and Ireland. Compiled from official sources. 38th annual issue. Pp. viii+366. (London: C. Griffin and Co., Ltd.)

La Physique Théorique Nouvelle. By Dr. J. Pacotte. Pp. viii+182. (Paris: Gauthier-Villars et Cie.) 12 francs net.

A Text-book of Geography. By G. C. Fry. Fourth edition. Pp. xxiv+527. (London: University Tutorial Press, Ltd.) 6*s*. 6*d*.

Meteorological Office: Air Ministry. British Rainfall, 1920. The Sixtieth Annual Volume of the British Rainfall Organization: Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1920 as recorded by about 5000 Observers in Great Britain and Ireland. Pp. xxviii+285. (London: H.M. Stationery Office.) 12*s*. 6*d*. net.

Department of Scientific and Industrial Research. The Physics and Chemistry of Colloids and their Bearing on Industrial Questions: Report of a General Discussion held jointly by the Faraday Society and the Physical Society of London on 25th October, 1920. Pp. iv+190. (London: H.M. Stationery Office.) 2*s*. 6*d*. net.

Relativisti Contemporanei: Vaihinger–Einstein–Rougier–Spengler–L'Idealismo Attuale–Relativismo e Rivoluzione. By A. Tilgher. Terza edizione. Pp. 81. (Roma: Libreria di Scienze e Lettere.) 3 lire.

La Loi de Newton est la Loi Unique: Théorie Mécanique de l'Univers. By Max Franck. Pp. iv+158. (Paris: Gauthier-Villars et Cie.) 12.50 francs.

The Framework of Wireless Telegraphy: A New Theory of Electric Wave Sources and Propagations, with Rational Applications. By R. C. Galletti di Cadilhac. Pp. 48. (London: Crosby Lockwood and Son.) 3*s*. 6*d*. net.

Department of Applied Statistics (Computing Section), University of London, University College. Tracts for Computors. Edited by Prof. Karl Pearson. No. 7: The Numerical Evaluation of the Incomplete B-Function. By H. E. Soper. Pp. 53. (London: Cambridge University Press.) 3*s*. 6*d*. net.

Diary of Societies.

THURSDAY, DECEMBER 15.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 4.30.—Major A. E. Milner: Diathermy in the Treatment of Lupus Erythematosus.

LINNEAN SOCIETY OF LONDON, at 5.—Prof. G. C. Bourne: The Raninidæ, a Group of Crustacea.—F. A. Potts: Narrative of the Carnegie Institution Expedition to Samoa.

NEWCOMEN SOCIETY (at King's College, Strand, W.C.2), at 5.—Annual General Meeting.—At 5.15.—R. C. S. Walters: Greek and Roman Engineering Instruments.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—J. H. Jeans: The New Dynamics of the Quantum Theory (Lecture). The following papers will be taken as read:—W. P. Milne: The Relations Between Apolarity and Clebsch's Mapping of the Cubic Surface in a Plane.—Miss G. D. Sadd: Certain Types of Plane Unicursal Curves.—H. M. Shaffer: The General Theory of Notational Relativity.—Pundit Oudh Upadhyaya: (1) Note on Gauss's Quadratic Identity; (2) A General Formula in Cubic Forms.—J. R. Wilton: Gibbs's Phenomenon in Fourier's Series and Integrals.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—Discussion on Paper by H. F. Collins: The Igneous Rocks of the Province of Huelva and the Genesis of the Pyritic Orebodies.—A. V. Reis: Underground Working of Wide Pyritic Orebodies.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.——Capt. F. M. Green: Development of the Fighting Aeroplane.

SOCIETY OF ARCHITECTS, at 6.

CHILD STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss von Wyss: Vital Elements in Art Teaching.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—L. H. A. Carr: Induction-type Synchronous Motors.

CONCRETE INSTITUTE, at 7.30.—E. F. Sargeant: (*a*) The Preparation of Concrete Aggregates; (*b*) Moving Forms.

CHEMICAL SOCIETY, at 8.—G. T. Morgan and J. D. Main Smith: Researches on Residual Affinity and Co-ordination. Part VII., Cobaltic Lakes of the Alizarin Series.

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates' Meeting), at 8.—E. Chatterton: The Design of Automobile Clutches.

CAMERA CLUB, at 8.15.—F. F. Renwick: The Action of Dyes in Colour Sensitising and Desensitising Dry Plates.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE, at 8.15.—Dr. A. Balfour: A Medical and Sanitary Survey of Mauritius—Past, Present, and Future.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, DECEMBER 16.

INSTITUTE OF TRANSPORT (at Royal Society of Arts), at 5.—J. Paterson: The Operation of a Road Distributing Agency.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—G. Mitchell: Conveying and Elevating Machinery.—R. E. Knight: Discharge of Grain Cargoes in the Port of London by Pneumatic Elevators.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—A. J. Simpson: Notes on Searchlight Construction and Operation.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 8.—L. Richmond: Address.

SATURDAY, DECEMBER 17.

PHYSIOLOGICAL SOCIETY (at London Hospital), at 4.—H. E. Roaf: (i) The Relation of Plant Pigments to Urinary Pigmentation; (ii) A Useful Modification of the Induction Coil; (iii) The Acidity of Muscle during Maintained Contraction.—W. A. M. Smart and H. E. Roaf: The Relation of Methæmoglobin to Oxyhæmoglobin.—W. A. M. Smart: A Simple Refractometer.—R. N. E. Condon: A New Drop-recorder.—H. E. Roaf: A Simple Method for the Detection of Nitrogen in Physiological Fluids.—G. Williamson: Note on the Resonator System in the Cochlea, with a Model.—T. Lewis, A. N. Drury, C. C. Iliescu, and A. M. Wedd: The Action of Quinidine on the Mammalian Auricle.—E. C. Dodds and J. McIntosh: Changes in the CO_2 Content of Whole Blood and Plasma produced by Meals.—V. H. Mottram: Growth of Cats on Various Pure and Mixed Fats.—H. Hartridge: Vindication of the Resonance Theory of Hearing.—D. T. Barry: Spontaneous Rhythmic Contractions of Flexor Type in the Dog's Hind Limb. Postural Influence, etc.

MONDAY, DECEMBER 19.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Meeting), at 7.—C. Poole: Worm-gearing.

ARISTOTELIAN SOCIETY (at University Club, 21 Gower Street, W.C.1), at 8.—F. Tavani: Physical Space and Hyperspaces.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

TUESDAY, DECEMBER 20.

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

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—E. A. Rusher: Statistics of Industrial Morbidity in Great Britain: A Retrospect and a Scheme of Development.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—C. R. C. Petley: The Chamonix Valley (Lantern Meeting).

ROYAL GEOGRAPHICAL SOCIETY (jointly with the Alpine Club) (at Queen's Hall), at 8.30.—Lieut.-Col. C. K. Howard-Bury, G. L. Mallory, and other Members of the Expedition: The Mount Everest Expedition.

WEDNESDAY, DECEMBER 21.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.—C. J. S. Thompson: The Parturition Chairs—their History and Use.—Miss Eileen Power: An English Woman Doctor in the Fifteenth Century.

ROYAL METEOROLOGICAL SOCIETY, at 5.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—L. Owen: Notes on the Phosphate Deposit of Ocean Island, with Remarks on the Phosphates of the Equatorial Belt of the Pacific Ocean.—H. B. Milner: The Nature and Origin of the Pliocene Deposits of the County of Cornwall, and their Bearing on the Pliocene Geology of the South-West of England.

ROYAL MICROSCOPICAL SOCIETY, at 8.—E. A. Smith: The Microscope in Non-ferrous Metallurgical Research.—Dr. J. G. Parker and Dr. S. H. Browning: The Practical Value of the Microscope in Connection with Leather Manufacture.

PUBLIC LECTURES.

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

THURSDAY, DECEMBER 15.

ROYAL COLLEGE OF SURGEONS, at 4.—F. W. Twort: Recent Researches on the Biology of Bacteria (Brown Lecture) (3).

UNIVERSITY COLLEGE, at 5.—Prof. J. E. G. De Montmorency: Religion and Feudalism (7).

LEPLAY HOUSE, 65 Belgrave Road, S.W.1, at 8.15.—Dr. C. W. Saleeby: Light against Death.

MONDAY, DECEMBER 19.

ROYAL COLLEGE OF SURGEONS, at 4.—F. W. Twort: Recent Researches on the Biology of Bacteria (Brown Lecture) (4).

KING'S COLLEGE, at 5.30.—Dr. W. R. Ormandy: Liquid Fuel Engines (5).

TUESDAY, DECEMBER 20.

ROYAL COLLEGE OF SURGEONS, at 4.—F. W. Twort: Recent Researches on the Biology of Bacteria (Brown Lecture) (5).

KING'S COLLEGE, at 5.30.—Dr. W. Brown: Psychology and Psychotherapy (10).

WEDNESDAY, DECEMBER 21.

SCHOOL OF ORIENTAL STUDIES, at 12.—Miss Alice Werner: Bantu Tribes of East Africa (6).

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