THURSDAY, MAY 31, 1917.

NEW BOTANICAL HANDBOOKS.

(1) *Algae.* Vol. i., *Myxophyceae, Peridinieae, Bacillarieae, Chlorophyceae, together with a Brief Summary of the Occurrence and Distribution of Fresh-water Algae.* By Prof. G. S. West. (Cambridge Botanical Handbooks.) Pp. viii+475. (Cambridge: At the University Press, 1916.) Price 25*s.* net.

(2) *The Anthocyanin Pigments of Plants.* By Muriel Wheldale. Pp. x+318. (Cambridge: At the University Press, 1916.) Price 15*s.* net.

(3) *A Text-book of Botany for Colleges.* By Prof. W. F. Ganong. Pp. xi+401. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 8*s.* 6*d.* net.

(1) A SPECIAL interest attaches to Prof. G. S. West's volume on Algæ, as it is the first of a series of botanical handbooks which will be issued by the Cambridge University Press under the editorship of Prof. A. C. Seward and Mr. A. G. Tansley. The series has been designed to meet the need of books by specialists on different groups of the vegetable kingdom, and the present volume will be followed by others on Lichens, Fungi, and Gnetales, by Miss Lorrain Smith, Dr. Helen Gwynne-Vaughan, and the late Prof. W. H. H. Pearson respectively. Except for a faulty trimming of the pages (which, perhaps, is confined to review copies), the "get-up" of the book is excellent. An elegant cover, a clear text with numerous well-displayed figures, and a good index give promise of a series which, in the matter of production, should be admirable. The series opens well with the present volume, which is a biological account of the Algæ, both fresh-water and marine, included in the Myxophyceæ (or Cyanophyceæ), Peridinieæ, Bacillarieæ (Diatoms), and Chlorophyceæ (green Algæ). The greater part of the work deals with the green Algæ, a group to the investigation of which, especially the fresh-water forms, the author has devoted many years of thorough and painstaking research, and on the taxonomy of which he is one of the first authorities. The general structure, cytology, life-history, and biology of the various groups, of their subdivisions and more important genera, are described in considerable detail, and their classification and phylogeny discussed. Matters of controversy, such as the presence of a nucleus in the Myxophyceæ, or the mechanism of the movement of the Oscillatorieæ, are treated at some length with an impartial presentation of various opinions. As regards the nuclear question, the author decides in favour of its being an "incipient nucleus." There is also a valuable and expert discussion on the phylogeny and classification of the Chlorophyceæ, and the system adopted, which differs in detail from previous systems, is based on a critical review of the large amount of recent work and the wide experience of the author himself. The concluding chapter on the occurrence and distribution of fresh-water Algæ forms an introduction to their ecological study.

(2) It is not usual to begin a notice of a book with a reference to the bibliography, and it is in no sense disparaging to the value of the subject-matter of Miss Wheldale's account of the anthocyanin pigments of plants that we do so. But the admirable classified bibliography of 645 items, occupying seventy-six pages, indicates the wideness of the field and the variety of the points of view from which the study of the colouring matters in plants has been approached, from the investigations of Nehemiah Grew, towards the end of the seventeenth century, to the present day. It also supplies the motive for Miss Wheldale's book, which is a critical account of the various investigations which have been made upon the anthocyanin pigments along botanical, chemical, and genetical lines. The author is one of a number of recent workers who have raised the study of the colouring matters of plants from an empirical chemical examination of their nature and reactions, or somewhat hypothetical considerations of their biological meaning, to an important position in the study of inheritance. The development in plants of many and various anthocyanin pigments affords an almost unlimited supply of material for this study. "We have now, on the one hand, satisfactory methods for the isolation, analysis, and determination of the constitutional formulæ of these pigments. On the other hand, we have the Mendelian methods for determining the laws of their inheritance. By a combination of the two methods we are within reasonable distance of being able to express some of the phenomena of inheritance in terms of chemical composition and structure. There can be little doubt that exact information of this kind will be helpful for the true understanding of the vital and important subject of Heredity."

Miss Wheldale's work forms a text-book of an interesting and fertile branch of botany. The subject-matter is divided into two parts. Part i. is a "General Account," including an introductory chapter, or general survey, and chapters on the morphological and histological distribution of anthocyanins, their properties and reactions, isolation and constitution, the physiological conditions and factors influencing their formation, the reactions involved in their formation, and finally their biological and physiological significance. The second or special portion deals with anthocyanins and genetics.

(3) Prof. Ganong's published work on the teaching of botany is well known, and his apology for the issue of another text-book of botany is that his careful study of the psychology of the student has indicated that such a one is necessary. Introductory courses in botany are, he says, largely adapted to a preparation for a professional botanical career, whereas in the case of nearly all college students it forms part of a general education. "Knowledge is valuable to the specialist in the proportions of its objective importance, but to the general student in the proportions of its bearing on the actions and thoughts

of mankind." His book may be described as an attempt to present and interpret the humanly important aspects of plant nature in the light of our modern scientific knowledge, and the test of its value will be found, "not in whether my colleagues consider it a well-proportioned compendium of botanical fact, but in whether it leads students to pursue the subject in an interested and spontaneous spirit." Structure is treated before function, because that is the more practicable way, even though the reverse is more logical.

The present volume is Part i. of the whole work, and is entitled "The Structures and Functions of Plants." Part ii., "The Kinds and Relationships of Plants," containing the description of the groups of plants and comprising about 125 pages, is delayed, but is expected to be ready shortly. The subject-matter is divided into chapters which deal successively with the various organs, namely, leaves, stems, roots, flowers, fruits, and seeds. A summary of the treatment of the leaf will indicate the author's plan. The distinctive characteristics are first noted, the "green colour, flat form, and growth towards the light"; their function consists in the exposure of green tissue to light, under the action of which the plant forms its food out of water and mineral matters drawn from the soil and a gas received from the air. After a short account of general structure an experimental account of photosynthesis is given, which leads on to the study of the cellular anatomy and the characteristics of protoplasm and other cell-contents. Transpiration is then considered, and next the adjustments of green tissues to light. Various forms of foliage-leaves are described in association with various habitats, and in the following section the forms and functions of leaves other than foliage, such as leaves for storage, the insectivorous habit, climbing, bud-scales, and stipules. A section on the nutrition of plants which lack chlorophyll includes, besides phanerogamic parasites and saprophytes, a reference to the fungi. Sections on the autumnal and other coloration of leaves, and their economics and treatment in cultivation, are followed by a final section on the uses of photosynthetic food, which deals briefly with the various classes of substances found in the plant and their use to man. It is evident from this sketch that Prof. Ganong's treatment is somewhat unconventional. The text makes easy reading, and is facilitated by a large number of good figures; but there is sometimes a suggestion of scrappiness.

PHYSICAL CHEMISTRY.

A Text-book of Thermochemistry and Thermodynamics. By Prof. Otto Sackur. Translated and revised by Dr. G. E. Gibson. Pp. xvi+439. (London: Macmillan and Co., Ltd., 1917.) Price 12*s.* net.

AT the present time, when considerable attention is being given to the industrial importance and value of chemistry, it is very necessary to emphasise the factors which not alone place chemical technology on a scientific basis, but are absolutely essential for real industrial progress. That much has been accomplished by more or less empirical methods is undoubted, and in certain cases, as a matter of fact, "theory" lags considerably behind "practice." This, however, is not an argument for relegating theoretical principles to the background. Empiricism, which is unavoidable when an industry is in an undeveloped state, is ultimately the greatest bar to further progress. Modern synthetic chemistry, in its widest sense, includes much more than the purely descriptive. The success of a chemical operation rests not only on whether the process can be carried out at all, but also on the careful elucidation of the best conditions under which to carry it out. The discovery of these conditions does not, or, rather, should not, be merely a matter of trial and error. The rational control of a process is determined by considerations of a wide and general nature applicable to processes of the most varied kind. To take an illustration. The problems of rapidity of working, of yield and efficiency, are intimately bound up with such general considerations as reaction-speed and its dependence upon concentration, temperature, pressure, and the catalytic effects of the surroundings, with the question of the equilibrium state as defined by the equilibrium constant, and the variation of this quantity with temperature and pressure. Problems such as these represent some of the technical applications of the principles of physical chemistry. To go no further, it is evident that the technical chemist must be acquainted with the principles of chemical kinetics and chemical thermodynamics, especially the latter.

In these circumstances a good text-book of chemical thermodynamics, such as the late Prof. Sackur's "Thermochemistry and Thermodynamics," is an asset not alone for chemical science, but equally so for chemical technology. The book itself is an exceedingly lucid exposition of the principles of thermodynamics, specially adapted for the needs of the chemist. In addition to covering the ground which we now regard as classical, it introduces us to those newer ideas which mark some of the more recent advances in physical chemistry. The problem of chemical affinity, which is all-important for chemical operations, is particularly well done. One is impressed by the essential unity of purpose underlying the most diverse considerations and fields of investigation. In the old days it would scarcely have been conceived that properties so very "physical" as specific heats and vapour pressures, for example, were ever likely to play any important part in determining the direction and extent of chemical change, but in the light of Nernst's heat theorem and the recent work on the quantum theory we are able to appreciate the truly chemical importance of these and other physical properties.

The experimental material with which Prof. Sackur illustrates the conclusions arrived at is ample and well chosen. Certain subjects, such as liquid mixtures and fractional distillation, the

thermodynamic significance of the mass-action equilibrium constant, Helmholtz's method of calculating the E.M.F. of a cell, the meaning of thermodynamic probability in relation to entropy, the laws of radiation, and many other problems, by no means simple in themselves, are here treated in an exceptionally clear and convincing manner. Prof. Sackur's book, regarded as a whole, is a demonstration of the truth of the words with which the introduction commences: "Everyone will admit that a thorough understanding of physical chemistry, and of the success of its applications in science and in technology, can only be obtained on the basis of thermodynamics."

It only remains to add that Dr. Gibson's translation is thoroughly satisfactory.

W. C. McC. LEWIS.

OUR BOOKSHELF.

The Borderlands of Science. By Dr. A. T. Schofield. Pp. viii+255. (London: Cassell and Co., Ltd., 1917.) Price 6*s.* net.

DR. SCHOFIELD tells us in the preface that his object in writing this book is "to present to the reader an entirely new outlook on the subject with which it deals. The word 'borderland' has hitherto been practically confined to a study of psychic phenomena; but here the meaning is so extended as to cover all that is obscure and unproved in any science." The world of concrete and abstract things is pictured as a huge disc, in the centre of which is God, "the first great cause (though Himself uncaused), dwelling in perfect light" (p. 3); and round the edge of the disc stand "the scientists" in a crowded circle studying the disc by feelers which each mind possesses and "by the light of their own reasoning powers" (p. 4). There are patches of the disc only half illuminated by either the human light or the Divine light, and these patches form the "twilight" regions—the borderlands of science (p. 6); and also there are patches "which we should know and need to know, but which science now clearly sees cannot be penetrated by its lights" (p. 7). "The goal of all human knowledge . . . is in touch with the Light itself, although to scientists at the circumference, who use only their own lights, it may appear to be impenetrable darkness" (p. 4). The Central Unity is also the God of revelation (p. 40); "as we leave the clear though limited light of science we become conscious of a vague premonition or prescience of the spirit world" (p. 63), and "there are some few districts of thought which are illumed neither by science nor by religion" (p. 62).

One would like to know how Dr. Schofield knows all this about the Central Unity. There seem to be some sensible and tolerant views on the borderlands of psychical science, and it is mostly the fundamental parts that seem self-contradictory. But there are also somewhat contradictory statements about the functions of science and philosophy (p. 10 and p. 12) and what makes up "mathematics" (p. 240 and p. 246). We read on pp. 33–34: "According to Myers, Socrates originated the idea of material sciences; but Swedenborg first attempted to introduce a science of the unseen, and his most illustrious follower in this particular direction has been Sir William Crookes." ϕ

The Pruning-Manual. Being the Eighteenth Edition, Revised and Reset, of the *Pruning-Book*, which was first Published in 1898. By L. H. Bailey. Pp. xiii+407. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 8*s.* 6*d.* net.

THIS book deals with an important side of the care of fruit trees. The author considers that "the habit of growth, mode of flowering and fruit-bearing, and response to manipulation" may be grouped under the heading of pruning, and this wide view of the subject gives a special value and interest to the book.

In the earlier chapters the descriptions of the growth and branching of the more important fruit trees are remarkably clear, and should prove useful not only to fruit-growers, but also to teachers of botany and Nature-study. The later chapters deal with the general principles of pruning, and give directions for the treatment of the various fruit trees and ornamental shrubs grown in America. Prof. Bailey lays great stress on the necessity for the continuous good care of orchards as regards both pruning and tillage.

An interesting chapter on the care of street trees may be mentioned; instructions are given for the repairing and preservation of old trees which, on account of their position or association, may be specially valuable.

This manual is intended by the author to bring together the results of long experience in pruning "as handed down from gardener to gardener, fruit-grower to fruit-grower, and as recorded in many books." As early as the latter half of the sixteenth century the subject was dealt with by Heresbach in "Foure Bookes of Husbandrie" (1586), and also by Mascall (1575). The numerous references in this book, however, are chiefly to works published in the last twenty years, and especially to the reports of the valuable experimental trials which have been carried out at Woburn, at Wildpark (Germany), and in Utah, California, and Missouri. It is unfortunate that the author has not added a short bibliography, as the references are scattered in the text or in footnotes, and in one or two cases no date is given. H. A.

The Aviator and the Weather Bureau. By Dr. Ford A. Carpenter. Second edition. Pp. 54. (San Diego: Chamber of Commerce, 1917.)

THIS small book gives a brief history of American aviation as it is associated with southern California, and contains a considerable number of interesting illustrations. It points out the advantage of the climate of California for aviation studies, and gives in chap. iii. an account of an ascent made by the author over the city of San Diego.

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.*]

Plated Teeth of Sheep.

TWICE in recent years I have had brought to me by different people, as great curiosities, teeth of sheep or lambs, some of which were partly covered with a bright yellow metallic-looking film, which was thought to be gold. One of the persons referred to, as a foreign meat purveyor, had had a large experience with carcases of sheep, but had not observed the peculiarity before; and none of the farmers whom I questioned about the matter had ever seen or heard of it. But whether it is actually so rare a phenomenon as the above remarks suggest is doubtful, for the Rev. John Morton, in "The Natural History of Northamptonshire," published in 1712, p. 50, says:—

"Whether it be owing to some accidental uncommon Property in the Soil, that the Teeth of certain Sheep, and Cows, are tinged with a Golden, or rather Brazen Colour; whereof they have had instances in Staffordshire, as also here in this County, and of which I have now by me a pretty remarkable Sample that I met with at Oxenden; or whether it be owing to the feeding of Cattel upon yellow-flower'd Plants or to some other Cause, I shall not now stay to examine."

Actually, of course, the yellow film referred to consists of iron pyrites, and seems to require for its formation the concomitants of ferruginous matter, sulphates, and anaerobic bacterial action. Bacteria in the decomposing organic matter on or around the teeth may be supposed to reduce the sulphates with evolution of sulphuretted hydrogen, which latter reacts on the available iron to form the iron pyrites, FeS_2, a well-known chemical reaction commonly occurring in Nature under anaerobic conditions. It is consequently reasonable to suppose that the particular sheep, etc., exhibiting the characteristic spoken of, that of plated teeth, had been drinking water charged both with iron and sulphates.

Now most chalybeate waters are bog waters, where humic acids have first dissolved the iron, and then on oxidation deposited it in the form of the hydrated peroxide of iron, when sulphates may or may not have been present. But some chalybeate waters (including some bog waters), besides depositing iron, yield abundance of sulphates of iron, or calcium, or both; then obviously the original source of the iron was iron pyrites, probably marcasite. It would appear that this latter class of water would especially lead to the plating of the teeth of animals using it.

I should be rather glad to know of any instances where the result referred to could be actually traced direct to its cause. BEEBY THOMPSON.

67 Victoria Road, Northampton, May 19.

J. E. B. Mayor and Todhunter.

THE review of Dr. MacFarlane's "Lectures on Ten British Mathematicans" in NATURE of May 17 closes with a quotation about Todhunter.

The words cited are attributed to Prof. Mayor, but a note of interrogation seems to imply some uncertainty as to which of the two brothers Mayor it was who wrote them. The quotation is from the late professor of Latin, *John* E. B. Mayor.

On the death of Todhunter Mayor wrote an "In Memoriam" notice of his old friend. It appeared in three consecutive numbers of the *Cambridge Review* for 1884. The first instalment appeared in the number for March 5. The quotation in NATURE is from the number for March 19, p. 262, col. 1.

Todhunter was not only a mathematician, but also a linguist. "Besides most European languages (including Russian, of which he learnt enough to master a mathematical treatise), he had studied Hebrew, Arabic, Persian, and Sanskrit. He was a sound Latin and Greek scholar" (*loc. cit.*, p. 229).

Unlike his great master, De Morgan, who is said to have been a skilful performer on both the organ and the tin whistle, Todhunter lacked the musical faculty. "He used to say he knew two tunes; one was 'God save the Queen,' the other wasn't. The former he recognised by the people standing up" (p. 261, footnote). EDMUND SYMES PAYNE.

27 Constitution Hill, Clifton, May 21.

THE REMOULDING OF NATIONAL ADMINISTRATIVE INSTITUTIONS.

IN the recently issued third annual report (1916) of the Carnegie United Kingdom Trust, and fifteenth annual report (1915–16) of the Carnegie Trust for the Universities of Scotland, there is evidence of the deeply adverse influence which the heavy hand of war has exerted in directions usually the most remote from strife and rancour. The width of the influence is very evident, too, for these reports deal with subjects so diverse as higher education, scientific and literary research, music, church organs, libraries, etc. In the case of the former trust it is remarked that, "while the past year may confidently be said to have seen progress made with the work of the trust, the war and its reactions on the ordinary activities of the country have necessarily hampered any rapid development of schemes which are not directly concerned with its prosecution. A philanthropic trust is peculiarly subject to the difficulties of the moment, especially when its efforts must be entirely devoted towards the amelioration of normal conditions." In the case of the latter trust it is remarked that "the operations of the trust under the Research Scheme still continue to be considerably affected by the European war." Fellows and scholars of the trust "have been engaged on military duty," and some "are among the fallen." "The influence of the war . . . is seen in the diminished number of candidates for fellowships and scholarships, and still more in the fact that of those elected one half either did not avail themselves of the awards or resigned in the course of the session to engage in other work. It is also seen in the altered character of the research work of the beneficiaries, which, except in one or two cases, instead of following the usual lines, was directed to the solution of definite problems arising out of the war."

One can remember readily the time when applications were received by the universities from America, but never from the United Kingdom, for honours graduates to direct the labours of, *e.g.*, cotton manufacturers or gardening firms. That the war has made this old condition an impossibility for the future became forcefully clear in the recent report of the Advisory Council of

the Committee of the Privy Council for Scientific and Industrial Research. The report of the Universities Trust exhibits the effective response of the universities to recent calls. The report of the Council makes very evident the need, long recognised by scientific men, of change—drastic change—in the methods of industry, and the need for collaboration in endeavour. It makes also very evident the need for the theorist to direct and expedite the labours of the practical man; and, more satisfactory still, it shows that the practical man is now recognising it widely under the stress of war.

The future age is to be the age of specialisation and co-ordination. An interesting example of co-ordination appears in the reports of the Advisory Council and the United Kingdom Trust. The former body gave grants to the Stoke School of Pottery in order to aid "a threatened industry." The latter acquired the unique Solon Ceramic Library and presented it to the Stoke School in the hope that it might "help to strengthen the high standard of a national industry."

The specialisation and the co-ordination are to be directed towards the placing of national efforts on the fittest bases and in touch with the fittest methods. It is largely isolation and the lack of specialised scientific control in commercial and industrial endeavours that have led to the critical conditions upon which the war has focussed attention. The Committee of the Privy Council has already done much towards the removal of some of these conditions, and has proceeded tentatively to the inauguration of means to remedy widely the lack of co-ordination and the neglect of specialised control. The constitution of the machinery of the committee for the effective attainment of its national aims is very ideal. The committee itself includes the heads of the various governmental departments concerned, and its Advisory Council and very large Standing Committees are formed of *working scientific and technical experts*, whose decisions must obviously be determinative.

But there exist many pre-war administrations —boards, trusts, etc.—on a smaller scale, and many post-war administrations will arise also on a smaller scale, yet, nevertheless, dealing with matters of importance to the nation. In the case of the former there must be revision, in the case of the latter there must be supervision, in order that the fittest constitution may be framed and followed. In matters of business the framing should be moulded on business lines, and not, for example, on legal lines, though a slight admixture of legal opinion might be desirable. In matters of education the administrators should mainly be trained educationists, and not, for example, business men, though a slight proportion of these might be of advantage when the administration deals also with its own funds. In a mixed body it is not infrequently found that the best business member is one who never had a special business training; nevertheless, there are certain aspects of business which can be safely guided only by a trained specialist. On the other hand, it must also be recognised that the lines of success in a trading firm or a manufacturing firm are fundamentally different from those in an educational institution. Trade and ordinary business are of the nature of a war with tendencies, which may be, and often are, successfully combated, towards selfishness and hardness. And this tendency might easily develop into a national curse. In not very remote history a subordinate body, composed mainly of business men, intending to be well-intentioned, but misled by a mischief-maker and to some extent under the influence of the heritage of old feuds, worked behind the back of a superior body and almost involved both bodies in an utterly ruinous litigation. In that process they attacked, also behind his back and without his knowledge, a man whose life, in connection with the matter regarding which they attacked him, could easily challenge that of any one of them; for it had, in that very matter, been one of absolute innocence. Such a performance could scarcely be imagined in the case of a body of jurists, whose training begets sensitiveness to justice; or of a body of scientific men, whose training begets sensitiveness to accuracy and truth; or even of a body of literary men or artistic men, whose training confirms the sense of beauty.

In every case the scientific test of fitness must be applied. In pure business, the business man; in pure technics, the technical man; in technical science, the practical man and the man of science equally, or the latter preponderantly in cases of doubt; in education, the trained educationist, must have the determinative voice. So also in other matters. It is no less an important point that the specialists must be men *actively engaged* in the work which is their specialty. Under no other conditions can the fullest efficiency be attained. Nor can it be attained with certainty unless these men are *in the majority* as regards either numbers or, at least, the weight effectively attached to their views.

When proved by these tests, of the three administrations here specially considered, only that of the Committee of the Privy Council seems to be of quite the fittest type. Although there is full internal evidence in the reports of the Carnegie Trusts that great weight is attached to expert advice, possibility should be changed into visible certainty. Nevertheless, one ought not to take cognisance of this condition without at the same time acknowledging, with full appreciation, the height of the aims of these trusts and the greatness of the results to which they have attained.

W. PEDDIE.

ANTISEPTICS, AND THE TREATMENT OF INFECTED WOUNDS.

FROM the beginning of the war the Medical Research Committee has paid special attention to the important subject of antiseptics in the treatment of wounds. The part taken by Sir Almroth Wright and the bacteriological depart-

ment of the committee is well known. At the same time the committee has supported independent inquiries in other directions, which fall under two main heads. The first group comprises the studies of the properties of hypochlorites and their derivatives. At Edinburgh Profs. Ritchie and Lorrain Smith produced and investigated the solution now widely known and used as "Eusol," in which the prefix is not Greek, as might be supposed, but stands for Edinburgh University. Simultaneously, Dr. Dakin, working in collaboration with Prof. Cohen, of the University of Leeds, and Dr. Carrel, in France, brought forward the now well-known "Dakin" hypochlorite solution, used widely for the French Army, for the British Army in France, and in America. Later, Dr. Dakin, working for the committee in its biochemical department, investigated the properties of paratoluene sulphochloramide, prepared earlier for him in Prof. Cohen's laboratory by a modification of Chattaway's original process. This antiseptic has already obtained wide use in England and France, under Dr. Dakin's name, "chloramine-T," and in America under the name "chlorazene." Being non-toxic and less unpleasant than hypochlorite solutions close to the nose, it has been specially useful in mouth and jaw cases, and from its property of ready adsorption by textiles, it provides antiseptic gauzes of far higher potency than those previously available.

The second group of inquiries supported by the committee has been concerned with benzene derivatives, and chiefly those already known to the synthetic dye industry. At a very early stage in the war, Surgeon-General Cheatle, with Drs. Fildes and Rajchman, investigated for the committee a series of compounds, of which they brought forward malachite green as having high value in the treatment of infected wounds. More recently, Dr. Carl Browning, working in the Bland-Sutton Institute of the Middlesex Hospital, who had previously worked with brilliant green and other synthetic dyes as weapons in the technique of bacteriological discrimination, has examined for the committee other synthetic dyes. Much interest has been taken in his statement of the antiseptic properties of what he proposes to call "flavine." This is an acridin derivative previously prepared and actually patented in Germany, to which Ehrlich gave the name "trypaflavin," on account of its trypanocidal properties.

Owing to the war, supplies of this substance were unobtainable, but Dr. Barger, in the biochemical department of the Medical Research Committee, prepared "trypaflavin" for the purposes of Dr. Browning's investigation, with the results already published. This, now called "flavine," Dr. Browning found to have, in addition to high bactericidal potency, the very remarkable, and at present wholly unexplained, property of gaining, instead of losing, in potency in the presence of serum, and it has the further valuable property of appearing to leave undamaged the activities of phagocytes in dilutions which still have high bactericidal power.

The committee has arranged for the manufacture of "flavine" upon a commercial scale for Government purposes, and as the new supplies become available it is hoped that complete clinical trials may be made of its value in the treatment of wounds. The preliminary reports already received from surgeons, based upon the first results of the laboratory manufacture, are most encouraging.

HOME-GROWN SUGAR.

THE announcement in the *Times* of April 19 that the Treasury has sanctioned a grant of 125,000*l.* by way of loan from the Development Fund towards the purchase of an estate for the purposes of sugar-beet growing and sugar manufacture marks an advance of the highest importance towards the establishment in this country of this valuable industry.

For many years an active propaganda directed towards this end has been carried on, and much valuable preliminary investigation has been completed. Numerous experiments in different parts of the country have shown conclusively that over wide areas sugar-beet crops fully equal in yield and quality to those of the Continent can be grown, and the ground has been effectively cleared for putting the possibilities of the industry to practical test.

For several reasons, however, previous efforts to establish the industry have met with but scant success. On one hand the uncertainty as to national policy in relation to the once vexed question of sugar bounties has been a potent inhibiting factor, whilst on the other the necessary establishment of sugar-beet growing areas round the factory to give an assured supply of beets has also presented the greatest difficulties.

Repeated efforts to obtain State assistance have encountered the obstacle that such assistance could be given only to enterprises from which the element of private profit was entirely eliminated. At long last, however, the efforts appear to be within sight of fruition, and with the more clearly realised need for the establishment of the industry and the closer consideration given to the solution of the difficulties involved, a scheme has been devised which Lord Selborne's committee in its interim report felt able to endorse as well thought out and sound.

This enterprise for which Treasury support has been obtained is to be carried out by the British Sugar-Beet Growers' Society, Ltd., an organisation not trading for profit, and created specifically for the purposes of the scheme, with Capt. Beville Stanier, M.P., as chairman, and an influential and representative committee, with expert advisory assistance. Through the vice-chairman, Mr. E. Jardine, M.P., an estate of 5600 acres has been acquired at Kelham, near Newark, where it is proposed to grow a large area of sugar-beet and to erect a factory for its manufacture into sugar. The estate is very favourably situated for both rail and canal

transport, and would appear to be well adapted in every way for the purpose.

The enterprise, when fully developed, is estimated to cost 500,000*l.*, but, for obvious reasons, only a very limited development is possible at present. With the large acreage at its disposal, some of the difficulties which have beset earlier enterprises are obviously greatly reduced. The scheme also presents other features which inspire confidence in its ultimate success, and the progress of this important national experiment will be watched on all sides with the greatest interest. C. C.

SIR A. R. BINNIE.

A GREAT engineer, Sir Alexander Richardson Binnie, born in London in 1839, died on May 18 at the age of seventy-eight. He joined the Institution of Civil Engineers in 1865, and in 1905 became its president. He was a member of the Institution of Mechanical Engineers, the Geological Society, and other societies, and contributed to their Transactions several valuable papers. Always interested in historical studies, he sketched in an address to the Institution of Civil Engineers the progress of science and engineering during the eighteenth and nineteenth centuries.

Sir Alexander served a pupilage to Mr. T. W. Flanagan and John F. La Trobe Bateman, and was at first engaged on railway construction in Wales. After a short period of practice in London he went in 1868 to India, and as executive engineer in the Department of Public Works was engaged in coal exploration, on railways, and in carrying out schemes of water-supply. His most important work in India was the construction of a reservoir for the supply of the city of Nagpur. In 1875, when in England on furlough, he was consulted by the Bradford Corporation with regard to difficulties which had arisen in the water-supply of that city. He became the water engineer of Bradford, a position he retained for fifteen years. From 1890 to 1901 he was the chief engineer to the London County Council, and greatly assisted in the reforming activities of that time. He completed the sewage works at Barking and Crossness, and directed the construction of the Blackwall Tunnel, the Barking Road Bridge, and the Highgate Archway. In 1897 he was knighted. During this period he studied a scheme for the supply of water to London from North Wales. He surveyed a watershed in the valleys of the Wye and Usk capable of discharging 415 million gallons daily after allowing for losses. The water was to be brought to London by two conduits, 150 to 170 miles in length. The scheme was very carefully worked out, but its cost was deemed prohibitive, and London was content with a supply from less pure sources nearer at hand.

When in India Sir Alexander investigated questions of rainfall, evaporation, and flow off the ground, as to which for tropical countries there was not much information at that time. He was specially interested in tracing a connection between sun-spot periods and the fluctuations of rainfall.

Sir Alexander had great kindliness and courtesy and was greatly respected by all who knew him. He was an excellent witness before Parliamentary Committees and in the law courts, where his great knowledge, clear statement of his case, and obvious honesty gave weight to his evidence.

NOTES.

THE memory of the late Prof. Raphael Meldola is cherished with affection by workers in many scientific fields. It is to be hoped that a worthy memorial will eventually be established as a national tribute to his work and influence, but it is thought that the present is not an appropriate time for a public appeal with this object in view. Moved, however, by a desire to preserve a permanent impression of his features, some of Meldola's friends are arranging to present his portrait to the Royal Society and to the Institute of Chemistry, and subscriptions varying from half a guinea to ten pounds have already been contributed by those who have heard of this intention. There are doubtless others who will welcome the opportunity of taking part in this modest expression of esteem, for Meldola was known to students of widely different branches of science, and it is feared that some of them may have been overlooked when the invitation to subscribe to the memorial was sent out. We are glad to assist in repairing any such inadvertent omission by directing attention to the Meldola Portrait Fund, for which an account has been opened at Messrs. Barclay and Co.'s Bank, Oxford, Banbury Road Branch. In these columns it is unnecessary to dwell upon Meldola's scientific achievements, the breadth of his intellectual sympathy, or the patriotic zeal with which he wore himself out in his country's service—his friends knew these qualities fully, and it is they who wish to show appreciation of them by the presentation of his portrait to the two societies mentioned, both of which will gladly welcome this memorial of him. Mr. Solomon J. Solomon, R.A., has consented to paint the portraits, and has entered into the scheme in a most generous spirit. Contributions for the fund should be sent to Prof. E. B. Poulton, Wykeham House, Oxford.

DR. JØRGEN BRUNCHORST, Norwegian Minister in Rome, who died in that city on May 20, was in his early days a botanist. Born at Bergen on August 10, 1862, he was assistant to the professor of botany at Tübingen, and took the degree of Ph.D. at Heidelberg in 1885. He studied chiefly the physiology and diseases of roots, and published several papers on those subjects from 1884 to 1888. Appointed conservator of Bergen Museum in 1886, he soon took part in communal life by publishing a practical book on the diseases of the economic plants of Norway (1887). The age of D. C. Danielssen threw much administrative work on Brunchorst, who was first the museum's secretary, and succeeded to the post of director in 1901. It was he who took the lead in all public lectures to students and to the public, the editing of the popular periodical *Naturen*, the planning of the Botanic Garden, and the establishment of the Biological Station. Further than this, he strongly supported co-operation with the other northern nations and with this country in the fisheries investigation of

the North Sea. He was delegate to the Fishery Congress at Dieppe, and to the second conference on the International Catalogue of Scientific Literature held in London in 1898. Virile and straightforward in manner, of keen intelligence and wide sympathies, Brunchorst will be much regretted by those friends in this country from whom he has been taken at an age so unexpectedly early.

ENGINEER REAR-ADMIRAL G. G. GOODWIN, C.B., has been appointed Engineer-in-Chief of H.M. Fleet, with the rank of Engineer Vice-Admiral, in succession to Engineer Vice-Admiral Sir Henry J. Oram, K.C.B., F.R.S.

DR. C. D. WALCOTT, secretary of the Smithsonian Institution, has been elected president of the U.S. National Academy of Sciences, in succession to Prof. W. H. Welch, of the Johns Hopkins University; and Dr. A. A. Michelson, of the University of Chicago, has been elected to succeed him as secretary of the academy.

THE annual meeting of the Institution of Gas Engineers is to be held on Tuesday, June 5, at the Institution of Civil Engineers, when reports will be presented of the research committees on, respectively, Refractory Materials, Gas Lighting, Heating and Ventilation, and Life of Gas Meters. Lord Moulton, F.R.S., has been nominated for election as president of the institution for the year 1917–18.

AT the monthly general meeting of the Zoological Society of London, held on May 16, his Grace the Duke of Bedford in the chair, it was announced that, in comparison with the corresponding period in 1916, there was a decrease in the number of visitors of 75,353, and a decrease in the receipts of 1756*l*. The additions to the society's collections during the month amounted to 130, of which special mention may be made of a female chimpanzee from West Africa, two pandas (*Aelurus fulgens*) from Nepal, and a Demidoff's galago (*Hemigalago demidoffi*) from Ashanti.

WHILE we are glad to know that it has been decided to establish a National War Museum, we are not a little alarmed at the many impracticable and sometimes fatuous suggestions as to the nature of the objects which should find a place there. We do not, for example, consider that ornaments made of chewed bread, even though they were made by prisoners of war in internment camps, are worthy of a permanent place in such a collection. As well might we add a lump of mud from the wheel of a limber in Flanders! The writer of a long article on this theme in the *Museums Journal* for May expresses a hope that the Tower of London may be used as the repository of this collection, and there are even people who seem to agree with him. But if a tithe of the things he proposes to admit are collected, an annexe several times the size of the Tower will have to be provided. By all means let us have this museum, but let a little judgment be exercised in its formation.

IT is announced from New York by the Exchange Telegraph Co. that the members of the Crocker Land Expedition are safe at Etah. The expedition sailed for the Arctic in July, 1913, under the auspices of the American Museum of Natural History of New York, to explore the land supposed to lie north-west of the line of islands stretching from Grant Land to Prince Patrick Land. Two years later, however, Mr. Donald B. Macmillan, the leader, sent a message which, after recording several misadventures which the expedition had encountered, announced that Crocker Land did not exist. He and his companions have since remained in the Arctic, mapping uncharted coast lines and carrying on other scientific work.

THE fifteenth annual session of the South African Association for the Advancement of Science will be held at Stellenbosch, from Monday, July 2, to Saturday, July 7, inclusive, under the presidency of Prof. J. Orr. The sectional committees and their presidents will be as follows:—A: Astronomy, Mathematics, Physics, Meteorology, Geodesy, Surveying, Engineering, Architecture, and Irrigation, Prof. W. N. Roseveare; B: Chemistry, Geology, Metallurgy, Mineralogy, and Geography, Prof. M. M. Rindl; C: Bacteriology, Botany, Zoology, Agriculture, Forestry, Physiology, Hygiene, and Sanitary Science, J. Burtt-Davy; D: Education, History, Mental Science, Political Economy, General Sociology, and Statistics, Rev. Prof. N. J. Brümmer; E: Anthropology, Ethnology, Native Education, Philology, and Native Sociology, Rev. N. Roberts. The local secretary is Prof. B. van der Riet, Victoria College, Stellenbosch.

THERE lately passed away a notable public servant in the person of Mr. Alexander Gibson, late Senior Chief Cartographer at the Admiralty. The public hears much of some of its prominent officials, but is unaware of the existence of many highly technical services that are silently rendered to the State, without public recognition, and sometimes without much official encouragement. Mr. Gibson was, however, well known in that circle of scientific interests concerned with geographical and cartographical work, and had been a distinguished occupant of the official position referred to, from which he retired in 1914, after forty years' service at the Admiralty. When the war commenced he was recalled to continue his services, and was at work until a few days before his death. Mr Gibson's long and continuous service at the Admiralty had made him an unequalled authority upon the charts of the coasts and waters of the world, both British and foreign, and with his great capabilities for critical examination and research he contributed many important records of high value to the work of accurate chart construction.

DR. GEORGE SARTON will be known to many readers of NATURE as the editor of the excellent quarterly, *Isis*, which was published near Ghent until the war stopped publication. Dr. Sarton is at present lecturing at Harvard University, and is continuing with his usual vigour his important work in organising the history and use of science in civilisation. In *Science* for March 23 last he published a very interesting proposal for an American Institute for the history of science and civilisation, which appeals "to those interested in placing before American students advantages not only greater than are now offered in this country (America), but greater than those offered abroad." "Science," says Dr. Sarton, "is the strongest force that makes for the unity of our civilisation, and it is also essentially a cumulative process, and hence no history of civilisation can be tolerably true and complete in which the development of science is not given a considerable place." Particularly interesting among the activities of the proposed institute is that of publishing two journals, one of a popular nature, and the other of the highest scientific character. The scientific journal might be a series of editions of important scientific manuscripts, or a journal of the type of *Isis*, which should record the world's work on the subject. It may be added that perhaps this scheme might fit in with the admirable suggestion made by Prof. Rignano in NATURE of January 25 last of a quadruple scientific "Entente." Now America has jointed the Entente, our scientific future is certainly rosier. Dr. Sarton's note concludes with an imposing list of American men of science who are in sympathy with his project.

AT the May meeting of the Society of Glass Technology Prof. Herbert Jackson gave a short account

of the valuable work accomplished in glass research since 1914 at the instigation of the Institute of Chemistry and the Ministry of Munitions. One outcome of this work has been the placing of at least fifty new batch formulæ at the disposal of glass manufacturers, to experiment with, to adopt, and to improve. Amongst the most important formulæ available may be mentioned batches for resistant and ordinary chemical ware; soft glass for lamp work; combustion tubing; various types of glasses for X-ray work; opal glasses; thermometer glasses; and optical glasses. To show the widespread nature of the researches already carried out upon glass, he said, the effect of almost every known element has been tried, and many glasses with interesting properties are now available both for present and post-war use. By fostering research in many directions and by the admission of science in its most advanced form into their industry glass manufacturers have ensured the progress of the industry in the future. The enthusiasm of the manufacturer is reflected in the founding of the Society of Glass Technology, and the interests of the whole glass industry are being well served by the glass technology department of the University of Sheffield, and by the numerous representative committees set up by the Ministry of Munitions. The glass industry, in fact, is a striking example of the co-ordination of the manufacturer and man of science at its best. The next meeting of the Society of Glass Technology will be in June, at the University of Sheffield, when a joint discussion on refractory materials has been arranged with the Faraday Society.

IN the May issue of *Man* Mr. E. W. P. Chinnery describes the use among the coast tribes of Papua of the conch shell and wooden trumpet as a mode of signalling. This is usually performed by males, but women sometimes use these instruments, and in the Kikori River delta women beat a kind of tattoo with sticks on the sides of their canoes to announce the killing of men and pigs, while the males sound calls on the conch shell. This account is supplemented by a note contributed by Dr. A. C. Haddon, with a good bibliography, in which he describes the distribution of similar wooden trumpets in Netherlands New Guinea and on the Sepik River.

IN the Transactions of the Glasgow Archæological Society, N.S. (vol. vii., part i.), Sir P. I. Hamilton Grierson discusses the question of fosterage, not as a chronicle of phenomena, but as a process of evolution. By fosterage he means the rearing of a child, undertaken at the request of its parents by someone who is neither its father nor its mother, for a limited time, with the result that a bond is created between the foster-child and its foster-parent and foster-brethren, and, in many instances at any rate, between the natural father and the foster-father. Dealing with the question in detail from this point of view, he arrives at the conclusion that if we would make fosterage yield the secret of its origin, we must study it in connection with other forms of artificial relationship—the milk-bond, the bond of the blood-brothers, the bond of adoption, the bond of gossiprede, and the bond existing between teacher and scholar; and such a study will be found to illuminate not only the questions involved in this inquiry, but other vexed problems of early family relationships.

IN a pamphlet published for the Polish Information Committee, Mr. W. Nalkowski has endeavoured to show what the natural features of Poland are which give it its individuality ("Poland as a Geographical Entity." London: Geo. Allen and Unwin, Ltd., 6*d.* net). Despite considerable compression and a rather ponderous style, the author has succeeded in giving a very able and useful survey of the characteristics of Polish geography, and has proved his contention that the outstanding feature is the "transitionality" of Poland. It is a country in which western and eastern Europe mingle, and the reciprocal action of these influences gives a colour to its life. Whether or not that characteristic is one which fits Poland to stand as a separate nation might be open to argument, Mr. Nalkowski foresees this criticism, which he answers by pointing out that original Poland has clear frontiers to north and south, and in the basin of the Vistula has a nucleus around which the country centres. The latter contention, to a certain extent, is true, but the transitionality of Poland results not from her northern and southern frontiers, but from her eastern and western ones, which the author admits are weak. These indefensible frontiers have subjected Poland to heavy blows and ceaseless struggles in the past. The future of a regenerated Poland will show whether open frontiers favouring human intercourse stand a country in better stead than physical barriers crossed with difficulty. The pamphlet is a useful contribution of geography to a problem in world-politics and throws much light on the subject.

THE annual report for 1915 of the Technological Museums, Sydney, New South Wales, well indicates the way in which our Colonies are using the collections in their great museums. We learn, for example, that "it is clear to most people now that the prosperity and safety of the Empire will in a large measure depend upon the manner in which scientific research and discovery are encouraged in the future. If we are to succeed, no initial outlay should be spared, as it does not take long, once a discovery has been made into a going concern, for the initial outlay to be easily covered. This is well illustrated in one of the museum researches alone—*i.e.* on the pines of Australia—as the commercial advantages to the State will more than repay a hundredfold the cost of the whole of the researches carried out here. Consequently, I view with great interest the proposal of the Prime Minister to establish a Bureau of Scientific Research—a scheme which, if carried out on proper lines, will no doubt result in an effective achievement worthy of Australia." The present report deals with the technological work of the Technical Education Branch of the Department of Public Instruction, and the document is illustrated by reproductions of photographs of the "Australian Essential Oil Cases" and the "Museum Essential Oil Still." Mr. R. T. Baker is the curator.

THE life-history of bacteria is dealt with by Mr. Edward Hort in a paper in the *British Medical Journal* (May 5, p. 571). The current view is that bacteria reproduce by simple binary fission and occasionally also by endospore formation. Mr. Hort maintains that a relatively complicated life-cycle takes place in the enteric group of bacilli which he has studied. Superficial, median, and terminal minute buds are formed by gemmation from the parent, and these buds may undergo segmentation. The buds vary in size from about 0·1 μ to several μ, and the smallest forms may be filterable. Some of the aberrant forms in cultures may be mutations or developmental stages, and not involution forms as they are usually regarded. In order to demonstrate the various stages a somewhat acid broth was used as culture medium, and the films were treated by Benian's Congo-red absorption method for microscopical examination.

MR. N. L. BOWEN adds an important paper to his previous study of nepheline, and has prepared the potassium representative of this mineral artificially (*Amer. Journ. Science*, vol. xliii., p. 115, 1917). This

artificial kaliophilite is occasionally accompanied by leucite. An orthorhombic form of $KAlSiO_4$ has also arisen during the experiments. Readers of this paper may like to note Dr. A. Scott's references to artificial nepheline and carnegieite prepared by him (Trans. Geol. Soc. Glasgow, vol. xvi., p. 41, 1916).

MR. E. T. WHERRY (*American Mineralogist*, vol. i., p. 37, 1916) shows that crystals of glauberite, $Na_2Ca(SO_4)_2$, were deposited during the drying of fluviatile beds of Triassic age in eastern Pennsylvania, in place of those of rock-salt that are familiar in many areas. The author attributes this occurrence to the composition of the local waters; it seems possible that glauberite, which has a low solubility, represents a stage antecedent to that of the deposition of gypsum, and that the continued trickle of waters seaward carried off the sodium chloride and many other salts.

A PROCESS is described in the *Scientific American* for April 21 for coating the end portions of wooden propeller blades for aeroplanes, etc., with a thin layer of copper, by which they are strengthened, given a better cutting edge and surface, and protected from brush, etc., on landing. The details of the process are interesting. First, the wood is rendered impervious by saturating with a wax varnish, which is then coated with a thick linseed-oil varnish. Then a shellac varnish is applied and allowed to dry. A thin deposit of silver sulphide is produced by treatment with a silver nitrate solution made with alcohol and water, the surface being then exposed to sulphuretted hydrogen gas. Copper is electrolytically deposited on this film.

THE Ordnance Survey has published, at the price of 3*s*., a geological map of Dublin on the scale of 6 in. to 1 mile. The topographic basis is identical with sheet 18 of the Ordnance Survey map of the county of Dublin. The map embraces the city, Phœnix Park, and a large outlying residential district. The superficial deposits, boulder clay, glacial gravels, river gravels, alluvium, and materials on the area in-taken from the sea, together with the few patches of underlying limestone rock which rise to the surface, are indicated by separate colours. The alterations, due partly to human, partly to marine agency, in the coast-line at the west end of Dublin Bay are well shown by the insertion, in red dotted lines, of the coast as represented in a map by Bernard de Gomme, published in 1673. We believe this is the first urban district for which a cheap colour-printed map has been published on the six-inch scale. This excellent example might well be followed in the case of each of our larger town areas. Such maps, particularly if they were accompanied by a short, clear, explanatory pamphlet, would be invaluable for educational purposes, and copies should be hung in every urban school. They would also be of very great use to architects, surveyors, and engineers, and to all who are concerned with house-sites or town planning.

AN effort is being made by the American National Advisory Committee for Aeronautics to promote the study of the atmosphere over the United States and the adjacent seas, and have a set of accurate charts made for the benefit of aviators. We wish the committee every success in the endeavour, but there is a proverb "as uncertain as the wind," and it is difficult to see how so uncertain an element as the wind can be charted at all, much less "accurately charted." No doubt the Weather Bureau has a large amount of information as to the strength and direction of the prevailing winds, and in America, as in Europe, the wind at a few thousand feet height will in general agree more or less with the isobaric charts, but a knowledge of the prevailing wind will not much increase the safety of an aviator who has to fly at a definite time and place. It is a correct and definite forecast rather than a chart that he requires, and it has been, as a matter of course, the chief object of the U.S. Weather Bureau to be able to give such forecasts for many years past. Extending the forecast to some 5000 ft. altitude is a comparatively easy matter when the surface conditions can be accurately foretold.

SOME interesting results of a spectroscopic investigation of sources of ultra-violet radiation for therapeutic purposes are given by C. A. Schunck in the Journal of the Röntgen Society for April. Among the sources examined were electrodes of pure metallic tungsten, molybdenum, and iron; carbon rods impregnated by boiling in solutions of sodium tungstate, uranium nitrate, and ammonium molybdenate; cored carbons filled with uranium oxide or wolfram; and the Simpson electrodes, which are said to consist of wolfram. The most intense source of ultra-violet radiations was found to be the electric arc with metallic tungsten electrodes, the spectrum being so full of lines as to be almost continuous to the limit of the spectrograph employed, at λ 2130. The Simpson arc gives a very similar spectrum, but the unsteadiness of this source is a disadvantage. The impregnated carbons give much more intense radiation in the spark than in the arc, a mixture of uranium nitrate and ammonium molybdate being the richest in ultra-violet radiations of any spark source. Observations of the effects of the various sources appear to show that the radiations of greatest therapeutic value lie between λ 3000 and λ 1850, and further spectroscopic observations to ascertain which part of this region has the greatest efficiency are in progress. The paper is illustrated by an excellent series of photographs of spectra.

IN part 5 of vol. v. of the Science Reports of the University of Sendai, Japan, Prof. K. Honda and Mr. J. Ôkubo apply the theory of ferro- and para-magnetism, published three years ago by Prof. Honda, to the effect of temperature on the magnetism of ferro-magnetic substances, and find a close agreement between their deductions from the theory and the experimental facts. According to Prof. Honda's theory, the molecules of a ferro-magnetic substance are nearly spherical, and the impacts of the molecules on each other due to their thermal motions have only a small effect in rotating the molecules, while the effect of their mutual magnetic action on each other is considerable. The molecule of a para-magnetic substance has, on the contrary, a more or less elongated form, and thermal motions have in consequence a great effect on the molecular rotations. The effect of the rotations in the case of the ferro-magnetic material is worked out in detail for weak external fields in the present paper, and it is shown that the magnetisation will diminish as the rotation increases, at first slowly, then faster, and that at a given angle the magnetisation will disappear. The effect of temperature on the permeability of ferro-magnetic substances is also investigated, and the curves connecting permeability with the angle of rotation are shown to be of the type found by Hopkinson for the relation between permeability and temperature in weak fields.

IN the Bulletin of the Société d'Encouragement pour l'Industrie Nationale for March–April M. Paul Janet gives some interesting details of the foundation and activities of the Laboratoire Central d'Electricité at Paris, which is administered by the Société Internationale des Electriciens under an arrangement

with the State. The work of the institution is divided broadly into (1) tests and standardisation work for the public, (2) researches. The tests, etc., cover the checking of all kinds of electrical instruments. Among these may be mentioned the tests undertaken for the Marine Ministry on new types of storage battery for use in submarines, and standard tests on electric lamps used in the Navy. Investigations have been made for the War Ministry on meters, etc., used in gunpowder factories, also check tests on standard meters used by the Army in its own specification tests. The laboratory undertakes for the Ministry of Public Instruction and Fine Arts the verification of lightning arrester installations on public buildings. On the research side may be mentioned the important researches published by M. Ch. David on the various grades of carbons used for dynamo brushes; M. Jouaust's researches on the magnetic properties of iron, its magnetic viscosity, and its permeability at high frequencies; and MM. Laporte and de la Gorce's researches on the dielectric strength of insulating materials under continuous and alternating tensions and at varying frequencies. In 1914 the laboratory had in hand researches (which will be continued) on the Violle platinum light standard. MM. Broca and Laporte have undertaken experiments on the action on the human eye of various artificial sources of light, while Dr. Weiss and M. David have studied the mechanism of death from high-tension alternating currents. The Laboratoire Central represented France at the international experimental work carried out at Washington in 1910, as the result of the International Conference on Electrical Units and Standards held in London in 1908, and has published papers on the subject.

MR. A. CHASTON CHAPMAN'S lecture on "Some Main Lines of Advance in the Domain of Modern Analytical Chemistry," delivered before the Chemical Society in March, has been reproduced in the Journal (vol. iii., pp. 203–20). Attention is directed to the increasing use of physico-chemical methods, the spectroscope and polarimeter being now supplemented by the refractometer, the electrometer, and a wide range of electrochemical apparatus. In the same way the use of derivatives of hydrazine as qualitative and quantitative reagents in organic chemistry has been extended by using phloroglucinol to precipitate furfural in estimating pentoses and pentosans, of digitonin to estimate cholesterol, and of picric and picrolonic acids in identifying such bases as arginine, histidine, lysine, and guanidine. Organic compounds have also been introduced as reagents in inorganic chemistry, notably in the colorimetric estimation of nitrates and nitrites. Actual precipitation occurs, however, when benzidine hydrochloride is used to precipitate sulphates, or "nitron" to precipitate nitrates, the latter reagent furnishing for the first time a method for the gravimetric estimation of nitric acid. The separation of nickel from cobalt by means of dimethylglyoxime is characteristic of a considerable group of separations which can now be effected with remarkable ease and efficiency by making use of complex organic compounds. Biological processes, such as the selective fermentation of sugars by different species of yeasts, and the use of the "precipitin" reaction to distinguish between albumins from different sources, have also proved of great value in the analysis of foodstuffs. In conclusion, the lecturer urges the desirability of providing in this country professorships of analytical chemistry, similar to those which exist already on the Continent and in America.

MESSRS. J. WHELDON AND CO., 38 Great Queen Street, W.C.2, have just issued a catalogue (New Series, No. 79, "Books and Papers on Microscopical Science in all its Branches") which should be of interest to many of our readers. It is conveniently arranged under the headings:—Bacteriology, Parasitology, etc., Diatoms, Entomostraca, Foraminifera, Fresh-water Algæ and Desmids, Infusoria, Micro-Entomology, Micro-Fungi, Petrography, Crystallography, etc., Protozoa, Rotifera, Zoophytes, Biology, Histology, Physiology, and General Works on the Microscope. Many of the works catalogued, being published in enemy countries, are difficult to obtain at the present time. The list is to be had upon written application.

THE following works are in preparation for appearance in the "Cambridge Public Health Series" (*Cambridge University Press*):—"Ticks as Carriers of Disease," Prof. G. H. F. Nuttall; "Serum Diagnoses," Dr. C. Browning; "The Purification of Water in Sedimentation, Filtration, and Precipitation," Dr. A. C. Houston; "The Purification of Water by Ozone and Chlorine; and Domestic Filters," Prof. G. Sims Woodhead; "The Principles and Practice of the Dilution Method of Sewage Disposal," Dr. W. E. Adeney; "Disinfection," Dr. C. W. Ponder; "Housing in Relation to Public Health," Dr. C. J. Coleman; "School Hygiene," Dr. E. T. Roberts; "Soils, Subsoils, and Climate in Relation to Health," G. Walker; "Meat Inspection," Dr. W. J. Howarth and T. D. Young; "Vital Statistics," R. Dudfield and G. U. Yule; and "Foods, Sound and Unsound," Dr. H. C. Haslam.

OUR ASTRONOMICAL COLUMN.

COMET 1917*b* (SCHAUMASSE).—From observations of this comet made on April 28, April 29, and May 4, the following elements and ephemeris for Greenwich midnight have been calculated by J. Braae and J. Fischer-Petersen:—

$T = 1917$ May 18·2946 G.M.T.
$\omega = 119^\circ\ 11'\cdot90$
$\Omega = 9^\circ\ 37'\cdot25$ } 1917
$i = 158^\circ\ 42'\cdot87$
$\log q = 9\cdot88304$

1917		R.A. h. m. s.	Decl. ° ′	Log r	Log Δ
May 31	...	8 25 32	+38 30·2		9·7109
June 1	...	8 35 14	36 2·7	9·9101	9·7375
2	...	8 43 12	33 50·2		9·7636
3	...	8 49 52	31 50·8		9·7889
4	...	8 55 29	30 3·4		9·8133
5	...	9 0 16	+28 26·7	9·9255	9·8369

FIREBALLS IN JUNE.—Mr. Denning writes:—The twilight prevailing during the nights of the month of June is not favourable for meteoric work, but fireballs are often numerous and easily seen. During the first week of June many large meteors have appeared from a radiant in Scorpio at about 252°−22°, and they have had unduly long flights and slow motions. There are other striking radiants in Ophiuchus and Antinous. This year a special effort will be made by observers near the end of the month, with the object of ascertaining whether there is any repetition of the rich shower which occurred on June 28, 1916, and was presumably connected with the periodical comet of Pons-Winnecke. On that date the rich cluster of meteors through which the earth passed must have been more than 600 millions of miles from the cometary nucleus, so that the meteors are distributed along a very considerable section of the orbit, if indeed they do not form a complete elliptical stream.

KODAIKANAL OBSERVATORY REPORT.—Mr. Evershed's report on the work of the Kodaikanal and Madras Observatories during 1916 refers to several points of interest besides observations of a routine character. Solar observations were made on 342 days, and spectroheliograms in K light were obtained on 329 days. With the grating spectroheliograph photographs of the sun in H_α light were obtained on 258 days, and it was found that the number of absorption markings due to dense prominences on the disc had increased largely. It is interesting to note that visual spectroscopic observations were continued with reference to such phenomena as metallic prominences and displacements of the hydrogen lines, which are not readily photographed, and to furnish a check on the position angles determined from photographs. The spectrum of Venus was photographed with very high dispersion, and it is expected that besides yielding a fair value of the solar parallax, these plates will give valuable information as to the wave-lengths of solar lines on the side of the sun which is turned 90° or more from the direction of the earth. Mr. Evershed remained at Srinagar, Kashmir, until November 1. He reports that while the results obtained during the summer of 1916 confirmed his original estimates of the general excellence of the climate for solar work, the conditions during the months November to April inclusive did not appear to differ materially from those found in other localities; that is, the definition was generally good in the morning and evening, and poor near midday. In the summer months good definition throughout the day was the rule, and superlative definition was of quite frequent occurrence.

SOUTH GEORGIA.

THE island of South Georgia offers especially instructive evidence as to the geological history of the South Atlantic. Though one of the most isolated of the islands there, its structure is continental, and its geographical relations led Suess to the conclusion that it is a member of an island festoon which included the Falklands, Shag Rocks, Sandwich Islands, South Orkneys, South Shetlands, and Grahamland, and projected as a prolongation of the Andes into the South Atlantic, as the West Indies project into the tropical Atlantic.

South Georgia offers the best opportunities of deciding between Suess's theory and the alternative view that South Georgia and the Falklands are parts of an ancient South Atlantic land. Much new information as to the geology and geography of South Georgia was collected by Mr. D. Ferguson during a visit there made owing to the generosity of Mr. Theodore Salvesen, of Leith. Mr. Ferguson's results have been published in the Transactions of the Royal Society of Edinburgh (vol. l., part 4, Nos. 23–25, pp. 797–836, plates 81–94), and will be also issued in the Papers of the Geological Department of Glasgow University. Mr. Ferguson's account of the stratigraphical geology is illustrated by numerous excellent photographs, a geological map, and sections. This report is followed by papers based on Mr. Ferguson's collections dealing with the petrology by Mr. G. W. Tyrrell, and with the physical geography and palæontology. South Georgia is a long and narrow mountainous ridge, which rises to a height of more than 8000 ft. Its

FIG. 1.—Moraine Flat, glacier, small loch and stream, Cumberland Bay. From the Trans. Roy. Soc. Edinburgh.

central range, the Allardyce Mountains, is capped by perpetual snowfields, which feed numerous icefields and glaciers, some of which enter the sea, while others almost reach it, as is shown by Mr. Ferguson's photograph of Cumberland Bay (Fig. 1). Numerous spurs project north-westward from the central range and the coast is indented by an elaborate series of fiords and fiards. Mr. Ferguson claims that the scenery is the grandest and most picturesque in the Antarctic Islands of the South Atlantic. He compares it with that of north-western Scotland, and his beautiful photographs illustrate some of the resemblances between them. These arms of the sea form magnificent harbours, which are used by the South Atlantic whaling fleet. One of the chief centres, Leith Harbour, is shown in Fig. 2.

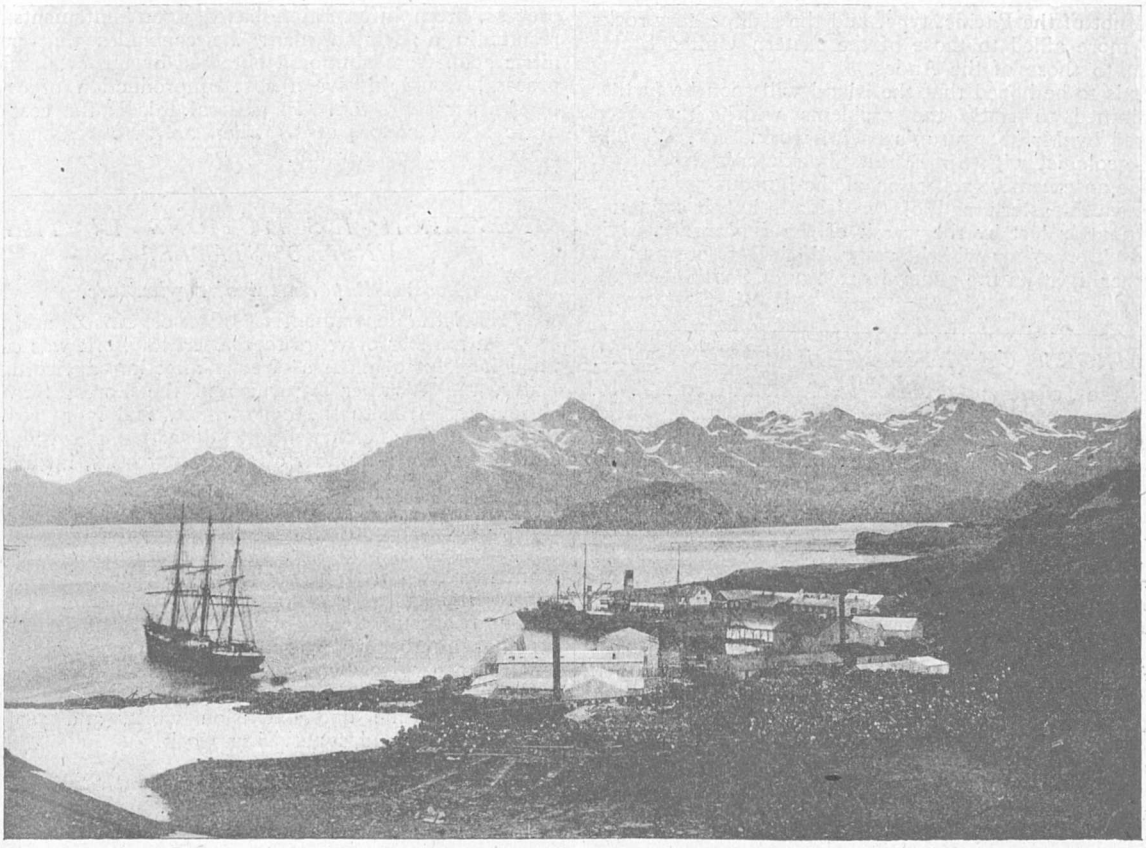

FIG. 2.—Leith Harbour, Stromness Bay, Whale Oil and Guano Works, South Georgia Co., Ltd. From the Trans. Roy. Soc. Edinburgh.

The island is mainly composed of sedimentary rocks, which have been much folded and faulted. At the south-eastern end of the island is an area of igneous rocks, amongst which Mr. Tyrrell has identified granite-porphyry, alaskite, quartz-trachyte, and felsite, and a sill of diabase occurs beside Cumberland Bay. Mr. Ferguson's field of work lay chiefly among the sedimentary rocks, which include phyllites, slates, mudstones, graywackes, cherts, and trachytic tuffs. Their composition is throughout generally similar, though the lowest rocks are the most altered and disturbed. Mr. Ferguson classifies the rocks into two divisions, a lower, or Cape George, series, and an upper, or Cumberland Bay, series. They are together more than 6000 ft. in thickness. The evidence as to the age of these rocks is conflicting. Their lithological character at first suggests that they are Palæozoic, but that is an unsafe guide. The palæontological evidence is difficult of interpretation, for the fossils are badly preserved.

The first fossil was obtained in an erratic block at Moraine Fiord in Cumberland Bay by the Swedish Expedition under Dr. Otto Nordenskjöld; it is a lamellibranch which has been identified as a Mesozoic Posidonomya. Dr. König, of the German Antarctic Expedition under Lieut. Filchner, found an ammonite in the middle part of the Cumberland Bay series; Prof. Pompeckj says that it may be an Acanthoceras, and, if so, is Cretaceous. Some cherts, which were collected by Mr. Ferguson at Cape Pariadin, the south point at the extreme north-west end of the island, contain radiolaria. They have been examined by Dr. Hinde, who regards their age as probably between the Triassic and the Cretaceous; but their evidence is inconclusive, and Dr. Hinde remarks that this view might be modified by further knowledge of these radiolaria.

The Middle Cumberland Bay series therefore appears to be Mesozoic; but the fossils obtained from the Lower Cumberland Bay series in the promontory between Leith Harbour and Nansen Harbour, near the middle of the north-eastern coast, appear much older. The fossils are so crushed that their identification is only put forward tentatively. One of them appears to be a tabulate coral resembling Omphyma. It is associated with some fucoids which resemble *Buthotrephis succulens* from the Trenton Limestone of New York, and with some branched fossils referred to Camarocladia, which occur with Buthotrephis in the Trenton Limestone of Illinois. The fossils have been

examined by Dr. Bassler and Mr. Ulrich, of the National Museum, Washington, who regard them as nearest to Camarocladia. A fragment that may be part of a graptolite was also found, but it is too small for confident identification. The evidence at present available suggests that the lower part of the Cumberland Bay series is Silurian or Ordovician, while the middle and upper parts of the series are Mesozoic. The difficulty in this conclusion is that Mr. Ferguson recognised no stratigraphical break at the top of the Lower Cumberland Bay series; there may be a hidden disconformity which would be easily overlooked, as the rocks above and below that horizon consist of material derived from the same source.

The material collected by Mr. Ferguson is against rather than in favour of the view that South Georgia belongs to an Andean loop, for the igneous rocks that have been determined are of the alkaline or Atlantic, and not of the Pacific, type, and the sedimentary rocks are more allied to those of the eastern United States than to those of the Andes.

It is to be hoped that the island will soon be further examined to settle the problems which have been raised by Mr. Ferguson's useful work. Mr. Wordie, the geologist with Sir Ernest Shackleton's expedition, made an extensive collection of the igneous rocks from the south-eastern end of the island, but it was unfortunately lost by the wreck of the *Endurance*. His field observations will, however, doubtless throw much further light on the general geology of South Georgia.

J. W. GREGORY.

SOURCES OF NITROGEN COMPOUNDS.

IN the *Scientific American* for April 21 Prof. T. H. Norton contributes a valuable article under the heading, "American Sources of Nitrogen." Prof. Norton has given special attention to this important question, and the Department of Commerce published in 1912 an exhaustive report by him on "The Utilisation of Atmospheric Nitrogen." In 1916 Congress appropriated the large sum of twenty million dollars for the purpose of constructing and organising Government works for the production of nitrogen compounds available for military requirements and for general economic purposes.

After outlining the wide application of nitrogen compounds for agricultural purposes, emphasising the importance of ammonia and its compounds in industry, and nitric acid for the production of explosives and dyestuffs, the sources of combined nitrogen are considered, the principal being (1) Chile saltpetre; (2) ammonia; obtained as a by-product from the carbonisation of coal and lignites, and from Mond type gas plants working on coal, peat, etc.; from cyanamide by fixation of atmospheric nitrogen by calcium carbide; synthetically from hydrogen and atmospheric nitrogen by the Haber method; (3) nitric acid; from saltpetre, by the fixation of atmospheric nitrogen by the electric-arc process, and by the oxidation of ammonia by the Ostwald catalytic process. It is shown that Chile saltpetre is subject to wide fluctuations in price, being dependent on current demands, rates of freight, etc. The export duty of 11 dollars per ton levied by the Chilean Government is a heavy addition to cost. The economics of the various alternative methods outlined above are carefully considered in detail.

Cyanamide made at Niagara Falls, on an annual rate for electric power of 12 dollars per horse-power year (h.p.y.), is estimated to cost 28·74 dollars per short ton; 4·12 tons of 20 per cent. cyanamide will yield one ton of anhydrous ammonia; the cost of manufacture will be 30·80 dollars, so that the total cost of one short ton of anhydrous ammonia by this process is estimated to be 149·21 dollars. By the Haber method (synthetically from its elements) it is estimated that the cost should be reduced to 64 dollars per ton, but the method involves technical supervision of a high grade.

Turning to the cost of nitric acid, prior to the war the cost in New York for acid obtained from Chile saltpetre is given as 144·5 dollars per short ton (100 per cent HNO_3), the cost in Hamburg being equivalent to 96·32 dollars. By the Norwegian, or Birkeland and Eyde, process, with electric power at 12 dollars per h.p.y., the pure acid would cost 56·17 dollars. It is claimed that the new American Rankin arc process gives a yield 33 per cent. greater than the Norwegian process per unit of electric power, and Prof. Norton estimates that the cost of nitric acid might be reduced to 41·47 dollars. With reference to the Ostwald catalytic process, from information based upon statements of results in a Belgian plant he concludes that pure nitric acid, from ammonia obtained by the cyanamide process, would involve a cost of production of 63·68 dollars per short ton. In general this is the cost of nitric acid (100 per cent.) when anhydrous ammonia costs 150 dollars per ton.

RESEARCH INSTITUTIONS IN THE UNITED STATES.[1]

Federal Department of Agriculture.

WHEN the department was first organised, and for a number of years thereafter, its work was confined largely to matters directly affecting agriculture. Later, the Weather Bureau and the Forest Service were transferred to the department, and more recent legislation has charged the department with the enforcement of a number of regulatory laws, including those relating to meat inspection, animal and plant quarantine, foods and drugs, game and migratory birds, seed adulteration, insecticides and fungicides, and vaccines and viruses. The income of the department increased from 16,000*l.*, in 1863, to 727,000*l.*, in 1889. In 1915 the expenditure was 5,330,000*l.* There are now about 15,000 employees in the department. Of that number 3000 are employed at Washington, and 12,000 elsewhere. Nearly 2000 persons are engaged in scientific investigations and research, 1400 in demonstration and extension work, and 700 in administrative and supervising work.

Agricultural Colleges and Experiment Stations.

The grants to agricultural colleges under the Acts of 1890 and 1908 are now fixed at 10,000*l.* to each of the forty-eight States, and to Porto Rico and Hawaii, and aid sixty-nine institutions. The total value of the property held by these agricultural colleges is approximately 32,000,000*l.*, and their annual revenue 7,000,000*l.*, of which about 700,000*l.* (10 per cent.) is derived from Federal grants under the above Acts, 3,600,000*l.* (52 per cent.) from State appropriations, and 2,700,000*l.* (38 per cent.) from tuition fees, endowments, and miscellaneous sources.

Statistics show that approximately 53 per cent. of the graduates of the agricultural colleges return to the farm, and that 95 per cent. devote themselves to agriculture in some form, including college and station work. Of those not graduating, practically all return to the land.

The Hatch Act, 1887, provided that in order to aid in acquiring and diffusing among the people of the

[1] From a Memorandum on the Organisation of Scientific Research Institutions in the United States of America by Mr. Gerald Lightfoot, issued by the Advisory Council of Science and Industry, Commonwealth of Australia.

United States information on subjects connected with agriculture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there should be established experiment stations under the direction of the colleges organised under the Morrill Acts. A sum of 8000*l.* per annum was granted to each State for the purpose of conducting researches and experiments. In 1906 the Adams Act was passed, and an additional sum of 1000*l.*, increasing in five years to 3000*l.* per annum, was granted to each State for that purpose. Not more than 5 per cent. of the annual grants can be used for the purposes of land or buildings.

There are fifty-two stations which receive grants under the two Acts, the total amount granted being 285,000*l.* The annual revenue of these stations from other sources is 748,000*l.*, including 515,000*l.* from the State Governments, making a total revenue of 1,033,000*l.*

A national system of agricultural extension work was provided by Congress by the passing of the co-operative Agricultural Extension Act of 1914, commonly known as the Smith-Lever Act. This Act provided that each State receiving the benefits of the Morrill, Hatch, and Adams Acts should inaugurate agricultural extension work in co-operation with the Federal Department of Agriculture.

For that purpose a sum of 2000*l.* per annum was granted to each State (a total of 96,000*l.* per annum), and in addition a sum beginning at 120,000*l.*, and increasing over a period of seven years to 820,000*l.* per annum, is allotted annually to the respective States by the Secretary of Agriculture in the proportion which the rural population of each State bears to the total rural population of all the States. But no payment of these additional appropriations can be made until the State or local authorities have appropriated an equal sum for the maintenance of co-operative agricultural extension work.

All the States have agreed to co-operate under the provisions of the Smith-Lever Act, and formal agreements between the presidents of the State agricultural colleges and the Department of Agriculture have been signed defining the duties and functions of the two parties. In the fiscal year 1915–16 a sum of 216,000*l.* was allotted to the States under the Smith-Lever Act. In addition, direct appropriations amounting to 240,000*l.* were made by Congress for extension work. The total Federal contribution thus amounts to 456,000*l.* This is supplemented by 530,000*l.* from the States. This sum includes 120,000*l.* to offset the equivalent allotment by the Federal Government under the Extension Act. The total from Federal and State sources is, therefore, approximately 1,000,000*l.*

The Forest Service of the Department of Agriculture.

The Forest Service has charge of the administration and protection of the national forests, and also promotes the practice of forestry generally through investigations and the diffusion of information. The national forests are administered in seven main districts, each with its central office in charge of a district forester. The annual expenditure for administration and protection is about 950,000*l.*, the expenditure on permanent improvements 120,000*l.*, and the total receipts 490,000*l.*

In the year 1915 the investigational work of the Forest Service was brought under one direction by the establishment of the branch of research. During previous years the various investigations were correlated by means of investigative committees, but the establishment of a separate branch was deemed advisable to make such correlation more complete, and at the same time to segregate investigational work in accordance with the policy established for the whole department.

The activities transferred to the new branch were:—

(i) Sylvicultural investigations conducted at eight forest experimental stations to determine the best methods of forest management to use in handling the national forests.

(ii) The Forest Products Laboratory established at Madison at a cost of approximately 50,000*l.*, with an annual appropriation which has been increased for the year 1916–17 by 15,000*l.*, making a total of 42,000*l.* a year. The technical sections of this laboratory are (*a*) timber physics, (*b*) timber tests of mechanical properties, (*c*) wood preservation, (*d*) derived products, (*e*) pulp and paper, and (*f*) pathology. It is stated that the results obtained at this laboratory are of great industrial value.

(iii) Economic studies of the lumber and other wood-using industries.

(iv) Fire protection studies, and

(v) Statistical investigations.

The Reclamation Service (Irrigation).

This service was organised in 1902 as a branch of the Department of the Interior, to carry into effect the provisions of the Reclamation Act of that year.

The Reclamation Act, 1902, provided that all money received from the sale of public lands in sixteen of the western States (except 5 per cent. of the proceeds of sales, already set aside for educational purposes) should be reserved as an official fund to be known as the "Reclamation Fund," and to be used for the construction and maintenance of irrigation works in the States specified. The Secretary of the Interior was empowered to locate and construct irrigation works, and to reserve from sale lands required for public purposes. The acreage of the allotments must be such as in the opinion of the Secretary may be reasonably required for the support of a family, and the charges over a period of ten years must be sufficient to return to the reclamation fund the proportionate cost of construction. In this way a "revolving" fund, which now amounts to about 18,000,000*l.*, has been accumulated.

The Bureau of Standards.

The total number of employees in the bureau is about 400, of which 300 are scientific and technical men. The junior scientific men are ordinarily university graduates, who begin on a salary of from 200*l.* to 250*l.* a year. Laboratory assistants and associate physicists and chemists receive from 400*l.* to 600*l.* a year, and physicists and chemists from 600*l.* to 800*l.* It is stated that these salaries are too small. The bureau is frequently losing able men whose place can only be filled by those who are inexperienced. In 1915 the Eastman Kodak Company took six men from the bureau, and the General Electric Company took three. Some men, however, prefer to remain in the bureau even when offered large increases in salary from outside. It should be observed that the loss of men in this way is a defect only from the immediate point of view of the bureau. From the broader industrial aspect it is a distinct advantage to have a Government institution which trains men in research work to go out and take positions as experts in industrial enterprises.

The laboratory grounds cover an area of sixteen acres near Washington, D.C. Experience has shown that the efficiency of the work of the bureau is greatly increased by the location of the laboratories in a section free from the ordinary disturbances of city life. The cost of the land and buildings is approximately 200,000*l.*, and of the equipment about 85,000*l.* The annual expenditure is about 125,000*l.*

The Bureau of Mines.

The Bureau of Mines was established as a separate branch of the Department of the Interior in 1910. Its aims are: (*a*) to bring about greater efficiency and the prevention of waste in the extraction, preparation, and utilisation of mineral products, and (*b*) to secure the safety and health of workers in the mining industries.

In its work the bureau seeks the co-operation of all interested persons, and welcomes the assistance and advice of workmen's organisations, of technical societies, and of State officials and State Governments. It maintains an experiment station and mine at Pittsburgh, where research work is carried on, and where investigations are made as to mining explosions, miners' lamps, and mining equipment, and the efficiency of mine rescue apparatus.

The bureau has given special attention to investigating the causes and methods of prevention of coal-mine explosions, and to safeguarding the lives of coal miners. In addition, coal and other mineral fuels belonging to or for the use of the Government of the United States have been analysed and tested with the view of increasing efficiency in their utilisation. Investigations have been undertaken with the view of increasing the efficiency and preventing waste in the metal-mining and miscellaneous mineral industries, and a considerable amount of research and experimental work in regard to metallurgical problems has been carried out. The expenditure of the bureau is about 120,000*l.* per annum.

The Public Health Service.

The Public Health Service now consists of 450 medical officers and fifty pharmacists, in addition to professors, technical assistants, and other officers. The total staff numbers about 2000, while the annual expenditure is now about 600,000*l.* In the United States public health matters within the limits of any one State are reserved to the States themselves, but the Federal Public Health Service has a broad field of activities, inasmuch as it is responsible for preventing the importation of disease and the spread of disease from State to State, and for assisting the States in the solution of various public health problems.

Through the Public Health Service, the Federal Government co-operates with the health authorities of the States individually and collectively; collects current information of the prevalence and geographic distribution of disease; is responsible for the administration of the inter-State quarantine laws and regulations for the prevention of the spread of disease from State to State; suppresses epidemics; carries on research work in matters pertaining to the public health; maintains the national quarantine for the prevention of the importation of disease from abroad; performs the medical examination of emigrants; regulates the manufacture and sale of vaccines, serums, anti-toxins, and analogous products in inter-State traffic; and furnishes medical care and treatment to various branches of the Government service and to the seamen of the merchant marine.

The Division of Scientific Research controls all matters relating to investigations of contagious and infectious diseases, and matters pertaining to the public health wherever made. In the field it is represented by the Hygienic Laboratory, with its four branches—(*a*) the Plague Laboratory in San Francisco, (*b*) the Leprosy Investigation Station in Hawaii, (*c*) the Pellagra Investigation Station at Savannah, and (*d*) the Station at Wilmington for the investigation of the parasites of man—and by officers engaged in investigations of typhoid fever, Rocky Mountain spotted fever, and other diseases.

The Smithsonian Institution, Washington.

This institution was founded in 1846 under the terms of a private bequest, by which a sum of approximately 100,000*l.* was donated to found "an establishlishment for the increase and diffusion of knowledge among men."

With a view to the increase of knowledge, the institute aids investigators by making grants for research and exploration, supplying books, apparatus, laboratory accommodation, etc. It occasionally provides for lectures, which are published. It has initiated numerous scientific projects, some of which have been turned over to the Government, and resulted in the creation of independent Government bureaux. It advises the Government in many matters of scientific importance, especially in those that have an international aspect. It co-operates with national scientific bodies, such as the National Academy of Sciences, the American Association for the Advancement of Science, the American Historical Association, etc.

The parent institute has the administrative charge of several branches which grew out of its early activities, and are supported by Congressional appropriations. These are the National Museum, including the National Gallery of Art, the International Exchange Service, the Bureau of American Ethnology, the National Zoological Park, the Astrophysical Observatory, the Langley Aerodynamical Laboratory, and the United States Regional Bureau for the International Catalogue of Scientific Literature.

STATE INSTITUTIONS.

Universities.

A large amount of research work is carried on in the universities and other higher educational institutions in the United States in respect both to pure science and to industrial problems. A great part of the research work conducted in these institutions is of a purely scientific nature, and is on the same general lines as that carried out in English and Australian universities. In the "State" universities in America there is, however, a greater tendency for the research work to be more directly associated with the industrial needs and progress of the community. These State universities were established from the revenue derived from land grants, and are maintained partly by means of these grants and partly by means of special taxes on rateable property. In so far as the agricultural and engineering experiment stations are concerned, research work has already been linked up with industry, and proposals have recently been made for the establishment of a National University at Washington, which would serve to organise the work of existing universities on lines more closely related to industrial interests.

Experiment Stations.

Agricultural Experiment Stations.—Reference has already been made to the agricultural experiment stations established under the Hatch and Adams Acts, and to the relations between the Federal and State authorities with respect to these stations. The research work of the stations covers the whole field of scientific agriculture.

Engineering Experiment Stations. — Experiment stations have been established at several of the universities in the United States. These stations have special staffs of officers who are free from ordinary instructional work. Their most important activities are generally in relation to engineering problems, but several of them are also engaged partly in investigational work connected with mining and other special industries. The engineering experiment station at the University of Illinois may be taken as typical of

the best organised and most highly developed of these stations.

The Illinois experiment station was organised in 1903 for the purpose of conducting investigations of importance to professional engineers and to the manufacturing, railway, mining, and building interests of the State. One important factor which led to the establishment of the station was the success which had attended the agricultural experiment station at the same university. It was thought that its establishment was justified in view of the need for scientific research and the application of science to industry.

The cost of maintenance of the Illinois station is about 10,000*l.* a year.

PRIVATELY ENDOWED INSTITUTIONS.

The Carnegie Institution, Washington.

The Carnegie Institution of Washington was founded by Andrew Carnegie in 1902, when he gave to a board of trustees an endowment of registered bonds of the value of 2,000,000*l.*; to this fund he added later the sum of 2,400,000*l.*; so that the present endowment of the institution is 4,400,000*l.*, yielding an annual interest of 220,000*l.*

The articles of incorporation of the institution declare in general "that the objects of the corporation shall be to encourage, in the broadest and most liberal manner, investigation, research, and discovery, and the application of knowledge to the improvement of mankind." Three principal agencies to forward these objects have been developed. (*a*) The first of these involves the formation of departments of research within the institution itself, to attack larger problems requiring the collaboration of several investigators, special equipment, and continuous effort. (*b*) The second provides means whereby individuals may undertake and carry to completion investigations not less important, but requiring less collaboration and less special equipment. (*c*) The third agency, namely, a division devoted to editing and printing books, aims at the publication of the results of research coming from the first two agencies, and, to a limited extent, also for valuable works not likely to be published under other auspices.

The Mellon Institute.

The Mellon Institute of Industrial Research and School of Specific Industries is a privately endowed institution, and is unique in its organisation. It was established with a twofold object, viz. (*a*) to solve problems submitted to it by those engaged in industry, and (*b*) to train young men successfully to prosecute research work. The institute is worked on a system known as the "Industrial Fellowship System." According to this system, an individual or a company having a problem requiring solution may become the donor of a fellowship by contributing to the institute a definite sum of money, for a period of not less than one year. This money is used to pay the salary of the man or men selected to carry out the investigation desired, and the institute furnishes such facilities as are necessary for the conduct of the work. The results obtained belong exclusively to the donor of the fellowship.

The system was inaugurated in 1911, in the Department of Industrial Research of the University of Pittsburgh, and the working of the scheme began in a temporary building erected at a cost of about 2000*l.* In 1913 the present institution was established on a permanent basis by a private endowment of about 100,000*l.* While the institute is an integral part of the University of Pittsburgh and works in close connection with the University, it possesses an endowment of its own and is under its own management. The present annual expenditure for salaries and maintenance is more than 30,000*l.*

The Rockefeller Institute, New York.

The scheme of organisation of this institute is of special interest, as it is regarded by many as ideal for a scientific institution established for a specific field of research. The work of the institute began in 1901, when Mr. J. D. Rockefeller promised the sum of 40,000*l.* per annum for ten years for the purpose of "medical research with special reference to the prevention and treatment of disease." The endowments were greatly increased in ensuing years, and by 1907 reached a total of 700,000*l.* for land, buildings, and equipment, and a fund of 2,100,000*l.* for maintenance. In addition, 200,000*l.* has been given for the equipment and endowment of a department of animal pathology, 100,000*l.* for a pension fund, besides other sums for specific investigations.

The experience of the institute in regard to research work is that the best method is to map out a field in which the more pressing problems arise; then to obtain the best man available in each branch, and to allow him to associate with himself assistants and collaborators and attack the problems in such ways as he may think fit. All that is necessary in the way of supervision is that some broad policy should be agreed upon, *i.e.* as to the general lines of the work and the most important problems, the solution of which is considered feasible in view of the existing state of scientific knowledge. Having decided these broad lines of policy, it is best to allow the persons selected for the research to work the problems out in any way and at such times as they like. It is quite probable, for example, that in attacking some one problem discoveries may be made which will lead directly to the solution of some other allied problem. In the Rockefeller Institute the greatest freedom is allowed to the members in charge of the various laboratories. They know what it is desired to accomplish, but whether to pursue any particular line, or to continue in that line, is left to their discretion. Two things are considered essential in research work, viz.:—

(*a*) To secure the best men available to undertake the research work, and to allow these men to choose their own associates.

(*b*) To give the men appointed the greatest freedom in the prosecution of their researches.

Public pressure is frequently brought to bear upon the Rockefeller Institute to solve particular problems, but the question as to which problems are to be investigated must depend very largely on the state and progress of knowledge in the particular branch of science involved. For example, the institute has often been asked to investigate "hay-fever," but it has refused, as it sees at present no likelihood of solving the problem.

In regard to the separation of research from instructional work the experience is that the best teachers are undoubtedly those who do research work, but it does not by any means follow that the best research men are those who also do instructional work. The question is largely one of temperament.

INDUSTRIAL LABORATORIES.

A large amount of research work having a direct industrial objective is done by private firms in the United States of America. Many large industrial concerns have established their own laboratories and staffs for research work, and in this respect considerable developments have taken place during the past ten years. It is stated by Mr. A. P. M. Fleming, of

the British Westinghouse Company, Ltd. (who visited the United States in the year 1915 for the purpose of inquiring into the organisation of industrial research), that there are probably more than fifty industrial concerns which have established research laboratories on an extensive scale, and that many of these laboratories expend from 20,000*l.* to 60,000*l.* a year on research work.

The Eastman Kodak Company.—The laboratories of this company at Rochester, N.Y., are maintained at an annual cost of about 20,000*l.*, and are generally considered to be among the finest in the country.

The Mulford Company.—This company, founded in 1894 at Philadelphia, affords an excellent illustration of what can be accomplished by the adoption of scientific research and the application of science to industry. The company now has a capital of 400,000*l.*, it employs 1400 persons on wages, and its scientific staff comprises about sixty graduate chemists, pharmacists, bacteriologists, and physicians. The company manufactures drugs, and specialises in the production of serums, anti-toxins, and vaccines.

The American Rolling Mill Company.—This company, which has a number of factories, is a large producer of sheet iron and steel. The laboratories comprise works laboratories in which routine testing and the elimination of manufacturing troubles are dealt with, and a separate research laboratory, established in 1910 at a cost of 10,000*l.*

The Detroit Edison Company.—This company maintains a small research laboratory, partly for the purpose of investigating troubles incident to the smooth working of the technical side of the enterprise, and partly for investigating the utilisation of electrical energy for special purposes.

The National Electric Lamp Association.—This association comprises about twenty electric lamp factories in different parts of the States. The research laboratories, at which there are about 200 employees, comprise fifteen separate laboratories, in addition to a model lamp factory, in which the results of laboratory investigations are tested and developed on a manufacturing scale. Another laboratory is maintained for testing and standardising the products of the factories. There is also a separate department which specialises in the development of automatic tools for lamp making. The scientific and technical members of the staff are drawn almost entirely from the universities.

The Pennsylvania Railway Company.—This company has an extensive research laboratory with a staff of more than 300. The investigations are connected mainly with materials utilised in railway work, and elaborate chemical, physical, and electrical equipment is provided. There is also a laboratory on a workshop scale used for the development of results obtained in the research laboratories.

The National Cash Register Company.—The research laboratory of this company at the works at Dayton, Ohio, is equipped for chemical, physical, and microscopic investigations. The staff of the laboratory numbers fifteen, about two-thirds of whom are university or technological college graduates. But little work of a purely scientific nature is undertaken, the investigations being directed mainly to the elimination of manufacturing troubles and improvements in the materials used.

The General Electric Company.—This company organised a department of chemical and physical research in 1901, with an initial capital expenditure of about 3000*l.*, and an annual expenditure of 600*l.* The investigations undertaken were connected directly with the field of electric engineering. At the present time the capital expenditure on the laboratory exceeds 100,000*l.*, while the annual expenditure is about 50,000*l.* The staff comprises about 200 men.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—An offer from the Rhodes Trustees to subscribe 50*l.* a year for three years for the provision of secretarial assistance for the Standing Committee of the Imperial Studies Committee has been accepted by the Senate with thanks.

The thanks of the Senate have been accorded to the Society of Antiquaries for the renewal for a further period of five years of the Franks studentship founded by them in memory of Sir A. Wollaston Franks, K.C.B., for the promotion of the study of the archæology of the British Isles in its comparative aspects.

The following doctorates have been conferred:—*D.Sc. in Psychology*: Mr. E. N. McQueen, an internal student, of University College, for a thesis entitled "The Distribution of Attention"; *D.Sc. in Botany*: Miss Lilian J. Clarke, an external student, for a thesis dealing with various experiments in botany gardens, and other papers; Mr. R. C. Knight, an external student, for a thesis entitled "The Interrelations of Stomatal Aperture, Leaf Water-content, and Transpiration Rate," and other papers; and Mr. S. G. Paine, an external student, for a thesis entitled "The Permeability of the Neash Cell," and other papers.

As was explained in these columns at the time, the Board of Education in July, 1914, proposed in Circular 849 to institute two annual examinations, a lower and a higher, for grant-earning secondary schools, to be conducted by university examining bodies in close co-operation with the Board of Education. In January, 1916, the Board announced that the proposals must be considered to be in abeyance, as the necessary financial aid was not forthcoming. The Board of Education now announces in Circular 996 the formation of a Secondary Schools' Examinations Council, the main function of which, we learn from the *Times*, will be the co-ordination of the numerous examinations to which secondary schools at present submit their pupils. The new council is to consist of eighteen persons, appointed by the universities and other bodies, including four by the Teachers' Registration Council.

THE Appointments Board of the University of London has issued a pamphlet describing its aims and work. Founded eight years ago, it has had its own secretary for the last six years, and has dealt with 2500 students and graduates, for many of whom it has found posts. While a large proportion of the posts filled have been in the teaching profession, the board is endeavouring to induce a greater number of graduates to enter business houses, and, on the other hand, is pointing out to employers the advantages of having well-educated men and women on their staffs. The present pamphlet gives no hint to intending clients as to the directions in which business openings are most likely to be found, but in a recent report of the board to the Senate of the University it was stated that a great demand exists at the present time for men and women with a scientific training in engineering, physics, or chemistry, and that this demand would probably continue after the war. The supply of such men and women is altogether too inadequate, and it seems to be the duty of our universities to increase the supply as soon as possible. If the experience of the Appointments Boards of the other universities is in any way like that of the London board, the fact is of great interest to the parents of future university students, and should not remain buried in the minutes of university bodies, but should be made known to the public without delay.

WE have received from Mr. Gilbert H. Richardson, of The Gables, Elswick Road, Newcastle-on-Tyne, a "Declaration concerning the Need for Standardising Auxiliary International Language," which he invites the readers of NATURE to sign. The declaration states that there is need for an international language, that there should be only one such language, and that at the close of the war a permanent International Commission should be appointed and financially supported by the Governments of the Powers for the purpose of settling all questions relating to the grammar, vocabulary, orthography, and pronunciation of the auxiliary international language. At the present time there are two such languages, "Esperanto," founded by the late Dr. Zamenhoff, and "Ido," which was proposed in 1901 as a simplification of Esperanto. It is now proposed that there should be a commission to examine both these languages, with power to impose its decisions upon those who wish to employ an international language. Should the commission decide in favour of either Esperanto or Ido, the report would promote the use of the language recommended. In the event, however, of yet a third language being drawn up by the commission, it is doubtful whether Esperantists and Idists would be prepared to adopt this new tongue. The verdict of the commission would depend largely upon its composition. We suppose that the French, Italian, and Spanish members would vote for Ido, while members of the Slav nationalities would support Esperanto. The terminations "aj," "oj," and "uj," constantly occurring in Esperanto, are disconcerting to English readers, who will certainly prefer the general appearance of Ido, which, when printed, looks remarkably like Italian. The circumflex accents over certain consonants, which make Esperanto difficult to print, are discarded in Ido. On the whole, we think that of the two languages Ido would be the more easily acquired by an Englishman.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, May 16.—Dr. Alfred Harker, president, in the chair.—T. **Sheppard**: British geological maps as a record of the advance of geology. Geological changes were often indicated on old topographical maps; consequently, old plans and charts were of use in connection with geological inquiries. Some maps, dating from Elizabethan times, show that in the Humber area great changes have taken place; large tracts of land have been denuded, and many towns and villages have disappeared; and large stretches of reclaimed land marked places where water once stood. Writers of 1595 were familiar with lithological differences in various parts of the country. Strachey (1719) and Packe (1743) produced some remarkable geological sections and plans. The first systematic series of maps, illustrating the geological features of the counties, was issued in the reports of the old Board of Agriculture, and dated from 1793 to 1822. One of the earliest attempts to prepare geological maps was by Prof. Jameson, who read a paper in 1805 "On Colouring Geognostical Maps" (Wernerian Nat. Hist. Soc., vol. i., published 1811). The first strictly geological map was apparently that made by W. Smith in 1799, showing the geological structure of the Bath district. The first geological map of England and Wales was a small one, also by Smith, and it was presented to the society when the first Wollaston medal was awarded to Smith in 1831. The society's collection includes geological maps of Scotland and Ireland, some of great value and historical interest. As examples of privately published maps, those by Sanders of the Bristol Coalfield, Jordan's London district, and Elias Hall's Lancashire area were described.

MANCHESTER.

Literary and Philosophical Society, May 8.—Mr. W. Thomson, president, in the chair.—R. F. **Gwyther**: The specification of stress. Part v. The formal solution of the statical stress equations, and a theory of displacement as consequent on stress. The first portion of this paper is intended to show how the stress equations, given in part iv. and part iv. continued, are capable of simple general solution. Particular integrals are supposed to be dealt with separately, and no attempt has been made to treat of any specific problem. The aim has been to establish a basis for a theory of dealing with stress and displacement by continual steps of approximation, developed in the second part of the paper. In the second part the theory and method proposed are described.—Dr. E. **Newbery**: Recent work on overvoltage. The overvoltages, cathodic and anodic, of a number of electrodes have been measured in acid, in alkali, and in certain solutions of metallic salts under varying conditions of time and current density. Elements in the same group of the periodic system show the same cathodic (hydrogen) overvoltage. Overvoltage is due to the high solution potentials of compounds of the electrode material with the discharged ion, or with a product of the discharged ion. These compounds (hydrides, higher oxides, etc.) form solid solutions in the electrode substance, and are usually stable only under the influence of high pressures or high temperatures. Metal overvoltages (during deposition or dissolution of the metal) are due to the presence of the same compounds which produce gas overvoltages, and are in most cases very low compared with gas overvoltages. Iron, nickel, and cobalt are exceptions to this rule. Changes of overvoltage are produced (*a*) by changes of constitution of the above compounds, and (*b*) by changes of concentration of the solid solutions formed. Passivity is due to the insolubility and good electrical conductivity of the above compounds, which form a protective coating over the attackable metal surface.

PARIS.

Academy of Sciences, May 14.—M. A. d'Arsonval in the chair.—J. **Boussinesq**: Solutions of the problem of thrust, resembling that of Rankine and Maurice Lévy for sand, and sustaining walls of rectilinear profile.—H. Le **Chatelier** and F. **Bogitch**: The refractory properties of clay. From a study of the melting points, it would be concluded that refractory clay bricks ought to serve for the construction of industrial furnaces in steel works. This is not found to be the case in practice, silica bricks being exclusively employed. It is shown that the gradual softening of the clay bricks and loss of resistance to pressure are the causes of this difference, and experiments on the alteration of shape by pressure at increasing temperatures are given. The results are in general agreement with the work of Mellor and Moore.—H. **Douvillé**: The geology of the country to the west of the Pyrenees chain.—L. **Mangin**: Arctic forms erroneously described under the name of *Chaetoceros criophilus*. The Arctic form belongs to a quite different species, and is allied with *C. peruvianus*, with which it has often been confused.—E. **Ariès**: The absolute value of entropy and energy.—E. **Kogbetliantz**: The summation of ultraspherical series.—M. **Pétrovitch**: Arithmetical theorems on Cauchy's integral.—J. **Guillaume**: Observations of comets made with the *coudé* equatorial at the Observatory of Lyons. Observations of Wolf's comet (1916*b*)

on April 26, 27, 28, and May 2, and of Schaumasse's comet on April 27, 28, and May 2.—MM. **Garvin** and **Portevin**: Experimental study of the cooling of various metals by water. A description of experiments on the determination of the cooling curves of metals and alloys suddenly immersed in cold water.—J. de **Lapparent**: The breccias of the Cretacean age in the neighbourhood of Hendaye.—L. **Bordas**: Some points on the anatomy of *Tortrix viridana*.—E. **Sollaud**: The post-cephalic appendages of the Branchiopods and their morphological signification.—A. **Frouin** and R. **Grégoire**: The action of metallic tin and oxide of tin in staphylococcus infections. Tin can be absorbed by the digestive apparatus from metallic tin and from oxide of tin without poisonous effects. The therapeutic value in experimental staphylococcus infections was proved.—R. **Wurtz** and R. Van **Malleghem**: Grave attacks in the so-called benign tertiary fever.

BOOKS RECEIVED.

The Advanced Atlas of Physical and Political Geography. By Dr. J. G. Bartholomew. Pp. 96+general index, pp. 31. (Oxford: University Press.) 8*s.* 6*d.* net.

Annual Chemical Directory of the United States. Edited by B. F. Lovelace. Pp. 305. (Baltimore: Williams and Wilkins Co.) 5 dollars.

Treatise on Hydraulics. By M. Merriman. Tenth edition. Revised, with the assistance of T. Merriman. Pp. x+565 (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 18*s.* 6*d.* net.

A Treatise on the Analytical Dynamics of Particles and Rigid Bodies, with an Introduction to the Problem of Three Bodies. By Prof. E. T. Whittaker. Second edition. Pp. xii+432. (Cambridge: At the University Press.) 15*s.* net.

British Forestry, Past and Present. By Prof. W. Somerville. Pp. 19. (Oxford: University Press.) 6*d.* net.

Radiodynamics: the Wireless Control of Torpedoes and other Mechanisms. By B. F. Miessner. Pp. v+206. (London: Crosby Lockwood and Son.) 9*s.* net.

Experimental Building Science. By J. L. Manson. Vol. i. Pp. vii+210. (Cambridge: At the University Press.) 6*s.* net.

Refractory Materials. Pp. 189. (London: The Faraday Society.) 12*s.* 6*d.* net.

Advanced Text-Book of Magnetism and Electricity. By R. W. Hutchinson. Two vols. Vol. i., pp. vii+372+xii. Vol. ii., pp. vi+468+xii. (London: University Tutorial Press, Ltd.) Two vols., 8*s.* 6*d.*

The Causes of Tuberculosis: together with Some Account of the Prevalence and Distribution of the Disease. By Dr. L. Cobbett. Pp. xvi+707. (Cambridge: At the University Press.) 21*s.* net.

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. i., 1916. Pp. 335. (London: Harrison and Sons.)

Magnetism and Matter. By Kôtarô Honda. Pp. 320+4+3. (Tokyo: Syôkwabo.)

One Hundred Points in Food Economy. By J. G. Ramsay. Unpaged. (London: G. Bell and Sons, Ltd.) 1*s.* net.

DIARY OF SOCIETIES.

THURSDAY, MAY 31.

ROYAL INSTITUTION, at 3.—The Art of the Essayist: A. C. Benson.

FRIDAY, JUNE 1.

ROYAL INSTITUTION, at 5.30.—The Brontës; A Hundred Years After: J. H. Balfour Browne.

GEOLOGISTS' ASSOCIATION, at 7.30.—The Post-Pliocene Non-Marine Mollusca of Ireland: A. S. Kennard and B. B. Woodward.

SATURDAY, JUNE 2.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

MONDAY, JUNE 4.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—British Honduras: Brigadier-General Sir Eric Swayne.

VICTORIA INSTITUTE, at 4.30.—Some of the Relations between Science and Religion as affected by the Work of the last Fifty Years: The Very Rev. H. Wace.

TUESDAY, JUNE 5.

ROYAL INSTITUTION, at 3.—The Flow of Ice and of Rock: Prof. W. W. Watts.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—Links of North and South: Prof. W. M. F. Petrie.

ZOOLOGICAL SOCIETY, at 5.30.—Exhibition on behalf of Messrs. Rowland Ward of Two Zebra-skins showing Abnormal Pattern: R. I. Pocock.—The Poultry Exhibition: D. Seth-Smith.

RÖNTGEN SOCIETY, at 8.15.—Annual General Meeting.—*Resumed Discussion*: The Future of the British X-Ray Industry: Captain R. Knox.

WEDNESDAY, JUNE 6.

GEOLOGICAL SOCIETY, at 5.30.—The Geology of the Old Radnor District, with special reference to Algal Development in the Woolhope Rocks: Prof. E. J. Garwood and Miss E. Goodyear.—A Contribution to Jurassic Chronology: S. S. Buckman.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Some Experiences in the Use of Copper Sulphate in the Destruction of Algæ: G. Embrey.—(1) A Combined Reichert-Polenske and Modified Shrewsbury-Knapp Process; (2) The Differentiation between Coconut and Palm Kernel Oils in Mixtures: G. D. Elsdon.—Orange Pip Oil: Dorothy G. Hewer.—The Estimation of Theobromine: Norah Elliott and G. Brewer.—Rapid Estimation of the Strength of Sulphuric Acid: H. D. Richmond and J. E. Merreywether.

ENTOMOLOGICAL SOCIETY, at 8.

THURSDAY, JUNE 7.

ROYAL INSTITUTION, at 3.—The Art of the Biographer: A. C. Benson.

FRIDAY, JUNE 8.

ROYAL INSTITUTION, at 5.30.—Industrial Applications of Electrons: Sir J. J. Thomson.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, JUNE 9.

ROYAL INSTITUTION, at 3.—The Electrical Properties of Gases: Sir J. J. Thomson.

ARISTOTELIAN SOCIETY, at 8.—(At Cambridge.)—The Conception of a Cosmos: Prof. J. S. MacKenzie.

SUNDAY, JUNE 10.

ARISTOTELIAN SOCIETY, at 8.—(At Cambridge.)—Symposium: Are the Materials of Sense Affections of the Mind?: Dr. G. E. Moore, W. E. Johnson, Prof. G. Dawes Hicks, Prof. J. A. Smith, and Prof. James Ward.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C. 2

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.
Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.