THURSDAY, NOVEMBER 8, 1917.

UNIVERSITIES AND THE SUPPLY OF RESEARCH WORKERS.

ONE of the most important matters to which the Department of Scientific and Industrial Research has to give close attention is the supply of research workers by our universities and colleges. Military necessity has reduced the number—already small—of students being trained in research methods at these institutions; and an inquiry shows that the output of such students must be greatly increased after the war if sufficient men are to be available to widen the foundations of our staple industries by the application of scientific knowledge. People are accustomed to think of universities as educational institutions only, whereas the essential standard of value, and the measure of their greatness, is the worth of their contributions to the growth of knowledge.

This principle was set forth very decidedly in the report of the Duke of Devonshire's Royal Commission on Scientific Instruction and the Advancement of Science more than forty years ago.

"On no point," said the Commissioners, "are the witnesses whom we have examined more united than they are in the expression of the feeling that it is the primary duty of the universities to assist in the advancement of learning and science, and not to be content with the position of merely educational bodies. We entirely concur with the impression thus conveyed to us by the evidence, and we are of opinion that the subject is one to which it is impossible to call attention too strongly. We think that if the universities should fail to recognise the duty of promoting original research, they would be in danger of ceasing to be centres of intellectual activity, and a means of advancing science would be lost sight of which, in this country, could not easily be supplied in any other way."

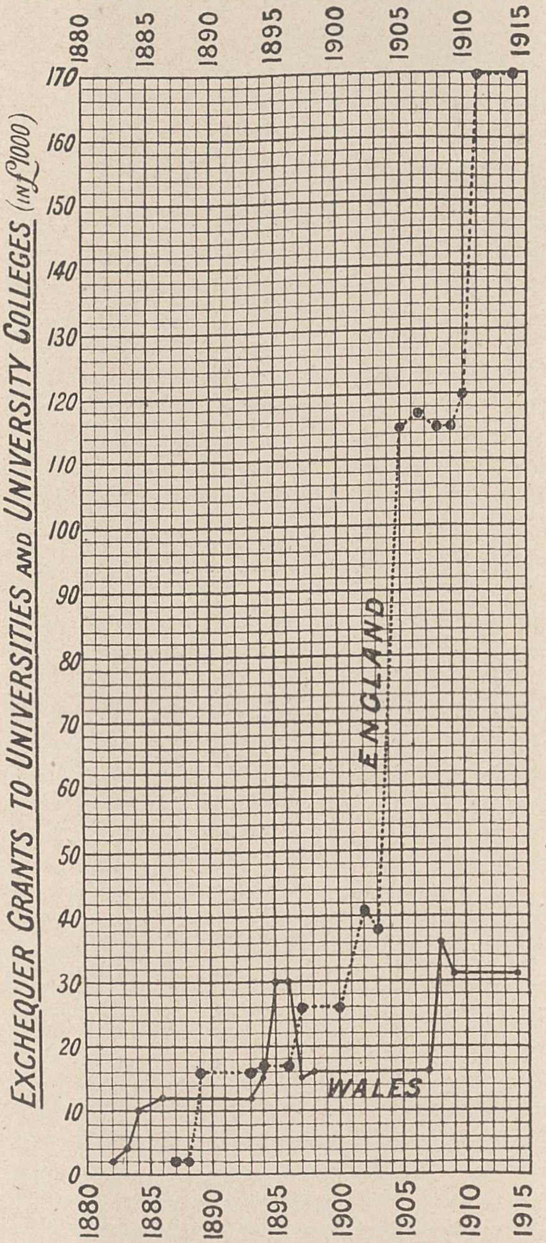
At the time when these words were written scientific research was all but dead in England; and so far as the advancement of knowledge was concerned we occupied the position of a third- or fourth-rate Power. Scientific men were convinced that action was urgently needed in order to promote the future development of our national industries, but neither the State nor the old universities to which the appeal was made took any steps to remedy the existing condition of things. The result is that, whereas we should have had hundreds of research workers trained in university institutions and making their influence felt afterwards in industrial works for a couple of generations, their numbers have had to be counted in tens.

The State began to accept its responsibility for providing facilities for university education and research when in 1889 the House of Commons decided to recognise university colleges as national institutions by voting 15,000*l*. for distribution among them. This grant, which was recommended for the London colleges and Owens College, Manchester, by the Devonshire Commission in 1874, was increased to 25,000*l*. in 1897, in addition to a grant of 12,000*l*. to the three University Colleges of Wales. In 1904, a large and influential deputation urged upon Mr. Balfour, then Prime Minister, the need for further assistance to university education and research; and in announcing that the grant would at once be doubled, as well as redoubled in the following year, Mr. Balfour stated that the increase, which represented a capital sum of 3,000,000*l*. at 2½ per cent., was given as the result of the appeal made in 1903 by Sir Norman Lockyer in his presidential address to the British Association at Southport. Ten years later, in 1914, the Exchequer grants to universities and colleges in England and Wales amounted to 201,000*l*.: the stages of growth by which this sum has been reached are shown graphically in the diagram on p. 182.

It cannot be said, even now, that the funds at the disposal of our modern universities are sufficient to ensure the supply of advanced students and research workers demanded by the conditions of industrial development and the competition of other countries. There must be an increase in the number of scholarships from secondary schools to universities, and every inducement should be offered to promising students to train for research as a post-graduate study.

The Consultative Committee of the Board of Education, in a report on scholarships for higher education, published last year, estimated that the cost of the additional scholarships and other forms of endowment advised in the report would be about 340,000*l*. a year. It was recommended that the State provide, at an estimated annual cost of 67,500*l*., about 250 scholarships for students from secondary schools who intend to pursue scientific or technical subjects at the universities, these scholarships to be awarded by the universities themselves, and to be renewable for a year or more after the conclusion of a degree course, upon the recommendation of a professor at the university, for the purposes of research in some branch of science or technology. An annual sum of 20,000*l*. was estimated to be required for these research scholarships.

The recommendations of the Consultative Committee have not yet been acted upon; but the scheme of the Committee of the Privy Council for Scientific and Industrial Research provides for the establishment and award of research studentships and fellowships, as well as for the undertaking of specific researches and the assistance of institutions, or departments of institutions, for the scientific study of problems affecting particular industries and trades. In the first report of this committee it was stated that grants had been recommended to an amount not exceeding 6000*l.* for about forty individual students and research workers, but the actual amount expended was only about 3550*l.* upon thirty-six workers; and the committee said in its second report: "Throughout our work has suffered in amount owing to the war, and we were unable to expend more than 14,524*l.* out of the 40,000*l.* placed at our disposal by Parliament for the financial year 1916–17." The committee recognises that a largely increased supply of competent researchers is necessary for the success of its work, and points out that the output of the universities is altogether insufficient to meet even a moderate expansion in the demand for research. It adds:—



"The annual number of students graduating with first- and second-class honours in science and technology (including mathematics) in the universities of England and Wales before the war was only about 530, and of these but a small proportion will have received any serious training in research. We have frequently found on inquiry that the number of workers of any scientific standing on a given subject of industrial importance is very limited. . . . The responsibility for dealing with the grave situation which we anticipate rests with the Education Departments of the United Kingdom. We shall be able to do something to encourage a longer period of training by the offer of research studentships and the like; but that will not suffice. It is useless to offer scholarships if competent candidates are not forthcoming, and they cannot be forthcoming in sufficient numbers until a larger number of well-educated students enter the universities. That is the problem which the Education Departments have to solve, and on the solution of which the success of the present movement, in our opinion, largely depends."

The report of the Consultative Committee already referred to suggests how the number of students might be increased by the State providing maintenance grants to enable selected scholars to continue their secondary education from the age of sixteen to that of eighteen or nineteen, by scholarships to universities from secondary schools and senior technical schools, and by the prolongation of scholarships for the purpose of training in research. Sir William Ramsay thought it preferable to subsidise teachers and teaching institutions with the object of increasing efficiency and reducing fees, rather than to add to the pecuniary resources of the student. His objection to the scholarship system was based chiefly on the method of award by competitive examination, by which it is impossible to estimate justly the capacity of candidates to deal with unfamiliar problems or ultimately to undertake research. This defect, however, may be obviated at the universities by placing the responsibility for the nomination for scholarships upon the professors under whom a student has been trained and making capacity for research a condition of award.

A considerable impetus to scientific study and training in research was given by the establishment of the now well-known science scholarships of the Royal Commissioners for the Exhibition of

1851. In 1889 the Commissioners announced their intention of appropriating from their accumulated funds an annual sum of not less than 5000*l.* a year for the foundation of scholarships to enable the most promising students in selected colleges to continue their studies beyond the ordinary period of three years, provided that they show high promise for advancing science and its applications. The scholarships are awarded, not by examination, but upon the nomination of the institutions to which they were allotted, and their value is 150*l.* a year for two years, with possible extension to three years. The principle of selection was decidedly in advance of any scheme existing at the time, and the value of the scholarships is sufficient to encourage students of high capacity to devote time to research.

These scholarships are given for research only, and they are not allowed to be held at the institution where the scholar has graduated. It is acknowledged that nothing has done so much to promote free interchange among the universities of the Empire, and also with those of other countries, as the 1851 Exhibition Scholarships, and they might well form the nucleus of a great system of scholarships and fellowships expressly designed to promote that end. Since 1891 the Commissioners have appointed, on the nomination of universities throughout the Empire, in every year twenty research scholars. The number of workers thus subsidised has been small in comparison with the needs of the Empire; but it is universally admitted that the results have far more than justified the expenditure. The Consultative Committee, in its Report on Scholarships for Higher Education, notes, however, that in 1916 out of 305 scholars known to be at work, only seventy-nine were engaged in industry, as against 194 engaged in educational work and thirty-two in Government service. Moreover, of the seventy-nine engaged in industry, twelve had appointments in the United States, and seven more outside the British dominions.

The probable reason why two-thirds of these capable research students became teachers at the end of their scholarship periods is that suitable posts were not open to them in industrial works. This waste of capacity for original investigation will not be avoided unless manufacturers offer to trained researchers positions and prospects much more attractive than have been customary. Improvements have certainly been effected since the opening of the war, and the signs are favourable that the demand will increase when peace is restored. Meanwhile, the governing bodies of our universities and technical colleges should consider whether their resources will enable original investigators on their staffs to be relieved of the necessity of preparing students for examination in order to train the most gifted of them in the methods of research. Unless this relief is given, and the first duty of the occupant of a scientific chair in an institution of university rank is recognised to be the promotion of research, the award of scholarships will be in vain, and the introduction of graduates into industry will not lead to the developments necessary to make our future position high and secure among the foremost nations of the world.

BRITISH ORNITHOLOGY.

(1) *A Bibliography of British Ornithology from the Earliest Times to the End of 1912, including Biographical Accounts of the Principal Writers and Bibliographies of their Published Works.* By W. H. Mullens and H. Kirke Swann. Parts i.–vi. (London: Macmillan and Co., Ltd., 1916.) Price 6*s.* net each.

(2) *British Birds.* Written and illustrated by A. Thorburn. In 4 vols. Vol. iv. Pp. vii+107+plates 61–80. (London: Longmans, Green, and Co., 1916.) Price, 4 vols., 6*l.* 6*s.* net.

(1) WITH the issue of the sixth part Messrs. Mullens and Swann bring to a conclusion their great "Bibliography of British Ornithology," forming a volume of more than 700 pages. This should, perhaps, be considered as only the first section of the whole work; for hopes are held out that it is to be followed by a geographical bibliography of the same subject, which will be another very laborious and most useful undertaking.

At the foot of their prefatory note the authors disarm criticism by very fittingly quoting from Dr. Samuel Johnson's preface to his Dictionary: "In this work, when it shall be found that much is omitted, let it not be forgotten that much likewise is performed." Much, indeed, has been performed in this monumental work, and as to omissions, some sixteen pages of addenda and corrigenda go far to supply any there may have been. This later matter has been printed on one side of the paper only for the convenience of those who wish to cut it up and insert in the proper places in the work.

We have already, when noticing the earlier parts, referred to the general plan of this work, to its far-reaching scope, and to its going back to the earliest days of anything in the shape of a study of our British birds. It goes back, indeed, to Bartholomæus Anglicus, who flourished about 1230–60, and whose "De Proprietatibus Rerum," in the translation printed by Wynkyn de Worde about 1495, is one of the earliest printed works on natural history in the English language. A feature of this final part is the remarkably full and able bibliography of the "Natural History of Selborne." The many editions are here arranged in groups, for of some of them there have been many issues, as, for instance, that of the popular Capt. Thomas Brown, which either as a new edition or as a re-issue has appeared more than a score of times. A list of separate books and reprinted articles dealing with White and Selborne is added. This final part also contains lists of the bibliographical and biographical works which have been consulted, of the periodicals cited, and of the special abbreviations used in the present work.

The biographical side of the book can scarcely be considered so satisfactory as the bibliographical portion. To begin with, it is avowedly, and by the plan of the work unavoidably, incomplete as a biography of British ornithologists; and, indeed, it never professed to be otherwise. The aim of the authors has been "to give a biographical account of each author or co-author of a separately published work," the result being a biography of the greater part of our ornithologists —and of a good many other people, too: to wit, the authors of works which mention birds, but are of a worthless nature, ornithologically speaking at all events. At the same time we miss well-known names of really good ornithologists who have done some of the best work, and whose writings will be referred to long after more popular and showy books have sunk into oblivion, as many of them had already done. But we miss the names of these good men in the present work because their published writings appeared only in periodicals, transactions, and the like, and were not separately published. The second portion, or continuation, of the bibliography, already alluded to, will, however, doubtless set this right and complete the biography of British ornithologists. As to the biographies given of living ornithologists—a delicate subject—they vary greatly in extent; and as in this respect they probably depended a good deal on the amount of information furnished by the subjects of the respective notices, they differ greatly, as may readily be imagined, in the kind, as well as in the extent, of the information they afford. British bird-men will read them all with considerable curiosity.

(2) Mr. Thorburn and his publishers are to be congratulated on the completion, by the issue of vol. iv., of this famous and beautiful set of coloured plates of the birds on the British list. A book which stands high in the fine arts, and from its price (low as this is for all these pictures) must be looked upon as one of the luxuries of life, has been begun and finished during the Great War. The volume now before us includes the wading birds (plovers, sandpipers, etc.), the terns, gulls, skuas, auks, divers, grebes, and petrels. They are beautifully drawn and coloured and true to Nature, though in one or two cases it may seem to some people that the peculiar attitudes are a little exaggerated. The colour reproduction leaves little or no fault to be found. But the former remark does not apply to the valuable and most interesting drawing of a "drumming" snipe, which, "made from sketches taken in the spring of 1914 after watching the bird, shows the position of the outer tail-feathers, spread out and separated only during the descent." The letterpress notes are concise, but most useful, informing, and very much to the point. To those who wish to have a good coloured figure of every species of bird which has ever occurred in a wild state in this country, it may be said that this is the only work which can satisfy them. A more desirable book for the country-house library or billiard-room it would be difficult to find.

THE NUTRITION OF FARM ANIMALS.

The Nutrition of Farm Animals. By Dr. H. P. Armsby. Pp. xvii+743. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 11*s.* net.

GREAT advances have been made in the study of animal nutrition since Dr. Armsby first began his investigations at the State College of Pennsylvania and wrote his "Manual of Cattle Feeding" and his "Principles of Animal Nutrition." He has now brought together the material and presented it anew. There has been no fundamental upheaval since the last edition of his earlier book appeared, but there have been remarkable changes in details, and in consequence the picture is now very different from what it was, though it is still recognisable in its main features.

In the first section, dealing with the composition of plants and of the animal body, considerable advances are recorded in our knowledge of the lipoids, the proteins, and the non-protein nitrogenous substances.

The second section deals with digestion and resorption, and gives a useful summary of the American and German investigations. Considerable interest attaches to the digestion of carbohydrates. For long it was supposed that the cellulose of feeding-stuffs was indigestible: no digestive enzyme was known to attack it, and there seemed no mechanism for breaking it down. Henneberg and Stohmann proved that it was digested, and at a later date both Wildt and Zuntz showed that the process occurs in the portions of the alimentary canal where the food stagnates, *i.e.* in the paunch of ruminants, and in the cæcum and colon. Later investigations indicate that it is brought about by organisms inhabiting the alimentary canal, and that it gives rise to considerable quantities of carbon dioxide and methane, as well as various acids, mainly acetic and butyric. These are resorbed as salts, which appear to constitute the sole contribution that cellulose makes to the nutrition of the animal body. One cannot help wondering whether better use could not be made of the cellulose by subjecting it to some chemical or bacterial treatment before using it. Apparently the pentosans are digested in the same way, and also the mucilage of linseed cake, according to Neville's experiments, which, however, the author does not mention. Bacteria cause some decompositions of protein, although Kellner's investigations indicate that the animal does not benefit thereby. The decomposition by bacteria is prevented in the stomach by the hydrochloric acid of the gastric juice, and in the lower part of the large intestine by the progressive resorption of water from the intestinal contents. In the small intestine, however, the organisms are more active, giving rise to ammonia, phenols, indols, etc. The two latter are largely resorbed; they are of little, if any, use to the animal—indeed, they are poisonous; they combine, however, with other substances and are excreted in the urine as the so-called ether-sulphates.

Considerable progress has been made in our knowledge of the utilisation of fat. At an early stage in the mobilisation of the reserve in the adipose-tissue cells the fat becomes hydrolysed, yielding glycerol, which, perhaps, serves as a source of dextrose, and a fatty acid, which is oxidised. Dakin and others have shown that the oxidation of the acid begins at the β carbon atom (*i.e.* at the second from the COOH group), and results in the splitting off of two carbon atoms at a time, yielding water, carbon dioxide, and another fatty acid containing two fewer carbon atoms than the original one, with which the same process of erosion is repeated. It is not yet clear, however, how the animal utilises formic, acetic, and propionic acids, although it undoubtedly does so.

The author then proceeds to discuss the various types of experiments made by investigators in animal nutrition: the simple feeding trial, in which the gross gain in body-weight is measured for a particular ration; the digestibility experiment, which requires more careful measurement and aims at determining what proportions of the various food constituents have been digested and resorbed; the "balance experiment," in which respiration determinations are added to the foregoing in order to make up a balance-sheet showing exactly what has become of the food; and, finally, the elaborate calorimeter experiment, in which an attempt is made to trace the energy changes involved.

The author is well known for his investigations on the energy relationships of nutrition, and his own beautiful calorimeter at State College is the envy of many another institution. He devotes considerable space to this aspect of the subject.

Incidentally, he makes an interesting comparison between the efficiency of a horse and that of a power plant. He finds the total useful work done by a working horse was 2·8 therms; the gross energy of the ration was 55·8; the over-all efficiency was, therefore, 5·1 per cent. The animal worked six hours per day. Supposing his bodily machinery was stopped for the other eighteen hours (as an engine would be), and he was charged with only a fourth of his maintenance requirement, the over-all efficiency would be raised to 6·3 per cent.—about that of a modern American locomotive. In actual practice the conditions with an animal are very much as if it were necessary to keep up a full head of steam for twenty-four hours, or to run an internal-combustion motor continuously, although work is only done for part of the time.

The author attaches less importance than usual to starch equivalents, which he considers may obscure the energy relationships. Altogether the volume is very interesting, and will be read by agricultural teachers with much pleasure.

ULUGH BEG'S CATALOGUE OF STARS.

Ulugh Beg's Catalogue of Stars, revised from all Persian manuscripts existing in Great Britain, with a vocabulary of Persian and Arabic words. By E. B. Knobel. Pp. 109. (Washington: Carnegie Institution, 1917.) Price 2 dollars.

THIS work forms a sequel to Mr. Knobel's edition of Ptolemy's Catalogue (see NATURE, vol. xcvii., p. 282). Owing to the war he has only been able to use codices existing in England, but these are fortunately rather numerous, and twenty-two Persian and Arabic MSS. have been collated. A partial collation of three Persian MSS. at Paris by the late Prof. C. H. F. Peters has also been utilised.

This catalogue of 1018 stars, the first original catalogue since that of Ptolemy, is founded on observations made during the reign of Ulugh Beg, a grandson of Tamerlane, at his observatory near Samarkand, the epoch being A.D. 1437. It was published in 1665 by Hyde from three codices at Oxford, and this edition was reprinted in 1767 in the collected edition of Hyde's works. It was again issued by Baily in 1843 in his edition of ancient star-catalogues, in which the stars were for the first time identified and the modern designations given. Mr. Knobel's edition differs from Hyde's not only by being founded on a far greater number of codices, but also by giving the places of the stars for 1437 computed from modern star-catalogues (by Peters) and a comparison of these with Ulugh Beg's places.

No particulars about the instruments employed or the methods of observing are known. Peters was the first to notice that the minutes of the longitudes are generally of the form $3n+1$, while the minutes of latitudes are multiples of 3, as if the circles of the instrument were graduated to $3'$ and some correction of $1'$, $4'$, or $7'$ had been applied to the longitudes. Ulugh Beg states that twenty-seven stars in Ptolemy's Catalogue were too far south to be observed at Samarkand, and that their places were, therefore, borrowed from Ptolemy, allowance being made for precession. Mr. Knobel has found that the longitudes of four other stars were derived in the same way, and were not observed. In addition to these, there are at least eighty-two pairs of stars of which the longitude of one star only was observed, while that of the other (a few degrees distant) was obtained by adding or subtracting Ptolemy's difference of longitude. The latitudes of sixty-eight stars were simply copied from Ptolemy, and there are at least forty-four pairs of stars of which the latitude of one star only was observed, while that of the other was obtained by means of Ptolemy's difference of latitude. Therefore, the longitudes of only about 900 stars were actually observed, and the latitudes of about 878 stars. But there is a strong suspicion that the original observations should be still further reduced, as there are some forty or fifty stars the errors of the places of which resemble the errors of Ptolemy, and thus suggest a derivation from the Almagest. These very interesting results of Mr. Knobel's examination of the catalogue have escaped the attention of all previous historians of astronomy.

The comparison with modern star-places shows that the accuracy of Ulugh Beg's observations was not much superior to that of Ptolemy's. Mr. Knobel reproduces a drawing of an altazimuth from a Persian MS. in the British Museum (a treatise on astronomical instruments), which shows the use of diagonal scales for subdividing graduations. As the MS. dates from A.D. 1700, the influence of knowledge derived from Western sources is not excluded. But as diagonal scales were known to Levi ben Gerson, a Spanish Jew who died at Avignon in 1344, it is very possible that some later Arabian observers may have employed them. Judging from his star-places, Ulugh Beg scarcely did so. We congratulate Mr. Knobel on this completion of the long labours of Prof. Peters and himself on ancient star-catalogues.

J. L. E. D.

OUR BOOKSHELF.

A Chemical Sign of Life. By Shiro Tashiro. (The University of Chicago Science Series.) Pp. ix+142. (Chicago: University of Chicago Press; London: Cambridge University Press, 1917.) Price 1 dollar or 4s. net.

DR. TASHIRO gives a useful and readable summary of the results which he has obtained on the production of carbonic acid in nerve and in seeds by the employment of an ingenious microchemical method. He regards the evolution of this gas as a sign of life analogous to the "blaze currents" described by Dr. Waller. The magnitude of the CO_2 production which he observes in nerve fibres has raised doubts as to the exact significance to be ascribed to the results obtained. The author deals with some of the criticisms which his work has evoked.

Morphology of Gymnosperms. By Profs. J. M. Coulter and C. J. Chamberlain. Revised edition. Pp. xi+466. (The University of Chicago Press.) Price 5 dollars net.

THIS important work was reviewed at length in the issue of NATURE for August 10, 1911 (vol. lxxxvii., p. 171). The revised edition is in no sense rewritten, but important changes and additions occur, the more important of which are in the chapter on Cycadales and in the bibliography. A supplementary list to the latter adds 150 titles to the 484 of the first edition.

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.]*

Tidal Energy Dissipation.

MR. STREET is in error in attributing to me (NATURE, October 25, p. 145) the "contention that viscous action in a solid earth cannot be an appreciable cause of the slowing of its rotation." I have never made any such assertion, it is opposed to my personal opinion, and in the present state of knowledge it is quite impossible either to affirm or to deny a statement of such definiteness. His criticisms of the law of viscosity used by me (M.N., R.A.S., vol. lxxvii., pp. 449–56) are confined to its precise mathematical form, to which I attach little importance, and do not touch the physical conceptions underlying it, which are fundamental. The mathematical argument was only a numerical illustration of the order of magnitude of the effects to be expected from these.

The theory that viscosity in the solid earth is the cause of the lunar secular acceleration requires its effect to be considerable for variable stresses with periods of the order of a day. If, then, the viscosity is of such a character as to permit an indefinite flow when a constant stress is applied for a long enough time, then for stresses with a period of a year or more the substance will have time to flow like a liquid, keeping approximately the hydrostatic form throughout the changes. Hence the Eulerian nutation, a long-period vibration depending for its existence entirely on solid rigidity, could not persist. Similarly, annual variations in the distribution of mass over the surface would be compensated by internal flow, and there could therefore be no annual variation of latitude.

If, on the other hand, the viscosity is not of a type that permits indefinite flow, the strain when a constant stress is applied must tend to a finite value, and afterwards remain approximately constant. The effect of viscosity must then be limited to the initial stage. In the case of a periodic stress the period of which is long compared with this initial stage, the rigidity will be of much more importance than viscosity, and the substance will behave nearly as if perfectly elastic. On the other hand, if the period is short in comparison, viscosity will be of greater importance. This is supported by the fact that if the viscous forces are directly proportional to the rate of straining, as is inherently probable on account of the analogy to electric resistance and fluid viscosity, the same is found to hold. On such ideas the law I called that of "firmo-viscosity" is based. If, then, the effect of such viscosity is considerable when the period is twelve hours, it must be more important than elasticity when the period is only a few seconds, as in the case of earthquake waves. Thus the transmission of these waves would be prevented. It follows that firmo-viscosity is absent from the earth so far down as seismic waves travel; it may, however, be important at still greater depths.

If on the application of a constant stress to a body the strain at once assumed a finite value, then slowly increased for a few days, and afterwards remained constant, the viscous properties of such a body would bear a close resemblance to those of the earth as a whole. In this case, however, the rigidity found from the Eulerian nutation should be much less than that found from earthquakes, which does not appear to be the case. This suggestion, therefore, alters the difficulty without removing it.

Mr. Street's statement that an infinite number of laws could be found that would satisfy the conditions is obviously true, but any of them, by what has been said above, would necessarily bear a strong resemblance to the firmo-viscous law, and the simplest hypothesis that is acceptable on physical grounds is that of firmo-viscosity near the centre.

I am unaware of having modified my views on this question in any vital matter save by addition; in any case, I fail to see that such modification would afford any argument against my present position.

HAROLD JEFFREYS.

St. John's College, Cambridge.

THE PROPOSED MINISTRY OF HEALTH.

WHEN Lord Rhondda some months ago declared that there was a great deal of overlapping in connection with the work of public health administration, and that a separate Ministry was urgently required, of the many who agreed with him few, if any, seemed to be prepared to tell him in detail how he might set about abolishing the overlapping and constructing the Ministry. The faults of the system under which health service was given to the public were plain to see. The reason for their existence was also obvious.

There was no real planning when the scheme was initiated; no one grasped the importance of health work or foresaw that it would and must grow. Even the enthusiasts underestimated the importance of the cause they had at heart, and the persons they induced or compelled to listen to them and to take action naturally also underestimated it. Both parties builded worse than they knew. They did, indeed, the worst thing possible: they chose the wrong foundations, and they did not look ahead and plan for future extensions.

Imbued with the dread, so common in relation to central administration in this country, that trouble would follow if there was any suggestion to form a new department; believing that, so far as Government work is concerned, the safest plan is "more men and fewer of them," they canvassed the existing departments for one or more upon which the new duties might be placed. Not unnaturally, they eventually found a department. That concerning itself with Poor Law administration, now known as the Local Government Board, was obviously the proper one to take on the new work. As organisation went, it was fairly well organised. It had some doctors and a number of lawyers attached to it, and through its officials of a lower grade it was in touch with the class of person whose health required most looking after.

The easy and pleasant task of placing new work in old departments, once commenced, was continued. As new lines of work were found and the necessity for doing something along these lines was recognised, it became essential once more to look round for departments to which the duty of doing what was required might be entrusted.

In some cases the Local Government Board felt unable or disinclined to undertake it, and it was taken round until another department more suitable or complaisant was found. There came at length a time when health work was regarded as the most important of all the public works, and the necessity for seeking departments to accept fresh work in this field ceased. Actually the departments began to compete for it, and it was counted as essential by each that it should have part of the nation's health work to do.

It was regarded as nothing that there should be absolute lack of uniformity and co-ordination; that work on behalf of the public health was so organised that one part, the largest perhaps, was at the Local Government Board with Poor Law administration, another part at the Board of Education, and portions more or less important at the Home Office, the Insurance Commission, the Board of Agriculture, the Board of Trade, the Admiralty, and the Ministry of Munitions.

Recognition of the fact that such a distribution of important work is undesirable and likely to lead to inefficiency, overlapping, and waste of money is easy. Those who recognised it, however, did little more than this. If they had anything to offer in the way of suggestions as to how the existing difficulties might be overcome and the Ministry of Health that was considered so indispensable formed, they did not advertise the fact very widely.

The one scheme that has been given publicity was drafted by certain persons interested mainly, apparently, in State insurance and bodies concerned with its administration. Quite obviously this scheme had for its chief intention the belittling of the importance of the work done by other departments, and particularly that of the Local Government Board, the body at present regarded as the central health department. This scheme and a Bill founded upon it the Prime Minister was asked to bless by a deputation that waited upon him on October 11. Wisely he refused to do so, pointing out that the matter bristled with difficulties, and hinting that consideration, involving a vast amount of time and trouble, would have to be given to it.

It is certain that long and serious consideration will be necessary. The drafting of a scheme is not the work of half a dozen persons known only to one class of the population and knowing but one side of health work. To suggest that a Commission would be the best body to deal with the subject is almost to ask to be regarded as ridiculous. Nevertheless, there is something to be said in favour of a suggestion that a Commission should be appointed, with the proviso that it must be something more than the ordinary body that meets and reports and rests.

The Ministry of Health Commission must consist of individuals possessing business ability and capable of taking a broad view, if the very best is to be done for the health of all the public. Further, it must be given a clear reference and a free hand; the right even to embody its recommendations, not in a report, but in a Bill, might be conferred upon it. If it is necessary to pass an Act of Parliament to allow of the creation of such a Commission and the giving of such powers, then the passing of such an Act must be the first step. The matter is so important as to justify such procedure. The difficulties with which it is attended, mainly because of the number of departments and interests that are involved, render it almost hopeless to expect that a solution will be found if only the methods regarded as constitutional are available.

1835-1917

PROF. ADOLF VON BAEYER, For.Mem.R.S.

THE announcement in the *Times* of September 8 of the death of Prof. Adolf von Baeyer at Starnberg, near Munich, in his eighty-second year, must have come as a shock to his many pupils in this country. It was known to several of us that he had not been in good health for some years, but the quiet life which he led at his beautiful home on the shores of the Starnberger See seemed to benefit his health so much that his sudden decease, even at his advanced age, was quite unexpected. It is questionable whether any teacher or investigator ever exerted a greater influence on the development of chemical science, and especially of organic chemistry, than Baeyer has done, for not only was he a great teacher whose pupils are to be found in every civilised country, but his researches have also laid many of the foundations on which the amazing structure of modern organic chemistry has been raised. Apart from the interest which always attached to his published work, it is probable that his main influence on chemical thought was due to his magnetic personality and power of imparting to others some of his enthusiasm for discovery.

For many years, and particularly during the period 1880–1900, it was the custom for the large majority of those who wished to come into contact with the later developments of experimental method to attach themselves, for a short time at least, to the laboratories at Munich. The power which Baeyer exercised in connection with the progress of chemistry in Germany can scarcely be better illustrated than by the fact that during these years almost every professor of chemistry in Germany of the first rank was a pupil of Baeyer. Among these we find, for example, the names of E. Bamberger, L. Claisen, Th. Curtius, Emil Fischer, Otto Fischer, P. Friedländer, C. Graebe, L. Knorr, C. Liebermann, Victor Meyer, H. v. Pechmann, J. Thiele, and R. Willstätter.

Baeyer's influence on the development of chemical industry, and especially of the colour industry, was not less remarkable, for in every works were to be found such men as Caro and Duisberg, Homolka and Weinberg, and a host of others who had learnt their chemistry and acquired their methods of research in the laboratories at Munich. If inquiry is made into the reason for the wide influence which Baeyer has exerted on chemical thought, it will be universally agreed that this has been due in the main to his extraordinary enthusiasm for research and the keen joy which he felt and expressed when he had succeeded in producing some new substance of importance which he had probably been seeking for many months, and possibly for years. On such occasions he used to walk about the laboratories beaming with delight and discuss his latest discovery and its probable consequences with his assistants and advanced pupils. His enthusiasm fired the enthusiasm of his hearers, and unquestionably did much to awaken and stimulate the desire to make discoveries and achieve something perhaps of equal importance. Baeyer was essentially an experimenter, and had little real interest in the development of new theories, although some of his views, such, for example, as those on the constitution of benzene, the structure of oxonium salts, the cause of colour in the triphenylmethane series, and the mechanism of the formation of sugar in the plant, were valuable contributions to theory, and his well-known "Spannungs Theorie" was a brilliant conception of real value in connection with stability in ring structures.

It was Baeyer's habit to adjourn to his private laboratory directly after his early-morning lecture, for perhaps an hour, in order to carry out any experiments which had occurred to him after the close of the previous day's work and to discuss the day's programme with his assistant. He would then walk through the research laboratories and talk over any difficulties with those with whom he happened to be working, and with others whose work happened to interest him. Baeyer's custom was to work himself with comparatively few of those engaged in research in his laboratories, and he left to the *Privatdozenten* almost entirely the supervision of the *Doctorarbeiten*.

Unless something of real interest had happened, it was usual for those working with him to tell him at once that there was nothing to report, and, in this way, Baeyer frequently made the tour of the large laboratories so rapidly that he was back in his private laboratory soon after eleven o'clock, and the whole of the rest of the day was spent at his own work. His private laboratory—a large and very well lit room—usually contained, besides one private assistant, some other researcher in whose work he was specially interested, and it was not unusual for such a student to remain in the private laboratory for weeks at a time. Such an experience was, of course, of the utmost value to those who were fortunate enough to enjoy the privilege; in such circumstances it was impossible not to be profoundly influenced by the skill, patience, and resource with which the experimental difficulties of so many intricate problems were gradually overcome. His equipment for research consisted almost entirely of test-tubes and glass rods, and it rarely happened that he used anything larger than quite small beakers and flasks. Large wooden racks containing hundreds of test-tubes were always at hand, and it used to be said that these test-tubes, after the usual wash, were subjected to a further cleaning, first with alcohol, and then with distilled water. Baeyer always insisted that the occurrence of a chemical change can be more easily observed and its course more closely followed with small quantities of material and the aid of a test-tube and glass rod than by the employment of a hundred grams of substance and large flasks or beakers. That this view was undoubtedly correct is demonstrated not only by the brilliant results which Baeyer himself achieved with such simple means, but even more conclusively by the fact that his pupils, if perhaps reluctantly at first, all ultimately adopted his method of work. There can be no doubt that the discovery and careful characterisation of so many substances, and the publication of so much important work covering such a wide field, would not have been possible had not Baeyer early acquired the habit of working with small quantities of material.

Baeyer's immense power of work is shown by the fact that, until his eightieth birthday, he delivered his usual lectures on five mornings of each week and continued to experiment in his laboratory with his usual unflagging energy. Had the war not robbed him of his private assistant and laboratory staff, it is probable that he would have gone on even longer. He confided to one of his intimate friends that work in the laboratory gave him as much pleasure after fifty years' toil as at any time during his career, and to the last he took the greatest interest in any developments in the domain of natural science which were brought to his notice. It is well known that he viewed with disfavour and apprehension the growing domination of military power in Berlin and Prussia generally, and it was mainly, no doubt, for this reason that he refused to accept the invitation to Berlin on the death of Hofmann.

Adolf Baeyer was born on October 31, 1835, in Berlin, and he spent his early life in the house (242 Friedrichstrasse) of his grandfather, which at that time was a centre of the literary life of Berlin, and it thus came about that Baeyer was brought up in a literary atmosphere. He always referred to this early intimate contact with literature with pleasure, and considered that the love for literature which he acquired in those days was of great service to him throughout his later career. Baeyer's chief interest in these early days seems to have been for botany and in living things generally, and his first contact with chemistry was on his ninth birthday, when his father gave him a copy of Stöckhardt's "Schule der Chemie."

In his "Erinnerungen aus meinem Leben," which he wrote for the celebrations organised in connection with his seventieth birthday, he tells us that he converted a passage in the house into a small laboratory, and there carried out the usual dangerous and unpleasant experiments associated with early youth. It was during this time that he made his first discovery, that of the double salt, $CuCO_3,Na_2CO_3,H_2O$. The activity of the small laboratory does not seem to have been altogether appreciated, and the poet, Paul Heyse, who was a frequent visitor at the house, had reason to protest:

Es stinkt in diesem Haus gar sehr
Das kommt vom Adolf Baeyer her.

When he entered the university Baeyer seems at first to have entirely forsaken his chemical experiments and to have devoted himself to physics and mathematics; but the interest in chemistry soon returned, and in 1856 he entered Bunsen's laboratory at Heidelberg. After studying the methods of analysis in this famous laboratory for a year, he came under the influence of Kekulé, whom he afterwards followed to Ghent, and whom he always considered was his real teacher.

Baeyer obtained the Ph.D. degree in 1858; his dissertation, "De arsenici cum methylo conjunctionibus," presented and printed in Latin, was a difficult and important piece of accurate work and a great achievement for so young an investigator, especially as it was commenced and carried out entirely on his own initiative. In the spring of 1860 Baeyer returned to Berlin and became *Privatdozent* at that university, but in the same year he was appointed teacher in organic chemistry in the Gewerbe Institut, an institution which later developed into the Berliner Technische Hochschule. The foundations of many of Baeyer's most important researches were laid during the next few years, for we find him publishing papers on the uric acid group, mellitic acid, isatin and indigo, the reduction of benzene carboxylic acids, acetylene derivatives, etc., subjects which later developed into the classical memoirs with which his name is so intimately associated. Among the distinguished workers who were attracted to Baeyer's laboratory during this time we find the names of Graebe, Liebermann, Nencki, and Victor Meyer, and it was in 1866 (*Annalen*, cxl., 295) that the method of reduction by distillation with zinc dust was elaborated which enabled Graebe and Liebermann to demonstrate that alizarin is a derivative of anthracene, and thus to proceed with the synthesis of this important colouring matter.

The next stage in Baeyer's career began in 1872, when he was appointed professor of chemistry in Strasburg, and it was here that he numbered among his pupils Emil and Otto Fischer and H. Caro, and produced many papers, of which those dealing with the phthaleins are probably the most important. Baeyer stayed in Strasburg for three years, and then proceeded in 1875 to Munich, where he remained for forty years, and it was in the Munich laboratories that most of his famous researches reached maturity.

It is impossible to mention even the titles of the long series of papers which appeared with such regularity during this long period, and are so well known to every student of chemistry. Mention may, however, be made of his researches on the phthaleins, the reduction of the phthalic acids, the constitution of benzene, indigo and its derivatives, and last, but not least, the researches on the polyacetylene derivatives, which are marvels of experimental skill and have perhaps never been sufficiently appreciated.

His later researches were concerned with the peroxides, the constitution of Caro's acid, and particularly with the constitution of the oxonium salts and of the coloured derivatives of triphenylmethane, and his last research, published in 1911 together with Jean Piccard, was on the oxonium salts derived from dimethylpyrone (*Annalen*, ccclxxxiv., 208, 224).

W. H. PERKIN.

NOTES.

THE announcement made by the Admiralty on Saturday that "an attack was made on our vessels patrolling the Belgian coast by an electrically controlled high-speed boat" (which was destroyed in the attempt) recalls the various suggestions and experiments made, ever since Hobson's "bottling" exploit at Santiago, to devise an unmanned craft capable of being steered for attack from a safe distance. Brennan's wire-controlled torpedo was a clumsy device compared with the radiotelegraphic control worked out by J. H. Hammond in America, and tested before the present war commenced. There is no doubt that it is possible to construct a craft steered by wireless which will attack and hit a target two or three miles off. The difficulty of seeing the craft at such distances from the steering station can be overcome at night by attaching to it a light directed backwards and invisible from the target. But the main objection to wireless control is that it can be "jammed" by the enemy. To meet this difficulty it has been proposed to use a selenium control actuated by a searchlight. There is little doubt that this can be successfully worked over a range of several miles, but here again the objection is that something must emerge and be illuminated, and that this something is liable to destruction by the enemy. The question resolves itself into one of adaptability to exceptional circumstances. It will be interesting to learn which of the various possible constructions has been adopted by Germany. The Press Association is authorised to state that four electrically controlled boats have already been destroyed. The boat destroyed last week had a petrol engine, was electrically controlled from the land, and was convoyed by an aeroplane.

AN article of considerable length upon the stabilisation of aeroplanes and ships by means of the gyroscope appears in *La Nature* for October 20. The apparatus designed by Sperry for these purposes is described in some detail. The application to the case of ships and the superiority of Sperry's stabiliser to that of Schlick are fairly well known, but the application to the aeroplane is perhaps less familiar and deserves a word of comment. The claims made for the apparatus are that it relieves the pilot of all control except that of the rudder, and that the machine will continue to fly for almost any length of time at the attitude for which the gyro controls are set. But this is also true of an inherently stable machine, and inherent stability can be obtained without any addition of weight and without any increase of head resistance such as that due to the windmills which drive the servo-motor and generator of the Sperry apparatus. The Sperry stabiliser may be of some utility for large aeroplanes used for commercial purposes or long passenger flights, but it is certainly not required for military aircraft. One of the greatest necessities for the military machine is flexibility of control and ability to execute manœuvres, such as looping, spinning, and steep nose-diving. For such a machine the Sperry stabiliser is worse than useless; indeed, the construction of the apparatus appears to be such that looping the machine would completely derange the adjustment. The additional weight of the apparatus and the extra head resistance involved are serious drawbacks to its use in any machine, and the great complexity of its mechanism is antagonistic to the best principles of aeroplane design—simplicity and directness of control.

THE Journal of the Royal Society of Arts for October 19 contains an extensive extract from Capt. B. C. Hucks's paper entitled "A Further Three Years' Flying Experience," which was read before the Aeronautical Society last June. This paper is an exceedingly interesting one, coming from such an experienced pilot, and contains many points of scientific interest. Possibly the most interesting of these is the question of flight in a cloud, or when the earth is not visible. Capt. Hucks vividly describes his own experience of such flights, and states that in gusty weather it is exceedingly difficult to keep the machine on a straight path, and that once control is lost it is almost impossible to regain it until out of the cloud. The air-speed indicator and other instruments fitted do not give sufficient indication of the machine's actual motion through space, and Capt. Hucks suggests that some instrument should be fitted which shows a line fixed in space, whatever be the motion of the machine. Such an instrument must apparently depend either on the earth's magnetic field or on gyroscopic action, and the latter seems the more promising. The chief difficulty in designing an instrument of this kind is to render the supporting gimbals sufficiently frictionless, as friction will cause the gyroscope to deviate from its initial position. It seems doubtful if an instrument can be made for continuous use throughout a long flight, but it should be quite possible to design one for intermittent use. The instrument could be set with the gyro axis in some definite direction, such as the vertical, when the machine was flying normally, and then set free when a cloud was encountered. The gyro would maintain its direction sufficiently well for a short time, and could be reset whenever an opportunity afforded. Such an instrument should prove an interesting problem in design for the scientific inventor, and would undoubtedly be a valuable addition to the instrument board on an aeroplane.

WE notice with much regret the announcement of the death on November 4, at forty-five years of age, of Mr. W. Duddell, F.R.S., C.B.E., past-president of the Röntgen Society and of the Institution of Electrical Engineers.

WE regret to announce the death on November 4, at seventy-two years of age, of Sir David C. McVail, professor of clinical medicine in St. Mungo's College, Glasgow, from 1889 to 1906, and author of a number of publications on physiological subjects, especially on diseases of the heart and lungs.

THE following is a list of those who have been recommended by the president and council of the Royal Society for election into the council at the anniversary meeting on November 30:—*President*, Sir J. J. Thomson; *Treasurer*, Sir A. Kempe; *Secretaries*, Prof. A. Schuster and Mr. W. B. Hardy; *Foreign Secretary*, Prof. W. A. Herdman; *Other Members of the Council*, Dr. H. K. Anderson, Sir G. T. Beilby, Prof. G. C. Bourne, Prof. A. R. Cushny, Dr. M. O. Forster, Prof. P. F. Frankland, Dr. J. W. L. Glaisher, Prof. B. Hopkinson, Mr. J. H. Jeans, Prof. W. H. Lang, Major H. G. Lyons, Dr. W. H. R. Rivers, Prof. C. S. Sherrington, Prof. R. J. Strutt, Mr. J. Swinburne, and Prof. W. W. Watts.

AT the annual general meeting of the London Mathematical Society, held on November 1, the president announced the award of the de Morgan medal to Prof. W. H. Young, and stated that, owing to Prof. Young's absence from England, the medal would be given into the charge of the Master of Peterhouse. The following were elected as council and officers for 1917–18:—*President,* Prof. H. M. Macdonald; *Vice-Presidents,* Prof. H. Hilton, Prof. E. W. Hobson, and Sir J. Larmor; *Treasurer,* Dr. A. E. Western; *Secretaries,* Dr T. J. I'A. Bromwich and Mr. G. H. Hardy; *Other Members of the Council,* Prof. W. Burnside, Dr. S. Chapman, Mr. A. L. Dixon, Miss H. P. Hudson, Mr. A. E. Jolliffe, Mr. J. E. Littlewood, Prof. A. E. H. Love, Major P. A. MacMahon, and Prof. J. W. Nicholson.

THERE is a widespread feeling of regret among metallurgists and chemists at the death of Mr. G. T. Holloway, which occurred, after a long and painful illness, on October 24. Mr. Holloway entered the Royal College of Science in 1881, and obtained the associateship in chemistry in 1884. He was assistant-demonstrator in chemistry in the college from 1884 to 1886. He spent some time in Newfoundland, and, returning to England, established a practice as analytical and consulting metallurgist in Chancery Lane. This practice was afterwards transferred to testing works and laboratories in Limehouse, and the business conducted in the form of G. T. Holloway, Ltd. He specialised in some of the less common metals, and few had more knowledge of their occurrence or methods of treatment. Mr. Holloway was a fellow of the Institute of Chemistry and a member of various other societies. He was specially interested in the Institution of Mining and Metallurgy, on the council of which he served for many years. He had considerable experience as an examiner, having acted in this capacity for the University of Birmingham, the Institute of Chemistry, and other bodies. His most recent work, and that perhaps by which in future he will be best known, was the chairmanship of the Canadian Government Commission on nickel. The report of this commission has been issued during the present year, and will long be a standard of reference and a model of what such reports should be. Handicapped from the first by pecuniary circumstances, permanent lameness, and a weak constitution, he had a remarkably clear intellect and a charming personality. He lived to accomplish more than many men who had all the advantages which he lacked. For one who found all physical effort a trial he was wonderfully active and had travelled considerably.

PROF. DASTRE, whose death was announced in NATURE of October 25, was one of the most distinguished pupils of the great physiologist, Claude Bernard. Another pupil, Paul Bert, succeeded Bernard in the chair of physiology at the Sorbonne, and, on Bert's death in 1886, Dastre was elected to the post. Portraits of all three of these noted men are to be seen in the well-known picture by Lhermitte, in which Dastre is represented as taking notes of an experiment shown by Bernard to a number of his friends. Dastre was for many years one of the editors of the *Journal de physiologie et de pathologie générale,* and his kindness in offering to *Physiological Abstracts,* on its foundation, the free use of the excellent abstracts published in his journal was much appreciated by British physiologists. His work in research covers a wide field, both in chemical and in what is sometimes called "experimental" physiology, but that done in conjunction with Prof. Morat on the vasomotor system of nerves is perhaps best known. In this work the existence of vaso-dilator nerves was shown to be more general than had previously been supposed, and much new light was thrown on the functions of the sympathetic nerves. Allied to these problems we find experiments made in order to elucidate the relations between the nervous regulating mechanism of the heart and the functions of the muscular structure itself. A number of papers was published relating to the digestion and metabolism of fats and sugars. The part played by the bile in the digestion and absorption of fats was pointed out. Of other important work, the rapid accommodation of the vascular system to the injection of large amounts of saline solutions and the method of mixed anæsthesia with morphine and chloroform may be mentioned. Contrary to general opinion at the time, Dastre showed that expired air does not contain any toxic substance. He also devoted some attention to the more morphological problems of embryology.

MR. WORTHINGTON G. SMITH, whose death was announced in NATURE of November 1, was a man with varied interests and a broad outlook. A good townsman (he was the first Freeman of Dunstable to be elected since the foundation of the borough by Henry I.), a keen politician, originally by profession an architect, a draughtsman and engraver, an antiquary of note, he was also among the first botanical artists in black and white, and an admitted authority on the larger British fungi. At the age of twenty-three he gave up the practice of architecture in favour of book illustration, and for many years drew architectural subjects for the *Builder.* Plant-forms, and especially the larger fungi, had attracted him, and in 1867 he drew, lithographed, and described two large coloured sheets of "Edible and Poisonous Mushrooms" for Mr. Hardwicke, the publisher. In 1869 he was discovered by Dr. Maxwell Masters, and from then onwards for nearly half a century supplied the drawings of new or noteworthy plants with which readers of the *Gardeners' Chronicle* are familiar. To his training as an architect we doubtless owe the sharp, clear accuracy of his drawings and his careful attention to detail. In 1884 was published his "Diseases of Field and Garden Crops," chiefly such as are caused by fungi, written and illustrated by himself. A beautiful memorial of his work on the larger fungi is exhibited in the botanical gallery at the Natural History Museum in the form of more than a hundred large sheets of coloured drawings of our British species. His "Synopsis of British Basidiomycetes," published by the trustees of the British Museum in 1908, is descriptive of these drawings. His "Guide to Sowerby's Models of British Fungi" (British Museum, 1891) is a capital little handbook on the larger species. Many of his drawings have been acquired by the museum, including a fine series illustrating the larger British fungi. Worthington Smith was a fellow of the Linnean and various other societies, and in 1903 he was elected president of the British Mycological Society. The Royal Horticultural Society showed its appreciation of his work by several awards, including the Knightian gold medal in 1895 for his researches into the life-history of the potato-disease fungus. An appreciation of Worthington Smith's work, with an excellent portrait, forms the leading article in the issue of the *Gardeners' Chronicle* for November 3.

THE trustees of the British Museum have issued three more of the useful pamphlets (Nos. 4, 5, and 6) of the "Natural History Economic Series." These describe mosquitoes, the bed-bug, and species of Arachnida and Myriopoda injurious to man, and are written respectively by Mr. F. W. Edwards, Mr. Bruce F. Cummings, and Mr. Stanley Hirst. The outward form, life-histories, and habits of the various creatures are clearly described, with good figures and some practical advice for the destruction of pests. Most readers of the last-named pamphlet will be surprised to learn of the number of species of centipedes and millipedes which are recorded as accidental inhabitants of the human intestine.

THE extreme severity of the winter of 1916–17 levied a heavy toll on the birds throughout the British Islands, and it seems to have borne no less heavily on our native flora. Not even Ireland escaped. Mr. C. B. Moffat has already placed on record a number of observations as regards the birds of Ireland, and he now follows these up with a similar survey of the havoc wrought among the native plants of Co. Wexford. In the *Irish Naturalist* for October he tells us that at least five species of plants have been so reduced that it seems doubtful whether they will recover their former plenty. These are the weld (*Reseda luteola*), pale-flowered flax (*Linum angustifolium*), fleabane (*Pulicaria dysenterica*), greater broomrape (*Orobanche major*), and the lesser broomrape (*O. minor*).

A VALUABLE and illuminating summary of what is known of the habits and migrations of Chimæræ off the Scandinavian coasts and the northern waters of our own shores is given by Prof. D'Arcy Thompson in the *Scottish Naturalist* for October. Though his survey includes two species, *Chimaera monstrosa* and *C. mirabilis*, his remarks are mainly concerned with the former species. Hitherto it has been generally supposed that this spawned only in deep water, but it is now shown to spawn off the Norwegian coasts in shallow water in winter-time, and to migrate to the depths during spring and summer. Prof. Thompson is disposed to regard these migrations as governed by temperature rather than by the search for food; for the species shows a partiality for cold or cool water, and while in general it finds this optimum temperature in the deeper waters outside the continental shelf, so also it finds it in winter, but then only in the shallow coastal waters of Norway. Many gaps, however, in our knowledge of these migrations yet remain to be filled; for it is pointed out that from its occurrence more or less all the year round off the south-west of Ireland we are precluded from supposing that the various localities where the species has been found lie in one continuous and regular route of migration. We cannot correlate what we know of it in Norway, in the northern North Sea, and off the Hebrides with what we know of it in the Bay of Biscay, the south-west of Ireland, and the Faröe Channel. It seems, on the whole, probable that in its more southern and more western habitats the habits of the species are different from those in the north; that it is here confined to deeper waters, but that it tends to resort periodically to still deeper parts of the ocean, where it chiefly spawns.

DR. J. D. F. GILCHRIST has sent to us a note on luminosity in South African earthworms. He refers to the Rev. Hilderic Friend's interesting letter in NATURE (vol. xlvii., 1893, p. 462) for earlier records, and states that other cases have been noticed since then. Opinions are, however, divided as to the source of the phosphorescence, the latest suggestion being that it is due to luminous fungi. During a dark and damp evening Dr. Gilchrist observed bright patches on the ground in a pinewood on the slopes of Table Mountain. These were traced to earthworms, specimens of which when dug up discharged a viscid luminous fluid from the mouth, and usually from the anus as well. Phosphorescent patches seen on the body were attributed to portions of this discharge, perhaps scattered by the movements of the worm; but they may have been due to something given out from an injury to the body. The luminous discharge contained numerous nucleated, granular cells, some of which showed active movements, and resembled Gregarines. Dr. Gilchrist thinks he has found sporoblasts and spores which confirm this view of their nature. The proof that the cells were luminous was obtained by examining them under the microscope, in a dark room, by means of their own light. The fluid containing them, when dried at 60° C., recovered its luminosity when breathed on or otherwise moistened. A useful survey of what is known in regard to the production of light by animals will be found in papers by Prof. U. Dahlgren, referred to in recent volumes of NATURE (vol. xcvii., p. 146; vol. xcix., pp. 191, 430).

WITH the continued improvement of cytological methods our knowledge of the minute details of the growth and maturation of the germ-cells is constantly increasing. At first attention was focussed upon the remarkable changes undergone by the nucleus and the mechanism of nuclear division during these processes, with results which are now well known to every serious student. More recently a large amount of laborious research has been devoted to the behaviour of the cytoplasm and its various inclusions—mitochondria, macromitosomes, micromitosomes, acroblasts and acrosomes, to mention only some of the numerous terms employed by recent investigators. The story of the behaviour of these enigmatical bodies is scarcely less remarkable than that of the behaviour of the nucleus, and may well be regarded as affording some justification for the view that the cytoplasm plays an important part in the transmission of inherited characters. To those who have not followed the gradual elaboration of this story by various writers a memoir in the current number of the *Quarterly Journal of Microscopical Science* (vol. lxii., part 3), by Mr. J. Bronté Gatenby, will come almost as a revelation. It deals with the cytoplasmic inclusions of the germ-cells in Lepidoptera, a subject which is far too complex to be adequately summarised in this place. This memoir is a veritable triumph of microscopical technique, and the numerous figures by which it is illustrated are remarkably beautiful and convincing. As a clear exposition of the latest views on the subject, as well as for the sake of the new results which it deals with, it should meet with a hearty welcome from all biological students.

AGRICULTURAL problems are largely represented in recent numbers of the *Atti dei Lincei*. Thus Prof. Alfonso Splendore (vol. xxv., 2, p. 12) describes researches on the bacterial parasites of the field mouse (Patymys) with a view to their application to the extermination of these pests. The parasitic fungi which give rise to the so-called "ink disease" in chestnut trees are discussed by Dr. L. Petri in the same number. Dr. Mario Topi (vol. xxvi., 1, p. 4) gives statistics showing the effect of arseniate of lead and tobacco in destroying the larvæ of the Tineæ, which attack vines. Dr. Benjamino Peyronel (vol. xxvi., p. 9) describes a potato disease new to Italy, due to the fungus *Spondylocladium atrovirens*, which was first discovered in Vienna on the tubers of potatoes in 1872, and described by Johnson as occurring in Ireland in 1903. It would appear, however, that though this fungus is difficult to destroy chemically, its effects on the tubers are mainly superficial. In a later number (vol. xxvi., p. 11) Prof. Vittorio Peglion discusses the Peronospora of the hemp (*P. cannabina*), which is referred to a new subgenus, and of which the life-history is still in doubt. The same writer, in a later number (vol. xxvi., 1, p. 12) discusses the gummy fungus which is at present threatening the apricot trees in Emilia, and is referred to the genus Sclerotinia. It appears to attack the flower, fruit, and all parts of the apricot.

THE October number of the *Journal of the Board of Agriculture* contains several articles of interest relating to seeds. A summary is given of the more general measures taken by the Governments of British Dominions and of foreign countries with the object of eradicating weeds and providing pure seeds. The summary deals mainly with measures for the prevention of the importation of weed seeds, restrictions on the internal sale of seeds, and control stations for analyses of seeds. It is of interest to note that the reproach that England is almost the only important country having no adequate seed regulations and no official seed-testing station is about to be removed, as it is announced that an official seed-testing station for England and Wales is being organised at the Food Production Department. The station will be under the direction of Mr. R. G. Stapledon, adviser in agricultural botany to University College, Aberystwyth. Other articles in the same number deal with seed production in Canada and economy in the use of vegetable seeds. The latter is published separately as Food Production Leaflet No. 8, copies of which may be obtained gratis on application to the Board.

THE disadvantages of the various thermometric scales in use is raised by Mr. A. McAdie, director of the Blue Hill Observatory, in a paper in the *Geographical Review* for September (vol. iv., No. 3) entitled "The Passing of the Fahrenheit Scale." The growing study of the upper air and the structure of the atmosphere has led, at least in America, to a tendency to use the Absolute scale, instead of the Centigrade or Fahrenheit. The chief advantage of the Fahrenheit over the Centigrade and Absolute scales is the smaller divisions, which give the readings more definiteness. In order to combine this feature with the advantages of the Absolute scale Mr. McAdie proposes a new scale, for which he has found no name. Zero is the same as in the Absolute scale ($-273{\cdot}02^{\circ}$ C.), and freezing point is 1000. The divisions are considerably smaller than on the Fahrenheit scale, there are no minus signs, and there is a fundamental difference between readings above and below freezing point, to cite only some of the merits which the author claims for his new scale.

THE weakest part of school geography as a rule lies in the teaching of climate. Broad generalisations based on the general laws of physics, but fallacious in their application, mar the treatment of the subject in almost all school books. We welcome, therefore, an article by Mr. B. C. Wallis on the monsoon in the *School World* for October (abridged from an article written for *Indian Education*). In this article Mr. Wallis sets out the facts of the monsoon and the incidence of the monsoon rains, wisely refraining from any attempt to explain the phenomena. He gives five rainfall areas for India, each marked by rainfall intensity at one or other period of the year, and indicates the major portions of each without vainly attempting to find precise boundaries. The article, which we notice is not copyrighted, should be most useful to teachers and students in its clear presentment of facts and its absence of any striving for false simplicity. Incidentally, it is hoped that it will help to kill the long-established myth of the monsoon as gigantic land and sea breezes based on the heating and cooling of Central Asia. This fallacy is still current in school geography, despite repeated attempts by the late Prof. Herbertson to dispel it in his many text-books.

A REPORT of the Fernley Observatory, Southport, with the meteorological results for the year 1916, under the directorship of Mr. Joseph Baxendell, meteorologist to the corporation, has been issued by the county borough of Southport. The observations are carried out with the greatest care, and the instruments and their positions are such as to render the results of the highest possible value. Close contact has been kept with the Meteorological Office, and detailed observations are supplied for the various official reports. In the statistical tables the new units of measurement are given, as well as the old. A new table is given which shows the amount, duration, and intensity of rainfall for each eight points of wind direction. For the year 1916 the largest amount of rain fell with south-west and south winds, the measurement being six times as great as with a north wind. The duration of rainfall was greatest with south-west, west, and south-east winds. A "discontinuity" in the amount of rainfall for the several months of the year is shown by the series of observations. During the twenty-six years from 1871 the average rainfall for July is given as 3·64 in., whilst during the subsequent nineteen years it was only 2·25 in.; September in the earlier series has 3·46 in., and later only 2·38 in. The later series of observations shows that all the months July to November have become drier, whilst six out of seven of the remaining months, December to June, have actually become wetter. Older records in the district show the change in the character of the weather to be subject to periodic variation.

RECENT writers on the subject of optical glass have shown a tendency to assign the whole of the credit for the introduction of the newer materials like baryta, magnesia, and the phosphates into glass-making to Abbe and Schott, of Jena. In an editorial note in the *British Journal of Photography* for October 19 it is pointed out that baryta has been used in glass-making since 1830, and that both Fraunhofer and Faraday made boro-silicate glass, Schroeder made magnesia glass, Maïs used zinc oxide, both Harcourt and Stokes made phosphate glasses, while French glass-makers have used thallium and fluorides for some time. The journal claims that some of the credit for the introduction of the newer materials now used in glass-making should be given to these pioneer workers.

WHAT is called the "uniform movement" of flame occurs when an inflammable mixture of gases is ignited at the open end of a horizontal tube closed at the other end. Messrs. W. A. Haward and S. G. Sastry (Journal of the Chemical Society, September, 1917) have determined the speeds of this uniform movement in mixtures of acetylene and air. When these speeds (obtained with a glass tube 12 mm. in diameter) are plotted against the percentages of acetylene, a curve is obtained which rises rapidly from 3 per cent. of acetylene to a maximum at 8–10 per cent., and then falls more slowly to 20 per cent. of acetylene. Mixtures richer than the last in acetylene deposit soot when burnt, and the propagation of flame is slow. There is a gradual flattening of the curve towards the limits of inflammability, as in other inflammable mixtures. Previous experiments with mixtures of acetylene and air, by Le Chatelier, led him to depict the results by a curve consisting of three straight lines, the first to a maximum at 10 per cent. of acetylene, the second falling from this maximum, and the third (from 20 per cent. acetylene to the limit of inflammability) corresponding with combustion with a fuliginous flame. As stated, the authors obtained a smooth curve not consisting of straight lines.

OUR ASTRONOMICAL COLUMN.

THE METEORIC SHOWER OF OCTOBER.—Between October 13 and 28 last, inclusive, observations were obtained at Bristol on fourteen nights, and 197 meteors were seen in twenty-three hours of watching, chiefly before sunrise. Fifty-six of the meteors recorded belonged to one or other of the two principal displays of the October epoch near ξ Geminorum ($98^\circ+14^\circ$, thirty-two meteors) and ν Orionis ($92^\circ+15^\circ$, twenty-four meteors). The former was also the stronger shower in 1916, and in some previous years, though in 1877 and 1887 the Orionids formed by far the richer display. Of the minor showers the most active were at $42^\circ+20^\circ$ in Aries, and $163^\circ+59^\circ$ near β Ursæ Majoris.

Two fireballs have been recently observed with sufficient completeness to allow their real paths to be ascertained, viz. :—

(1) October 18, 2h. 15m. a.m., radiant $90^\circ+16^\circ$, height seventy-two to forty-seven miles over Lincolnshire.

(2) October 23, 7h. 33m. p.m., radiant $42^\circ+20^\circ$, height sixty-five to thirty-three miles from over North Sea to west of Scarborough.

GALACTIC CONDENSATION OF STARS.—Expressing galactic condensation as the ratio of the number of stars per unit area at 5° galactic latitude to the number at 80°, Kapteyn found values ranging from 2·8 at the ninth magnitude to 27·7 at the sixteenth. The relatively large value for the very faint stars did not appear in Chapman and Melotte's discussion of the Franklin-Adams plates, but it has since been substantially confirmed by work with the 60-in. reflector at Mt. Wilson. A further investigation of this question has been based by Dr. F. H. Seares on the counts of nearly 600,000 stars which have been collected by Prof. Turner (*Astrophysical Journal*, vol. xlvi., p. 117). The galactic condensation deduced from these is in close agreement with the results obtained by Kapteyn. The variations of density with right ascension, however, are not greater than the uncertainties affecting the results, so that no evidence was found for the spiral of obscuring matter derived by Prof. Turner from the same data. It would appear that Prof. Turner did not make sufficient allowance for the high galactic concentration of the faint stars.

THE VARIABILITY OF B.D. +56·547°.—The variability of this star was first detected by Mr. J. Van der Bilt, and, at his suggestion, the photographic magnitudes have been determined by Messrs. Martin and Plummer from numerous plates taken at Dunsink in connection with a previous study of three other variables in the region of χ Persei (Monthly Notices, R.A.S., vol. lxxvii., p. 651). The star has turned out to be of rather special interest, inasmuch as it shows an unexpected periodicity. The interval from maximum to maximum is about 704 days, and the range of variation is from magnitude 9·8 to 10·3. The other three stars resemble it in having a high colour-index, and are therefore probably in a similar physical condition, but these vary in the irregular way which is characteristic of nearly all variables which are very red.

THE "JOURNAL DES OBSERVATEURS."—The index to vol. i. and the first number of vol. ii. of this publication have been received. The journal is especially noteworthy for communications relating to observations and ephemerides of minor planets and comets. The current issue gives ephemerides of the planets (108) Hecuba and (394) Arduina, together with observations of numerous planets made at Nice, and of Mellish's comet (1917*a*) made at the Cape Observatory. The editor is M. Henry Bourget, director of the Observatory of Marseilles.

MILITARY AIRCRAFT AND THEIR ARMAMENT.

AN article of considerable interest, under the title of "La Technique Allemande de l'Armement Aérien," appears in *La Nature* for October 6 by Jean-Abel Lefranc. The author traces out the development of German aerial warfare, with particular reference to the armament of military aircraft. Victory in the air, he says, depends on two sets of factors—tactical and technical. Under the former head he places favourable time of attack, good position, powerful formation; under the latter, armament, speed, flexibility of control, and altitude. To secure a good tactical position a machine must possess good technical factors; for instance, good armament is useless unless a machine is fast enough to be able to challenge the enemy to battle. Nevertheless, the pilot counts for a great deal, and the "Farmans" of 1915 beat the "Aviatiks," although the latter were faster, better armed, and more flexible. M. Lefranc remarks that the relative importance of the technical elements depends on the purpose of the machine; for a battleplane, he places them in the order speed, flexibility, armament, and altitude. The last attribute might be omitted, since a fast machine is always a good climber unless the landing speed is abnormally high. For slow and heavy machines designed for bombing, a powerful defensive armament is most essential. For night raiders radius of action, bomb capacity, and facility of landing are more important than armament. The speed of both French and German fighters varies from 100 to 120 miles per hour. These speeds could be higher but for the necessity of a reasonable landing speed and a good climbing rate. The heavy bombing machines fly at speeds from eighty to ninety-five miles per hour. Flexibility has now developed almost without limit.

M. Lefranc divides the period since the war commenced into two parts. In the early days the importance of the mastery of the air had not been fully appreciated, and aerial combats were rare. The chief use of aeroplanes was to obtain information as to the enemy's position. The French machines, being of the "pusher" type, mounted the gun in front, and had a large "dead angle" behind, which was out of the range of fire of the gun. The German machines were mostly tractors and mounted their guns behind the main planes. They had the decided advantage that their "dead angle" was under the surveillance of the pilot. Early aerial fights were generally ineffective, and resulted in a few bullet-holes in the wings, mainly owing to difficulties of aim and the small quantity of ammunition carried.

The later period of the war has produced three main types. The first type resulted from the design of a gun firing through the propeller and under the control of the pilot. Firing through the propeller may be achieved by fitting metal shields to the blades to prevent destruction by the bullets, but is better attained by automatic timing of the firing to miss the blades, as this need not interfere with the design of an efficient propeller. The second type, a heavier machine, mounts a rear gun on a turntable, in addition to that firing ahead through the propeller. In the third type, of which the 1916–17 Gotha is an example, twin propellers are used, and both forward and rear guns have a wide angle of fire. There is also a third gun firing below the fuselage, as a defence against attack from below—a very vulnerable point in the older machines. This third type has no "dead angle," but can bring one or other of its guns to bear on any point. One of the greatest difficulties of effective gun practice in the air is that due to error of aim resulting from the relative movement of the two machines. Various attempts to correct the aim by automatic sights have been made, but the most effective measure is to fire as many rounds as possible during the combat; hence the frequent duplication of a forward fixed gun.

M. Lefranc concludes his article with a brief description of the types of bullet used by the Germans. He mentions four types: the ordinary bullet, the perforating bullet for destroying the engines and metal parts of a machine, the incendiary bullet, and the explosive bullet. The article is liberally illustrated with sketches and diagrams, and is well worthy of perusal. Any attempt to trace developments further than M. Lefranc has done would doubtless be censored; indeed, some ten lines of the article in question have been censored as it is. We have, therefore, contented ourselves with a brief *résumé* of the most important points of the article, as they will doubtless be of interest to those who follow the progress of the scientific development of aircraft.

REPORTS ON CLIMATES.

AN interesting memoir on the climate of Bagdad ("Sul Clima di Bagdad"), by Prof. Filippo Eredia, appears in a recent issue of the *Bollettino della Reale Società Geografica Italiana*, under the auspices of which a mission was dispatched in 1908, led by Dr. A. Lanzani. Prof. Eredia summarises the more salient features of this expedition's work, and further utilises information given in various papers by Eliot, Hann, and Gilbert Walker. Bagdad is in lat. 33° 19′ N., long. 44° 26′ E., the height of the cistern of the barometer above sea-level being 127 ft. The mean barometric pressure at 32° F. sea-level and lat. 45° is 29·893 in., being highest, 30·149 in., in January, and lowest, 29·543 in., in July, a variation in the monthly means of 0·60 in. The mean annual temperature is 73·0° F., ranging from 94·5° in July and August to 48·9° in January. The mean of the daily maxima is 86·0°, the mean monthly values ranging from 109·9° in August to 59·5° in January. The mean of the night minima is 60·1°, highest in July, 79·5°, and lowest in January, 38·1°. The highest temperature recorded was 122°, and frost is not uncommon from November to February. The mean daily range of temperature varies from 33° in August and September to 20° in December. The relative humidity is 58, rising to 80 per cent. of saturation in December and January, and falling to 38 per cent. in June. The mean cloud amount (overcast sky=100) is only 16, the extremes being 29 in March and 1 in July. Various authorities place the annual rainfall between 6·94 in. and 9·04 in., practically all of which falls between November and April. June, July, and September are rainless, but slight showers have fallen in May, August, and October.

A useful paper appears in the *Bollettino d'Informazione* (Anno iv., N. 7–8–9) of the Italian Ministry for the Colonies, by Prof. Eredia, on the climate of Derna, an important commercial centre of Bengasi, situated in lat. 32° 45′ N., long. 22° 40′ E. Some fragmentary data collected by previous writers is first summarised, but the greater part of the paper is taken up with a discussion of observations extending from March, 1913, to December, 1915, made with a complete instrumental installation. The observations made at 9 a.m., 3 p.m., and 9 p.m. are collected in ten-day periods for each of the three hours. The mean annual temperature is 68° F., of August, the warmest month, 78·3°, and of January, the coldest month, 57·4°. The extremes noted have been 112° and 40°. The mean annual barometric pressure is exactly 30 in., showing a range of 0·17 in. between December (the month of highest pressure) and July (the month of lowest pressure). The annual rainfall is 7·94 in., of which 86 per cent. falls between November and February. There are fifty-one days in the year with precipitation, July and August being rainless. In spite of the small rainfall heavy downpours are occasionally observed. Thus 3·13 in. have fallen in two days, and three daily falls exceeding an inch have occurred. The prevailing wind, except in December and January, is north-west, one result of this being the remarkable steadiness of the relative humidity, which in no month differs appreciably from the annual mean of 62. The mean amount of cloud varies from 9 per cent. in July to 57 per cent. in February.

Prof. Eredia discusses in vol. xxvi. of the *Rendiconte della R. Accademia dei Lincei* the monthly variations of barometric pressure at twelve places in Italy, based on data for the thirty-five years 1881–1915. The maximum is in January and the minimum in April at all stations. At Pesaro, Florence, Rome, and Lecce there is a well-marked secondary minimum in July. The variation in the monthly means diminishes appreciably with latitude, the amplitude between the months of highest and lowest pressure being 0·07 in. less on the southern coasts than at northern inland stations. Prof. Eredia also contributes a paper, "Le Brine in Italia," to a recent issue of the *Bollettino Bimensuale della Società Meteor. Ital.*, in which he summarises the results of an investigation into the frequency of hoar frost in Italy. The mean monthly number of cases is given for fifty stations well distributed over the country for the five months, November to March, during the twenty years ending 1915. The greatest number of cases is in January, closely followed by December. Pavia, in Lombardy, has an average of forty-one cases during the five months under consideration, whilst at Naples the mean frequency is only 0·4. In most districts coastal stations have a relatively small number of cases as compared with inland stations contiguous. The distribution of pressure and also local conditions favourable to the production of hoar frost are discussed in considerable detail. The insertion of a small map showing the position of the stations utilised would add much to the interest of Prof. Eredia's valuable investigations into various phases of Italian climatology.

R. C. M.

EVOLUTION OF THE PRIMATES.

DR. W. K. GREGORY, of the American Museum of Natural History, New York, has contributed to the Bulletin of that institution a series of studies on the "Evolution of the Primates." In part i. he reviews the theory of cusp-formation which was first formulated by Cope and afterwards elaborated and perfected by Osborn, and contends that all later discoveries have justified their supposition that the upper molars of primates (and also of all typical placental mammals) are modifications of a common tritubercular type, while the lower molars are modifications of a "tuberculo-sectorial" form. In his opinion the similarity of the molar type in all forms of man and anthropoid, both living and extinct, is a matter beyond dispute.

In part ii. Dr. Gregory discusses the phylogeny of the known anthropoid and human types. He regards the chimpanzee and gorilla as man's nearest allies, and, on the present evidence, thinks the common stock from which all three arose may have been in existence during the Miocene period. His review of the dental characters of extinct anthropoids is most welcome. He cannot agree that the genus Sivapithecus, recently described by Dr. G. E. Pilgrim, of the Geological Survey of India, stands in the direct line of human ancestry. He supports his colleague, Dr. W. D. Matthew—in opposition to the view generally held in this country—in regarding the lower jaw of Eoanthropus as that of a Piltdown chimpanzee associated by a curious chance with the Piltdown man in a pocket of gravel. We look forward to the appearance of parts iii. and iv. of Dr. Gregory's studies, in which he proposes to review the phylogenies of the catarrhine, or Old World, monkeys, and platyrrhine, or New World, monkeys and Lemuroids.

HEREDITARY CHARACTERS IN RELATION TO EVOLUTION.

PROF H. S. JENNINGS, of the Johns Hopkins University, delivered a lecture on March 15 before the Washington Academy of Sciences on "Observed Changes in Hereditary Characters in Relation to Evolution." This lecture, published in the Journal of that Academy (vol. vii., No. 10), consists of a discussion on the factors of evolution of such great interest that we have decided to print an abridgment so that readers of NATURE may have the opportunity of studying and appreciating his arguments as set forth in his own words. The older school of biologists in this country will doubtless welcome Prof. Jennings's brilliant and ingenious interpretation of the recent work of American zoologists on genetics, so as to support the Darwinian interpretation of the evolutionary process. Prof. Jennings's criticism of Mr. Bateson's British Association address (1914) leaves the reader in doubt whether he has appreciated the view that the "loss and disintegration" in the germ-plasm are conceived by Bateson as the shedding of successive inhibitory factors the withdrawal of which leaves the hypothetical fundamental germ-complex free to produce an increasingly complex result in the developing organism.

The problem of the method of evolution is one which the biologist finds it impossible to leave alone. Can we bring the facts which experimental work has brought out into relation with the method of evolution?

What we may call the first phase of the modern experimental study of variation is that which culminated in the establishment of the fact that most of the heritable differences observed between closely related organisms—between the members of a given species, for example—are not *variations* in the sense of alterations; are not active *changes* in constitution, but are permanent diversities; they are static, not dynamic. This discovery was made long ago by the Frenchman Jordan; but, as in the case of Mendelism, science ignored it and pursued cheerfully its false path until the facts were rediscovered in recent years. All thorough work has led directly to this result: that any species or kind of organism is made up of a very great number of diverse stocks, differing from each other in minute particulars, but the diversities inherited from generation to generation. This result has in recent years dominated all work on the occurrence of variations; on the effects of selection; on the method of evolution. The condition is particularly striking in organisms reproducing from a single parent, so that there is no mixing of stocks; I found it in a high degree in organisms of this sort which I studied. Thus the infusorian Paramecium I found to consist of a large number of such heritably diverse stocks, each stock showing within itself many variations that are not heritable.[1] *Difflugia corona* shows the same condition in a marked degree.[2] A host of workers have found similar conditions in all sorts of organisms. It led to the idea of the genotype (Johannsen), as the permanent germinal constitution of any given individual; it supported powerfully the conception of Mendelism as merely the working out of recombinations of mosaic-like parts of these permanent genotypes. The whole conception is in its essential nature static; alteration does not fit into the scheme.

[1] Jennings, 1908–11. (See Bibliography.)
[2] Jennings, 1916. (See Bibliography.)

This discovery seemed to explain fully all the observed effects of selection within a species; but gave them a significance quite the reverse of what they had been supposed to have. It seemed to account for practically all the supposed variations that had been observed; they were not variations at all, in the sense of steps in evolution; they were mere instances of the static condition of diversity that everywhere prevails. Jordan, the devout original discoverer of this condition of affairs, maintained that it showed that organisms do not really vary; that there is no such process as evolution; and, indeed, this seems to be the direct logical conclusion to be drawn.

Now, this multiplicity of diverse stocks really represents the actual condition of affairs, *so far as it goes*. Persons who are interested in maintaining that evolution *is* occurring, that selection *is* effective, and the like, make a very great mistake in denying the existence of the condition of diversity portrayed by the genotypists. What they must do is to accept that condition as a foundation, then show that it is not final; that it does not proceed to the end; that the diverse existing stocks, while heritably different as the genotypists maintain, may also change and differentiate, in ways not yet detected by their discoverers.

But, of course. most of the adherents of the "orthodox genotype theory" do not maintain, with their first representative Jordan, that no changes occur. Typically, they admit that *mutations* occur; that the genotype may at rare intervals transform, as a given chemical compound may transform into another and diverse compound. We all know the typical instances: the transforming mutations of Œnothera: the bud variations that show in a sudden change of colour or form in plants; the dropping out of definite Mendelian units in Drosophila and elsewhere; the transformation of particular Mendelian units into some other condition.

So much, then, may serve as an outline of a prevailing theory; organisms forming a multitude of diverse strains with diverse genotypes; the genotype a mosaic of parts that are recombined in Mendelian inheritance; selection a mere process of isolating and recombining what already exists; large changes occurring at rare intervals, through the dropping of bits of the mosaic, or through their complete chemical transformation; evolution by saltations.

Certain serious difficulties appear in this view of the matter; I shall mention merely two of them, for their practical results. One is the very existence of the minutely differing strains, which forms one of the main foundations for the genotype theory. How have these arisen? Not by large steps, not by saltations, for the differences between the strains go down to the very limits of detectibility. On the saltation theory, Jordan's view that these things were created separate at the beginning seems the only solution.

Secondly, to many minds there appears to be an equally great difficulty in the origin by saltation of complex adaptive structures, such as the eye. I shall not analyse this difficulty, but merely point to it and to the first one mentioned, as having had the practical effect of keeping many investigators persistently at work looking for something besides saltations as a basis for evolution; looking for hereditary changes that would permit a continuity in transformation.

Where reproduction is from a single parent we meet the problem of inheritance and variation in its simplest form; for there is nothing which complicates genetic problems so enormously as does the continual mixing of diverse stocks in biparental inheritance. In uniparental reproduction we have but one genotype to deal with; we can be certain that no hereditary characters are introduced from outside that genotype.

To hope for results on the problem in which we are interested, we must resolve to carry on a sort of second degree research, as it were. We must take a single stock—choosing an organism that is most favourable for such work—then proceed to a most extensive and intensive study of heredity, of variation, and of the effects of selection for long periods within such a stock.

Such an organism, most favourable from all points of view, I found in the rhizopod *Difflugia corona*. It has numerous distinctive characters, all congenital, all inherited in a high degree, yet varying from parent to offspring also; none of these characters changed by growth or environmental action during the life of the individual.

Long-continued work showed that a single strain of this animal, all derived by fission from a single parent, does differentiate gradually, with the passage of generations, into many hereditarily diverse strains. The important facts about the hereditary variations and their appearance are the following:—

(1) Hereditary variations arose in some few cases by rather large steps or "saltations."

(2) But the immense majority of the hereditary variations were minute gradations. Variation is as continuous as can be detected.

(3) Hereditary variation occurred in many different ways, in many diverse characters. There was no single line of variation followed exclusively, or in the overwhelming majority of cases.

(4) It gave rise to many diverse combinations of characters: large animals with long spines; small animals with long spines; large animals with short spines; small animals with short spines; and so on. Any set of characters might vary independently of the rest.

(5) The hereditary variations which arose were of just such a nature as to produce from a single strain the hereditarily different strains that are found in nature.[3]

I judge that if the intermediate strains were killed, the two most diverse strains found in Nature might well be classed as different species, although the question of what a species is must be left to the judgment or fancy of the individual.

How do these results compare with those found by other men? If we take a general survey, we find the following main classes of cases:—

(1) First, we have the mutations of Œnothera and its relatives: large transformations occurring suddenly.

(2) Secondly, we have a large miscellaneous collection of mutations observed in various classes of organisms: "bud variations," dropping out of unit factors, and the like—all definite saltations, but not genetically fully analysed.

(3) In Drosophila as studied by Morgan and his associates, we have the largest and most fully analysed body of facts which we possess with respect to changes in hereditary character in any organism. The changes here are pictured as typical saltations; but of these I shall speak further.

(4) In palæontology, as the results are presented in recent papers by Osborn,[4] the evidence is for evolution by minute, continuous variations which follow a single definite trend.

(5) Finally, we have the work in biparental inheritance from Castle and his associates[5]; this gives evidence for continuous variation, not following a single necessary trend, but guided by external selection.

Furthermore, we discover in our survey that there are at least two well-marked controversies in flame at the present time:—

First, we have the general controversy between, on one hand, those who are mutationists and adherents of the strict genotype view; on the other, those who, like Castle, believe that we observe continuous hereditary variations in the progress of biparental reproduction. The mutationists attempt to show that the apparent gradual modification of characters observed in breeding is in reality a mere working out of Mendelian recombinations.

Secondly, we have a somewhat less lively controversy between the genotypic mutationists and the palæontological upholders of evolution by continuous variation.

Now let us look briefly into the points at issue in the controversy between the "genotypic mutationists" and the upholders of gradual change during biparental inheritance.

Castle finds that in rats he can, by selection, gradually increase or decrease the amount of colour in the coat, passing by continuous stages from one extreme to the other. As to this, he holds two main points:—

(1) The change is an actual change in the hereditary characteristic of the stock; not a mere result of the recombination of Mendelian factors. This is the general and fundamental point at issue.

(2) More specifically, he holds it to be an actual change in a single-unit factor; this single factor changes its grade in a continuous and quantitative manner.

On the other side, the critics of these views maintain that the changes shown are not actual alterations in the hereditary constitution at all, but are mere results of the recombinations of Mendelian factors. And specifically, they find a complete explanation of such results as those of Castle in the hypothesis of *multiple modifying factors*. There is conceived to be a single "main factor" which determines whether the "hooded pattern" shall, or shall not, be present. In addition to this there are a considerable number of "modifying factors" which, when the "hooded pattern" is present, increase or decrease the extent of pigmentation. When many of the positive factors of this sort are present, the rat's coat has much pigment; when fewer are present, the extent of pigment is less, and so on. The process of changing the extent of pigmentation by selection consists, according to this view, merely in making diverse combinations of these factors, by proper crosses.

This same explanation is applied to a great variety of cases. Castle had carried the war into the enemy's country by predicting (or at least suggesting) that the so-called unit characters in Drosophila would be found to be modifiable through selection.[6] Later research by MacDowell (1915), Zeleny and Mattoon (1915), Reeves (1916), Morgan (1917), and Sturtevant (1917) actually verified this prediction; it has indeed been found that the Drosophila mutations can be modified by selection. Again, the mutationists counter the blow with their explanation of multiple modifying factors, which are segregated in the process of selection; and they give some real evidence that such is actually the case. What I am going to do is to abandon the ground that Castle would defend, proceed directly into the territory of the enemy, accept the conditions met there, then see where we come out in relation to the nature of variation, the effects of selection, and the method of evolution.

In no other organism have heritable variations been

[3] The full account of this work is given in Jennings, 1916. (See Bibliography.)

[4] Osborn, 1912, 1915, 1916. (See Bibliography.)

[5] Castle, 1915 *a*, 1916, 1916 *a*, 1916 *b*, 1917; Castle and Phillips, 1914, etc. (See Bibliography.)

[6] Castle, 1915, p. 39. (See Bibliography.)

studied so thoroughly as in Drosophila, and no other body of men have been more thoroughgoing upholders of mutationism and of the multiple factor explanation of the effects of selection than the students of Drosophila—Morgan and the others. We may therefore turn to the evidence from Drosophila with confidence that it will be presented with fairness to the mutationist point of view. We shall first ask (1) what we learn from the work on Drosophila as to the possibility of finding finely graded variations in a single unit character. Next we shall inquire (2) as to the relation of the assumed modifying factors to changes in hereditary constitution; to the nature of the effects of selection.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. F. C. Bartlett and Mr. G. M. Bennett have been elected to fellowships at St. John's College. Mr. Bartlett, who was placed in the first class in the Moral Sciences Tripos, 1914, is assistant in experimental psychology, and is acting as interim director of the psychological laboratory during the absence of the director. Mr. Bennett was placed in the first class of the Natural Sciences Tripos, both in Part I. in 1914 and in Part II. (chemistry) in 1915.

LEEDS.—The University has received with great regret the resignation by Prof. A. S. Leyton of the chair of pathology and bacteriology in the University. In accepting this resignation, the University Council has taken the opportunity of recording its high appreciation of the valuable services which Prof. Leyton rendered to the University during his tenure of the chair.

A COURSE of eight lectures on the philosophy of mathematics is being given this term by the Hon. Bertrand Russell at Dr. Williams's Library, Gordon Square, W.C.1. The lectures (of which the first was delivered on Tuesday, October 30) are given on Tuesdays at 5 p.m. The present course, which deals with the theory of order, cardinal numbers, and formal deduction, will probably be followed after Christmas by one on the philosophy of the proposition. Applications for tickets should be made to Miss D. Wrinch, Girton College, Cambridge.

THE recently established Department of Technical Optics of the Imperial College at South Kensington has now begun its work. It will be remembered that on the initiative of the London County Council a general scheme for providing instruction in this highly important national work was agreed upon by the several parties concerned in the early part of the year when an Advisory Committee to the County Council representative of the trade, the workers, and other interests concerned was appointed, under the chairmanship of the Rt. Hon. A. H. Dyke Acland. An important part of the scheme was the establishment of the above department, which is administered under the governors of the college by the same committee. In June Prof. F. J. Cheshire was appointed director of the new department; in July Prof. A. E. Conrady was appointed to the chair of optical design, and other subordinate appointments are in hand. During the summer two courses of lectures were given on the designing and computing of telescope systems, and attended by sixty-six students, of whom forty-two came direct from the workshop—a gratifying indication of the recognition by the manufacturers of the importance of this work. About twelve of these were men of academic distinction. The Ministry of Munitions, the National Physical Laboratory, the Royal Observatory, and Woolwich Arsenal were well represented. This session well-attended courses are being given in optical designing and computing, practical optical computing, the construction, theory, and use of optical measuring instruments, theory of the microscope, and microscope technique. Every effort is thus being made to meet the more immediately urgent demands arising in connection with the war. A complete curriculum for optical students will be introduced as soon as the exigencies of the time permit.

THE current issue of the *Quarterly Review* includes two contributions on educational subjects. One, by Mr. Edward Porritt, not only reviews the condition of agricultural education in the United States, but also provides an interesting historical survey of the steps taken to bring the work of the Department of Agriculture to its present high degree of efficiency. The Department of Agriculture at Washington has been a department of first rank in the executive branch of the Government of the United States—a department presided over by a Cabinet Minister—since 1889. In the fiscal year 1916–17 approximately 6,800,000*l*. was being expended by the U.S. Government on the department, on the agricultural colleges and experiment stations, and on extension work, the object of all these branches of the work being to improve all departments of farm economy, to ameliorate conditions on the farms and in the farm homes, and thereby to retain in rural pursuits the men, women, and children who are now on the six million farms of the United States. Mr. J. E. G. de Montmorency writes on national education and national life, and shows in a convincing manner that much useful guidance can be obtained from history in considering current suggestions for educational reform. One of our earliest historical documents, he tells us, for example, is an edict of the Emperor Gratian regulating the salaries of teachers. The proposals of Mr. Fisher's Education Bill are examined in the light of the experience of previous centuries, and after his criticisms Mr. de Montmorency comes to the conclusion:—"It would be a sad thing if a great scheme of educational reconstruction, which at last brings to the doors of the people the larger hope that is essential to a great democracy, were to fail because, in a comparatively small matter of money, the Government lacked that courage which is needful for the conduct of peace as it is for the prosecution of war."

ON October 18 the President of the Board of Education received an influential deputation representative of the North-East Coast Institution of Engineers and Shipbuilders and other technical societies and educational interests in the same district. It will be remembered (NATURE, August 23, vol. xcix., p. 519) that this institution has elaborated an excellent scheme for the training of apprentices, and the object of the deputation, which was headed by the Duke of Northumberland, was to lay before Mr. Fisher its reasoned opinion regarding the organisation of junior day technical schools. The most suitable school for the prospective engineer is of this type, and the institution has already demanded that adequate provision of these schools should be made in the North-East Coast area, which has about 14,000 marine engineering and shipbuilding apprentices, and that these schools should be regarded as in no sense inferior to secondary schools. Mr. Rowell referred in detail to the Board's regulations for junior day technical schools, and expressed the view that the declaration in the regulations that they were "not intended to promote the establishment of courses planned to furnish a preparation for the professions, the universities, or higher full-time technical work" was open to grave exception, as viewing the work of such a school as lying within a blind-alley. The point was, surely, one of spirit rather than of administration, for he could not imagine that the

Board would deliberately arrest a sequential scheme of development, such as that set out in the institution's report. Mr. Fisher promised that the points raised would receive careful consideration. Those who have been intimately acquainted with the working policy of the Board of Education towards junior technical schools will be gratified that a large and influential body of engineers has at last spoken out with no uncertain voice, and will look with renewed hope for the speedy removal of the crippling regulations under which such schools have been governed.

THE widespread disappointment at the Government's decision to postpone for the present any further consideration of Mr. Fisher's Education Bill continues to receive expression in resolutions passed by public bodies and in letters to the Press. Among the latter may be mentioned a letter signed by a number of representative persons, including the Bishops of Oxford and Winchester, the Master of Balliol, Mr. W. L. Hitchens (chairman of Messrs. Cammell Laird), and several Labour members of Parliament. The letter states that the signatories are convinced that they express the opinion of a large majority of their countrymen when they say that no more urgent task confronts the nation than the creation of an educational system which will cultivate more fully the physique, the intellect, and the character of the rising generation of English children, and that it would be little less than a national disaster if the present opportunity were allowed to pass unused. Again and again in the last ten years the nation has been warned that in allowing nearly one-half of its children to leave school before their fourteenth birthday, and more than three-quarters of those between fourteen and eighteen to escape educational supervision altogether, it is creating a moral and economic problem which no intervention at a later age can solve. The chief medical officer of the Board of Education has directed attention to the prevalence among large numbers of school children—one million is the latest figure—of ailments which undermine their vitality, which render futile the efforts of the teachers and the educational expenditure of the State, but can be remedied only by the adoption of a more comprehensive system of physical education and medical treatment. The general character of the right educational policy is not disputed. If it be said that the crisis of a great war is not the right moment to proceed with educational legislation, the answer is that if the improvement of our national system of education was desirable before the war, the war itself has made that improvement indispensable. The letter urges that it is in the public interest that at least the educational proposals of the Bill should be passed into law at a sufficiently early date to be brought into operation before the conclusion of the war. We are glad to see the statement in the *Times* of November 6 that the Government has been so much impressed by the amount of feeling aroused by its decision not to proceed any further with the Education Bill this session that the position is to be reconsidered.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 1.—Sir J. J. Thomson, president, in the chair.—Lord **Rayleigh**: The reflection of light from a regularly stratified medium. The remarkable coloured reflection from some crystals of chlorate of potash described by Stokes, the colours of opals and of old decomposed glass, etc., lend interest to the calculation of reflection from a regularly stratified medium, in which the alternate strata, each of constant thickness, differ in refrangibility. The higher the number of stratifications, supposed perfectly regular, the nearer is the approach to homogeneity in the light of the favoured wave-lengths. A general idea of what is to be expected may be arrived at by considering the case where a single reflection is very feeble, but when the component reflections are more vigorous, or when the number of alternations is very great, a more detailed examination is required. An important distinction reveals itself according to the relative values of the refractivity and thicknesses. In one case a sufficient multiplication of the number of strata leads to complete reflection; in the other it does not.—Sir William **Abney**: Two cases of congenital night-blindness. The two cases were examined spectroscopically. An interesting fact appeared that in their extinction of the different rays of the spectrum all light disappeared throughout the spectrum at the same moment that the colour vanished, and that the *colour* vanished to the normal eye at the same point that it did to the colour-blind. This pointed to the fact that the colourless part of the rays failed to give any sensation of light. As normal eyes see in a faint light with these colourless rays, it is to be presumed that the night-blind owe their blindness in faint lights to the absence of certain retinal processes which the normal eyes possess.—Hon. R. J. **Strutt**: Duration of luminosity of electric discharge in gases and vapours—further studies. (1) The behaviour of jets of luminous gas flowing away from the region of discharge at a low gaseous pressure has been investigated, using the principal permanent gases, also mercury vapour. In a transverse electrostatic field the luminosity is deflected, part of it in most cases going to the positive plate, and part to the negative. But in hydrogen, when the pressure is not very low, nearly the whole of the luminosity is deflected to the positive plate, a small part remaining undeflected. As the pressure is reduced, an increasing part of the luminosity goes to the negative plate. Similar results are observed in mercury vapour. (2) Further observations are recorded on these jets at higher pressures, arranging a spark discharge so that the gas can flow out from it through an orifice into a sustained vacuum. With hydrogen (condensed discharge) the exuded jet of luminosity, about 9 mm. long, shows the Balmer series. The discharge spectrum shows widened lines. These become narrow as the luminous gas emerges. (3) Nitrogen in the same arrangement, with an uncondensed discharge, shows a jet with periodic swellings similar to those observed by Mach and Salcher and Emden when a jet of compressed air, examined by the shadow method, escapes into the open. The wave-length agrees with that to be anticipated from their experiments. (4) This nitrogen jet luminosity is not to be confused in any way with active nitrogen. The time for which it endures is of quite a different order of magnitude, and the spectrum is essentially different.—G. W. **Walker**: Surface reflection of earthquake waves.—Dr. H. S. **Allen**: Characteristic frequency and atomic number. (1) Simple relations are found to hold between the values of the product $N\nu$ for different elements (N being Moseley's atomic number and ν the characteristic frequency). (2) For twenty-five metals it is found that the product can be expressed in the form $N\nu = n\nu_A$ (n a whole number and ν a constant of value $21{\cdot}3 \times 10^{12}$ sec.$^{-1}$ approximately). (3) The same rule is obeyed in the case of certain non-metallic elements. (4) Similar results are found when the characteristic frequency is calculated from the elastic constants by Debye's formula. The value of n thus obtained is not in all cases the same as that deduced from the specific heats. (5) Application of the theory of probability shows that there is but a small chance of the product $N\nu$ approaching so nearly to integral multiples of a constant frequency by a mere accident. (6) It is found that the atomic numbers of Moseley give better agreement with the proposed relation than do the atomic ordinals of Rydberg. (7) The empirical results are discussed from the viewpoint of the quantum theory, and it is suggested that the integer n may be related to the number of electrons concerned in determining the crystalline space-lattice of the element in the solid state. (8) A relation similar in character is found to hold for certain electronic frequencies. In such cases ν_A must be replaced by $\nu_E = 3{\cdot}289 \times 10^{15}$ sec.$^{-1}$ (Rydberg's constant). (9) This relation is considered with reference to the maximum of the photoelectric effect, the limiting frequency of this effect, ionisation potentials, and thermionic potentials.—Dr. C. **Chree**: Historical note on a relation between the gravitational attraction exercised and the elastic depression caused by load on the plane surface of an isotropic elastic solid.

Zoological Society, October 23.—Dr. A. Smith Woodward, vice-president, in the chair.—H. D. **Badcock**: Ant-like spiders from Malaya, collected by the Annandale-Robinson Expedition, 1901–2.—Miss Ruth C. **Bamber**: A hermaphrodite dogfish.

Mathematical Society, November 1.—Prof. H. M. Macdonald, president, in the chair.—J. H. **Grace**: Tetrahedra in relation to spheres and quadrics.—Prof. M. J. M. **Hill**: The continuation of the hypergeometric series.—Prof. W. H. **Young**: Restricted Fourier series and the convergence of power-series.—Prof. E. B. **Stouffer**: Invariants and covariants of linear homogeneous differential equations.—H. W. **Turnbull**: The simultaneous system of two quaternary quadratic forms.

BOOKS RECEIVED.

Principles of Quantitative Analysis. By Prof. W. C. Blasdale. Second edition. Pp. xii+402. (London: Constable and Co., Ltd.) 10*s*. 6*d*. net.

The Student's Handbook to the University and Colleges of Cambridge. Sixteenth edition, revised to June 30, 1917. Pp. vi+703. (Cambridge: At the University Press.) 6*s*. net.

Manuring for Higher Crop Production. By Dr. E. J. Russell. Second edition. Pp. vi+94. (Cambridge: At the University Press.) 3*s*. 6*d*. net.

The Chemistry of Linseed Oil. By Dr. J. N. Friend. Pp. vii+96. (Chemical Monographs.) (London: Gurney and Jackson.) 2*s*. 6*d*. net.

A Roumanian Diary, 1915, 1916, 1917. By Lady Kennard. Pp. vii+191. (London: W. Heinemann.) 5*s*. net.

The National Physical Laboratory. Report for 1916–17. Pp. 67. (Teddington: W. F. Parrott.)

The National Physical Laboratory. Collected Researches. Vol. xiii., 1916. Pp. 278+fig. (London: Harrison and Sons.)

Modern Whaling and Bear-Hunting. By W. G. Burn Murdoch. Pp. 320. (London: Seeley, Service and Co., Ltd.) 21*s*. net.

The Distances, Absolute Magnitudes, and Spectra of 734 Stars. Arranged for Use with Ordinary Star Maps. By T. E. Heath. Pp. iv+52. (Tenby: Miss Crealock.) 2*s*. 6*d*. net.

Foods and their Relative Nourishing Value. By Prof. W. H. Thompson. Second edition. Pp. 38. (Dublin: University Press.) 4*d*. net.

The Pupils' Class-Book of Geography. Scotland. Pp. 96. Asia, with Special Reference to India. Pp. 128. By E. J. S. Lay. (London: Macmillan and Co., Ltd.) 7*d*. and 8*d*. respectively.

Biology. By Prof. G. N. Calkins. Second edition. Pp. viii+255. (New York: H. Holt and Co.)

The Born Fool. By J. W. Byrd. Pp. 316. (London: Chatto and Windus.) 6*s*. net.

Probleme der Volksernährung. By Dr. A. Lipschütz. Pp. 74. (Bern: Max Drechsel.) 2.80 francs.

Power Wiring Diagrams. By A. T. Dover. Pp. xv+208. (London: Whittaker and Co.) 6*s*. net.

Continuous-Current Motors and Control Apparatus. By W. P. Maycock. Pp. xvi+331+4 Appendices and Index. (London: Whittaker and Co.) 6*s*. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 8.

ROYAL SOCIETY, at 4.30.—The Galvanometric Measurement of "Emotional" Physiological Changes: Prof. A. D. Waller.—The Structure, Evolution, and Origin of the Amphibia. I. The "Orders" Rachitomi and Stereospondyli: D. M. S. Watson.—The Enzymes concerned in the Decomposition of Glucose and Mannitol by *Bacillus coli communis*. II. Experiments of Short Duration with an Emulsion of the Organisms. III. Various Phases in the Decomposition of Glucose by an Emulsion of the Organisms: E. C. Grey.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—President's Address: C. H. Wordingham.

OPTICAL SOCIETY, at 8.—Certain Optical Stores Captured from the Enemy: Lt.-Col. A. C. Williams.

FRIDAY, NOVEMBER 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 5.—The Thermo-electric Properties of Fused Metals: C. R. Darling and A. W. Grace.—Triple Cemented Telescope Objectives: T. Smith and Miss A. B. Dale.

MONDAY, NOVEMBER 12.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

THURSDAY, NOVEMBER 15.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Investigation into the Imbibition Exhibited by some Shellac Derivatives: A. P. Laurie and C. Ranken. —Phenomena connected with Turbulence in the Lower Atmosphere: G. I. Taylor.—The Relation between Barometric Pressure and the Water Level in a Well at Kew Observatory: E. G. Bilham.

INSTITUTION OF MINING AND METALLURGY, at 5.30.

FRIDAY, NOVEMBER 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.

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