THURSDAY, FEBRUARY 14, 1918.

LIFE AND WORK OF JAMES GEIKIE.

James Geikie: The Man and the Geologist. By Dr. M. I. Newbigin and Dr. J. S. Flett. Pp. xi+227. (Edinburgh: Oliver and Boyd; London: Gurney and Jackson, 1917.) Price 7s. 6d. net.

THE life of James Geikie deserved to be written, for he was not only a good geologist with marked literary gifts, but also had an innate love of travel, Nature, and the humorous, with the art of making friends. The task has been well done, the biographical part by Dr. Marion Newbigin, the strictly geological by Dr. J. S. Flett. The book avoids the error, so common in biographies, of needless prolixity; it contains well-selected specimens of Geikie's letters and writings, grave and gay, with three good likenesses and an amusing sketch, and abstains from commonplace padding.

Born at Edinburgh in 1839, James Geikie (Murdoch, his second Christian name, was early discarded), after its High School and a short period of uncongenial employment, obtained, in 1861, an appointment to the Geological Survey. On that he worked for twenty years, rising to be District Surveyor, then gave it up reluctantly to become Murchisonian Professor in the University of Edinburgh. One of his earliest duties in the former capacity was to map the drifts of Fifeshire and the Lothians, which attracted him to the problem of their origin and moulded his future studies. Then he went on to the solid geology of Ayrshire, the Lanark coalfield, the Cheviots, and other districts of southern Scotland. As professor he discharged the duties of his chair zealously until the early summer of 1914, and on March 1 of the following year died suddenly from heart failure. As a worker, whether in the field, the class-room, or the study, he was indefatigable; in fact, he evidently overtasked even his vigorous constitution, often suffering in his later years from more than one form of nervous exhaustion, and probably somewhat shortened his span of life. Notwithstanding his numerous ties, professional and social—for he was a devoted husband, father, and friend—he was able to see more than a little of other lands, visiting Iceland, the Faröes, and Norway, France, Germany, Switzerland, and Italy, with Egypt, the Canaries, Canada, and the United States, always keenly observant and gathering notes for use in the lecture-room and his numerous contributions to scientific literature.

The most outstanding of his works are "The Great Ice Age" and "Prehistoric Europe." Of them and of the author's position in the Glacial controversy Dr. Flett writes clearly, concisely, and apparently as if he thought his client to have gained his cause. Be this as it may—and the present writer unfortunately differs in some important respects from the late professor's interpretation of Nature's hieroglyphs of the Ice age, scarcely less than from his inferences about metamorphism in Ayrshire—all students will gladly acknowledge the value of the above-named books. The third edition of "The Great Ice Age" (published in 1894) is a veritable mine of information, collected from many lands and diverse sources, about its deposits and their significance; and the other volume—"Prehistoric Europe"—discusses in addition the advent of man, which, according to its author, was anterior to the Glacial Epoch.

But even antagonists who think that he was a little too prone to put his trust in Continental prophets of the Ice age (when they were favourable to his views), and to ignore rather than to refute the criticisms of opponents, will assign a high place to these volumes as works of reference. The same may be said of his geological articles —and they would themselves make a volume—in "Chambers's Encyclopædia," where he successfully puts off the advocate to become the judge. In all that he published his style was attractive; he evidently wrote with facility, sought to make himself intelligible, and never shirked his work. In brief, he was a many-sided, very able, and most genial man, who had the power of winning the regard of his students, and whose loss was regretted by everyone who had been his workfellow, his friend, or even his antagonist.

T. G. BONNEY.

THE COMPLETE DAIRY FARMER.

Dairy Cattle Feeding and Management. By Dr. C. W. Larson and Prof. F. S. Putney. Pp. xx+471. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1917.) Price 11s. 6d. net.

THE ancient art of agriculture has always been invested with a halo of romance, through which only in times of the severest national stress has its essentially prosaic character as the great industry of food production been clearly discernible to the popular eye. In the lay imagination the idea commonly persists that the art still retains essentially its primitive form, amounting to little more than a crudely systematic collection of the gifts which from year to year a benevolent, though not always generous, Providence is pleased to bestow upon mankind.

It is lamentable, but inevitable, that in all aspects of human activity the advance of knowledge should tend to overlay the rosy tints of romance with the more sombre hues of reality. The philosopher-ploughman of yesterday gives way to the motor engineer of to-morrow; the milking machine dispels the last vestige of romance from the art of the dairymaid.

In the days before the Industrial Revolution the production of milk was largely incidental to the production of crops and meat, and the needs of the community could be satisfied without recourse to even such simple intensive methods of milk production as could then have been employed. With the steady divorce of the food consumer from food production, and the increasing dependence of civilised peoples upon cow's milk for the feeding of infants, the need for the development of milk supplies and for the organisation of distribution has steadily grown until at the present time the production of milk has been developed by the leaders of the industry into the most highly organised and efficient branch of agriculture in the more densely populated regions of the civilised world.

Before the development of modern science the business of milk production was necessarily run on simple lines. Alternative feeding-stuffs were few in number, and the significance of chemical composition was unknown. With the development of chemistry and physiology, and the consequent elucidation of the fundamental principles of nutrition, a more elaborate adjustment of rations to milk output became possible, and was further facilitated by the increased range of feeding materials which the concurrent expansion of commerce and industry placed at the disposal of the farmer. The discovery of micro-organisms and of their relation to public health has exercised, and must continue to exercise more and more, a potent influence upon the methods of milk production and distribution. A knowledge of the principles underlying improvement of livestock by breeding has also become an essential item in the intellectual equipment of the modern dairy-farmer, and acquires additional importance with the development of the infant science of genetics. The further complexities introduced by the modern developments of transport and marketing facilities are obvious.

It is thus patent that the technical education of the dairy-farming expert of to-day cannot be compressed into any narrow curriculum, and demands for its efficient assimilation a level of intellect and capacity which is scarcely associated as yet in the public mind with the farming industry. The provision of the necessary educational guidance is a formidable task that has nowhere been faced with more courage and success than in America. From their inception the American agricultural colleges and experiment stations in dairying areas have placed great emphasis upon the importance of scientific method in dairy-farming, and the literature of the subject bears witness to the persistent effort which has steadily brought American work into the very foremost position in this branch of applied science.

As in so many other branches of technology and science, British readers in the past have been accustomed to draw largely upon German literature, but in this particular field the German has been surpassed, and no country now possesses a dairying literature equal in volume and general level of quality to that which America has produced. The work of Dr. Larson and Prof. Putney is an excellent example of the best type of modern American text-book, and is primarily designed to secure the closest co-ordination between classwork and private study. The material is arranged in twenty-nine lectures, which cover the whole field of feeding, breeding, management, hygiene, housing, cost accounting, and distribution. A commendable feature is the outline of a course of practical work which is given in the appendix. It is obvious that an exhaustive treatment of the subject is impossible within the compass of one volume of this size, and some sections bear evidence of compression beyond what the student may reasonably expect to find. On the whole, however, the compression has been judiciously effected, without omission of essential information or of adequate illustrative matter from experimental records. The work may be warmly commended to the dairy student and teacher as being perhaps the most comprehensive class-book on the subject.

C. C.

PHILOSOPHICAL IDEALISM AND NATURAL SCIENCE.

The Idea of God in the Light of Recent Philosophy. The Gifford Lectures delivered in the University of Aberdeen in the Years 1912 and 1913. By Prof. A. Seth Pringle-Pattison. Pp. xvi+423. (Oxford: At the Clarendon Press, 1917.) Price 12*s*. 6*d*. net.

IN his recently published Gifford Lectures, Prof. Pringle-Pattison, starting from Hume's "Dialogues concerning Natural Religion," passes in review the reasoning of successive philosophical writers up to the present time on the nature of ultimate reality. His personal point of view is that of the idealism so strongly represented in recent British philosophy, including his own former works; but in the course of very acute and yet thoroughly sympathetic criticisms of other writers, and particularly his fellow-idealists, he has now carried philosophical idealism a considerable step forward, and brought it into more living touch with natural science and other developments of human thought and action. A clear and very graceful literary style adds largely to the value of what is unmistakably a great philosophical book.

To many men of science it will perhaps come as something of a shock to find that the world of apparent "objective" physical reality is treated by philosophers as only the one-sided or subjective appearance of a deeper reality. Prof. Pringle-Pattison traces the steps by which philosophical thought has developed in the direction of showing that the real world is a world of what he constantly refers to as "intrinsic values." "Idealism," as he puts it, "takes its stand on the essential truth of our judgments of value, and the impossibility of explaining the higher from the lower. Beauty and goodness are not born of the clash of atoms; they are effluences of something more perfect and more divine." A distinctive key-note of the book is his treatment of imperfection and suffering as organic to the development and very existence of these intrinsic values. The hedonistic test of perfection is examined and rejected.

Perhaps the designation "idealism" is somewhat misleading. What it mainly indicates is a direct historical descent from Berkeley, Hume, and the great German idealists of a century ago. Philosophy is only the endeavour to describe reality; and the result of this endeavour, as set forth in the book before us, is that the conceptions of the sciences are in themselves no more than inadequate ideal constructions of what can only be described finally as spiritual reality.

In a short notice it is impossible to give any detailed account of the whole book, but some reference may be made to the fourth chapter, entitled "The Liberating Influence of Biology." The author is in full agreement with those biologists who now claim that biology must be regarded as a science with a distinctive working hypothesis which separates it from the physical sciences. The basis of this claim is simply that it is not possible to describe and interpret the distinctive facts of biology in terms of the working hypothesis of physics and chemistry: the conception of life itself must be employed as a fundamental working hypothesis. In referring to this claim he is careful to dissociate himself from what is ordinarily understood as vitalism, and to show that the claim goes much farther than that of the vitalists, who occupy what seems to him an untenable position. While he agrees, for instance, with Driesch's criticisms of the mechanistic account of life, he points to radical weakness in Driesch's own vitalistic position. The "liberating" influence of biology results from the fact that the new biology treats as mere working hypotheses of limited application what had come to be regarded as absolute truths established by physical and chemical investigation. He points out that a similar liberating influence has resulted from recent discoveries as to the nature of atoms. There is thus no reason now for concluding that in ultimate analysis the phenomena of Nature, including human activity, must be reducible to an interplay of material particles, in accordance with the metaphysical theory which he designates as "naturalism." The way is left open to interpretations on a higher plane, and each of the sciences is left free to use its own special working hypotheses.

Perhaps most scientific readers will be inclined to think that the author under-estimates the strength of the position of what he calls the "old guard" of mechanistic biologists; but, however this may be, his treatment of the whole subject, and references to Darwin, Huxley, Bergson, Driesch, and other writers, will be found to be of much interest. The book may be recommended confidently to all those who wish to understand modern philosophical idealism and the grounds for its uncompromising rejection of "naturalism."

J. S. H.

OUR BOOKSHELF.

Highways and Byways in Wiltshire. By E. Hutton. With illustrations by Nellie Erichsen. Pp. xvii+463. (London: Macmillan and Co., Ltd., 1917.) Price 6*s*. net.

This book, with its charming illustrations from pen-drawings, is more nearly a guide to the ecclesiastical and monastic architecture of the Middle Ages in Wiltshire than any other yet published. It is not, it is true, in the form of a guide-book, but is arranged more or less as a description of a series of walks, taken by the author from different centres, beginning with Salisbury and South Wiltshire, which is treated of far more fully than the northern portion of the county.

The author has, indeed, an eye for natural scenery and dwells thereon at length on occasions; but his real interest lies in medieval architecture and in Church life previous to the Reformation, which for him is the end of all things good in Wiltshire or in England. As for Puritans, Protestants, Anglicans, they are, with scanty exceptions, anathema to him. George Herbert, Richard Hooker, and the "White King" are, it is true, amongst the exceptions, but for everybody even remotely connected with the destruction of the monasteries, for Seymours, and Thynnes, and Hungerfords, and especially Bayntons, he can find no words to fit their baseness. The only greater criminals are the modern restorers of churches. Of the restored statues in the West Front of Salisbury Cathedral he remarks: "Is it not monstrous that ignorance and imbecility should be allowed to disport themselves on such a work as this?" Yet, for all his violent preferences, he writes well and very readably, and for those whose interests lie in the same direction as his own there is a vast deal of architectural information, very largely taken, as he acknowledges, from the pages of the *Wiltshire Archaeological Magazine*. But it is a pity that the proofs were not more carefully read by the author. There are many misspellings and misprints, some of which make nonsense of the passages in which they occur. The index is good.

The Vegetable Garden. By Ed. J. S. Lay. (The Pupils' Class-book Series.) Pp. 144. (London: Macmillan and Co., Ltd., 1917.) Price 1*s*. 6*d*.

Elementary education is indebted to Mr. Lay for a number of school books on various subjects intended to train children to do more and think more for themselves. Were school gardening made a subject of scientific study as well as of manual instruction, it would teach children to think as well as to work. Unfortunately, this is not always the case, and, even in the counties where most is done to encourage observation and experiment, many gardening teachers find it difficult to get away from rule of thumb. If only to help such, Mr. Lay's book is to be welcomed. Intended for class reading to accompany outdoor work, it not only describes the operations, crops, insect pests, etc., of the garden, but also puts, in an interesting way, the problems that have to be faced, and leads the children to make simple experiments through the results of which many of the problems can be tackled intelligently. As a class reader it is the most useful gardening book that has yet appeared in this country, and its use should greatly enhance the value of school gardening as a means of real education. It comes at an opportune time, for in connection with the food production campaign school gardens are being multiplied, so that a host of new teachers will be grateful for its guidance.

(MXX Botany — Physiology
XX Plants & Nutrition)

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.*]

Flights of Rooks and Starlings.

I MAY be writing of what is so commonly known to naturalists as to be unworthy of record; the facts, however, are new to me. On a fine, still day last September I observed a large flight of rooks attended, as Gilbert White notes, by starlings. As they passed across the sky both rooks and starlings mounted higher and higher until they were lost to sight in the distance. Whatever may have been the occasion of the concourse, it was a subject of much interest to rooks in general, for solitary birds hurried by, cawing loudly, to join the main body. These belated individuals mounted in fairly regular spirals.

About a fortnight later I had the good fortune to be able to follow with powerful glasses a similar flight, but of rooks unaccompanied by starlings. As before, the mean movement in the still air was a steady oblique ascent, and the general impression that of a crowd of birds the individual movements of which were confused and irregular. This impression of confused flight was, however, probably wrong, for the few individual birds I was able to follow were undoubtedly rising in fairly regular spirals.

The surprising and, to me, novel character of the flight did not appear until the birds had risen to a height beyond the limits of unaided vision. The movements of individual birds then changed from the even sweep of the spiral to what can only be called trick flying. The wildest antics were indulged in, the commonest being a dive with closed wings, the bird sometimes rolling over and over. I could not fit the character of the movement to the hypothesis that the birds were darting after insects on the wing.

The two facts new to me were the height attained and the fact that a bird of such sedate manners as the rook should on occasion condescend to do "stunts."

W. B. HARDY.

The Athenæum Club, Pall Mall,
February 4.

National Union of Scientific Workers.

THERE is appearing in your advertising columns an announcement relating to this Union; will you allow me space to explain its objects very briefly, but rather more fully than is possible in an advertisement?

There is a general agreement that it is imperative for the best interests of science that those who pursue it should possess greater political and industrial influence. The founders of our Union believe that they can attain that influence only by adopting the form of organisation which has proved effective in experience. That organisation involves the formation of a Union including, so far as possible, every professional scientific worker, and governed in a completely "democratic" fashion. It is such a Union that we are trying to form.

In the pamphlet for which everyone is urged to write further details of our aims and methods of attaining them are suggested. But we feel that no self-appointed body can possibly legislate permanently for a Union designed to embrace the whole world of science. Our immediate endeavours, therefore, are to set up a preliminary organisation which will lead to the summoning of a thoroughly representative general meeting having the authority necessary to set the Union on a permanent basis. The pamphlet is mainly devoted to an account of this organisation. Until it has done its work the constitution and policy of the Union will remain unsettled; we would urge accordingly that any divergence, except on the fundamental principle, from the views of the founders is an argument for, rather than against, taking part in the preliminary work.

One last point. We are often asked what is our attitude towards other societies, existing or proposed. Our answer is that, since none of them are both all-inclusive and democratically governed, none, according to our view, can do our work. But, of course, we recognise that there are other ways of advancing the cause of science which are being followed effectively by other bodies. We recognise further that our relations to these other bodies will need careful consideration and regulation; but to discuss exactly what the relations must be would be to exceed the space I can ask you to put at my disposal.

NORMAN R. CAMPBELL
(General Secretary N.U.S.W.).

North Lodge, Queen's Road, Teddington.

THE GREEN LEAF: ITS SCIENTIFIC AND ECONOMIC EXPLOITATION.

THROUGHOUT the unnumbered ages which have witnessed the rise and fall of successive civilisations upon this planet, the one thing that has stood between mankind and extinction by lack of food has been the activity of the chloroplast of the green leaf. Perhaps, before equal time has again rolled over the world, the synthetic production of food may have been achieved, and man in all his intellectual glory may claim equality with the lilies of the field. Until then the fixation of organic carbon by "photosynthesis" in green cells must, by us, be regarded as the basal chemical happening of our planet. Thousands of years of empiric agriculture have enabled man to exploit this aspect of vegetation with remarkable success, but the problem of carbon assimilation found its way into the laboratory only at the end of the eighteenth century by the genius of Priestley, and its broad aspects were first formulated by the wisdom of De Saussure in 1812.

We may consider in this article what progress has been made with this matter, as a problem of pure and applied science, in the century that has elapsed since then. The recent appearance of a summary review of our knowledge of the subject by I. Jørgensen and W. Stiles[1] gives a good foundation for such consideration.

Investigators have not been idle. The bibliography contains 250 entries, but these are not a tenth of the papers published, for our authors' intention is to ignore historical development and give only a critical account of those researches which mark the present advance line of knowledge on the many separate, but converging, roads by which this well-defended secret of Nature has been attacked. The authors are as severely critical as the commissioners on a military campaign. They have carefully thought over the aspects of the subject

[1] "Carbon Assimilation: A Review of Recent Work on the Pigments of the Green Leaf and the Processes connected with Them." By Ingvar Jørgensen and Walter Stiles. *New Phytologist* Reprint, No. 10. Pp. 180. (London: Wesley and Son, 1917.) Price 4s.

as one connected whole, and are impatient of the many individual attacks which have wasted half their effort by failure to keep contact with flanking movements by workers coming from other directions, who should be regarded as allies, but are often treated as rivals. This report ought to have a valuable effect in unifying research activity. No similar presentation of the subject has appeared before in any language.

A century of laboratory attack has driven several salients forward, of which perhaps three stand out conspicuously. We may briefly consider how far each has progressed, as reported in this pamphlet, and what may be expected of the future. These advances concern (1) the pigments of the leaf (chap. ii.); (2) the products of carbon assimilation formed in the leaf (chap. v.); and (3) the influence of external factors on the rate of carbon assimilation (chap. iv.).

In chap. vii. will be found set out those speculations that have any significance as theories of the assimilation process. During the process that takes place in the illuminated green cell, whereby carbon dioxide disappears and sugar appears, it is clear that, somehow or other, reduction and "synthesis" must take place; but even now it is quite unclear to what system of reactions this result is to be attributed. Many hypotheses have been put forward, and Baeyer's "formaldehyde theory" has been almost canonised as an eternal verity, yet there is really no good evidence for it. Its perennial attraction no doubt is due to its æsthetic simplicity. It appears now that the reaction must be much more complex (unless, as is possible, we are entirely on the wrong tack), and this is our excuse for the slowness of progress. A knowledge of the reacting system at work would be equivalent to storming the citadel of the whole defence, but so far no one has advanced a satisfactory hypothesis that can be put to the proof of experiment. We have still to advance by slow hammering tactics from various directions.

The advance that has been made in elucidating the nature of the pigments of the green leaf under the guidance of Prof. Willstätter really amounts to a shock attack, so continuous and rapidly widening has been the progress.

In 1864 Sir George Stokes stated that he had proved that the green matter of leaves consisted of two green and two yellow pigments, though he never published his evidence. In the last decade this conclusion has been finally established by the monumental research of Prof. Willstätter and his colleagues. Before Prof. Willstätter there was no clue to the real chemical nature of these two green pigments, and it could be hoped that when their chemistry was known the process of reduction of carbon dioxide would be elucidated.

The curious nature of the green and yellow pigments is now made quite clear; the greens are esters of a big alcohol molecule, phytol, and a tricarboxylic acid based on a nucleus of four pyrrole rings. Magnesium is also an essential constituent, not electrolytically dissociable, but believed to be directly united with the nitrogen. The difference between the two green pigments is simply this, that "chlorophyll *b*" contains one atom more of oxygen (and two less of hydrogen) than "chlorophyll *a*." In complete contrast to this complexity is the simplicity of the yellow pigments; "carotin" is an unsaturated hydrocarbon, and "xanthophyll" an additive oxidation derivative of it. Both the yellows, when isolated from the cell, spontaneously absorb oxygen in abundance. It is easy to assume that these differences of oxygen-potential occurring within both the green and the yellow pairs are significant for the reduction of carbon dioxide; but there is no evidence on this point at present.

A second line of attack into which much work has been put is the determination of the nature and amount of the carbon-containing substances which arise in the leaf as CO_2 disappears. Is the CO_2 quantitatively reduced to its theoretical yield of carbohydrates, or do other substances arise in "multiple photosynthesis"? The measurement of the CO_2 intake by the green leaf is not difficult, but difficulties attend the correction of this apparent photosynthesis for the amount of CO_2 simultaneously produced in the body of the leaf by respiration—an amount which is large at high temperatures, but must be known and added in for exact statements of photosynthesis. At the other end of the reaction the determination of the carbohydrates produced continues to present considerable difficulties, so that no one has yet managed to measure in one experiment both the initial CO_2 used up and the final carbohydrates produced whereby we might judge of their equivalence. Much discussion has taken place on the question of what is the first sugar to appear in photosynthesis, though this is largely a strife of ideas rather than of facts.

The identification and accurate determination of individual sugars and polysaccharides in a mixture of such bodies form a special field of analytical work the difficulties of which have been much lightened by recent English researches, set out in chap. v.; but these have not been fully overcome yet. Further, these carbohydrates have all to be extracted from the leaf unaltered by the enzymes that lie in wait for them in the cell, and finally not one determination, but two differential determinations are required to establish changes due to photosynthesis; one, at the beginning of the experiment, being on some other area of leaf that can be held to furnish a strictly comparable control. Progress in this important line of work waits upon absolutely trustworthy methods of extraction and analysis of carbohydrates.

The third significant advance that has been made is that towards an understanding of the influence and mode of interaction of the many external and internal factors that can influence the rate of photosynthesis. The control or measurement of the external factors of illumination (sunshine or artificial light), temperature, and CO_2 supply require elaborate apparatus and considerable physical experience in the fields of radiometry, photometry, scientific illumination, thermo-electric measurement of leaf temperature, etc. Of internal factors the amount of chlorophyll and the degree of openness of the stomata are sometimes significant.

When the magnitudes of the three external factors are known or controlled, there arises the important question of the nature of their interaction when the magnitudes of them vary independently—a problem which has been elucidated largely by English investigations. In any possible combination of these factors, the rate of photosynthesis at any moment is not an expression of their combined magnitude, but only of the magnitude of a particular one of them acting as a "limiting factor" to the rate of functional activity. Which of the factors happens to be the limiting factor in any combination of them can be determined experimentally by application of the principle that increase of the magnitude of the limiting factor, and of this factor only, can increase the rate of photosynthesis.

With high rates of photosynthesis, yet a new factor has to be brought into account, as internal causes produce a regular falling off of the power of photosynthesis from moment to moment of time. Until the internal causation of this is fully explained it may pass by the non-committal name of the "time-factor."

There is yet another important aspect of our attack on the problem of photosynthesis which is still in its infancy, and that is the "energetics" of the process, dealt with in chap. vi. of the pamphlet.

The essential human value of the chloroplast activity lies, of course, over and above the indispensable accident that its products are edible, in the high energy content of these carbohydrates. Therefore, the energetic aspect of the process is the fundamental one, and the whole problem should be investigated on this basis. This involves measurement of the energy incident on the leaf-surface, with determinations of the amount transmitted, or reflected, or used in transpiration, as compared with the fraction stored up in photosynthesis, which last finds expression in the increased heat of combustion of unit-area of leaf-surface enriched by carbon assimilation. In this field of work progress can be made only by elaborate physical apparatus and critical determination of physical constants.

Let us now turn to the economic aspect of photosynthesis regarded as a problem of industrial or applied science. In these times, when cereal food supply threatens to become a limiting factor to the endurance or free existence of nations, the question of what science can do to multiply the number or heighten the activity of the chloroplasts subserving the cause of humanity acquires a poignant interest.

It cannot be said that the physiological study of chlorophyll activity has yet enabled any improvement to be made in the applied science of agriculture. The conditions of present-day agriculture are too little intensive, and not yet such as to make it worth while to attempt to exploit the researches of plant physiologists. Cultivation of new acreage, selection of types, and increase of transport facilities are the present solutions of the limitation factor of carbohydrate food supply.

The utilisation of researches on the augmentation of photosynthesis would be of profound importance in the imaginary case of a self-contained or strictly isolated community of limited acreage, a wealthy and intelligent community with a large population on a small area of soil for sunshine or artificial illumination. Their problem would have to be solved on the basis of investigations on the factors controlling photosynthesis of the type we have already mentioned.

In such a community the relation between plant physiology and agriculture would become something like that holding now between human physiology and medicine. To-day every progress in human physiology is eagerly correlated with medicine, and lavish endowment and encouragement are extended to pure physiological science on account of its generally recognised applicability to medicine. The outlook of medicine and hygiene is, however, individual, and not commercial; there is a desire to save every life and continue the activity of every individual, however worthless it may be to the community. With agriculture and plant communities there is no such outlook, and with regard to any application of plant physiology it is required that the intensification of the synthetic activity of the plant aimed at shall pay economically.

We see, then, that it is probable that the main cereal crops will for a long time be left to the mercy of natural vagaries of light, heat, water, and carbon dioxide, but minor activities of intensive food cultivation are now utilising deliberate or unconscious control of one or more of the factors of photosynthesis. It becomes, therefore, highly important that there should be carried out a comprehensive investigation of the physiology and energetics of carbon assimilation dealing with the possibilities of intensive photosynthesis under all artificial combinations of factorial conditions. From what we have said as to the complexity of this matter it is clear that no one or even two investigators are likely to have all the special chemical, physical, and physiological experience required for rapid progress, so that this would have to be an organised combined research, and continued over a number of years with good equipment and liberal endowment.

In conclusion we may express the opinion that, in the eyes of all who know the results of modern work on chlorophyll, Germany has acquired lasting credit for her great achievement with this difficult and elusive problem. Under the inspiration of Prof. Willstätter many workers have striven for years in the National Research Institute, and thousands of pounds have been spent, on a novel type of investigation involving tons of leaf material. Their credit is not the less for this, that the results have not at once proved to be of economic importance: one more province of ignorance has been strenuously conquered and annexed to the empire of knowledge.

An equal spirit of organised research and munificent endowment in this country should enable us to raise here, on the basis of existing English pioneer work, a similar monument of research on the physiology and energetics of carbon assimilation.

F. F. B.

THE ADOPTION OF THE METRIC SYSTEM.

AN account of the position of the subject of the adoption of the metric system in this country was given in NATURE of August 30 last. That the question is being very seriously considered by the controllers of our larger industries is clearly indicated by the two papers on the subject read recently before the Institution of Electrical Engineers. In the paper, "A Case for the Adoption of the Metric System (and Decimal Coinage) by Great Britain," by Mr. A. J. Stubbs, the multiplicity of standards—and, worse still, variations from these standards—is so clearly shown that one is not surprised that the writer should arrive at the conclusion that the change must come, and that delay but increases the difficulties of the change. The final conclusion, *"Do it now,"* will meet with unqualified approval from those who feel that the change is urgently needed.

Very different is the paper from Mr. Llewelyn B. Atkinson on "The 'Pros and Cons' of the Metric System." Broadly speaking, it is a paper "damning with faint praise." Starting from the three possible systems, namely, (1) the British system, (2) the metric system, (3) the C.G.S. or absolute system, the writer proceeds to discuss the questions of (*a*) decimalisation, (*b*) the actual magnitudes involved, and (*c*) policy. The main point made is that there is always so much to be said for the other side that everything is questionable. The further difficulty of the enormous number of readjustments of tolls, rates, dock dues, wage lists, etc., which would have to be made, is emphasised.

If our object were simply to criticise this paper rather than most seriously to urge the adoption of the metric system in the full light of all the difficulties actually known to be involved, we should simply ask Mr. Atkinson to produce his British system—say, for the textile industries; and in reply to the difficulty raised respecting the readjustment of tolls, rates, etc., we would suggest that the sooner the whole of the agricultural and commercial worlds of this country receive the shaking up that such a change would give them the better. But the paper is too good to be thus summarily dismissed.

The question of decimalisation admittedly resolves itself into a careful weighing up of the pros and cons. That uniformity, accuracy, and speed make a strong trio in favour of the decimal system is, however, beyond question. If proof of this be required it may be readily obtained from those who have worked in both British and Continental mills and works.

The question of the actual magnitudes involved is complicated by reference to the varying weights of the bushel of wheat, of barley, of oats, etc. This is typical of the whole trend of the paper. Whatever standards of measurement be adopted, the same difficulty will be in evidence. This approximates any two systems to one another in the sense that it involves them in a common difficulty—but does it therefore leave them equally useful for world service? If there were a chance of either Japan or China adopting any such British system as could be speedily designed, there might be something in the argument. But is there?

The question of policy is debated rather from the point of view of Britain holding certain markets by the imposition and retention of her peculiar weights and measures—in other words, by the methods employed by some of our machinists, who purposely adopt their own peculiar standards in order that they may absolutely bind to themselves any firms once depending upon them for machinery. Does not this savour far too much of subterfuge? And where subterfuge comes in, in the long run efficiency goes out.

From this point of view international coinage and rates of exchange form an interesting study. If the time ever comes when the spirit of scientific finance, rather than the spirit of "opportunism," dominates industry, then will commerce have made possibly the greatest step forward on record.

In the final paragraph of his paper Mr. Atkinson asks for some indication of how the change can in practice be effected in the case of the textile industries. This change was definitely made and the metric system employed in the textile industries department of the Bradford Technical College for more than a year. The experiment revealed the simplicity of the change, and has materially influenced the views of the writer of this article on the possibilities of the metric system in the textile industries. That the cotton section of the textile industries will profit least from the proposed change is certain, since it already possesses many of the advantages conferred by a world-wide system; but surely it will join hands with its less fortunate associates in advocating a change which to those with long vision seems almost likely to be the factor deciding our fate in the commercial warfare looming ahead.

But perhaps the deficiencies of outlook in evidence in Mr. Atkinson's paper may best be attributed to an apparent lack of appreciation of the questions of mentality (or psychology) involved. Every mathematical problem solved—be it simple or complex—serves in two ways. Directly, it gives the particular answer required; and indirectly, it incorporates itself into the intuitive faculty of the thinker. Thus each problem solved will naturally tend either to strengthen or to weaken the intuitive mathematical faculty. A multiplicity of standards with many haphazard variations will inevitably tend, through confusion of precept, to suppress, and ultimately entirely to eliminate, the intuitive mathematical faculty; whereas scientific standardisation will tend to promote that type of brain culture which ultimately resolves itself into cumulative efficiency. That our people markedly lack this intuitive mathematical faculty is too painfully in evidence. A great opportunity is opening out before us to correct this defect. Are we going to make the attempt? Risk there will, of course, always be, but in this case the risk of standing still seems to be far greater than the risk incident upon the compulsory adoption of the metric system.

A. F. B.

CONTROL OF SEX IN PIGEONS.[1]

THE late Prof. Whitman, of Chicago, was the first to show the remarkable suitability of wild pigeons for the analysis of the sex-problem. He found, for instance, that generic crosses (Columba and Turtur), when not permitted to lay many eggs, produce mostly or only males; that such pairs, when made to lay many eggs (crowded reproduction), produce males predominantly from their earlier stronger eggs, and predominantly or only females from the later eggs laid under stress of overwork; and that from eggs of pure wild species the first egg of the pair or clutch more often hatches a male, while the second egg of the pair more often produces a female. Dr. Oscar Riddle has followed up Prof. Whitman's work with very important results, bearing not only on the theory of sex, but also on possible practical control.

It seems certain that there are two kinds of eggs in the pigeon's ovary. The male-producing egg of the spring stores less material than the female-producing egg of the autumn. The male-producing egg of the clutch stores less material than does its female-producing fellow. The eggs of old females store more material and yield a higher percentage of females than do the eggs of birds not old. During the season successive clutches present higher and higher storage, and the eggs of the low-storage period give rise (in the generic cross) to males, and those of the high-storage period produce females.

Increase in storage capacity means decrease in oxidising capacity—a lowered metabolism; and the fundamental difference between the female-producing ovum and the male-producing ovum is a difference in the level of metabolism. Though there are a few discrepant results, it may be said that femaleness in the egg is associated with low metabolism, lower percentage of water, and a higher total of fat and phosphorus, or of phosphatides; and conversely for maleness. The less hydrated state of the colloids will favour increased storage, while a more hydrated state will favour a higher rate of oxidising metabolism. Analysis of the blood and constitutional features of adult birds gives some indication that the metabolic differences of male and female germs persist in the male and female adults. A calorimetric determination of the energy-value of hundreds of eggs confirmed the reality of what may be called metabolic dimorphism, agreeing with the conclusions reached from studies on the weights of yolks and on yolk analysis, and strikingly consistent with the breeding data. "We could say, if we wished to make merry with our colleagues, the cytologists, that we here get closest to the facts of sex when we *burn* our chromosomes."

Some of the incidental corroborations of Dr. Riddle's thesis are very interesting. Thus females hatched from eggs laid early in the season tend to be more masculine in their sex-behaviour than their own full sisters hatched later in the season. "Several grades of females can be thus seriated according to the season of hatching." Again, the female hatched from the first egg of a clutch is, in a great majority of cases, more masculine than her sister hatched from the second of the clutch. Another sidelight may be found in the frequency of a persistence of the right ovary in birds hatched from eggs which are otherwise known to be most feminine.

Numerous facts converge to the conclusion that "sex and characteristics other than sex, such as fertility and developmental energy, not only bear initial relations to the order of the egg in the clutch, but that sex and these other characteristics are progressively modified under stress of reproductive overwork, until at the extreme end of the season certain aspects of femininity are abnormally or unusually accentuated. In the light of these facts sex reveals itself as a quantitative modifiable character," associated with modifiable metabolic levels.

Dr. Riddle's view of sex, based on experimental results, is akin to the biological interpretation expounded by Geddes and Thomson in "The Evolution of Sex" (1889), that the fundamental difference between maleness and femaleness is a difference in the ratio of katabolic to anabolic processes, and that the determination of sex is to be looked for in factors affecting the rate and the nature of metabolic processes in the germ-cells or in the early stages of development. Dr. Riddle partially recognises the anticipation: "A general classification of male and female adult animals on the basis of a higher metabolism for the one and a lower for the other was indeed made by Geddes and Thomson many years ago. It now seems beyond question that this conclusion of these authors is a correct and important one."

Dr. Riddle's physiological view of sex is in harmony with many experimental results reached by other investigators, as may be illustrated by reference to Baltzer's beautiful experiments on the worm Bonellia, where there is striking dimorphism between the large female and the pigmy male. The newly hatched larvæ are capable of becoming either. If they happen to become attached to the proboscis of an adult female they become males; if they settle into the sand and mud they undergo, quite slowly, further development into females (almost exclusively). If the free-swimming, indifferent larvæ are artificially helped to a connection with the proboscis of an adult female, and then removed at progressively longer periods, the significant result is the production of practically all stages of hermaphroditism. Those

[1] "The Control of the Sex Ratio." By O. Riddle. Journ. Washington Acad. Sci., vii. (1917), pp. 319–56.

first removed become almost perfect females; others with longer and longer periods of attachment become more and more perfect males.

The general idea, then, is that "sexually differentiated organisms, from the first, have had the problem of producing germs pitched at two different metabolic levels." In connection with the establishment of these two metabolic levels (which appear to us to be also illustrated by variational alternatives quite apart from those of sex), the germ-cells have sometimes at least produced two different chromosome complexes. "But, as we have seen, the requisite metabolic level of the germ may be established in the absence of the appropriate chromosome complex, and the sex of the offspring made to correspond with the acquired grade or level of metabolism." Sex is plastic, reversible, quantitative in nature. "Seemingly this can only mean that other hereditary characters are also modifiable." Dr. Riddle has made a very notable contribution towards the solution of a long-standing problem.

NOTES.

THE mastership of Trinity College, Cambridge, is in the gift of the Crown, and to this post, vacant by the recent death of Dr. Butler, Sir J. J. Thomson has been appointed. No fellow of that great house has had a more distinguished career, and his appointment was not unexpected. He is the first layman to hold the office. Three other fellows of the Royal Society are heads of Cambridge colleges, namely, Dr. A. E. Shipley, Christ's; Dr. H. K. Anderson, Gonville and Caius; and Prof. A. C. Seward, Downing. "J. J.," as he is commonly called, was born just over sixty-one years ago, entered Trinity in 1876, was made a lecturer of his college in the same year in which he took his M.A. degree, and shortly afterwards, at the early age of twenty-seven, was appointed Cavendish professor at Cambridge in succession to Lord Rayleigh. His success in developing the Cambridge school of mathematical and experimental physics must be familiar to all readers of NATURE, and there is scarcely any civilised country which has not sent students to work under him in his laboratory. The brilliant researches carried on there were surveyed in NATURE of March, 1913, when Sir Joseph Thomson was the subject of an article in our series of "Scientific Worthies." In 1905 Sir Joseph Thomson was appointed professor of physics at the Royal Institution, and was awarded a Nobel prize for physics in the following year. He was president of the British Association in 1908, and four years later received the coveted distinction of the Order of Merit. In 1915 he was elected president of the Royal Society, and now his academic course is crowned by the headship of the leading college in his University. This is not the place to describe Sir Joseph Thomson's discoveries. It is more interesting to turn to the future. He is a ready speaker, a good talker, has the "saving grace" of humour, is popular, and knows and is known by all physicists and most chemists. He has now a great opportunity, and we predict with confidence that, aided by his wife, his rule in Trinity will add further lustre to his career, and bring university society into ever closer touch with leaders of scientific thought in Europe and America.

PROF. W. W. WATTS, professor of geology at the Imperial College of Science and Technology, has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, and for public service."

SIR NAPIER SHAW, director of the Meteorological Office, has been elected a foreign honorary member of the American Academy of Arts and Sciences, Boston.

WE regret to announce the death on February 7, in his seventy-first year, of Prof. G. A. L. Lebour, professor of geology in Armstrong College (formerly Durham College of Science), Newcastle-upon-Tyne, since 1879, and vice-principal of the college since 1902.

THE Perkin Medal Committee, consisting of members of several chemical societies, has, says *Science*, awarded the Perkin medal for 1918 to Auguste J. Rossi, of Niagara Falls, New York, in recognition of his work on titanium.

THE death is announced, at eighty-six years of age, of Prof. G. P. Girdwood, professor of chemistry in the faculty of medicine of McGill University, Montreal, from 1869 to 1902.

AT the ordinary scientific meeting of the Chemical Society, to be held at Burlington House, W.1, on Thursday, February 21, at 8 p.m., the Hon. R. J. Strutt will deliver a lecture entitled "Recent Studies on Active Nitrogen."

WE learn from *Science* that the Nichols medal for meritorious research in organic chemistry has been conferred on Prof. T. B. Johnson, of the Sheffield Scientific School of Yale University. The medal is awarded annually by the New York Section of the American Chemical Society on the merit of the original communications published in the journal of the society.

THE following officers and other members of council were elected at the annual meeting of the Malacological Society on February 8:—*President*, J. R. le B. Tomlin; *Vice-Presidents*, Rev. A. H. Cooke, A. Reynell, Tom Iredale, and H. O. N. Shaw; *Treasurer*, R. Bullen Newton; *Secretary*, G. K. Gude; *Editor*, B. B. Woodward; *Other Members of Council*, A. S. Kennard, Charles Oldham, G. B. Sowerby, A. E. Salisbury, E. R. Sykes, and W. J. Wintle.

THE officers and ordinary members of council of the Royal Microscopical Society, elected for the ensuing year, are as follows:—*President*, J. E. Barnard; *Vice-Presidents*, E. Heron-Allen, F. Martin Duncan, A. Earland, and R. Paulson; *Treasurer*, C. F. Hill; *Secretaries*, Dr. J. W. H. Eyre and D. J. Scourfield; *Ordinary Members of Council*, A. N. Disney, Dr. R. G. Hebb, T. H. Hiscott, Dr. Benj. Moore, Dr. J. Milton Offord, P. E. Radley, E. J. Sheppard, A. W. Sheppard, Dr. C. Singer, C. D. Soar, J. Wilson, and B. B. Woodward; *Librarian*, P. E. Radley.

THE twelfth award of the Reuben Harvey triennial memorial prize of the Royal College of Physicians of Ireland will be made on July 1 next. The competition is open to all students of the various recognised schools of medicine in Dublin, and to graduates or licentiates of the medical licensing bodies in Ireland of not more than three years' standing. The essays must show original research in animal physiology or pathology, be illustrated by drawings or preparations, and reach the registrar of the Royal College of Physicians of Ireland, Kildare Street, Dublin, not later than June 1.

MISS EDITH H. MARTYN records from Cheltenham the appearance of a fine peacock butterfly (*Vanessa Io*) on February 8. Though Blomefield, in his

"Naturalist's Calendar," gives February 28 as the earliest date of occurrence of this butterfly near Cambridge, it is not unusual for specimens to be seen in the south of England several weeks earlier. Two peacock butterflies were seen by the present writer near Arundel, Sussex, a fortnight before the date of Miss Martyn's record. They were no doubt insects which had hibernated and had been stirred into flight by the warm sunshine.

AT the anniversary meeting of the Royal Astronomical Society held on February 8 the officers and council were elected as follows:—*President*, Maj. P. A. MacMahon; *Vice-Presidents*, Prof. A. S. Eddington, Dr. J. W. L. Glaisher, Prof. R. A. Sampson, and Prof. H. H. Turner; *Treasurer*, Mr. E. B. Knobel; *Secretaries*, Dr. A. C. D. Crommelin and Prof. A. Fowler; *Foreign Secretary*, Dr. A. Schuster; *Council*, Mr. A. E. Conrady, the Rev. A. L. Cortie, S.J., Dr. J. L. E. Dreyer, Sir F. W. Dyson, Col. E. H. Hills, Mr. J. H. Jeans, Mr. H. S. Jones, Mr. E. W. Maunder, Dr. W. H. Maw, Prof. H. F. Newall, Prof. J. W. Nicholson, and the Rev. T. E. R. Phillips.

THE possibility of producing from home sources, hitherto neglected, a certain proportion of the vast amount of mineral oil and its kindred products, now so vital a necessity to our national existence, has been much discussed for some time past in both the general and technical Press. Particular interest, therefore, is attached to the paper entitled "A New British Oil Industry," by Mr. E. H. Cunningham Craig, Dr. F. Mollwo Perkin, Mr. A. G. V. Berry, and Dr. A. E. Dunstan, to be read at the meeting of the Institution of Petroleum Technologists on February 19, at 8 p.m., at the house of the Royal Society of Arts, Adelphi, W.C.2. The president of the institution, Mr. C. Greenway, will occupy the chair.

THE council of the Paisley Philosophical Institution has decided to initiate a special research section, and to equip a laboratory for the use of members who desire practically to investigate problems of geology and biology. The institution has a practical interest in the well-equipped Coats's Observatory, in which research in astronomy and meteorology is provided for. It possesses, also, an outfit for the encouragement of photography. Members are to be at liberty to join the new section by payment of an additional subscription. The satisfactory equipment of the laboratory will cost money; and this has to be found. The institution has a small reserve fund, but it is proposed to raise a special fund of 150*l*. by subscription, and towards this Mr. Robert Russell, a vice-president, has given 50*l*.

IN a report presented to the Imperial Institute Committee for Australia on the recent work of the institute for the Commonwealth, particulars are given of the results of an investigation into a series of oils prepared during the Australasian Antarctic Expedition and forwarded to the institute by Sir Douglas Mawson. These materials included sea-leopard oil, Weddell seal oil, and penguin oil. The oils have been carefully examined in the Scientific and Technical Department of the Imperial Institute in order to determine their characters in comparison with commercial oils of a similar kind, and have also been submitted to buyers of such oils in the United Kingdom. The oils were of good quality, and could be utilised for the purposes to which commercial seal and whale oils are applied, viz. for soap-making, leather-dressing, burning, etc. There is no doubt that there would be a ready sale for consignments of any of these oils at about the current price of whale and seal oils if they should become available in commercial quantities.

PROF. MAGNUS MACLEAN, of Glasgow, gave the Kelvin lecture to the Institution of Electrical Engineers on February 7. He took for his subject Kelvin as a teacher; and as he was for fifteen years Lord Kelvin's official assistant at Glasgow University, he threw many interesting sidelights on the everyday life of the great physicist. The lecture consisted mainly of extracts from Kelvin's letters to his assistant, generally giving him instructions to carry out researches. They all show intense eagerness to extend the boundaries of our knowledge of physical science and impatience at the length of time requisite to carry out the necessary experiments. Kelvin's experiments on electric fuses in 1886 and on "ampere gauges" (ammeters) in 1888 showed how he almost intuitively knew the difficulties that would arise, and apparently that he never was at a loss for methods of obviating these difficulties. In connection with his ampere gauges, for instance, he suggested that they might be made "dead heat" by means of a dash-pot. His first suggestion for making the latter was a metal plate dipping into a solution of sugar in water contained in a test-tube, as by this means any desired amount of viscosity could be obtained. Prof. Maclean also stated that Kelvin never regarded seriously any suggestions for "rationalising" our system of electric units. In fact, he regarded the proposals as "frivolous nonsense."

IN the old days electricians used to regard a "magneto" as a toy dynamo, and thought that it would be beneath the dignity of a first-rate designer to suggest improvements. Now neither labour nor expense is being spared in order to perfect it. Before the war there were only two or three firms in this country which made magnetos; there are now at least twenty times as many. As most of the pre-war magnetos came from Germany, our manufacturers were hard put to it in the early days of the war, and many of them slavishly followed the well-known design patented by Bosch. Great improvements were soon made by the British engineers in the ignition circuit, and there are now many types of magneto which are greatly superior to the Bosch. There is still a great demand for further improvements, but the engineer finds it difficult to determine whether he has to design for a minimum amount of energy or for a big potential gradient in the sparking-plug, and this hinders progress. The Students' Section of the Institution of Electrical Engineers ably discussed this question at a meeting at Faraday House on February 8, when Mr. R. W. Corkling read a paper on magnetos. Mr. Corkling showed all the latest types of magneto. He gave a full description of the one taken from a Zeppelin brought down in this country in 1916; its finish and accuracy of manufacture left little to be desired, but the design was poor. Mr. James, the vice-chairman of the section, suggested that the problem of "jamming" the ignition circuit of an enemy aeroplane by a suitable wireless method ought not to be an insuperable one; men of science had solved much more difficult problems in the past. There was a large number of youthful electricians present, who all took the greatest interest in the proceedings.

AN account of the life and mathematical work of Giuseppe Veronese is given by Prof. Corrado Segre in the *Atti dei Lincei*, vol. xxvi., (2), 9. Born at Chioggia on May 7, 1854, the son of a small painter, Veronese early showed a taste for art, which he later cultivated as a hobby, but after studying at the technical schools in Chioggia and Venice (where he partly supported himself by copying and giving lessons), Veronese went to Vienna, undertaking work there in connection with the Danube and designs for the exhibition. A year later he went to the Polytechnic at Zurich, studying mechanics at first, and then pure mathematics under Fiedler. Here he became interested in the work of Steiner, and sought to investigate the properties of the Pascal lines of the sixty hexagrams formed by joining up six points in every possible way. In 1876 Veronese asked to study at Rome under Cremona and Battaglini, where he was soon appointed assistant lecturer in projective geometry. His work on the hexagram was published in April, 1877, and some years later the Lincei published two memoirs by him on certain configurations in planes and in space. In 1880–81 Veronese went to Leipzig under Klein, and published an important memoir in German on the geometry of hyperspaces, and this was followed by further writings on this and kindred subjects. In October, 1881, he succeeded to the chair of geometry at Padua, and it is noteworthy that his predecessor, Bellavitis, was a disbeliever in the new-fangled "geometrical aberrations," as he styled the studies in which Veronese revelled. In addition to more advanced work, Veronese was the author of a successful treatise on elementary geometry. He appears, however, to have had a practical side to his character entirely distinct from his more abstruse studies, for he occupied himself assiduously with hydrographical problems with special, but not exclusive, reference to the Venetian lagoons. In addition, he served on the Municipal Council, and in 1904 was nominated Senator, in which capacity he made many important speeches. He was one of the first and most enthusiastic supporters of the war, but unfortunately his health had begun to break down in 1911–12 as the result of influenza, and he died on July 17 of last year.

THE third report of the Committee for the Exploration of the Irish Caves has just been issued by the Royal Irish Academy (Proceedings, vol. xxxiv., Sect. B, No. 3). It deals with the Castlepook Cave, Co. Cork, which was excavated under the direction of the late Mr. R. J. Ussher, and yielded more than 30,000 bones and teeth. A description of the cave by Mr. Ussher himself shows that it originated by the usual widening of joints in the Carboniferous Limestone, and the deposits on the floor consist not only of cave earth (decomposed limestone) and stalagmite, but also of sand and stones introduced by running water. As pointed out by Prof. H. J. Seymour, all the stones are of local origin, while many of those in the Boulder Clay of the surrounding country have been brought from a long distance. It therefore seems probable that the deposits containing the bones of animals which no longer live in Ireland are pre-Glacial. There is no evidence that the cave was ever occupied by man—indeed, it seems to have been always too damp for human habitation; but, as shown by abundance of remains in the lowest layer of the floor, it was at first frequented by a large variety of the brown bear, and, as equally evident from numerous bones and coprolites in the second layer, it then became a den of spotted hyænas. These animals introduced into the cave an immense number of bones of the reindeer and some young individuals of the mammoth. Among them are also numerous remains of the Scandinavian lemming and a new species related to the Arctic lemming. In later deposits there are bones and teeth of domesticated animals, which have been introduced partly by foxes, partly by accidental falls from above. Dr. R. F. Scharff, who describes the mammalian remains, emphasises the importance of the discovery of the cave hyæna in Ireland, and the interest of the proof that it was a contemporary of the reindeer.

THE classification and study of the anaerobic bacteria of war wounds is the subject of a report by Dr. James McIntosh, published by the Medical Research Committee (Special Report Series, No. 12, 1917). Infection of wounds by this class of organisms has been very common in the present war, and some of the resulting complications, such as gas gangrene, are very dangerous. A good deal of confusion and uncertainty has hitherto existed as to the particular micro-organisms involved on account of the great difficulty of isolating them in pure culture. In the investigations detailed in the present memoir Dr. McIntosh has used elaborate precautions to establish really pure cultures as surface growths. This has been accomplished by the use of palladium-black as a means for obtaining anaerobic conditions—a method elaborated by Dr. McIntosh and Dr. Fildes. Some nineteen types of anaerobic bacteria are fully described, of which seventeen were isolated from wounds. The memoir is illustrated with fifteen plates, and Dr. Fildes contributes an account of the principles involved in anaerobic cultivation. The publication of this valuable and important piece of work is particularly opportune at the present time.

MR. GILBERT ARROW, in the *Entomologists' Monthly Magazine* for January, gives a brief account of the life-history of one of the Coccinellid beetles (*Scymnus capitatus*), including what appears to be the first accurate figure yet published of the larva. "It is interesting to note," he remarks, "that before attaining the fully mature condition the freshly developed beetle passes through stages of pigmentation which are represented in allied species of Scymnus."

A NORTHWARD extension of the range of the purple sea-urchin (*Strongylocentrotus lividus*) is recorded in the *Irish Naturalist* for January by Mr. W. F. Johnson, who gives a brief description of specimens taken from the Island of Inishkeel, Co. Donegal. At Bundoran, where this species occurs in some numbers, it lives in cup-shaped hollows excavated in the surface of the rock. The specimens found at Inishkeel seem in no case to have made similar excavations, from which it is inferred that they have but lately established themselves. Both the purple and the reddish varieties were found.

UNTIL now the white-winged black tern (*Hydrochelidon leucoptera*) has been extremely rare in Australia, but during Easter of 1917 it was found in great numbers along the west coast so far south as Fremantle—a thousand miles south of its normal winter range. It would seem that the birds followed the trail of a dragonfly (*Hemianax papuensis*), which, during this time, was to be seen in myriads. On these the birds were feeding. This occurrence is one of quite peculiar interest, not merely to ornithologists, but also to students of migration generally, who will find an admirable summary of the occurrence in the *Emu* for October last, which has just reached us.

THE Ipswich and District Field Club is fortunate in securing for its Journal (vol. v., for 1916, published November, 1917) a paper by Prof. P. G. H. Boswell, dealing with the Palæozoic floor as revealed by borings in East Anglia. Details of wells and borings for water made in Suffolk since 1906 are appended, as a supplement to those recorded in the Memoirs of the Geological Survey.

THE Summary of Progress of the Geological Survey of Great Britain for 1916 includes details of deep borings made for coal and ironstone near Dover and Folkestone, the cores from which have been in large part examined by the officers of the Survey. Mr. Lamplugh records the details of a boring made at Battle in 1907–8 from near the top of the Wealden Ashdown Sand to the base of the Kimmeridge series, a total depth of 2071 ft. A useful educational section is given, showing our knowledge of the floor of eroded Carboniferous rocks that underlies eastern Kent.

MR. C. A. COTTON, of Wellington, N.Z., contributes to the *American Journal of Science* (vol. xliv., p. 249, 1917) a paper illustrated by numerous diagrams on "Block Mountains in New Zealand." This is in part a summary of his previous work, and is accompanied by an important bibliography. The expository methods of Prof. W. M. Davis are utilised, and fault-scarps, in various stages of maturity, are traced as the margins of block-masses throughout central Otago. The importance of tors as measures of the amount of erosion of a land-surface is usefully pointed out.

SEVERAL changes have been instituted in the Monthly Meteorological Chart of the Atlantic Ocean beginning with the January number for this year. The part which refers to the Mediterranean has been discontinued and replaced by inset maps showing the mean annual rainfall and the mean rainfall of the current month over Nigeria. To the coast line of the great American lakes the results of observations for pressure, air, and sea temperature and currents are added. Among other changes and additions there is a map showing the distribution of specific gravity. The similar monthly chart of the Indian Seas has also undergone some changes, and now includes a large-scale map of the China Sea, showing the distribution of pressure, air, and sea temperature.

THE rainfall of 1917 in the British Isles was about the average, but large areas of deficient rainfall occurred in all parts of the country. According to *Symons's Meteorological Magazine* for January (vol. lii., No. 624) the most important of these areas were in the centre, part of the north, and the south-west of England, all of which had deficiencies of more than 10 per cent. The east midlands of Scotland were also dry, the deficiency exceeding 20 per cent. over an area extending from the Firth of Forth to the Grampians. The southern half of Ireland and the extreme north and the south of Wales had a rainfall below the average. Unusually wet regions included the west and north of Scotland, the north of Ireland, the Yorkshire Wolds, Cardigan Bay, and the London district. August, October, and November showed a general excess of rainfall over the country. May was rather wet in Ireland and June in England, especially locally. February and December were unusually dry, and there was, on the whole, a general deficiency of rainfall during the first seven months of the year.

PART I of vol. xxx. of the Proceedings of the Physical Society of London is exceptionally strong in optical papers. Mr. T. H. Blakesley points out the convenience of representing a simple lens by a point on a plane diagram in which the co-ordinates are the quotients of the two radii of curvatures of the two bounding surfaces by the thickness of the lens at its middle point. Lenses having some particular property are then represented on the diagram by the points on some line which in many cases turns out to be straight. Mr. T. Smith and Miss Dale, of the National Physical Laboratory, show that the mechanically strong triple-cemented objective may with advantage be substituted for the non-cemented doublet of flint and crown glass at present usual in small telescopes. Such triple objectives, it is shown, can be designed with the first-order spherical aberration and coma zero and the second order small, and these conditions do not necessarily limit the lens surfaces to those of small curvature.

WITH reference to the possible risk involved in the use and transportation of celluloid articles, an investigation into the effects of heat upon such articles was carried out by the U.S. Bureau of Standards in 1907. In view of the present interest in nitro-cellulose products it has recently been thought desirable to publish the results, which are now given in Technologic Paper No. 98, issued by the bureau. The chief conclusions arrived at were that when celluloid is exposed to heat, decomposition commences at temperatures in the neighbourhood of 100° C., and above 170° the decomposition takes place with explosive violence. If loss of heat by radiation is prevented, the heat of decomposition at temperatures of about 120° to 135° may raise the temperature of the mass to the ignition point; and momentary contact with bodies having a temperature of 430°—below visible red-heat—may ignite celluloid articles. The rate of combustion was found to be from five to ten times that of paper, pine-wood, or poplar wood of the same dimensions and burning under the same conditions. Nitro-cellulose exists and reacts as such in celluloid, and the rate of its decomposition when heated is not diminished by admixture with zinc oxide (a common ingredient of celluloid products) in proportions up to 20 per cent. There appears to be no good evidence that celluloid articles often inflame spontaneously, or that they are directly explosive under any conditions. The vapours evolved by decomposition are poisonous and extremely combustible, and may be ignited by the heat of decomposition of the celluloid itself. The decomposition is autocatalytic, and while not necessarily explosive, it may readily approach that condition as a limit.

IN the *Journal of Geology*, vol. xxv., p. 629, 1917, Prof. L. V. King, of McGill University, discusses the internal friction and limiting strength of rocks under conditions of stress such as exist within the earth. Taking his data from Adams and Bancroft's experiments on the effect of intense end pressures applied to small rock specimens enclosed in nickel-steel cylindrical jackets, he shows that a simple theoretical treatment of the elastic stage suffices to explain the mode of shearing rupture observed in the rock and the enclosing jackets. His main purpose, however, is to test Navier's modification of Tresca's theory that a stressed solid would commence to flow (without rupture) as soon as the maximum shearing stress exceeded a limiting value K characteristic of the solid; Navier's hypothesis replaced K by $K+\mu N$, where N is the stress normal to the shearing plane, while μ is a coefficient of internal friction. Prof. King concludes, from the work of Adams and Bancroft, that for some kinds of rocks constants K and μ do exist, although the theory does not lead to very accordant values from different sets of experiments. In some cases, while the limit of plasticity certainly increases with the hydrostatic pressure, the internal friction does not seem to be simply proportional to the normal stress; this was particularly so for some of the hardest rocks, such as dolomite, which appear to possess great internal friction. These conclusions have an important bearing on questions of geology and geodynamics. Sir G. Darwin estimated that under the continents of Africa and America the strain must be so great that marble would break under it, though *strong* granite would stand. This was based on the limiting stresses found from ordinary crushing tests, but it now appears that the limiting stress will be much greater at considerable depths, owing to the great hydrostatic pressure. It is suggested that great movements of the earth's crust have mainly proceeded by slow and gradual adjustment, rather than by series of cataclysmal collapses.

In the study of the chemical actions involved in the dissolution of gold by sodium cyanide solutions it is necessary to know the extent of the hydrolysis of the latter, because it has been shown that this is an important factor in the rate of dissolution. An ingenious method for the estimation of the degree of hydrolysis of sodium cyanide solutions has been devised by Messrs. F. P. Worley and V. R. Browne (Chemical Society's Journal for December). A set of three flasks and three test tubes is set up in such a way that a current of air can be aspirated through all six vessels, the flasks alternating with the test-tubes. The latter contain an alkaline solution of sodium picrate; the first flask contains hydrocyanic acid of one concentration, the second the sodium cyanide solution, and the third hydrocyanic acid of a second concentration. The depth of the reddish-brown colour produced in the picrate indicator solution depends on the concentration of hydrogen cyanide vapour in the air current. Consequently, by varying the concentration of the hydrocyanic acid solutions until one is found which gives the same intensity of colour as the sodium cyanide solution, the concentration of hydrocyanic acid which has the same hydrogen cyanide pressure as the sodium cyanide solution is determined. It was shown that the amount of hydrogen cyanide removed from solution is too small to affect the degree of hydrolysis, and that the whole of the vapour was absorbed by one tube of picrate solution.

Messrs. W. O. Robinson, L. A. Steinkoenig, and C. F. Miller have analysed the ashes of a large number of legumes, vegetables, grasses, trees, and bushes to determine whether the rare elements which have been found in certain soils occur in plants which have been grown on those soils. The results, together with analyses of the soils in question, are published in Bulletin No. 600 of the U.S. Department of Agriculture. Spectroscopic quantities of lithium were found in all the plants examined, and rubidium was present in the majority of cases, the quantity of it being larger than that of other rare alkalis. But plants containing 0·01 per cent. or more of rubidium oxide had been grown on soil in which rare alkali minerals are known to occur. Cæsium was detected in the ashes of timothy grass from Mount Mica, Paris, Me., the red raspberry from Beryl Mountain, Acworth, N.H., and the beets from Marlboro, N.H. Cæsium beryls have been found in the first two of these localities. Molybdenum was never detected; chromium and vanadium were occasionally found, though only in traces. Determinable amounts of barium were found in the ash of all the plants examined, and strontium in all except bean seeds. Very small quantities of titanium were present in the ash of all the plants. All the plant ashes analysed, except two, contained aluminium. Pine needles contain an exceptionally high amount of the latter element. The larger the amount of rubidium and cæsium, but not of lithium, present in the soil, the more is absorbed by the plant. There is no evidence that vanadium replaces phosphorus (as phosphoric acid) in its functions in the plant. The authors conclude that of the elements determined none need be considered in fertiliser practice except those commonly used, and sulphur, chlorine, and manganese in some cases. The appendix to the bulletin contains a detailed account of the analytical methods employed.

Messrs. H. Sotheran and Co., 140 Strand, have just issued a catalogue (No. 770) of rare and standard books on exact and applied science, which is of exceptional interest and value. It includes the scientific portion of the library of the late Lord Justice Stirling, and selections from the collections of George Rennie, F.R.S., Samuel Roberts, F.R.S., and other men of science, and gives particulars of a large number of very scarce works. The list is particularly strong in sets of journals of scientific societies. Among many rare volumes we notice the following:—The first edition of the *Opus Majus* of Roger Bacon; the Edizione Nazionale of Galileo's works; Borgo's "Libro de Abacho" (the first edition of the first printed treatise on arithmetic); the first Continental edition of Napier's "Logarithmorum Canonis Descriptio," etc.; the first edition of Gilbert's "De Magnete, Magneticisque Corporibus, et de Magno Magnete Tellure, etc."; the first octavo edition of Newton's "Opticks," with MS. additions and corrections in Sir Isaac Newton's handwriting; and Dalton's "New System of Chemical Philosophy," complete. The catalogue is published at 2*s*. 6*d*. net.

OUR ASTRONOMICAL COLUMN.

Galactic Co-ordinates.—An interesting article on the galactic circle as a plane of reference for star places is contributed to the February number of *Scientia* by Dr. A. C. D. Crommelin. Following a comparison of the more familiar systems of co-ordinates, it is explained that catalogues of stars giving positions with respect to a plane which is independent of the earth's motions would have the great advantage that they would not get out of date as our present catalogues do, as only small corrections for proper motion would be required. The most obvious circle of reference is that provided by the Galaxy, for almost every feature either of distribution or of motion of the various classes of stars is based on the Galaxy as a plane of symmetry. It is difficult to give precision to the definition of the galactic circle, but from a consideration of eight determinations, Dr. Crommelin suggests that the adopted position of the north galactic pole, for the equinox of 1900, should be R.A. 12h. 42m. 37s., decl. $+27^\circ\ 32'$. It is further suggested that an actual star should be selected to mark the zero of galactic longitude, say α Cygni, which has an extremely small proper motion. The general adoption of some such scheme has been widely advocated, and will doubtless sooner or later be realised.

Molecular Scattering of Light.—In a paper communicated to the Astronomical Society of France (*L'Astronomie,* January), Prof. Ch. Fabry gives an account of Lord Rayleigh's explanation of the blue coloration of the sky, and announces that the theory has been experimentally verified in his laboratory at Marseilles by M. Cabannes. Prof. Fabry suggests that several hitherto mysterious phenomena in the heavens may possibly be explained as effects of this scattering of light by gaseous molecules. In the case of the solar corona, for example, the portion of the luminosity which gives a continuous spectrum does not necessarily imply the presence of solid or liquid particles, but may be attributed to the diffusion of photospheric light by molecules of truly gaseous coronal matter. A density of only one-thousand-millionth part of that of atmospheric air would suffice to account for the observed intensity of the coronal light, and the polarisation of the light would be simply explained, as in the case of the light of the sky. A part of the luminosity of the tails of comets may be explained in a similar manner, and in this case the density must be less than one milligram per 1000 cubic metres, as otherwise the luminosity would be greater than any which has ever been observed. Other possible effects of molecular scattering are also suggested. It may be added that Prof. R. J. Strutt has also succeeded in observing the scattering of light by dust-free air in a laboratory experiment with artificial illumination (Nature, October 25, 1917).

LEEDS ASTRONOMICAL SOCIETY.—The Journal and Transactions of this society for the year 1916 has been received. The number of members was fifty-two, and in view of the prevailing conditions, an average attendance of fourteen may be taken as an indication that the meetings continued to be interesting and helpful. Numerous observations of interest are recorded, and among the contributed papers, one by the Rev. I. Carr-Gregg on "The Invisible Universe," and another on "Sir William Herschel," by Miss C. A. Barbour, call for special mention. The editor is Mr. C. T. Whitmell, who has also made numerous contributions.

WAVE-LENGTHS OF HELIUM LINES.

ON account of its great intensity and the convenient distribution of the lines, the spectrum of helium furnishes a valuable source of standard wave-lengths in spectroscopic and optical work. A new series of determinations of the wave-lengths of the brighter lines which has been made by Mr. P. W. Merrill at the U.S. Bureau of Standards, Washington (*Astrophysical Journal*, vol. xlvi., p. 357, December, 1917), will therefore be generally welcomed. The highest possible precision has been aimed at, and as lines belonging to all the six series which constitute the spectrum of helium were included in the measurements, the new wave-lengths will also provide valuable data for computations of theoretical interest.

An interferometer of the Fabry and Perot type was used, and nine of the lines were compared directly with the fundamental standard—the red line of cadmium—by photographing the helium and cadmium spectra simultaneously on the same plate. Other wave-lengths were then determined from photographs of the helium spectrum alone. The adopted values for the twenty-one lines measured are given in the appended table, which also includes the values given by previous observers. The values given by Lord Rayleigh (two sets) and Eversheim were derived from interferometer observations, but those by Runge and Paschen were determined in the more usual way from grating photographs; the latter have been corrected from Rowland's scale to the international scale in order to make them directly comparable with the other values.

Wave-lengths of Helium Lines (in I.A.).

Bureau of Standards	Rayleigh		Eversheim	Runge and Paschen
	a	*b*		
2945·104				106
3187·743				701
3613·641				641
3705·003				007
3819·606				605
3888·646				638
3964·727				727
4026·189				192
4120·812				821
4143·759				766
4387·928				934
4437·549				549
4471·477	(478)	480	493	475
4713·143	(171)	142	154	074
4921·929	925	928	922	919
5015·675	680	678	683	556
5047·736				641
5875·618	616	623	639	650
6678·149	144	147	151	14
7065·188	189	197	207	22
7281·349				53

In the case of double lines the wave-lengths are those of the stronger components. From the general agreement of individual determinations it is considered probable that the error is in no case so much as 0·003 A., and that in most cases the errors are smaller than that amount. It is shown that the Kayser and Runge formula for spectral series, based upon three consecutive lines, will not reproduce accurately even the next member in any one of the six helium series.

THE CORAL-REEF PROBLEM.

FROM time to time recent work on the topography of coral-reefs has been referred to in NATURE, and the existence of submarine platforms from which atolls and encircling reefs rise has been very generally demonstrated. Prof. R. A. Daly regards these platforms as wave-cut plains, produced from coral banks and volcanic isles when the level of oceanic waters was lowered by ice-accumulation in Glacial times. The melting of the ice caused a general submergence of the platforms and of the adjacent coasts, giving rise to drowned valleys and all the features that have been attributed to a subsidence of the ocean-floor. The existing coral-reefs are thus for him post-Glacial, and grew up on the submerged platforms when warmer conditions were renewed.

In a summary of his views in *Scientia* (vol. xxii., p. 188, 1917) Daly points out that flat, reefless banks occur "in every ocean, inside and outside the tropical belt . . . covered with 45 to 100 metres of water." He urges that the inner walls of reefs are not well graded to the floors of the lagoons, and that the upper wall thus indicates a rise of water-level (whether we attribute it to flooding or subsidence) since the formation of the level inner floor. He believes that this floor is part of the platform, and is not due to infilling, though it is not clear why he should demand "millions of years" for such deposition within the wall (compare also his paper on "A New Test of the Subsidence Theory of Coral Reefs," Proc. Nat. Acad. Sci., vol. ii., p. 664, 1916). He holds that "the mean depths of water above the flat floors of wide lagoons are nearly equal to the mean depths found on reefless banks," and that there is a close similarity of depth in the greater lagoons throughout the reef areas of the Pacific and Indian Oceans. Daly regards the reefs as "peripheral growths on wave-cut platforms," those nearer the centres of the platforms having been extinguished by mud and sand swept over the shoals.

On the other hand, Prof. W. M. Davis, in a series of critical papers, based on a recent visit to the Pacific isles, has greatly strengthened the Darwinian view. Thanks largely to his reasoning, even those who cannot find evidence for a general subsidence of ocean-floors are inclined to invoke block-faulting to explain the drowning of certain areas. Davis ("A Shaler Memorial Study of Coral Reefs," *Amer. Journ. Sci.*, vol. xl., p. 223, 1915) urges that if the lagoon floor is part of a wave-eroded plain from which the reefs rise, the sea would have cut cliffs in the surviving volcanic isles, the tops of which should appear as truncations of the spurs that bound the subsequently drowned valleys. Such cliffs occur in Tahiti ("Clift Islands in the Coral Seas," Proc. Nat. Acad. Sci., vol. ii., p. 284, 1916), but are very exceptional features. Davis regards them as emphasising the general absence of cliffs, even if they "are the work of abrasion during the lowered sea-stands of the Glacial period" ("Problems Associated with the Study of Coral-Reefs," *Sci. Monthly*, vol. ii., p. 564).

Davis, in his three papers in the *Scientific Monthly* (1915) and elsewhere, lays stress on the mature forms of the valleys in the reef-encircled isles as indications of their antiquity. These valleys cannot have been deepened and widened to their present condition during the relatively short epoch of glacially lowered sea-level. The embayed shores, first used by J. D. Dana as a confirmation of Darwin's subsidence-theory, have none of the characters of recently dissected land. Another point firmly brought forward is the unconformity between the reefs and the floor from which they have grown upward. That floor may be seen, for instance, beneath elevated fringing reefs in the New Hebrides. It has, at some epoch, been subject, not to marine planing, but to subaerial denudation. At Havannah harbour in Efate it must have stood above the sea before the corals grew. The joint evidence of the drowned valleys with their mature forms and of the unconformity of the reefs on an old land-surface points very strongly in favour of Darwin's views. Efate and Oahu in the Hawaiian Islands furnish instances of oscillatory movements, and some authors have held these to be incompatible with a broad system of subsidence. Davis justly styles this objection as "the most singular of all." Finally, the inequality of the depths to which drowning has taken place in adjacent regions is a powerful argument against ascribing the submergence to an increase of water in the sea. Davis, with characteristic width of outlook, believes that "some combination of regional subsidence with Glacial changes of sea-level—or with changes of sea-level caused by movements of the sea-bottom—is worthy of careful consideration as being probably nearer the truth than either process taken alone." But his reasoned conclusion is that subsidence has played by far the greater part.

In a still more recent paper Davis deals with the Queensland platform ("The Great Barrier Reef of Australia," *Amer. Journ. Sci.*, vol. xliv., p. 339, 1917), which he believes to be due in large measure to coral-reef agencies, which produced a mature reef-plain before the subsidence occurred that gave rise to the present barrier reef and the embayment of the coast.

GRENVILLE A. J. COLE.

A BACTERIAL DISEASE OF CITRUS.

DR. ETHEL DOIDGE, mycologist to the Department of Agriculture of the Union of South Africa, who is becoming well known for her researches into the bacterial diseases of plants, is to be congratulated on the excellent piece of work which is described in detail in an article on "A Bacterial Spot of Citrus."[1] At a time when research in phytopathology is largely at a standstill, it is refreshing to read of such ably conducted scientific investigations in our Colonies as these are.

The citrus "spot" is a disease of economic importance in the citrus orchards of the Western Province of the Cape, and attacks not only the fruit, but also the leaf and the branch of the tree. The fruit is disfigured and ultimately destroyed, while the attacks on the tissues of the stem cause very commonly gummosis in the spring.

The cause of the disease was ascertained to be a species of Bacillus new to science, *B. citrimaculans*. A comparative table is given of the characters of this and the two organisms known to attack the citrus in America, viz. *Bacterium citriputeale* and *Pseudomonas citri*. The description of *B. citrimaculans* given by the author, together with its full "group number," may be held up as a model to be followed by workers in this field. The opinion is expressed that very probably the organism is a soil bacillus, which first invaded rotting fruits lying on the ground, and has now taken on a parasitic habit. The organism loses its virulence rather rapidly when cultivated on artificial media. The most frequent method of infection is through wounds, and the author considers the possibility of stomatal infection an open question at present. While preventive measures are not discussed, it is pointed out that any improvement in the sanitation of the affected orchards would doubtless prove beneficial. Since it was found that the organism is very sensitive to copper sulphate, it is suggested that spraying with Bordeaux mixture should be tried.

E. S. S.

[1] *Annals of Applied Biology*, vol. iii., January, 1917, pp. 53–81, with 10 plates.

THE FLORA OF THE SOMME BATTLEFIELD.[1]

THE ground over which the Battle of the Somme was fought in the late summer and autumn of 1916 rises gradually towards Bapaume, and at the same time is gently undulating, with some well-marked branching valleys initiating the drainage system of the area. Before the war the land was for the most part under cultivation, but on the highest levels there were large areas of woodland, such as High Wood and Delville Wood, now shattered and destroyed.

During last winter and spring all this country was a dreary waste of mud and water, the shell-holes being so well puddled that the water has remained in them, and even in the height of the summer there were innumerable ponds, more or less permanent, in every direction.[2]

The underlying rock is everywhere chalk with a covering of loam of varying thickness. As a result of the bombardment the old surface soil has been scattered and the chalk partially exposed. One effect of the shelling, however, has been to disintegrate the underlying chalk and produce a weathering effect which has been accentuated by the winter rains, snow, and frost. A general mixing of chalk, subsoil, and scattered top soil and also a rounding of the sharp edges have taken place, so that instead of the new surface soil being sterile, the shelling and weathering have "cultivated" the land. That this is so is proved by the appearance of the Somme battlefield during the past summer.

Looking over the devastated country from the Bapaume Road, one saw only a vast expanse of weeds of cultivation which so completely covered the ground and dominated the landscape that all appeared to be a level surface. In July poppies predominated, and the sheet of colour, as far as the eye could see, was superb; a blaze of scarlet unbroken by tree or hedgerow. Here and there long stretches of chamomile (*Matricaria chamomilla*, L.) broke into the prevailing red and monopolised some acres, and large patches of yellow charlock were also conspicuous, but in the general effect no other plants were noticeable, though a closer inspection revealed the presence of most of the common weeds of cultivation, a list of which is given below.

Charlock not only occurred in broad patches, but was also fairly uniformly distributed, though masked by the taller poppies. Numerous small patches were, however, conspicuous, and these usually marked the more recently dug graves of men buried where they had fallen. No more moving sight can be imagined than this great expanse of open country gorgeous in its display of colour, dotted over with the half-hidden white crosses of the dead.

In all the woods where the fighting was most severe not a tree is left alive, and the trunks which still stand

[1] Abridged from an article by Capt. A. W. Hill, Assistant Director, Royal Botanic Gardens, Kew, in the *Kew Bulletin of Miscellaneous Information*, Nos. 9 and 10, 1917, by permission of the Controller of H.M. Stationery Office.

[2] For a description of the battlefield shortly after the fighting Mr. John Masefield's recently published book, "The Old Front Line" (Wm. Heinemann), should be read.

are riddled with shrapnel and bullets and torn by fragments of shell, while here and there unexploded shells may still be seen embedded in the stems. Aveluy Wood, however, affords another example of the effort being made by Nature to beautify the general scene of desolation. Here some of the trees are still alive, though badly broken, but the ground beneath is covered with a dense growth of the rose-bay willow herb (*Epilobium angustifolium*) extending over several acres. Seen from across the valley, this great sheet of rosy-pink was a most striking object, and the shattered and broken trees rising out of it looked less forlorn than elsewhere.

The innumerable shell-hole ponds present many interesting features to the biologist. In July they were half-full of water, and abounded in water beetles and other familiar pond creatures, with dragonflies flitting around. In nearly every shell-hole examined, just above the water-level, was a band of the annual rush (*Juncus bufonius*, var. *gracilis*), and this plant appeared to be confined to those zones where the ground was relatively moist, and to occur nowhere else. With the Juncus, and often growing out of the water, were stout plants of *Polygonum persicaria*, and water grasses, not in flower, were often seen spreading their leaves over the surface of the pools.

In the battlefield area not only were the common cornfield weeds to be seen, but here and there patches of oats and barley, and occasionally plants of wheat, sometimes apparently definitely sown, perhaps by the Germans, though more often the plants must have grown from self-sown seeds of crops that were on the land before the war. Here and there, too, could be seen opium poppies representing former cultivation and remnants of battered currant and other bushes which alone remained to show where once had been a cottage garden. Both weeds and corn afford good evidence that the soil has not been rendered sterile by the heavy shelling, but how and when the land can be brought into a fit state for cultivation are questions not easily answered.

On the banks and sides of the roads traces of the old permanent flora still remain, and perennial plants, such as *Scabiosa arvensis*, *Eryngium campestre*, *Galium verum*, chiccry, *Centaurea scabiosa*, *Cnicus acaulis*, and other characteristic chalk plants were occasionally seen.

The clothing of this large tract of country with such a mass of vegetation composed almost entirely of common annual cornfield weeds is remarkable when one remembers that it has been the seat of encampments, and for the most part out of cultivation since the autumn of 1914. It is well-nigh impossible that such masses of seed can have been carried by wind or birds to cover these thousands of acres, and the plants must therefore have grown from seed lying dormant in the ground. No doubt in the ordinary operations of ploughing and tilling of the ground in years before the war much seed was buried which has been brought to the surface by the shelling of the ground and subsequent weathering. In this connection the presence of charlock on the more recently dug graves, where the chalk now forms the actual surface, is of interest, since it adds further proof of the longevity of this seed when well buried in the soil.

List of Plants.

Delphinium Ajacis, Reichb., larkspur; *Papaver Rhoeas*, L., poppy; *Fumaria officinalis*, L., fumitory; *Raphanus Raphanistrum*, L., white charlock; *Brassica sinapis*, Vis., yellow charlock; *Matricaria chamomilla*, L., chamomile; *Centaurea cyanus*, L., cornflower; *Cnicus arvensis*, Hoffm., thistle; *Sonchus arvensis*, L., corn sowthistle; *Sonchus oleraceus*, L., sowthistle; *Specularia speculum*, A. DC., looking-glass flower; *Anagallis arvensis*, L., scarlet pimpernel; *Myosotis arvensis*, Hoffm., forget-me-not; *Convolvulus arvensis*, L., small bindweed; *Solanum nigrum*, L., nightshade; *Plantago major*, L., etc., plantain; *Veronica hederaefolia*, L., etc., speedwell; *Galeopsis ladanum*, L., hemp-nettle; *Chenopodium album*, L., goosefoot; *Atriplex patula*, L., orache; *Polygonum aviculare*, L., knotgrass; *Polygonum persicaria*, L., persicaria; *Rumex obtusifolius*, L., dock; *Euphorbia helioscopia*, L., sun spurge; *Mercurialis annua*, L., dog's mercury; *Juncus bufonius*, L., var. *gracilis*, St. Amand rush. A few grasses and occasional plants or patches of oats, barley, and wheat.

COAL CONSERVATION AND ELECTRIC POWER SUPPLY.

WE referred in our issue of January 3 to the interim report on electric power supply in Great Britain prepared by the Coal Conservation Sub-Committee of the Reconstruction Committee. Dr. C. Addison, Minister of Reconstruction, states in an introductory note that the important issues affecting municipalities and public bodies raised in the report will be explored in all respects by the Government before any action is proposed to Parliament upon the subject.

The report deals, first, with the extent to which conservation of coal could effect economy in the production of motive power and other forms of energy used for industrial purposes in this country; secondly, with the expansion of industry which should result, in the way of new manufactures, from the proper use of the coal so saved; and thirdly, with the steps necessary to attain these objects.

It contains many valuable tables and other details, and the following summary of the chief points dealt with and the conclusions arrived at:—

(1) The coal consumption involved in the production of motive power in the United Kingdom amounts at the present time to 80,000,000 tons per annum, equivalent in value to, say, 40,000,000*l.* at pit-head.

(2) In the industrial reorganisation which must take place on the termination of the war the further development of power is of great importance. The present use of motive power per employee is only about half that in the United States of America. Large quantities of electrical power will be required for the development and carrying on of new processes not at present undertaken in this country. Processes involving some millions of horse-power at present worked in America, Norway and Sweden, Germany, etc., can be profitably carried on, and, having in view the desirability of making all essential products in the Empire, should be carried on in this country.

(3) It is only by largely increasing the amount of power used in industry (by two or more times) that the average output per head (and as a consequence the wages of the individual) can be increased. The pre-war earning power, or wages, of each individual was far too low.

(4) Power may be most efficiently applied to industry by the medium of electricity.

(5) The economical generation of the electrical energy so required is thus of great importance, and the first question to be answered is whether the best economy can be obtained by each works or municipal area providing for its own individual needs, or by a comprehensive scheme.

(6) Technically and economically the electrical energy can be best provided by a comprehensive system, as may be amply proved from experience gained in those

parts of the world where such systems are in existence, notably in Chicago (Illinois), on the north-east coast of England, on the Rand, and in certain industrial districts of Germany. Power production in large super-plants, with generating machines of 50,000 h.p. or more, will not only be far more economical than in a large number of smaller plants, but will also ultimately involve great economies of capital by securing a better load and a more effective use of the plant. Such super-plants, if suitably situated on large sites, would make it possible—so far as it was economical to do so—to extract the by-products in the shape of oils, motor spirit, etc., from the coal before using it as fuel, thus avoiding to a large extent the necessity of importing them.

(7) The super-plants would feed into the main trunk distribution system, which must be laid down throughout the country. For this purpose the country should be divided into some sixteen districts, throughout each of which there should be a standard periodicity and main trunk voltage.

(8) This main trunk distribution system would collect any waste power available wherever situated and deliver it where it could be profitably used. It would also, by saving the cost of transport, make it commercially possible to bring to the surface much coal at present wasted and left in the pit which, under the new conditions, would be turned into electrical energy at or near the pit-head.

(9) If power supply in the United Kingdom were dealt with on comprehensive lines and advantage taken of the most modern engineering development, the saving in coal throughout the country would, in the near future, amount to 55,000,000 tons per annum on the present output of manufactured products.

(10) If the coal so saved were used for the production of further power it would be possible to generate continuously not fewer than 15,000,000 horse-power, which would more than compensate for the absence of large water powers in this country and admit of the manufacture here of many products which are at present made only in America and on the Continent.

(11) The development of such a power system may be likened to the development of the railways of a country, and it is just as impossible to secure economical power generation and supply by each municipal area working independently, which is the position to-day, as it would be to have an efficient railway system if each municipal area owned its own lines, and long-distance transport were provided for by running-power agreements. History shows that in the early stages of railway development in this country exactly the same process of amalgamation had to be gone through.

(12) The present system of electrical power distribution throughout the country, which is undertaken by more than 600 authorities in as many separate districts, is technically wrong and commercially uneconomical. The present average size of a generating station is only 5000 horse-power, or about one-fourth of what should now be the smallest generating machine in the power station. The "Power Act" legislation inaugurated some fifteen years ago has not had the desired result on account of the restrictions imposed upon the power companies.

(13) A national system of electric power supply would greatly facilitate the electrification of railways with its attendant advantages, save large sums of money at present spent on the transport and distribution of coal, and bring within reach of the community as a whole the great benefits of an increase in the use of electricity for domestic purposes, advantages which, taken together, are perhaps of more value than the direct coal-saving.

PHYSICAL SCIENCE AND THE ART OF EXPERIMENT.[1]

THE exigencies of the war had seriously impeded the work of the Physical Society, as of all our scientific institutions. Many members were at the front; many others were busy on war work, and there was little time available for normal scientific pursuits. Since his predecessor's address, the scientific community had been stirred to an extent which he thought was unnecessary by the passing of the Daylight Saving Act. Scientifically the thing was a sham, and as such was naturally distasteful to us; but the community at large was not scientific, and had a very vague notion of the meaning of time. In the stress of war people had realised the desirability of starting the day earlier to save, not daylight, but paraffin and gas, and the simple operation of putting all the clocks wrong, though hateful in principle, did not disturb the public at all.

In reference to the question of the metric system, this was important in relation to education. The reason why English schools were so backward in mathematics was that so much of the available time had to be devoted to memorising tables of weights and measures and similar medieval relics.

Another matter of public importance was the recognition of science as an element of general education. It is sometimes urged that our officials need not be scientific, because they can get all the scientific advice they want. But they may not know when they require it, or appreciate the force of it when they get it. He might instance in this connection the wasteful method of street darkening which still prevails after three years. The annual trouble with frozen water pipes was another example of the general ignorance of scientific principles. Burst pipes were unknown in really cold countries, where the elements of common sense were allowed to prevail.

All his own contributions to physical science had been experimental, and some words on the art of experiment might not be out of place. In order to succeed as an experimentalist it was necessary to find by personal experience how as many materials as possible behave under as many conditions as possible, and this can only be done by one who will practise every art and use every tool and instrument that he can. While endeavouring at first to imitate the practices of the professional mechanic and acquire as much of his skill as possible, the experimentalist must not be bound by tradition and custom in his methods. It is the slavery to tradition and practice that makes the assistance of the professional so tiresome to the experimentalist. In this connection a saying of Fresnel had greatly impressed him—"If you cannot saw with a file and file with a saw you will be no use as an experimentalist," or words to that effect. He had made it his business to use every tool and to handle every material that he could. On one occasion he had had the somewhat rare opportunity of handling five or six large uncut diamonds, each as big as a walnut. Glass-blowers are familiar with the difference in the contact of freshly blown bulbs and of bulbs some time blown; but the contact of diamonds was unlike either. When brought lightly into contact they emit a curious squeaking note of possibly 2000 vibrations per second. This meant that the diamonds were bouncing with slowly diminishing excursions of 1/80,000 of an inch approximately, a phenomenon only possible with a material of such perfect elasticity or hardness. It was possible that a test of this kind might be useful for discriminating between the hardness of the harder materials. The whole question of what hardness was, and if, indeed, it were really

[1] Abstract of the presidential address delivered to the Physical Society January 25 by Prof. C. V. Boys, F.R.S.

a definable quantity having definite dimensions, was one to which the attention of physicists could profitably be devoted. Another such question was that of the oiliness of lubricants. This appeared to depend on something other than viscosity. Animal and vegetable oils lubricated better than mineral oils of the same viscosity.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. W. BOXWELL has been elected professor of pathology and bacteriology in the schools of surgery of the Royal College of Surgeons in Ireland.

A RESEARCH scholarship in mental affections has been instituted at the Western Asylums' Research Institute, Glasgow. Its annual value will be 250*l.*, but no appointment will be made during the war.

THE Board of Education announces, in Circular 1026 of February 5, that after this year it will discontinue to hold its general examinations in science and technology. The higher general examinations will be held this year for the last time, and will be conducted in accordance with the "Regulations and Syllabuses for Examinations in Science and Technology, 1915," so far as they are still applicable. This intention to discontinue these general examinations was announced in the prefatory note to the 1915 regulations, and the decision was arrived at after consultation with representative educational and administrative bodies directly interested in the examinations. The present announcement marks the final stage in the gradual elimination of the personal examination of students in its classes by the Board. In 1912 the old elementary stage examinations in science, instituted by the now defunct Science and Art Department, were discontinued, and lower and higher examinations took the place of elementary, advanced, and honours stages. In 1909 the special examinations, which had for many years been held for young students attending day classes in science, were discontinued, as for some years the number of papers worked at day examinations had steadily diminished as the conditions of work in secondary schools improved. It is reasonable to hope that the abolition of these official examinations will strengthen the development of initiative of local education authorities and encourage them to promote schemes of instruction designed to meet local requirements.

THE main measure to be brought forward in the eighth session of the present Parliament, opened by the King on Tuesday, is the Education (No. 2) Bill. The British Science Guild has just circulated a memorandum in which cordial approval is expressed of the provision made in the Bill for the following:—(1) The general development and organisation of all forms of education other than elementary; (2) practical instruction for all elementary-school children, provided that such teaching does not involve direct instruction for a trade; (3) continuation schools and compulsory attendance thereat for 320 hours per annum; (4) co-operation of local education authorities, particularly by means of the formation of federations, chiefly because many local education authorities are obviously unable to deal adequately with higher education, *e.g.* university and higher technological work and the training of teachers; (5) the removal of the 2*d.* rate limit for higher education in county areas; (6) abolition of exemption from attendance at school between the ages of five and fourteen; (7) further restrictions as to employment of children; (8) school holiday camps, centres for physical training, playing-fields, school baths, school swimming-baths, etc.; (9) the extension to secondary schools and other provided schools of the powers and duties of local education authorities respecting medical supervision and treatment; (10) aiding teachers and students in carrying on research; (11) the collection of information respecting schools and educational institutions not in receipt of grants from the Board of Education. The British Science Guild recommends that provision be also made in the Bill (*a*) to compel local education authorities to provide nursery schools in those districts where the Board of Education deems such schools necessary; (*b*) for the inspection, by an approved authority, of all schools not now liable to inspection, whether a request for inspection is made by the school authorities or not; (*c*) for the adequate registration of all schools and other educational institutions.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 31.—Sir J. J. Thomson, president, in the chair.—A. **Mallock**: The growth of trees. An account is given of some recent observations of the growth of trees. The observations consisted in the measurement, at short intervals of time, of the variation of the girth of the trees at a height of 4 ft. or 5 ft. above the ground. The measures were made by an "interference" method, which is described. The results showed a well-marked daily period in the variation of girth, different for different species of tree, but in all cases having a maximum at night and a minimum shortly after noon. Diagrams of sets of observations, each extending over several days, are included, showing the growth of a black poplar, an oak, and a Douglas fir. From twenty to thirty readings were taken in the course of each twenty-four hours.—Prof. B. **Moore** and T. A. **Webster**: Action of light rays on organic compounds and the photosynthesis of organic from inorganic compounds in presence of inorganic colloids. The results are recorded under three sections:—(*a*) Photosynthesis by inorganic transformers; (*b*) action of sunlight and of ultra-violet light upon concentrated solutions of formaldehyde; (*c*) the general formation of formaldehyde by the action of light upon organic substances of biochemical origin. In the concluding section a general reversible reaction is described as a result of which formaldehyde rises in all intense reactions of light upon substances of biochemical origin. This reaction in presence of excess of light is an interesting reversal of the process by which all organic matter has been built up from inorganic sources. The bearing of this process upon the germicidal action of sunlight, and upon the destruction of living organisms by ultra-violet light, is discussed, and it is pointed out that the simple organic products so formed are incompatible with the life-processes of living organisms and so lead to their destruction. Taking such a reaction as travelling in the reverse direction, it is shown that the building up of organic matter from inorganic must have been a necessary precedent to any existence of living organisms on the earth, and that all accumulations of reduced substances possessing stores of chemical energy must have arisen in this manner from storage of the energy of sunlight.—Capt. W. J. **Tulloch**: The isolation and serological differentiation of *Bacillus tetani*. (1) More than one variety of non-toxic endosporing bacillus resembling *B. tetani* in morphological characters can be recovered from wound-exudates in cases of the disease. (2) There are at least three different types of toxic *B. tetani*. (3) The "U.S.A. type" of the bacillus—that commonly used for the preparation of antitoxin—is not frequently obtained from wound-exudates in cases of the disease occurring among men who have received prophylactic inoculations of antitetanic serum. (4) Culture in a selective medium, followed by agglutination of the washed growth, in presence of the three-type sera, gives valuable information. It is, however, apparently not so delicate a test for the presence of *B. tetani* as is animal inoculation after culture of the wound-exudate.—Dr. J. **Brownlee**: An investigation into the periodicity of measles epidemics in the different districts of London for the years 1890–1912. In a previous paper it was found that during the years investigated the chief epidemic periodicities were respectively 87, 97, 109½, and 114 weeks, the most marked period being that of 97 weeks. It is found now that the epidemic with the 87 weeks' period occurs solely south of the Thames, where it is a very marked phenomenon; that the epidemic with the 97 weeks' period, while very marked in the whole of London, is especially marked in the western district; that the epidemic with the 109½ weeks' period is present throughout London with the exception of the east, but is most marked in the western districts; while that with the 114 weeks' period is most marked in the central districts and least present in the eastern districts. The most important fact found, however, is that the epidemics of different periods have special phenomena of their own. In the case of the chief period, that of 97 weeks, the epidemic practically breaks out synchronously in the whole city. In the case of the epidemic with the 87 weeks' period a quite different phenomenon is found, the permanent seat of this epidemic being St. Saviour's or Bermondsey, whence the disease spreads to the neighbouring districts. With regard to the period 109½ weeks, there is evidence that, in both, the conditions just described exist, this epidemic breaking out synchronously in several districts and extending from these to neighbouring districts.

Röntgen Society, February 5.—Capt. G. W. C. Kaye, president, in the chair.—Dr. G. B. **Batten**: A simple method of obtaining "static currents" from an induction coil. One pole of the secondary winding is earthed, while the other is connected, through a series spark-gap and a series condenser, to the patient, who is insulated from earth. The function of the condenser is that of a high resistance, and the apparatus is most effective when employed with the old type of coil with a long and fine secondary winding. The main advantages of the apparatus are that the method is not affected by a damp atmosphere, and its cost is small. Suitable adjustment of the spark-gaps enables any of the six usual methods of application of static electricity to be given.—E. E. **Burnside**: A mobile Snook apparatus. This is constructed on the same principle as the larger pattern hitherto in use, but is made in a more compact form by reducing the maximum spark-gap to 7 in. Mr. Burnside also showed a small transformer constructed for employing the continuous-current main supply to heat the spiral of the Coolidge tube. A small rotary converter changes the direct current into alternating current, which is stepped down to 12 volts by the static transformer. The secondary is well insulated from the rest of the apparatus, and regulation of the filament current is obtained by a variable choke-coil in the primary circuit of the transformer.

MANCHESTER.

Literary and Philosophical Society, February 5.—Mr. W. Thomson, president, in the chair.—Capt. L. **Munn**: Ancient mines and megaliths in Hyderabad. During his thirteen years' experience as Inspector of Mines to the State of Hyderabad, Capt. Munn discovered large numbers of ancient gold and copper mines, many of them of great depth and extent, of which no remembrance has persisted among the people. These mines, as well as the old diamond pits, show the association with megalithic monuments to which Perry directed the attention of the society two years ago; but Capt. Munn's discoveries are of peculiar importance, because Perry was not aware of the presence of ancient gold mines in Hyderabad, although he attached primary importance to gold as the chief attraction of the megalith-builders in other parts of the world. Capt. Munn also discussed the interesting problem of the ancient iron and steel workings in Hyderabad.—Prof. G. Elliot **Smith**: The origin of early Siberian civilisation. At least as early as 3000 B.C. the people who developed Sumerian and Elamite civilisations at the head of the Persian Gulf were already exploiting the country east of the Caspian for copper, and probably turquoise and jade also. It is highly probable that somewhere in the neighbourhood of Meshed the art of making bronze was discovered. The earliest prospectors came from the shores of the Persian Gulf, and had already credited pearls with certain remarkable magical properties. The fact that the special appreciation of jade by the Chinese is due to the mineral being credited with the same powers of life-giving, birth-promoting, corpse-preserving, and luck-bringing as the pearl acquired on the shores of the Erythræan Sea affords conclusive evidence that the incentive to work jade did not originate in China, as Laufer believes, but came from the Khotan-Kashgar region, where the mineral acquired its peculiar virtues by transference from the pearl, the legends concerning which were brought to Turkestan by miners from the south. The inspiration of the early civilisations of both Central Asia and China came directly from Turkestan, which in turn was influenced early in the third millennium B.C. by miners from the Erythræan coasts exploiting its gold and copper and its precious stones. Some centuries later, when bronze came into use, the deposits of tin in Transcaspiana probably attracted men from all parts of the then civilised world; and the effect of this was that to the Babylonian influence in Turkestan and Central Asia was added that of the Mediterranean area.

PETROGRAD.

Academy of Sciences, December, 1917.—V. I. **Palladin**: The influence of wounds on plant respiration.—V. I. **Pavlov**: Investigations on the luminescence of mercury vapour under the action of low-velocity electrons.—N. A. **Abramenko**: Sugar-beet cultivation by the peasants of the Governments of Poland.

BOOKS RECEIVED.

Memento Oppermann à l'Usage des Ingénieurs, etc. Pp. 268. (Paris and Liège: Ch. Béranger.) 6 francs.

The Wonders of Instinct. By J. H. Fabre. Translated by A. Teixeira de Mattos and B. Miall. Pp. 320. (London: T. Fisher Unwin, Ltd.) 10*s.* 6*d.* net.

Late Cabbage from Seed until Harvest: also Seed Raising. By E. N. Reed. Pp. xiii+131. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s.* net.

Soil Biology. By Dr. A. L. Whiting. Pp. ix+143. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s.* net.

School Entomology. By E. D. Sanderson and L. M. Peairs. Pp. vii+356. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s.* net.

The Chemistry of Farm Practice. By S. E. Keitt. Pp. xii+253. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s.* net.

A Laboratory Manual of Farm Machinery. By F. A. Wirt. Pp. xxii+162. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s.* net.

Microscopical Examination of Steel. By Prof. W. Fay. Pp. iv+18+illustrations. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6s. net.

A Course in Food Analysis. By Dr. A. L. Winton. Pp. ix+252. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7s. net.

Irrigation Works Constructed by the U.S. Government. By A. P. Davis. Pp. xvi+413. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21s. net.

Engineering for Masonry Dams. By W. P. Creager. Pp. xi+237. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11s. 6d. net.

French Forests and Forestry, Tunisia, Algeria, Corsica. With a translation of the Algerian Code of 1903. By S. S. Woolsey, jun. Pp. xv+238. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 11s. 6d. net.

Lecture Notes on Light. By J. R. Eccles. Pp. vi+215. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12s. 6d. net.

The British Journal Photographic Almanac and Photographer's Daily Companion, 1918. Edited by G. E. Brown. Pp. 660. (London: H. Greenwood and Co., Ltd.) 1s. 6d. net.

A Laboratory Outline of College Chemistry. By Prof. A. Smith. Pp. v+206. (London: G. Bell and Sons, Ltd.) 3s. net.

Experimental Inorganic Chemistry. By Prof. A. Smith. Sixth edition. Pp. vii+171. (London: G. Bell and Sons, Ltd.) 3s. 6d. net.

Introduction to Inorganic Chemistry. By Prof. A. Smith. Third edition. Pp. xiv+925. (London: G. Bell and Sons, Ltd.) 8s. 6d. net.

Liquid Fuels for Internal Combustion Engines. By H. Moore. Pp. xv+200. (London: Crosby Lockwood and Son.) 12s. 6d. net.

Imperial Institute Monographs on Mineral Resources, with Special Reference to those of the British Empire. Zinc Ores. (London: Imperial Institute.) 2s.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 14.

ROYAL SOCIETY, at 4.30.—The Artificial Production of Echinoderm Larvæ with Two Water-vascular Systems, and also of Larvæ Devoid of a Water-vascular System: Prof. E. W. MacBride.—The Quantitative Differences in the Water-conductivity of the Wood in Trees and Shrubs: Prof. J. B. Farmer.—The Efficiency of Muscular Work: Capt. M. Greenwood.

ROYAL SOCIETY OF ARTS, at 4.30.—The Hide Trade and Tanning Industry of India: Sir Henry Ledgard.

MATHEMATICAL SOCIETY, at 5.—Note on Functional Equations which are Limiting Forms of Integral Equations: Prof. A. C. Dixon.—The Singularities of Trochoidal Curves: Prof. D. M. Y. Sommerville.—A Statement by Fermat: L. J. Mordell.

FRIDAY, FEBRUARY 15.

ROYAL INSTITUTION, at 5.30.—The Mechanism of the Heart: Prof. E. H. Starling.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Annual General Meeting.—Traction on Bad Roads or Land: L. A. Legros.—Utility of Motor Tractors for Tillage Purposes: A. Amos.

GEOLOGICAL SOCIETY, at 5.30.—Anniversary Meeting.

SATURDAY, FEBRUARY 16.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

MONDAY, FEBRUARY 18.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—A Transformation of the Magnetic Dip Chart: E. A. Reeves.

ROYAL SOCIETY OF ARTS, at 4.30.—The Economic Condition of the United Kingdom before the War: the Real Cost of the War: and Economic Reconstruction: Edgar Crammond.

ARISTOTELIAN SOCIETY, at 8.—Anthropomorphism and Truth: Prof. J. B. Baillie.

VICTORIA INSTITUTE at 4.30.—Sun-spots and some of their Peculiarities: E. W. Maunder.

TUESDAY, FEBRUARY 19

ROYAL INSTITUTION, at 3.—The Problems of British Anthropology: Prof. A. Keith.

ZOOLOGICAL SOCIETY, at 5.30.—The Development of *Echinocardium cordatum*: Prof. E. W. MacBride.—An African Civet Attacking Human Beings: Capt. G. D. Hale Carpenter.—Reptiles from the River Tajan: L. A. Lantz.

ROYAL STATISTICAL SOCIETY, at 5.15.—Statistics of Poland and Lithuania: G. Drage.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Further Discussion*: The West Quay of Madras Harbour: The Hon. Sir Francis J. E. Spring and H. H. G. Mitchell.—*Probable Paper*: Modern Developments in Gasworks Construction and Practice: A. Meade.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—A New British Oil Industry: F. H. Cunningham Craig, Dr. F. Mollwo Perkin, A. G. V. Perry, and Dr. A. E. Dunstan.

WEDNESDAY, FEBRUARY 20.

ROYAL SOCIETY OF ARTS, at 4.30.—Picturesque Architecture: M. B. Adams.

GEOLOGICAL SOCIETY, at 5.30.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Photo-synthetic Action Induced in Living Cells, and their Products: Prof. B. Moore.—Illustrations of Preparations: Col. Rawson.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Barometer Record at the Radcliffe Observatory, Oxford, with Special Reference to Prof. Turner's Suggested Discontinuities: F. A. Bellamy.—The Diurnal Variation of Barometric Pressure at Seven British Observatories, 1871–82. A Correction and some Additions: Dr. C. Chree.

THURSDAY, FEBRUARY 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Scattering of Light by Spherical Shells, and by Complete Spheres of Periodic Structure, when the Refractivity is Small: Lord Rayleigh.—The Nature of Heat as Directly Deducible from the Postulate of Carnot: Sir Joseph Larmor.—Curved Beams: J. J. Guest.—(1) Monoclinic Double Selenates of the Iron Group; (2) Selenic Acid and Iron. Reduction of Selenic Acid by Nascent Hydrogen and Hydrogen Sulphide. Preparation of Ferrous Selenate and Double Selenates of Iron Group: Dr. A. E. H. Tutton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Switchgear Standardisation: Dr. C. C. Garrard.

INSTITUTION OF MINING AND METALLURGY, at 5.30.

CHEMICAL SOCIETY, at 8.—Recent Studies on Active Nitrogen: Hon. R. J. Strutt.

LINNEAN SOCIETY, at 5.—Notes on the Bionomics, Embryology, and Anatomy of Certain Hymenoptera Parasitica, with Special Reference to *Microgaster connexus*, Nees: J. Bronté Gatenby.—Experimental Studies in the Specific Value of Morphological Characters in the Fungi: W. B. Brierley.

SATURDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 3.—Problems in Atomic Structure: Sir J. J. Thomson.

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