THURSDAY, JULY 27, 1916.

THE NATIONAL AWAKENING.

WHEN the events of the early days of the South African war made men reflect upon the consequences of a conflict with a strong European Power, the nation was partly awakened from its sleep in the Garden of Ease. There were demands for the reorganisation of our forces for peace and war, and an incipient feeling prevailed that the plan of depending upon rule-of-thumb methods and knowledge acquired from endless mistakes—many of them painful—was not completely satisfactory. Over-prosperity was responsible for the lethargy into which we had fallen, and we began to learn in the school of adversity that modern struggles require strenuous preparation for success. With the end of the war, however, the stimulus subsided, and the nation again closed its eyes to the marvellous progress which other countries were making.

We have now been at war for nearly two years with the chief of these countries; and the consequent dislocation of trade and commerce has forced attention upon the ramifications of its influence throughout our Empire. It is realised now more than ever before that the development of our natural resources, and the profitable employment of our discoveries, have been left largely to the initiative of an alien people, and that there must be an Imperial Renaissance if we are to be independent of such enterprise in the future. We entered into the war in defence of international right against an aggressive military Power: we have to see that, when success has been achieved by our arms, the nation is fully prepared for the economic struggle to follow.

The recent activities of many national interests show that the need for a new Imperial policy is widely understood. Political parties have united to present an undivided front to the enemy; and whatever opposition exists to them has for its object the effective prosecution of the war and the promotion of industrial progress afterwards. We hope that the electorate will never again be deluded by the platitudes of the party politician of the pre-war era, and that the line of cleavage will be between obscurantism and progressive development. Commerce, industry, and education have ranged themselves with science to fight inactivity and inefficiency. Educational associations are endeavouring to produce reformed curricula and connecting links between school and university; trade associations and chambers of commerce are asking for the creation of departments of State which will promote the development of industry and research and co-ordinate their efforts; engineers, chemical manufacturers, and other productive bodies have organised themselves for the advancement of their particular interests; and scientific societies have formed a joint committee to deal with matters of national importance. All these bodies are separate organisations, though their aims are the same. It is obviously desirable that, while retaining their individual characteristics, they should, to give them political strength, come together in a single body like the British Science Guild, which represents the interests of education, commerce, and industry, as well as of science.

Without a unifying policy there is little possibility that a sufficient body of opinion will be created to carry into effect the reforms which are being advocated. A series of articles on "The Elements of Reconstruction," which began in the *Times* of July 17, traces the outlines of an economic principle by which "those who are attacking the problem of the industrial reorganisation of the Empire and those who are working for educational reconstruction" may be made to join hands. The State has already assumed full powers of reorganisation towards the scientific foundations of industries concerned with the provision of munitions of war: it should be induced to carry on the same policy after the war, and thus enable the nation to meet the competition of advancing rivals. In business the dominating influence is individual interest, and it will not be necessary to urge the advantages of education and science when the community as a whole really believes that they can be made creators of wealth. These agents must be brought into close connection with economic life if they are to have a decisive voice in national affairs. This does not mean that teachers and men of science should necessarily seek seats in Parliament, but they should associate themselves with any organisation which endeavours to secure supporters for measures designed to increase national efficiency by means of educational and scientific work.

The action of the State when it comes in contact with business must be determined by economic values and represent the action of the community as a whole in the conduct of modern business. The only way in which the community can advance as a whole is by an increase of the total production or an improvement in the quality of what can be distributed. To secure either of these things knowledge must be kept progressive; and, if wisdom is to control the State, provision

must be made for its development to the utmost. It is only by the introduction of these principles into the field of practical politics that the resources of the Empire can be fully developed, and we shall be able to hold our own against the competition of other countries, or maintain that supremacy which was obtained under entirely different conditions by rule-of-thumb methods and speculation.

Mr. Henderson, the President of the Board of Education, referred to the changing conditions, and the need for reform, in his speech in presenting the Education Estimates to the House of Commons on July 18. In the course of his remarks he said:

The war is assisting in the creation of a greater body of public opinion in favour of a more liberal expenditure on education; and the essential importance of a comprehensive and efficient system of education on the progressive development of national life and the solidifying of the Empire is going to be more universally recognised. This principle must be encouraged and fostered, and on no account should the nation, in consequence of its expenditure on the war, be detained from bringing it into action.

The Government has decided to appoint committees to reorganise our whole system of education, and one of these committees will be concerned with the position of science. British educational endeavour has too often proved unproductive because of its haphazard character and its control by men out of touch with modern needs. A classical education at one of the fashionable public schools, followed by something very similar at an ancient university, accompanied probably by the pursuit of some branch of athletics and almost certainly by a continuous neglect of all branches of science, is the typical training of our statesmen and administrators. It is impossible for these men to know what scientific teaching means to the nation, or to understand the real difference between it and purely literary studies. Book-learning may be ornamental to the individual, but it is not of much practical value to a progressive community and is a danger when it prevents attention to scientific things. None of us wish the training of character to be disregarded in education, nor do we desire to depreciate the influence of literature, art, philosophy, and religion. But we have to safeguard our existence both in peace and war, and scientific knowledge is necessary to ensure this aim. The Empire is awake to the need for a policy which will correlate education, science, and industrialism for the benefit of all classes: if our statesmen do not respond to the call to action we hope that a new party of reform will arise to drive them into the wilderness.

SCIENCE FOR LIFE.

Discovery; or, The Spirit and Service of Science. By R. A. Gregory. Pp. x+340. (London: Macmillan and Co., Ltd., 1916.) Price 5*s*. net.

THIS book is the realisation of a long-cherished project, "une pensée de la jeunesse exécutée par l'âge mûr," its ambition being to make clear what science—and natural science in particular—aims at, what its human values are, and what spirit characterises the discoverer. We think that Mr. Gregory has done notable service in submitting his apologia at the present time, when the disposition to turn with expectation to science is probably more widespread than ever in the past, and we would congratulate him on the success with which he has stated his case. For while he hides no convictions, he has written temperately and good-humouredly, with such wealth of concrete and personal illustration that there is no hint of sermonising to offend. Perhaps the only passage in the book which betrays a trace of impatience—and we are not surprised—is one in which the author speaks his mind in regard to politicians. But it is all "good hunting," and the politicians will not wince at worse.

We admire greatly the restrained enthusiasm with which Mr. Gregory writes of the advancement of natural knowledge and of the great masters who have contributed to this, and the carefulness with which he gives chapter and verse from the history of science, so that even a prejudiced reader cannot but be impressed. Contributing greatly to the pleasant temper of the book is the author's evident sympathy with humanistic as well as scientific studies, and his clear recognition that if an antithesis is made there is something wrong either with the science or the humanism. It is ours to warm both hands at the fire of life.

Mr. Gregory is quite clear that scientific work is not confined to any particular body of facts or to any number of laboratories. As Clifford said, "there are no scientific subjects. The subject of science is the human universe—that is to say, everything that is, or has been, or may be related to man." "The work of science," Ruskin said, "is to substitute facts for appearances and demonstrations for impressions." These quotations are taken from a very interesting series (not of uniform value, we must confess), which occur as a sort of intellectual *hors d'œuvre* at the beginning of each of the twelve chapters.

"La République n'a pas besoin de savants," coldly remarked the president of the tribunal of French Revolutionists which condemned Lavoisier to death in 1793, and a "crime against the whole intellectual world" was perpetrated. In such measure as science is wilfully neglected and discoverers are starved or smothered in toil, civilisation remains impenitent, and it is part of the merit of this book that it presses the charge home. The fine chapter on "The Conquest of Disease" illustrates one side of the debt that humanity owes to science, and not less eloquent chapters on

"Scientific Motive" and "Practical Purpose" are very convincing. "Savoir c'est prévoir; prévoir c'est pourvoir." But there is no bowing in the house of utilitarianism, for the author takes such wonders of the modern world as wireless telegraphy, the telephone, the aeroplane, radium, antiseptics and antitoxins, spectrum analysis and X-rays, and shows most circumstantially that "each one of these things had its foundations in purely scientific work, and was not the result of deliberate intention to make something of service to humanity." In this connection we confess to being staggered by a remarkable quotation from the late Prof. W. K. Brooks; we like better one from Prof. A. N. Whitehead that "it is no paradox to say that in our most theoretical moods we may be nearest to our most practical applications."

In the very first volume of NATURE a strong plea was made on behalf of scientific discipline, and from time to time since powerful voices have urged upon the nation the imperativeness of paying more heed to the advancement and application of natural knowledge and to the cultivation of the scouting intelligence. Much has been done which it would be inaccurate and ungrateful to ignore, but still the people perish in thousands for lack of knowledge, and science, as Mr. Gregory says, is still too much the Cinderella in the house of education. It is valuable, therefore, that we should have in this book a judicial and factual statement showing not merely that natural science has given great gifts to mankind and put into our hands the keys to many doors, but that the mastery of some of its methods and the understanding of some of its principles are in themselves an educative discipline that cannot be attained in any other way whatsoever. We are glad that the author has gone a step further in insisting on the ethical value of learning to be a respecter of things and of habituating oneself to a high standard of accuracy.

In his references to the life and work of men like Galileo, Newton, Faraday, Darwin, Huxley, Kelvin, and Pasteur, the author illustrates the spirit of the discoverer—his fanaticism for the sanctity of truth, his disinterestedness and impersonal detachment, his delight in his work, and his cautious yet alert recognition of the possibility of error. As we read of the masters we feel a freshened conviction of the value of studies—far too rarely prosecuted—in the history of science. Much of the book is an eloquent commentary on the text: "The future of our civilisation depends upon the widening spread and deepening hold of the scientific habit of mind." And since the happiness of a people depends not a little on their capacity for the profitable enjoyment of leisure, we welcome the author's insistence on the inexhaustible delights of what our fathers called the pursuit of knowledge. It is man's prerogative to try to know Nature increasingly well, and it is certain that in proportion to his sincerity in this endeavour will be his enjoyment of her acquaintance.

Mr. Gregory has been well advised to dwell at considerable length on certain illustrations of the moods and methods of the discoverer, for the reader thus gets adequate concrete material on which to base an appreciation of his own. This greatly increases the value of the book. It has been quizzingly said that "the man of science appears to be the only man in the world who has something to say, and he is the only man who does not know how to say it." It is unnecessary to mention that Mr. Gregory, at any rate, must be exempted from this reproach, for his style is luminous and refreshing. We find, indeed, but one blemish in his work—that he does not tackle with sufficient directness the very interesting problem of the different kinds of discoverer, for there are certainly several distinct species which it would be profitable to have discriminated.

J. ARTHUR THOMSON.

MATHEMATICAL TEXT-BOOKS.

(1) *Arithmetic.* Part i. By F. W. Dobbs and H. K. Marsden. Pp. xv+353. (London: G. Bell and Sons, Ltd., 1915.) Price 3*s.*

(2) *First-year Mathematics for Secondary Schools.* By E. R. Breslich. Fourth edition. Pp. xxiv +344. (Chicago: The University of Chicago Press; London: Cambridge University Press, 1915.) Price 4*s.* net.

(3) *Mathematics for Machinists.* By R. W. Burnham. Pp. viii + 229. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 5*s.* 6*d.* net.

(4) *A First Course of Geometry.* By Dr. C. Davison. Pp. 89. (Cambridge: At the University Press, 1915.) Price 1*s.* 6*d.*

(1) THIS text-book consists chiefly of sets of examples and test-papers, with some typical solutions. Detailed explanations are left to each teacher to give as he thinks fit. This has the double advantage of keeping the book within reasonable compass and at the same time including as much as any boy is likely to require, for boys do not, and probably never will, read long discussions in the text. But when revising or doing out-of-school work a certain number of specimen solutions are of real use. We like the general appearance of the book; there are numerous interesting and attractive questions, those on contours and map-reading deserving special mention.

(2) The author has drawn up a continuous course of algebra, geometry, and very simple trigonometry, suitable for a first reading. He claims that the fusion of these subjects in a single volume increases the interest of the students, enriches the content of the teaching syllabus, and emphasises the relation between the different subjects. The geometry includes simple properties of parallelism, congruence, tangency, and similarity; the algebra goes up to factors and quadratic equations. The book is printed in a most attractive form, and there are a number of excellent portraits of famous mathematicians, with interesting historical notes attached.

(3) The author of this volume has had consider-

able experience in the training of mechanics, and he remarks on the surprising number of cases where their knowledge of mathematics is limited to the first four rules. This naturally leads to an unintelligent use of formulæ and a marked inability to make applications to practical problems as they arise. The plan of this book is designed to meet these cases. It starts with the use of fractions and decimals, and includes chapters on percentage, mensuration, constructions, trigonometry, and some of a more technical character on lathes, threads, machines, gears, and business organisation.

(4) This small book includes the principal theorems of the first three books of Euclid. It is intended to be used after the ordinary introductory graphical course, and aims at giving the reader a bird's-eye view of a subject to be covered in more detail at a second reading. Those who are familiar with Dr. Davison's larger work will recognise a similarity of treatment in these pages. It would be an improvement if answers to the numerical exercises were given.

APPRENTICE TRAINING.

The Principles of Apprentice Training, with Special Reference to the Engineering Industry. By A. P. M. Fleming and J. G. Pearce. Pp. xiii+202. (London: Longmans, Green and Co., 1916.) Price 3*s.* 6*d.* net.

MANY interesting opinions are expressed in this book, but the same thing is repeated too often under different headings. The authors give particulars of the mode of selecting and training apprentices which was begun in 1913 at the British Westinghouse Company's works at Manchester; all the lecturers are either engineers or foremen, and many of the former are graduates in engineering. Men so chosen are not always good teachers, though they may be excellent as practical men; so future lecturers are being trained from among the apprentices under the supervision of the authors. So far the scheme seems to promise success. In October, 1915, there were 309 apprentices out of a total of 1348 youths in the works; the number of apprenticed boys is increasing. The course, while thoroughly practical, makes reasonable demands on the pupils' intelligence.

On the general question the authors give details as to the present inadequate methods of preparing for work in life both "specialists"—by which term they indicate repetition workers using automatic or semi-automatic machinery—and craftsmen, who need wider experience, skill, and intelligence. They point out that in the elementary schools book-learning is predominant; they show how inadequate is the time spent in manual training and other forms of "doing." They indicate that in the secondary schools most of the pupils are trained as though their main object in life was to pass the entrance examination to a university—although the percentage of such children who become undergraduates is small.

All this is but too true, and there is little likelihood that it will be changed so long as practically all the higher officers in the Board of Education and in the Civil Service generally are selected from those who have had a literary training. For science, modern languages, and manual work are regarded as forms of improper educational "specialisation," and Latin and Greek as the sole means for developing the character and intelligence of British youth; and this, although our naval officers, whose characters and intelligence most of us admire, are trained by means of mathematics and science, and have been deprived of the supposed indispensable benefits of classical training. J. W.

OUR BOOKSHELF.

A Bibliography of British Ornithology, from the Earliest Times to the End of 1912. By W. H. Mullens and H. Kirke Swann. Part i. Pp. 112. (London: Macmillan and Co., Ltd., 1916.) Price 6*s.* net.

WE have not hitherto had an adequate bibliography of British ornithology, for the one by Elliott Coues begun thirty-six years ago was never, we believe, completed, and, excellent as was the first instalment so far as it went, it is, of course, now out of date. The bibliography upon which Major Mullens (who has already done work which may be considered as the basis of the present book) and Mr. Swann have embarked is of an ambitious and comprehensive nature. The aim of the authors has been to give a biographical account of each author of a separately-published work, followed by a bibliography of their works and of their papers contributed to journals bearing on British ornithology. Collations are given and spaced titles of books published before 1850; critical notes also on many books are included.

The first part of the book (of which there are to be six) has now been issued, and fully comes up to the promise of the prospectus. Even in this one part we meet with many books and authors with which few book-loving birdmen were probably previously acquainted. Under the heading "Anonymous" alone there are more than eighty items, and the present biographers have been very successful in hunting down the authors of these. The biographical notices are sufficiently full and, especially in the case of the older writers, very interesting. In fact, the book promises to be not only a very useful work of reference for British ornithologists, but also, what at first sight we might not expect, a very readable and entertaining book. It is well printed on very good paper.

An Elementary Manual of Radiotelegraphy and Radiotelephony for Students and Operators. By Prof. J. A. Fleming. Third edition. Pp. xiv+360. (London: Longmans, Green and Co., 1916.) Price 7*s.* 6*d.* net.

IT is unnecessary to do more than refer very briefly to the third edition of Prof. Fleming's

book, as we have already reviewed the first editions in NATURE, and also, on two occasions, Prof. Fleming's more comprehensive treatise on wireless telegraphy. We ventured then to predict that both these books would become standard manuals on the subject, and our forecast is shown to have been correct by the recurring necessity for the issue of new editions. There is not much difference to be noted between the present volume and its forerunners, but certain additions have been made to bring it up to date.

No doubt when the present war is over much valuable experience which has been gained of the use of wireless telegraphy both in sea and land operations will, by degrees, become public, but one does not look for such information at present. It is to be hoped that this experience may be turned, in due course, to more peaceful ends, in which case one may look forward to a fresh edition of Prof. Fleming's book. In the meantime, it remains the best introduction to the subject for all students, and a sufficient manual for those who intend to take up the practical application, but who do not wish to go too deeply into the theoretical and mathematical side. The book is well and amply illustrated, though some of the process-blocks are not so clear as could be wished.

M. S.

An Inquiry into the Statistics of Deaths from Violence and Unnatural Causes in the United Kingdom. By Dr. W. A. Brend. Pp. v+80. (London: C. Griffin and Co., Ltd., 1915.) Price 3*s.* 6*d.* net.

THE object of this book (a thesis approved for the M.D. degree, University of London) is to examine the official statistics relating to deaths from violence and unnatural causes in the United Kingdom, to investigate their usefulness and the accuracy of the returns, and to suggest modifications in the present system.

Several different authorities (Home Office, Board of Trade, Local Government Board, Registrar-General, etc.) compile the returns, but the different reports do not seem to be co-ordinated. Thus during the same period the deaths from alcoholism in Liverpool are given by the Registrar-General as 36, by the Home Office as 113; the Local Government Board records deaths from "starvation and privation" as 94, the Home Office ("want and exposure") as 231, and the Registrar-General ("cold and starvation") as 146, and these instances might be multiplied!

More accurate returns are needed in many instances. The importance, for example, of trustworthy information concerning infant mortality from overlying and deaths of children from burning is obvious.

Dr. Brend's analysis shows that there are classes of deaths of which our knowledge, both statistical and otherwise, is seriously inadequate. At present, for example, the records of coroners' courts are practically inaccessible; the suggestion is made that all the records should be sent to a central office where they could be further analysed.

LETTERS TO THE EDITOR.

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

The Universities, the Technical Colleges, and the Army.

A COUPLE of months ago it occurred to myself and the staff of the Heriot-Watt College that the first-year engineering course for the diploma would—with a few modifications—form an excellent preliminary scientific training for boys entering the Army who might hope for promotion to an officer cadet unit, the course at the same time still to remain an integral part of our diploma course.

The suggestion did not meet with local approval, but while thinking out the details, I also brought the matter before the Board of Education and the Association of Technical Institutions, where, I gather, it is meeting with some attention. I also found that similar suggestions had already been made by Mr. Darling in NATURE (January 20 and February 10) in some communications which I had missed, and also that a similar scheme was being carried out in certain English public schools.

Among those to whom I wrote was the Vice-Chancellor of Leeds University, and I have just heard from him that in his hands the whole scheme has taken a wider aspect, the idea being to devise courses of training which, while valuable as a preliminary scientific training for boys entering the Army, will at the same time be allowed to qualify as part of the course required for a university degree. It is on account of this wider aspect given to the matter by Principal Sadler that I venture to write to you on the matter.

The idea, which I believe originated with Lord Haldane, of drawing upon the universities for officers in the Army, and the establishment of the O.T.C., is no doubt a sound one. At the same time, at that stage the conception seemed to be to allow a student to go on with his ordinary university course while giving him in his spare time a certain amount of *military* training on the lines required by an officer.

It seems to me that among us we have evolved a much sounder conception of the duties of the university towards the Army, and that is, to give the boys such a *scientific* training as will be of value to them when they go to their special *military* training. There can be no harm in giving them a little drill, but the main object of the universities and the technical colleges should be to devote the time at their disposal principally to laying the foundations of the scientific knowledge of which modern warfare is an application.

A. P. LAURIE,
Principal.

Heriot-Watt College, Edinburgh, July 18.

The late M. Joseph Déchelette.

OF the many scientific men who have fallen in the present war none calls forth a deeper note of regret than the eminent and promising French archæologist and anthropologist, M. Joseph Déchelette, who was killed while leading his company to attack on October 4, 1914. A committee, embracing all the leading archæologists and anthropologists of France, has been formed "de conserver son effigie et de glorifier sa mémoire." The committee has secured the co-operation of the sculptor, M. Henry Nocq, to prepare a portrait plaque with, on the reverse: "L'épée moderne

de l'héroïque capitaine s'y croisera, au travers d'une large couronne de lauriers, avec le glaive de la grande époque gauloise que l'archéologue a si bien fait revivre." Nor can one abstain from quoting from the circular, which has been sent out by our colleagues in France, the following sentence:—"C'est l'unité d'une carrière riche d'œuvres, plus pleine encore de promesses, que rappellera la légende: GALLIAE • RELIQUIAS ILLUSTRAVIT • PRO • GALLIA • MILES • CECIDIT."

There is not a British archæologist or anthropologist who is not indebted to M. Déchelette, and I am certain they will be only too glad to participate in a movement which has been rightly initiated by their French colleagues. Subscriptions should be sent to M. le Comte O. Costa de Beauregard, Sainte-Foy, par Longueville (Seine-Inférieure). Those sending a subscription of 10 francs are entitled to a replica of the plaque in bronze, those giving 50 francs to one in silver, and those giving 80 francs to one in enamel, should they so wish.

ARTHUR KEITH,
President of the Royal Anthropological Institute of Great Britain and Ireland.
50 Great Russell Street, W.C.

A Sunset Phenomenon on July 22.

AN interesting sunset phenomenon was visible here at 8.10 p.m. G.M.T. on Saturday last, July 22. Two very well-marked dark bands were seen rising from the south-eastern horizon across the pale pink counter-glow. On the north-western horizon the tops of two very distant cumulo-nimbus clouds were visible, the tops being about half a degree above the horizon; the clouds were dark against the sunset, but their upper edges were bright. The dark bands were the shadows of these clouds projected right across the sky. The shadows could be followed for some distance from the clouds, but were not visible in the plane at right angles to the direction of sunset. They were visible for quite ten minutes after I first noticed them, by which time the twilight arch was some way above the horizon and the dark bands rose from it. The two cumulo-nimbus clouds and a small patch of cirrus were the only clouds visible; their bearings were 302° and 305° respectively. An inquiry by telephone elicited the fact that no clouds were visible at Benson Observatory, and the cumulo-nimbus must have been at a great distance. It would be of some interest to know this distance, and I should be very grateful to any readers of NATURE in Herefordshire, Wales (especially Anglesey and the west coasts), and any part of Ireland roughly between Co. Dublin and Sligo and Donegal Bays, if they could let me know the character of the weather at the time mentioned, whether any cumulo-nimbus clouds were noticed, and especially if rain or thunderstorms were experienced, or even merely whether the sky was clear or cloudy. I fear the weather of a week ago is not often remembered, but it is possible that some of your readers may recollect it or have recorded it.

Had the clouds been more numerous the shadows would have encroached more on the sunset glow and on the counter-glow, and the appearance would have resolved itself into crepuscular rays, the explanation of which has been a matter of some discussion.

C. J. P. CAVE.
Meteorological Office, South Farnborough, July 24.

Silvanus P. Thompson as a Painter.

THE late Prof. S. P. Thompson was a man of such extraordinary versatility and power that his artistic side was scarcely done justice to in the Press. It may therefore be interesting to put on record what our friend, George Flemwell, the well-known painter, naturalist, and writer, living in Switzerland, says in a letter from Zermatt:—

"To my mind enough has not been said of his power for rendering ice in water-colour. I knew nobody to touch him in the painting of glacier ice at close quarters." (I believe Mr. Flemwell, himself a distinguished painter of Alpine scenery, has seen little of Edw. Compton's work.) "And his method was, considering the excellence of the result, the simplest and most direct I have ever seen. With the utmost care he worked with great quickness and facility. A few simple washes, and there was the ice: its form, its structure, and its quality. His values were right and his colour clean; he got the body and substance of the glacier. I am happy to think I have two or three pencil sketches I made of him when he was working on the Glacier d'Argentière and at the Mer de Glace; and I was with him when he painted the original of the Christmas-card of which you speak. . . ." H. S. T.
Bristol, July 17.

The Utilisation of Waste Heat for Agriculture.

MR. C. TURNBULL'S scheme (NATURE, July 20, p. 422) for artificially heating the soil, if feasible, would tend to encourage the insect pest. As all farmers and fruit-growers are aware, this has of recent years increased to an alarming extent. But for the seasonal lowering of the soil temperature it would become more serious still.

C. CARUS-WILSON.
Casterton, Kirkby Lonsdale, July 22.

THE INDIAN BOARD OF SCIENTIFIC ADVICE.

THE Report for the year 1914-15 of the Board of Scientific Advice for India consists almost entirely of isolated summaries of the work done during the year by the several scientific departments and scientific institutions of the Indian Government. As most, if not all, of these departments and institutions issue independent annual reports of their own, it is, to say the least, disappointing to find these technical summaries filling the report of a scientific body styled advisory; unless, indeed, the term "advice" be understood in the commercial or notificatory sense as merely indicating the existence in working order of these various departmental instruments of research.

The advisory proceedings of the Board occupy only thirty-seven lines of the 180 pages of the report, and all the information they afford is that the Board accepted the programmes of the several scientific departments, but would rather not have them in so much detail in future; and that it recommended (*a*) that officers attending the next Indian Science Congress should be regarded as on duty, (*b*) that a catalogue of scientific serials prepared by the Asiatic Society of Bengal should be published at the expense of Government, and (*c*) that experiments should be undertaken, as requested by the Punjab Veterinary Department, to determine the vitality of rinderpest virus under Indian conditions—all three mere departmental

matters that scarcely need to be referred to a special advisory board.

Of any far-reaching advisory purpose, of any great original directive enterprise, of anything in the nature of spontaneous movement, this report shows no record; one looks in vain for any reference to scientific education, or even for a connected account—as contrasted with bald, disjointed departmental summaries—of the general progress of science in India, vital affairs in which a Board of Scientific Advice might be expected to exercise a missionary influence, if not to take a commanding lead.

The simple fact is that, so far as the advisory business goes, this Report of the Board of Scientific Advice for India is a document of the *ex officio* genus; and it can scarcely be otherwise when the President of the Board is merely an *ex officio* hierarch of the Indian Secretariat, instead of being a man of science specially selected for his critical knowledge of scientific affairs.

ELIAS METCHNIKOFF. 1845-1916

ONE of the most remarkable figures in the scientific world passed from among us on July 15. Elie Metchnikoff, as they wrote his name in France, his adopted home, stands out as the type of a gifted, indefatigable investigator of Nature who, in accordance with his beautiful and earnest character, never faltered in his career, but from his boyhood onwards devoted himself to the minute study of animal life, and by a natural and as it seemed inevitable process passed through the study of the microscopic structure and embryonic growth of simple marine organisms to the investigation of human diseases and his great discoveries of the nature of the process known as inflammation and of the mechanism of "immunity" to infective germs and the poisons produced by them. By every zoologist in the world he was especially honoured and revered; for it was to him that we owed the demonstration of the unity of biological science and the brilliant proof of the invaluable importance to humanity of that delightful pursuit of the structure and laws of growth and form of the lower animals which he and we had pursued from pure love of the beauty and wonder of the intricate problems of organic morphology.

Just as his chief and friend, the great Pasteur, was privileged to proceed directly and logically in his own life's work, by his genius and insight, from the discovery of astonishing new facts as to crystalline structure—which seemed to have no bearing on human affairs—to the understanding (by the aid of those discoveries) of fermentation and infective disease; so did Metchnikoff himself both discover the activity and universality of the organic cell-units which he called "phagocytes," and at once proceed to demonstrate their prime importance in the process known as inflammation and the understanding of "immunity," which has revolutionised medical theory and practice.

Elie Metchnikoff was born in 1845 at Ivanavka, near Kharkoff. His father was of Moldavian ancestry and an officer of the Imperial Guard, from which he retired with the rank of major-general. He was devoted to the pursuits of a country gentleman, among which horse-racing was his special favourite. He had no tendencies to scientific study. Elie's mother, whose family name was "Nevakóvitch," was a Jewess. He owed his mental gifts largely to her. From childhood he showed a strong taste for the study of Nature. After passing through the high school of Kharkoff he entered the university at the age of seventeen and completed his degree examinations in two years, when he went off (in 1864) to Germany for further biological training. He had already, in 1863, when he was only eighteen, published a paper in Reichert's *Archiv* on the stalk of Vorticella, and another on the nematode Diplogaster. In 1864 he published some observations on the Acinetarian Sphærophrya. After a brief sojourn in Heligoland he went to work in Leuckart's laboratory at Giessen, and accompanied the professor to Göttingen when the latter was promoted to that chair. In Leuckart's laboratory he worked at the parasite of the frog, *Ascaris nigrovenosa,* and made the important discovery of the fact that the hermaphrodite parasite of the frog's lung hatched from eggs gives birth viviparously to a free-living generation of males and females. This he published in 1865 in Reichert's *Archiv,* and a translation of his paper appeared in the *Quarterly Journal of Microscopical Science* in 1866. Leuckart claimed to have made the discovery "with the assistance of Herr Mecznikow," but Metchnikoff briefly stated that this was erroneous and that he alone had done the work in the absence of Prof. Leuckart and without his aid or suggestion. Naturally this terminated their friendly relations. In the same year he published some notes on those little-known microscopic animals, Icthydium, Chætonotus, Echinoderes, and Desmoscolex. This also was translated for the *Quarterly Journal* in 1866, and thus I became familiar with his name and the interesting character of his work, though I did not make his personal acquaintance until twenty-two years later, when (in 1888) Pasteur introduced me to him in his laboratory in the rue Vaugirard.

These papers were rapidly followed in 1866 by others showing his first-rate powers of accurate observation and originality, viz. on a European land Planarian; on the development of Myzostomum, the ecto-parasite of the feather-star, which he showed to be a modified Chætopod; on insect embryology (Hemiptera and Diptera); on the remarkable new rotifer, *Apsilus lentiformis*; and on the viviparous reproduction of the larvæ of the fly Cecidomyia. Then he sojourned for a time (1867) at Naples (before the days of Dohrn's Zoological Station) and wrote on the embryology of the cuttle-fish Sepiola, on the strange marine forms Chætosoma and Rhabdogaster, and in 1869 on Tornaria (which he showed to be the larva of Balanoglossus) and on the embryology of Echinoderms and of jelly-fish.

In 1870 he was appointed professor ordinarius

Appreciation.

of zoology in the University of Odessa, and soon afterwards published papers on the embryology of Chelifer and of Myriapods. In the previous year he published an interesting paper on the little nematode parasite of fishes' gills—Gyrodactylus—and joined with that fine naturalist, Claparède, whom he met at Naples, in a paper on the embryology of Chætopods.

After his appointment at Odessa his work was interrupted by the illness and death from tuberculosis of his first wife, whom he had married in 1868. In spite of every care and a long sojourn in Madeira, whither he accompanied her, she died there in 1873. But in 1874 we find a paper by him "On the Eyelids of Mongolians and Caucasians," of considerable value to anthropologists, and in 1877 one of a bionomic character on "The Struggle for Existence between Two Species of Cockroaches—*Periplaneta orientalis* and *Blatta germanica*."

In 1875 he married his second wife, Olga Belocoyitoff, who was only seventeen years of age. She had just completed her studies in the "lycée" of Odessa, and attended after her marriage her husband's zoological teaching in the university. She survives him, and was his constant companion and ceaselessly devoted friend and helpmeet. She often aided him in laboratory work and by her knowledge of English and other languages, though her own special gifts, which she has cultivated to a high degree of excellence, are in painting and sculpture. From time to time she has published her own contributions to subjects which were occupying her husband's attention. The earliest of these is one "On the Morphology of the Pelvis and Shoulder-girdle of the Cartilaginous Fishes," published in the *Zeitsch. wiss. Zoologie*, 1880.

Metchnikoff holds an important place beside his great fellow-countryman and intimate friend, Alexander Kowalewsky (who died some years ago), in the establishment of what may be called cellular embryology and the investigation of the early stages of development of invertebrata by following out the process of cell-division and the arrangement of the early formed cells in layers. In the twelve years 1875 to 1886, when his last embryological paper was published, he produced many important memoirs on cellular embryology—namely, on that of calcareous sponges (in which he showed that the inner and outer primitive layers had been transposed in regard to their origin by Haeckel and Miklucko-Macleay); on that of jelly-fishes, of Planarians, of Echinoderms, of Ctenophora, and of Medusæ. These were accompanied by important theoretical discussions and suggestions as to the ultimate ancestral origin of the endoderm and the mesoblast. He also wrote on that curious group of minute parasites, the Orthonectids, and on insect diseases.

But the new departure in his fruitful career was approaching. It grew out of his observations on living jelly-fishes and sponges and on the transparent marine embryos of Echinoderms and the transparent floating mollusc Phyllirhöe. In 1882, owing to political disturbances in the University of Odessa, Metchnikoff migrated to Messina, the harbour of which is celebrated among zoologists for its rich fauna of transparent floating larvæ and adult glass-like Pteropods and jelly-fishes. Here he developed his views, already foreshadowed in 1880 (*Zoolog. Anzeiger*), on intracellular digestion exhibited by the amœboid cells of animal organisms, and published a series of papers in which the name "phagocyte" is first applied to these cells. In this, as in similar cases of discovery, neither Metchnikoff himself nor any of his friends claimed that he was the first to observe all the facts leading to his generalisation. He was *not* the first to witness the ingestion of foreign particles, of fragments of dead tissue, and even of bacteria, by the amœba-like cells of the animal body. He knew and cited the early observations of Haeckel on the ingestion of pigment granules by the amœboid blood-corpuscles of the sea-slug Tethys. He knew and cited the numerous observations on the activity of large amœboid cells in assisting the resorption or rapid destruction of other tissues in some special instances. He knew the observations of Jeffrey Parker and others on the intra-cellular digestion of food particles taken into their substance by the endoderm cells lining the digestive cavity of Hydra. He knew Koch's observation of bacilli within a colourless vertebrate blood-corpuscle, attributed by that observer to the active penetration of the blood-corpuscle by the aggressive bacilli. These and other like instances were all regarded as exceptional by their observers and not interpreted as evidences of a definite and universal activity of the amœboid cells of large physiological significance. Metchnikoff was acquainted with the remarkable discoveries of Cohnheim, Stricker, and others (in some of which I had a pupil's share during my stay in the winters of 1869-70 and 1870-71 at Vienna and Leipzig respectively). The pathological laboratories were full of observations and talk about the "diapedesis" and "outwandering" of the amœboid corpuscles in inflamed tissues, the origin of pus-corpuscles, and the activity of the amœboid cells in the stellate cavities of the frog's cornea and other connective tissues when stimulated. Metchnikoff put two and two together, and formulated the proposition that in all multicellular animals the main function of the cells derived from the deep or mid-embryonic layer between the dermal and intestinal lining layers is nutritional, and that they possess the power of ingesting and digesting—as does an amœba—solid particles, whether such particles are introduced from the outside or are parts of the organism which, owing to one reason or another, must be broken up and removed. The amœboid cells in connective tissues and in the blood and lymph are such eater-cells or phagocytes, as he now termed them.

He at once proceeded to explain the significance of these phagocytes and their utility to the organism, not only by pointing to their work as scavengers removing injured and dead tissue, to which

they are brought in hundreds of thousands by the process known as inflammation, but he also immediately gave first-class importance to their recognition by connecting them with Pasteur's great discoveries as to the cause of infective diseases by poisonous "microbes" which intrude into previously healthy organisms, and he further connected his generalisation with Darwin's theory of the origin of species by the natural selection of favoured races in the struggle for existence. He published in 1884 an essay entitled "The Struggle of the Organism against Microbes," in which he maintained the thesis that the phagocytes, universally present in multicellular animals, have been developed and established by natural selection in the animal organism as a protection against intrusive disease-causing bacteria.

He was able in 1884 to observe and give illustrative drawings of a demonstrative case of the activity of the phagocytes in the blood of a transparent fresh-water flea (Daphnia) when it was infected by a yeast-like parasite called Monospora. This parasite frequently makes its way into the blood of the water flea and, multiplying there, often causes death. Metchnikoff watched with his microscope and made careful drawings of the phagocytes as he saw them in the living flea engulfing and digesting the intrusive Monospora. In some cases the phagocytes, in others the Monospora, got the upper hand. Later when I knew him he had a small aquarium dedicated to the cultivation of these demonstrative water fleas and their infective microbe.

Having now determined to give up his zoological and embryological researches in order to devote the rest of his life to the development of his doctrine of "phagocytosis," Metchnikoff accepted the invitation to become director of a new bacteriological laboratory at Odessa, but, finding the conditions there not favourable to his special work, he relinquished the post in 1888 and, having fortunately been cold-shouldered in Berlin, came to Pasteur in Paris, who, thoroughly appreciating the value of his work, gave him a laboratory and every facility for his investigations in his own institute, at that time located in the Ecole Normale, rue Vaugirard. When a few years later the Institut Pasteur was built in the rue Dutot Metchnikoff was given a fine suite of laboratories, lecture-room, and space for keeping animals, and became sub-director of the institute a few years ago.

Young investigators now came in growing numbers to Paris in order to work in Metchnikoff's laboratory, and he pursued with triumphant success, but not without opposition and sometimes insult from the older and more ignorant medical men, the establishment of his views as to the essential importance of "phagocytosis" in resistance to disease. Among his more fatuous opponents was a prominent English pathologist who scornfully alluded to his views as "Metchnikoffism."

In 1892 he produced as an illustrated volume, with the title "The Comparative Pathology of Inflammation," the substance of a course of lectures delivered at the Institut Pasteur. It is one of the most delightful examples of scientific method conceivable. It is essentially a careful and logical presentation of minute observations arranged so as to bring before the reader the evidence in favour of his argument. He invariably followed this method in the controversies in which he necessarily engaged. He never recriminated; he never cited mere authority nor endeavoured to falsify his opponent's statements by "smart" word-play. He simply made new experiments and observations suggested by his adversary's line of attack, and so practically smothered him by the weight of honest, straightforward demonstration of fact. He showed that in the lower animals the phagocytes are attracted in hundreds by "chemiotaxis" to intrusive or injurious bodies which occur in the tissues, and then either enclose or digest them. He proceeded to show that in the vertebrates, where the immense network of the blood-vessels is under the control of the nervous system, "inflammation" is set up as a curative process, and that the elaboration of its mechanism has been established by natural selection. A local arrest of the blood-stream is produced by the nerve-control of the vascular system, resulting in the out-wandering from the now nearly stagnant blood of phagocytes chemically attracted to an injured spot, where, arriving like an innumerable crowd or army of scavengers, they proceed to engulf and digest tissue which has been killed by injury, and similarly to isolate or to destroy and digest injurious intrusive substances, prominent among which are infective poisonous bacteria.

Metchnikoff thus finally and conclusively "explained" the process called "inflammation." His attention and that of his pupils was now given for some years to the great question of "immunity." How is it that some individuals are either free from the attacks of parasitic micro-organisms to which their fellows are liable, or, if attacked, suffer less seriously than others do? To answer this question is to go a long way to the solution of the great practical question as to how to produce immunity to infective disease in man. It involved the investigation of the chemical activities of the phagocytes, to the knowledge and theoretical understanding of which a great number of highly gifted leaders of experimental inquiry—to name only Ehrlich, Behring, and Almroth Wright—have contributed in the most important way. It is impossible on this occasion to enumerate or even indicate the large series of investigations and records of experiment now continuously produced by Metchnikoff or by assistants under his immediate supervision. The *Annales de l'Institut Pasteur* are largely made up of these records and discussions. In 1901 Metchnikoff produced his great book on "Immunity in Infectious Diseases," an English translation of which was at once published. The subject branched out into various lines, such as are indicated by the names serotherapy, toxins and anti-toxins, hæmolysis, opso-

nins, and bacteriotropins. It must suffice here to state that Metchnikoff successfully established the doctrine that it is to the healthy activity of our phagocytes that we have to look not only for temporary protection, but for immunity against the micro-organisms of disease.

Since 1901—until he fell ill last winter—Metchnikoff was incessantly active in his laboratory, working there from early morning until evening, when he took train to his country house on the heights above the Seine. Rarely would he tear himself away from his absorbing work to enjoy a holiday. He went a few years ago to Astrachan, on the Caspian, to inquire for the Russian Government into the occurrence of bubonic plague in that region, and studied also the incidence of tuberculosis in the town populations and among the Kalmuck Tartars. On the latter subject he gave (in response to my urgent request) a valuable lecture in London before the National Health Society (in 1912), and on other occasions he made short visits to this country in order to receive honours and deliver special discourses—as at the Darwin celebration at Cambridge in 1909. The variety of infective diseases to the experimental investigation of which he turned the resources of his laboratory and his theoretical conceptions is truly astonishing. As late as 1911 he wrote: "Perhaps before long it will be possible to explain diabetes, gout, and rheumatism by the injurious activity of some variety of microbe" (preface to the invaluable volume, "Microbes and Toxins," by Dr. Etienne Burnet, published in London by Heinemann).

In 1903 he found time to write a profoundly interesting popular book, "The Nature of Man" (London: Heinemann), in which, among other things, he discourses of old age, and his view that unhealthy fermentation commonly occurring in the large intestine produces poisons which are absorbed, and lead to deterioration of the tissues of the walls of the arteries, and so to senile changes and unduly early death. He satisfied himself, experimentally and clinically, that the use of "sour milk" as an article of diet checks or altogether arrests this unhealthy fermentation in the intestine by planting there the lactic bacillus which, forming lactic acid, renders the life and growth of the bacteria of those special poisonous fermentations (which cannot flourish in an acid environment) impossible. Hence he himself daily took a pint or so of sour milk, and he recommended it to others and arranged for the commercial preparation of a particularly pure and agreeable "sour milk," from the sale of which he scrupulously abstained from deriving any pecuniary profit. This small, though valuable, adventure of his in dietetics has been—unfortunately, but perhaps inevitably—the one and only feature of his long career of vast scientific discovery which has impressed itself on the somewhat erratic intelligence of the "man in the street."

Metchnikoff was a foreign member and Copley medallist of the Royal Society, a member of the Institute of France, of the Academy of Sciences of Petrograd, and of many other societies. In 1908 he was awarded the Nobel prize for his researches on immunity, and he received only a fortnight before his death the announcement that the Albert Medal of the Society of Arts of London had been this year awarded to him in view of the benefit to humanity of his scientific discoveries.

I cannot close this imperfect survey of the impressive and ideally complete career of my friend without some few personal notes. From the day when I met him in Pasteur's laboratory in 1888 we became warm friends. He was singularly simple, genuine, and unaffectedly good and unselfish. I could tell a hundred tales of his benevolence and humane spirit; of the unrecorded charitable aid given by him and his wife to the poor of Paris and to expatriated Russians; of his exquisite politeness and consideration to all those who were his servants. I am convinced that the devotion of the latter half of his life to the solution of the problems of disease was due to his goodness of heart and his ardent desire to alleviate human suffering. He never was a smoker, and twenty years ago gave up the use of alcohol entirely. He had no taste for sport of any kind, and never indulged in "recreations" or "amusements" or big social functions. He was a devoted lover of music, and had much knowledge of art and many friends in the great art world of Paris. His beard was large and his hair long, and he was thick-set and muscularly strong, though he became more and more bent, as the years went on, by his constant stooping over the microscope. No year passed, after I first knew him, without my spending some time with him and Madame Metchnikoff in Paris or in their home at Sèvres, and on several occasions he has stayed with me in London or earlier in Oxford. From time to time he has shown to me the experiments and microscopic evidence upon which his own and his pupils' discoveries were based, and has put before me the preliminary hypotheses by aid of which he was seeking—as opportunity offered—to arrive at further knowledge of appendicitis, syphilis, the yaws, infantile paralysis, green diarrhœa, cholera, tubercle, cancer, diabetes, gout, and rheumatism. Only three years ago he carried out some new researches on a zoological subject—the natural removal of black pigment from the wing-feathers of gulls—which he proposed to publish in the *Quarterly Journal of Microscopical Science*. But the terrible events of the last two years put such work out of his power. In his last moments he insisted very urgently that an immediate autopsy should follow his death. He had suffered for six months from pneumonia, pleurisy, and latterly bronchitis. The autopsy showed atheroma of the aorta and related cardiac disease. Metchnikoff died in the apartments of the Institut which had been assigned as a dwelling to Pasteur. According to his wish, his remains have been incinerated, and the urn containing his ashes will be placed in the library of the Pasteur Institute.

E. RAY LANKESTER.

SIR VICTOR HORSLEY, F.R.S.

SIR VICTOR A. H. HORSLEY, whose death on July 16 we record with the deepest regret, was born in 1857 of a family long distinguished for ability in natural science and the arts. His descent was chosen by Galton to illustrate the view that unusual talents are hereditary in certain stocks of the community in this island.

On leaving school he entered University College, and carried all before him. He early showed his interest in the physiology of the nervous system, and in 1884 published a study, with Prof. Schäfer, on the functions of the marginal convolution. The same year, at the early age of twenty-seven, he was appointed professor-superintendent of the Brown Institution, a post much coveted by physiologists. His energy and enthusiasm, coupled with his astonishing youth, were a revelation to all who came into contact with him. In his company work became a fascinating game, and never was there such a keen playmate. He was singularly attractive, with a charming voice and infectious laugh; his manner was boyishly unaffected, and as he struck out one line after another in the application of physiology to medicine our enthusiasm was unbounded. He was always sincerely interested in the work of others, and would devote much time and energy to understanding it thoroughly. Throughout his period at the Brown Institution he worked more particularly at hydrophobia, and the functions of the thyroid and pituitary body, besides continuing his studies in cerebral localisation.

Horsley was surgeon to University College Hospital and to the National Hospital for the Paralysed and Epileptic, Queen Square, W.C., and it was at this time that he became the pioneer of surgery of the central nervous system. Instigated by Dr. Hughlings Jackson and Sir William Gowers, he was the first successfully to operate on the brain and to remove a tumour pressing on the spinal cord. To us his operating was an inspiration; he was never at a loss, and his brilliancy lay rather in his attitude to the problem in front of him than in pure mechanical dexterity. He was never afraid, and the complete reliance he placed on his subordinates was sometimes almost embarrassing.

Honours poured upon him. He was early elected a Fellow of the Royal Society, and obtained the Royal medal; Halle made him an M.D., Paris elected him a Fellow of the Académie de Médecine, and numerous medical societies all over the world claimed him as an honorary member. No British worker in his field has been so much admired on the Continent as Horsley.

Practice came to him abundantly, but until shortly before the war he always devoted one day in the week to work in his private laboratory, tucked away under the lecture theatre at University College. Here he did all his work on the functions of the brain, including the long series of researches with Dr. R. H. Clarke on the cerebellum, carried out with an accuracy never before attainable. Many younger men who are now distinguished as neurologists in different parts of the world came to work with him here in London, and owe the success of their researches not only to his guidance, but to his remarkable operative skill on animals, for in almost all cases the actual experimental lesions were his handiwork.

He was Croonian lecturer to the Royal Society, and on this occasion published the work carried out with his brother-in-law, Prof. Gotch, on electrical changes in the spinal cord.

He was, however, essentially a pioneer, interested mainly in working at a subject until the field was laid open to all. This accounts for the comparatively small bulk of his publications. He showed all the surgeons of the world how to operate on the brain and spinal cord, but left no co-ordinated account of his methods, procedure, or results. This was in part due to impatience at being forced to go back over the road he had travelled, and partly to the overwhelming worries of the political and social work into which he threw himself with all his original scientific ardour.

His death was characteristic of his desire always to be moving forwards, to be in the advance, for, as consulting surgeon and inspector of hospitals, he might have stopped in the Mediterranean, where he had been occupied usefully for some time. But he demanded to be sent to Mesopotamia, where he knew the need was urgent, and there he died at Amara, laying down his life at the early age of fifty-nine. H. H.

NOTES.

THE death of Sir William Ramsay on July 23 has deprived the world of one of its greatest men and science of a pioneer whose work has opened up the richest fields of research explored in modern times. For several months the sympathies of scientific men have been with Sir William on his bed of affliction, and rebellious thoughts have surged through the minds of all of us that such an intellectual giant should have been rendered helpless when his dominating influence was most needed in national life. Though he was sixty-three years of age, he was much younger in spirit and vigour; and until last November everyone who knew him supposed that he had a long period of activity still in front of him. He has now passed to his rest, and no words can express the grief felt by his countless friends and admirers at the loss sustained by them and by the nation. His genius was undoubted, and in personal characteristics, as well as in productive work, he represented science at its highest and best. His funeral is taking place at Hazlemere Church, High Wycombe, as we go to press, but the place where his remains should rest is Westminster Abbey, for the honour which he brought to his country would have been justly recognised by this mark of national recognition. The greatness of his work, and the high regard in which it is held, were shown in an article on Sir William Ramsay in our series of "Scientific Worthies" in NATURE of January 11, 1912. His memory will be cherished with affection by all who came under the influence of his attractive personality, and his contributions to knowledge will constitute a permanent monument to him in the fields of science. The nation itself has been exalted by his achievements, and a memorial of them should be placed where all may see and be uplifted by the spirit of scientific life so fully manifested in him.

AN instructive example of the manner in which Germany has in the past been permitted to exploit British resources is provided by the management by a German company of the Travancore monazite deposits. The sand was obtained in Travancore at a cost of about 4*l*. per ton, and shipped to Germany for the use of the manufacturers of Germany. Only a limited quantity of the sand was allowed to be sold in the United Kingdom, and the price of about 36*l*. per ton was demanded. In a paper on the British rare-earth industry, read by Mr. S. J. Johnstone at the annual meeting of the Society of Chemical Industry, these and other interesting particulars were given. Prof. Wyndham Dunstan, director of the Imperial Institute, dealt with the same subject in a paper read to the Indian Section of the Royal Society of Arts on June 1, and printed in the issues of the society's journal of July 7 and 14. Thorium, the constituent of monazite of industrial importance, is essential to the gas-mantle industry, which until lately was under German control. Germany, having secured the monopoly of the Brazilian supplies of monazite, was able to dominate the manufacture of gas mantles in this country. Owing to the activities of the Imperial Institute, Ceylon was found to supply scattered monazite and thorianite, the richest known ore of thorium, containing more than 80 per cent. of thoria, as against about 5 per cent. in Brazilian monazite. In 1909 monazite sand was discovered on the coast of Travancore, and the monazite found to contain nearly twice as much thoria as the monazite of Brazil. Thorianite has been secured by the Imperial Institute for British users, by whom virtually the entire output of Ceylon has been taken. Though at first Travancore monazite was worked in German interests, a reconstruction since the war of the company working it will secure its produce also for British industry.

As was the case last year, the Swedish Government has decided to postpone, this time until July 1, 1917, the distribution of the Nobel prizes in physics, chemistry, medicine, and literature.

THE Finsbury Technical College Old Students' Association is preparing a scheme to perpetuate the memory of the late Prof. Silvanus P. Thompson in a suitable manner. All who wish to assist in the establishment of such a memorial should communicate with Mr. J. E. Raworth, Queen Anne's Chambers, 28 Broadway, Westminster, London, S.W.

THE death is announced, at the age of seventy-eight, of Dr. Bushell Anningson, lecturer in medical jurisprudence in the University of Cambridge since 1884. Dr. Anningson was the author of "Evolution of Human Communities in Relation to Disease," "The Origin and Progress of Sanitary Endeavour," and other works.

LIEUT. J. J. BALL, who was killed at the front on June 27 while acting as observing officer, entered the University of London, University College, as a student of civil engineering in 1912, and had just completed his second year's course at the outbreak of the war. He was by no means a "bookworm," but perhaps his distinguishing feature as a student was the quiet determination with which he tackled his studies, even when they were clearly distasteful. His friends and teachers at University College feel that by his death the war has robbed them of a promising young engineer, as well as of a man they were glad to call friend.

MAJOR (TEMPORARY LIEUT.-COL.) BOYD ROBERT HORSBRUGH, who died recently at his home, Oxted, Surrey, was well known as an authority on the birds of South Africa, where he had lived for nearly seven years, and had travelled extensively throughout the country; he also served with distinction in the South African war. He is best known as the author of a book on the "Game Birds and Waterfowl of South Africa," published in 1912, a most useful work to the naturalist, but mainly designed to meet the requirements of the average sportsman in that country. A special feature of the work is the field notes by the author and artist, and the beautiful series of coloured plates by Sergt. C. G. Davies, Cape Mounted Riflemen, which bear evidence of being drawn from life by one who had watched and studied in their native haunts the subjects of his pencil.

THE death of Paul Lemetayer in Chile closes a most useful career. Born at Avranches in 1849, he was the pupil and later the collaborator of Paul Issidor. In 1881 he was appointed director of the agricultural station at Santiago, and held a distinguished position in connection with agricultural and analytical chemistry in Chile. As technical adviser to the Government, Lemetayer contributed much to the welfare and progress of Chile. The important nitrate industry, the growth of sugar-beet, and the development of vineyards have been specially encouraged by State grants, but agricultural enterprise has also been stimulated in other directions. The "Quinta Normal d'Agricultura," with which Lemetayer was closely connected, is regarded as the largest and best organised of agricultural schools in South America, and is rivalled by few similar institutions in Europe.

MR. EDGAR ALBERT SMITH, who died on July 22, was born in 1847. His father was Frederick Smith, a well-known entomologist, and assistant-keeper in the zoological department of the British Museum. In 1867 Edgar Smith joined the staff of the museum as an assistant, and took charge of the mollusca; for several years he was largely occupied with the arrangement of the famous "Cuming Collection." Afterwards, when the collections were transferred from Bloomsbury to South Kensington, he was responsible for the arrangement of the shell gallery, which he planned especially for the convenience of the numerous amateur collectors and students of shells who visited the Natural History Museum, and at whose service he freely placed his wide knowledge and experience. In 1895 he was promoted to the rank of assistant-keeper, and in 1903 he received the I.S.O.; he retired in 1913. Mr. Smith was recognised as a high authority in conchology, and he was the author of more than 300 monographic and faunistic works on mollusca, including the important volume on the *Challenger* Lamellibranchs. He had held the office of president of both the Conchological and Malacological Societies, and was a member of the Academy of Natural Sciences of Philadelphia and of the Linnean Society of New South Wales.

CAPT. J. M. CHARLTON, who was killed on July 1, at twenty-five years of age, was an enthusiastic naturalist and amateur taxidermist, and had written and illustrated several short works on ornithology, among them "The Birds of South-East Northumberland." He was in Uppingham School from 1907 to 1910. During his last two years there he was one of the official "observers" of the Ornithological Section of the Natural Science Society, and for his last year he was secretary of the section. He was always very keen on birds, spent all his spare time in observing them, and would travel miles on the off-chance of

seeing anything novel to the district. He had also artistic power, and in 1908 was awarded first prize in the school exhibition for some coloured studies of birds. In the Public Schools Essay Competition of 1910 he was awarded a special bronze medal for his essay on "Observations during a Fortnight's Holiday on the Island of Gigha."

IT is officially announced that in view of the possibility of the failure of the third attempt now being carried out by Sir Ernest Shackleton, in a small vessel, to rescue the twenty-two men of his party left on Elephant Island, South Shetlands, and at his urgent request, the Government has now decided to dispatch a vessel from England as soon as she can be fitted out, no suitable wooden vessel being available in any South American port. The Governor and Company of Adventurers of England Trading into the Hudson's Bay have generously placed their vessel, the *Discovery*, which was specially built for Antarctic exploration, at the disposal of the Admiralty, for as long as she may be required for this service, free of all cost. Lieut.-Commander James Fairweather has been appointed to command the vessel, which is now fitting out at H.M. Dockyard, Devonport. On her completion, if news has not been received of a successful issue of Sir Ernest Shackleton's present attempt to reach Elephant Island, she will then proceed to Elephant Island, embarking Sir Ernest Shackleton on her way.

AT the meeting of the City of London Court of Common Council on Thursday, July 20, it was resolved:—(1) That in view of the great advantages which would accrue to British commerce in foreign markets by the use of the decimal system of coinage and weights and measures, in the opinion of this court it is desirable that steps should be taken to ensure its immediate introduction, so that it may be already in operation at the conclusion of the war; (2) That in view of the fact that England and the Allies are entering into arrangements for concerted action with regard to future trade matters, it would be of immense value if one language could be recognised as the commercial language, and taught in all schools, here and abroad. By so doing, English, French, Russian, Esperanto, or any other language decided on would form the basis of communication on business matters throughout the world.

AT the beginning of July a party of thirty men, led by Mr. Birger Johnsson, left Sweden for Spitsbergen in order to work the coal deposits at the head of Bell Sound (Braganza Creek) and Isfjord. At Braganza Creek the coal, though of Tertiary age, is said to be of good burning quality, and there is an average thickness of 2·15 metres over an area of about 100 kilometres. At the Pyramid Hill and in Bünsow's Land, at the head of Isfjord, on the other hand, the coal is culm of Carboniferous age, and is not so good as at Braganza. None the less, these two areas are calculated to yield about 3000 million tons of good coal. Other members of the expedition are Mr. S. Öhman, who will be responsible for the mapping; Mr. H. Odelberg, agronomist, who will see to the provisioning; Mr. E. Lundström, who will serve as botanist and make a map according to Prof. De Geer's photographic method; and a palæontologist, Mr. Erik Andersson, of Upsala, who was recently studying the fossil fishes of Spitsbergen in the British Museum. Mr. Lundström is taking some plants to see if they will grow there. Among them are various willows, the dwarf birch, *Convolvulus sepium*, *Potentilla fruticosa*, and *Papaver nudicaule*.

OF great interest to zoologists is the proposal, reported in the June number of the *Bul. Imp. Acad. Sci.*, Petrograd, to establish a biological station on Lake Baikal. The largest of the fresh-water lakes of Europe and Asia, and said to be the deepest in the world, it possesses a fauna in many respects unique. Some of its fishes are found nowhere else, and some live at a greater depth than any other fresh-water fishes. Among them are very ancient forms, and, according to some investigators, vestiges of the Upper Tertiary and sub-tropical fauna of Siberia and, possibly, of Central Asia. Though Lake Baikal has long since attracted the attention of Russian zoologists, much remains to be done, and it is felt that private research, valuable as its achievements have been, should be supplemented by a fully equipped biological station, which alone can cope with the problems involved in a thorough and systematic investigation. The subject has been mooted for some time past in Russian scientific circles and is now brought within measurable distance of realisation by a donation of 1600*l.* received from a Siberian gentleman, Mr. A. Vtorov, and the Academy has appointed a commission to take immediate steps to give concrete form to a project destined to be of great importance for biological science.

IN the July issue of *Man* Mr. J. Reid Moir publishes a further report on the discovery of human bones and other articles of Neolithic and later date in the Ipswich district. The skeleton of an individual buried in the contracted posture has been examined by Prof. Arthur Keith, who reports that it is that of a lad of the Neolithic age, decidedly smaller and of slighter make than a modern boy. Of another skull Prof. Keith remarks that "amongst British skulls, attributed to a prehistoric or pre-Roman date, a markedly prominent nose is very rare: I have never seen a single case." As regards the stature and muscular development of some of these skeletons, it is to be regretted that, although the skeleton was represented in each case, the long bones were so fragile and fragmentary that it was found impossible to obtain complete reconstruction.

WE have received from the National Clean Milk Society copies of two publications just issued by the society. One is a leaflet intended for distribution among producers of milk, containing recommendations for the care of cows and of milk which should be observed by farmers and dairymen. These are simple and capable of being carried out by all, and if observed would do much to ensure a clean milk supply. The other publication is a form of agreement for the wholesale purchase and sale of milk by institutions, dealers, and milk producers. In particular it provides for the tuberculin testing of all cows and for a bacterial content of the milk not exceeding 60,000 bacteria per cubic centimetre. This last provision is certainly a very stringent one, and difficult to attain; unless the conditions of bacteriological examination are very carefully defined it will lead to trouble, for American investigations have recently shown an extraordinary variation in the bacterial content of the same milk sample examined by different observers. The agreement is, however, for a high-grade milk, the price of which is put at 3*d.* per gallon more than that of ordinary or market milk.

THE need of a publication in English which will contain not only abstracts of purely physiological papers, but also summaries of important papers bearing on physiology in other branches of science, has long been recognised. It is hoped that the *Physiological Abstracts* will meet this need, and will also

form a link between British and American physiologists and their colleagues in France, Russia, Italy, Scandinavia, and Holland. The abstracts are issued by the Physiological Society of Great Britain and Ireland, under the able editorship of Prof. W. D. Halliburton, and with the co-operation of the American Physiological Society; associated with the editor are many of the most eminent physiologists in this and other countries. The publication is issued monthly, and although, up to the present, only four numbers have appeared, there is no doubt as to its value for purely physiological workers. Indeed, its success appears to be assured, not merely from a scientific point of view, but also as regards its wider purpose of more closely uniting physiologists in the allied and neutral countries.

MENTION has already been made in these columns of the very useful and comprehensive survey of the phenomena of light production by animals which Mr. Ulric Dahlgren is publishing in the Journal of the Franklin Institute of Pennsylvania. In the May and June numbers he proceeds with his task, surveying now the marine worms and the crustacea. The author makes no claim to originality in regard to this work, but he has added materially to our knowledge of the histological structure of these light-producing tissues. Particular attention is directed to the difficulty of finding any satisfactory interpretation as to the significance of the extraordinary luminosity of Chætopterus, one of the most luminous of living animals, but which, like the mollusc Pholas, endowed with like powers, lives in a burrow on the sea-floor. In some of the crustacea a luminous discharge is made which seems to serve, like the ink of the cuttle-fish, as a means of escape from enemies.

THAT the maple aphis (*Chaitophorus aceris*) gives rise to dimorphic larvæ, the one normal, the other having a tessellated carapace, and the abdomen, anterior border of the head, and the limbs fringed with small leaf-like expansions, has long been known. When first discovered, however, this curiously modified type was regarded as representing a distinct species. In the Proceedings of the South London Entomological and Natural History Society, 1915–16. Mr. E. J. Bunnett reviews the work of earlier observers, and adds some valuable observations of his own, based on specimens bred from two black apterous females during June, 1914. In the course of his investigations he was further enabled to show that this "pseudomorphic," or periphyllous, form is produced also by the winged black form. An admirable figure of this most puzzling larva compared with the normal form adds immensely to the value of this contribution.

No. 3 of vol. iii., series ii., Fishery Investigations, Board of Agriculture and Fisheries, has just been published. It is an analysis and review of the English plaice-marking experiments carried out in the North Sea since 1903. In the course of this work more than 17,000 living plaice were marked and liberated. The objects of the investigation were mainly the detection of migrations and of their causes, an estimate of the rate of growth of the fish in different seasons and areas, and an estimate of the actual effect of fishing upon the North Sea plaice population. In spite of the large mass of material dealt with, it has not been possible to attain to very definite conclusions with regard to these questions. The movements of plaice in the North Sea are rather of the nature of general dispersions than of movements along definite paths, correlated with seasonal conditions. Growth, too, is remarkably variable. An important and interesting result apparent from the experiments is the practicability of carrying out "transplantation" on a very large scale with valuable commercial results. In such areas as that of the Dogger Bank growth is much more rapid than in the coastal areas, and removal of small fish from the latter to the former grounds would be an economically valuable proceeding if possible on an international scale.

IN the *National Geographic Magazine* for May Mr. Hiram Bingham, director of the expedition sent to Peru in 1915 by the National Geographic Society and Yale University, gives an account of the operations. Its main object was to secure information about the inhabitants of the wonderful city of Machu Picchu, which was discovered during the exploration of 1911. Several ancient Inca trails leading to the city were examined, and it was ascertained that Machu Picchu was the centre of a densely populated region, the inhabitants of which possessed a highly organised civilisation. Amongst other discoveries, a considerable number of trepanned skulls were found. It is remarkable that a people capable of constructing these fine megalithic buildings, and whose skill in engineering, pottery, and textiles was of a high order, should not have succeeded in inventing an alphabet or even some form of hieroglyphic writing similar to that which existed in Mexico and Central America. The report is illustrated by an excellent collection of photographs.

WE have received the report of the Survey of India for 1914-15, which shows considerable progress despite the shortage of staff. Of the 1-in. map 154 sheets were published during the year, of the "degree" sheets seven, and of the "one-millionth" map five sheets. A preliminary edition of the map of Tibet, on a scale of 1 to 2,000,000, has been published. The Government of India has sanctioned the publication of a new "half-inch" map of India, which is to be compiled from available sources. One sheet has, so far, appeared, but several new sheets should be ready shortly. In addition to this work, a great deal of topographical survey was done during the year. Quicker progress in survey work can be expected in future years, as it has been decided to reduce the scale for certain sparsely populated areas. About half of the 600,000 square miles that remain are to be surveyed for a half-inch or smaller scale.

COMMUNICATIONS No. 147 and 148 from the University of Leyden contain new data obtained by Prof. Onnes and his pupils with regard to the behaviour of oxygen, nitrogen, neon, and helium at low temperatures. For helium the vapour pressure varies with absolute temperature as follows:—At 1·48° $p=0·42$; 3·52°, 36; 4·20°, 75·8; 4·9°, 133; 5·16°, 167 cm. of mercury. For neon the isothermals at 20° C., 0°, −183°, −200°, −208°, −213°, and −217·5° are given, and liquid neon is shown to provide a much-needed constant temperature bath in the gap between 55° absolute, which is furnished by liquid oxygen, and 20° absolute, for which liquid hydrogen is available. The behaviour of neon corresponds closely with that of argon. The previous vapour pressure tables of oxygen and nitrogen are corrected according to the most recent comparisons of the platinum with the hydrogen thermometer, and for oxygen vapour pressures are given from 90·2° absolute when the pressure is 76·7 cm., down to 57·4° when it is 0·27 cm. For nitrogen vapour pressures are given from 80·5° when $p=108·6$, down to 57°, at which it is 2·2 cm. of mercury.

MR. A. B. DOBROWOLSKI has recently contributed to the *Arkiv för Kemi, Mineralogi och Geologi* (vol vi.,

No. 7, pp. 1–53), under the title "Les cristaux de glace," an interesting *résumé* of what is as yet known of this the commonest of substances, in which he points out the lacunæ that remain and the questions that are still unsettled. He has himself studied no fewer than 3000 photomicrographs of actual ice crystals under the microscope, the photographs being taken from the fine collections formed by A. W. Bentley, G. Nordenskiöld, and F. Hallberg. There appear to be three different types of habit of natural crystals of ice, viz. lamellar, rod-like, and acicular, of which the first is by far the commonest. The author hazards the suggestion that the other two result from the transitory presence in the air of certain unstable gases, but hesitates to say which. From a study of the tapering, rod-like crystals he concludes that ice belongs to the tourmaline class of the hexagonal system, which is characterised by a trigonal polar axis of symmetry. No measurements which will permit of the determination of a satisfactory value for the ratio of the crystallographical axes have yet been published; that quoted in the text-books is based upon some extremely rough observations made by Nordenskiöld, and is quite untrustworthy. In the rod-like and acicular types twinning about 0001 is common, as is shown by the existence of groups in which two tapering ends are aligned in contact. It is well known that laboratory experiments have produced different kinds of crystals of ice. For instance, water when containing more than 50 per cent. of alcohol forms cubic crystals on freezing. For a smaller percentage such crystals, if formed, are unstable, and their occurrence in Nature would therefore appear doubtful. Certain photomicrographs taken by Bentley and by Hallberg appear to suggest cubic symmetry, but, failing optical tests, it remains uncertain whether they may not be merely distorted forms of the ordinary type of crystals.

THE following volumes are announced for early publication in the "University of Chicago Science Series" by the University of Chicago Press (London: Cambridge University Press):—"The Origin of the Earth," T. C. Chamberlin; "The Isolation and Measurement of the Electron," Prof. R. A. Millikan; and "Finite Collineation Groups," Prof. H. F. Blichfeldt. Other volumes in preparation for the same series are:—"The Evolution of Reptiles," S. W. Williston; "Food Poisoning," E. O. Jordan; "The Problem of Individuality in Organisms," C. M. Child; "The Development of a New System of Organic Chemistry, based on Dissociation Concepts," J. U. Nef and J. W. E. Glattfeld; "The Living Cycads," C. J. Chamberlain; "Mechanics of Delayed Germination in Seeds," W. Crocker; "The Rigidity of the Earth and of Materials," A. A. Michelson; "The Problem of Fertilization," F. R. Lillie; and "Linear Integral Equations in General Analysis," E. H. Moore.

MESSRS. CONSTABLE AND CO., LTD., announce the following books of science:—"The Flying Machine from an Engineering Standpoint," F. W. Lanchester (the James Forrest Lecture, 1914, including a discussion concerning the Theory of Sustentation and the Expenditure of Power in Flight); "Some Modern Methods of Ventilation, with Special Reference to Public Buildings," R. Grierson, illustrated; "Mining and Mine Ventilation," J. J. Walsh, illustrated; "Practical Surveying," E. McCullough, illustrated; "Colour and its Applications," M. Luckiesh, illustrated; "Atoms," J. Perrin, translated by D. L. Hammick, illustrated; and a new and enlarged edition of "Manual of Reinforced Concrete," C. F. Marsh and W. Dunn.

OUR ASTRONOMICAL COLUMN.

PONS-WINNECKE'S COMET AND THE METEORIC SHOWER OF JUNE 28.—Mr. Denning writes:—"That the remarkable display of June 28 was due to the earth passing through or very near a cometary orbit appears highly probable. The elements of the meteoric shower present some resemblances to those of Pons-Winnecke's comet of 1819, which has a period of about 5·8 years, and last reached perihelion on September 1, 1915. Any meteoric shower connected with Pons-Winnecke's comet, though not visible in past years, may well be perceptible in future times. In 1869 the perihelion distance was 0·7815, or about 21½ millions of miles inside the earth's orbit, but in 1915 the P.D. had increased to 0·9725, or only 4 millions of miles inside our orbit. Planetary perturbations have effected changes in the orbital elements of the comet, and brought it so near to us at one section that a meteoric *rencontre* seems very likely."

DIFFERENTIAL MEASUREMENT.—Mr. H. H. Plaskett has made an interesting study of some questions involved in measures of the distance between a pair of lines with the object of tracing the origin of differences found when different observers measure the same spectrograms, with special reference to spectrographic determinations of the solar rotation (Journal Roy. Ast. Soc. of Can., vol. x., No. 5). He finds the chief source of these differences is the "attitude" of the observer, and defines two modes of measurement, the "attentive" and the "automatic," according as the measures are made under the influence of prepossessions or otherwise. It must suffice to add that the automatic mode is found to possess the desirable advantages of speed, accuracy, and economy of effort, but is marred by high fortuitous error (apparently, greater p.e.). Mr. Plaskett is of the opinion that the highest accuracy can only be attained in replacing differential measures by determinations of changes of wave-length with the help of standard absorption lines. A very successful application of these results has already been made at Ottawa (NATURE, May 18).

WAVE-LENGTHS IN THE IRON SPECTRUM.—Interferometer measures of the wave-lengths of some 400 lines in the spectrum of the iron arc in the region covered by the international secondary standards have been made by Messrs. Burns, Meggers, and Merrill in continuation of the revision of wave-lengths undertaken at the United States Bureau of Standards (Scientific Paper No. 274). The poles used were either of electrolytic or Norwegian iron, and only iron lines were measured. The reductions were based on the international secondary standards, and the final wave-lengths were corrected by means of a smoothed curve obtained by plotting the differences between observed and normal wave-lengths of the standard lines. The mean difference is stated to be about one part in four millions. Three interferometers have been used in measuring each line, and, in addition to the work on wave-lengths, considerable attention has been devoted to observations of the physical characteristics of the lines. Thus, more than five hundred lines have been divided into four groups according to the limiting path difference at which interference is shown, and the data have been examined in connection with pole-effect, intensity, and pressure shifts. It appears that lines showing negative pole shift are never sharp; lines of faint or moderate intensity are sharper than strong lines, whilst the lines shifted by pressure are more likely to be broad than unaffected lines.

SOUTHERN GEORGIA AND ITS HYDROGRAPHY.[1]

ALONG the eastern coast of North America, commencing at Long Island and passing southward through Virginia, North and South Carolina, Georgia, and Florida, there lies a broad tract of country known as the Atlantic Coastal Plain. This plain, which also extends round the northern part of the Gulf of Mexico, where it is distinguished as the Gulf Coastal Plain, is a region of low elevation, with a relatively gentle seaward slope. Part of it passes through and embraces 35,000 square miles of the southern half of the State of Georgia, and this constitutes the purview of an extremely interesting and informative report issued by the United States Geological Survey, from which the following particulars are gleaned.

Although characterised as a plain in comparison with the mountainous country behind, the expanse under consideration is not entirely without topographical features and contrasts. There are hilly and broken areas, especially towards the north, but these do not rise above the general level, and their summits present an even skyline. The plain lends itself to subdivision into six physiographical districts, the nature of which may be to a large extent gauged from their designations, viz., the Fall-Line Hills, the Dougherty Plain, the Altamaha Upland, the Southern Lime-Sink Region, the Okefenokee Plain, and the Satilla Coastal Lowland. The lithological components of these belts are principally sands, clays, and marls, with, subordinately, limestones and sandstones. The former are largely unconsolidated, and have undergone little alteration since their original deposition. The sediments are representative of the Lower Cretaceous and subsequent systems, and include the Ripley Formation, about 950 ft. thick, of grey, calcareous, and micaceous sand, and sandy clay, and the Midway Formation, about 400 ft. thick, of ferruginous sand, with local beds of white clay, and fossiliferous limestone and calcareous quartzite. The Cretaceous deposits immediately and unconformably overlie a basement of crystalline rocks believed to be pre-Cambrian.

The mean annual rainfall of the plain is about 49 in., and the quantity absorbed by the soil and rocks is roughly estimated at 90 to 95 per cent. of the total. If nearly 60 per cent. of the rainfall be assumed to be lost by evaporation and 4 or 5 per cent. escape as run-off or flood-flow, there remains about 35 per cent. to form the underground water supply; but much of this is not actually utilisable, on account of the depth to which it descends.

Although several of the cities in central Georgia, such as Augusta and Macon, obtain their water supplies from adjacent rivers, the majority of the inhabitants have to depend upon supplies drawn from artesian wells, of which there are probably some 700 or 800 in active operation. These wells range in depth from 100 to 1000 ft. All the Cretaceous formations contain water-bearing strata, as also the Eocene and Oligocene series of the Tertiary system. The Quaternary system furnishes non-artesian water, which is tapped by shallow borings. Such water, on account of its high content of organic matter in many cases, is not generally suitable for domestic use.

A large number of analyses of the ground waters have been made, and from them it is computed that relatively few contain normal carbonate (CO_3), while the presence of hydrogen-sulphide gas and of excessive amounts of iron is reported in waters from all the formations. The gas imparts an objectionable odour in certain instances and gives rise to corrosion in boilers and mains. The iron, which in a number of cases exceeds three parts per million, is then perceptible to the taste, and tends to produce stains in fabrics which are washed in it. B. C.

[1] "Underground Waters of the Coastal Plain of Georgia." By L. W. Stephenson, J. O. Veatch, and R. B. Dole. (Water Supply Paper No. 341.) Pp. 530, with photographs, maps, and diagrams. Washington: United States Geological Survey, 1915.)

HARDNESS AND CRITICAL COOLING VELOCITIES OF STEELS.

THE maximum cutting hardness of pure carbon tool steel is achieved by water-quenching. With the introduction of Mushet's special steel, engineers obtained a material which was called "self-hardening," because it did not require to be water-quenched in order to bring out its maximum cutting hardness. It was sufficient for the tool to be cooled from above a certain critical temperature in air. The modern high-speed tool steel falls into the same class of materials, the chief difference from Mushet's special steel being that the "lip" or "nose" of the tool requires to be actually melted and then cooled in an air blast if the maximum cutting hardness is to be obtained. Stated in general terms, therefore, the rapid-cutting tool of to-day is gas-quenched as contrasted with the carbon tool, which is water-quenched.

Various theories of the mechanism of the above changes are held, and therefore the research by Prof. C. A. Edwards, of the University of Manchester, assisted by J. N. Greenwood and H. Kikkawa, recently presented to the Iron and Steel Institute, on some very remarkable properties of a chromium steel, is to be welcomed in that it throws valuable light on what are to some extent matters of dispute. This steel contained 6·15 per cent. of chromium and 0·63 per cent. of carbon, the balance being iron, except for impurities unavoidably present in small amounts. By suitably varying the initial temperature and the cooling velocity of this steel by air-quenching, Brinell hardness numbers varying from 194 to 700 could be obtained. Such a material therefore falls within the category of self-hardening steels in the sense that water-quenching is not required to harden it. On the other hand, it was found that unless a certain critical velocity of cooling was exceeded depending on the initial temperature this steel did not harden. In this sense, therefore, the steel does not appear to be self-hardening. On this point the authors say:—"Whilst with the chromium steel the cooling rates which produce hardening are extremely slow as compared with those which are obtained in the hardening of steels by quenching, the two operations are fundamentally the same. In other words, a given rate of cooling, which might be regarded as slow for carbon steels, really constitutes quenching in the case of some special alloy steels." The authors have further found that the hardening of the steel coincides with the presence of large quantities of martensite, and a diminution in the magnitude of the carbide thermal change. The maximum hardness was obtained when the thermal transformation had been entirely prevented, and when this was accomplished the steel was purely martensitic in structure. The following table gives the connection between the initial temperature and the cooling velocities between 836° C. and 546° C. which suppress the carbide change:—

Initial temperature °C	Cooling velocities ′ ″
860	1 36
908	2 24
960	3 0
1029	4 0
1147	6 0
1200	7 0
1267	8 56

H. C. H. CARPENTER.

THE SOCIETY OF CHEMICAL INDUSTRY.

THE annual general meeting of the Society of Chemical Industry was held in Edinburgh on July 19–21. The meeting this year took the form of a congress on the progress made since the outbreak of war in British chemical industry. The following papers were read and discussed:—

(1) *Fuel.*—Fuel economy: a national policy required, Prof. H. E. Armstrong; Some recent improvements in coke works practice, Dr. G. P. Lishman; Waste in coal production, Prof. H. Louis. (2) *Shale Oil.*—The shale oil industry, D. R. Steuart. (3) *Tar Distilling.*—A short review of the influence exerted by the war on the tar distilling industry, W. H. Coleman; The extraction of tar fog from hot gas, G. T. Purves. (4) *Dyes.*—The difficulties of coal-tar colour-making in war-time, C. M. Whittaker (British Dyes, Ltd.). (5) *Fine Chemicals.*—Notes on the production of alkaloids as affected by the war, D. B. Dott; The manufacture of synthetic organic drugs as affected by the war, F. H. Carr; The manufacture of fine chemicals in relation to British chemical industry, C. A. Hill and T. D. Morson. (6) *Paper-making.*—The paper-mill chemist in war-time, J. F. Briggs. (7) *Patent Law.*—The overhauling of our Patent Law, J. W. Gordon; The influence of the Patent Laws upon industry, W. F. Reid; Proposed amendments to English Patent Law, W. P. Thompson. (8) *Rare Earths.*—The progress of British rare-earth industry during the war, S. J. Johnstone.

To illustrate the progress that has been made, an exhibition was held, at the same time, of specimens of British-made coal-tar dyes, glass, porcelain, and filter paper, along with several other interesting substances now made in Edinburgh. Among these may be mentioned cobalt-blue—a substance never before manufactured in this country—now made by the Beaverhall Colour Co.; trinitrotoluene by the Lothian Chemical Co.; erasers, etc., manufactured by the North British Rubber Co., the supply of which formerly was entirely imported from Germany. The papers, and the discussions upon them, will be printed in the Journal of the Society of Chemical Industry.

TECHNICAL EDUCATION AND INDUSTRY.

AT the annual conference of the Association of Teachers in Technical Institutions on June 24 Dr. W. Garnett read a paper on technical instruction after the war. His arguments and examples, drawn from his long experience of the administration of technical education in London, should convince statesmen and manufacturers of the imperative need for a close *rapprochement* of industry and science. Dr. Garnett thinks that one of the most important effects of the war has been the bringing together of men of science and leaders of industry. Manufacturers have learned more clearly than before that scientific men can help them in the solution of technical problems of industry, and men of science appreciate more fully that the world of manufacture provides problems worthy of their best attention. Urging the necessity for industrial research, he said the greatest need of the teachers in technical institutes is more time and facility for research, and the greatest need of British industry is that more research should be devoted to it. Dr. Garnett also dealt comprehensively with the organisation of technical training, the need for changes in the character of the science teaching in secondary schools, and the part that science should take in Civil Service examinations.

The principal points of the paper are summarised as follows:—

(1) Leaders of industry must place a higher value on industrial scientific research, which is the greatest need of British industry.

(2) Teachers in technical institutions must be more closely associated with industrial leaders.

(3) Time and other necessary facilities must be given to teachers in technical institutions to enable them to carry out industrial research.

(4) Consumers must be willing to make a sacrifice in order to contribute to the nursing of infant industries, so as to avoid entire dependence on foreign sources for the necessaries of life or civilisation.

(5) The war has shown that our universities and technical schools are able to render services to the State which very few persons two years ago believed to be possible.

(6) Trade associations and technical institutions should combine to co-operate with the Advisory Council for Research.

(7) A better connection is required between the elementary school and the technical institute, and this will, in part, have to be supplied by a compulsory continuation school for boys leaving the day school at fourteen, and by extension of the leaving age in central and higher elementary schools.

(8) A more complete organisation of the educational system is required so as to provide suitable training for all ranks of industrial workers, making appropriate distinction between the manual workers and the thinkers.

(9) A more liberal system of scholarships is necessary, especially to enable university students to engage in post-graduate research.

(10) Reasonable prospect of suitable promotion must be offered to students who have passed through a course of training intended to prepare them for higher industrial appointments.

(11) Science should be taught to all the pupils of secondary schools, but the course of instruction for boys in classical forms should differ from that for boys who are intending to pursue the study of science after leaving school.

(12) In Civil Service and other public examinations a general knowledge of physical phenomena and the applications of science to industry should be required of all candidates; but science should not be pitted against the humanities in competitive examinations.

(13) With elementary students practice must almost always be in advance of theory; and theory should not be introduced into elementary teaching until the pupils have been led to recognise its necessity.

(14) Much of the equipment of the schools and some of the methods of instruction will be modified in consequence of experience gained during the war; and it is desirable that all teachers in technical institutions should be prepared for these changes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LEEDS.—The University has decided to institute a new course of study in scientific and technical subjects preparatory to military duties, and to accept this course as a part of the intermediate course for degrees in arts, science, law, and commerce. The new course, while counting as a degree subject, will be carried out in conjunction with the work of the Officers Training Corps.

Mr. W. Morrison, to whose personal interest in its library the University is under obligation, has given 1000*l.* for the development of the new School of Russian Studies, of which the Sir James Roberts professorship of Russian language and literature will be the centre.

LONDON.—At a meeting of the Senate held on July 19 offers were accepted with thanks from (1) an anonymous donor to establish an endowment fund producing 200*l.* a year, to be devoted to the prosecution of experimental scientific research at King's College by members of the staff and post-graduate students of the college; (2) Dr. R. W. Seton-Watson to provide 100*l.* a year for five years towards the expenses of the library of the School of Slavonic Studies at King's College; (3) the War Office to present to the University a German aeroplane which had been shot down in France by the Royal Flying Corps.

The following doctorates in science have been conferred:—*Botany*: (1) Mr. W. Brown, an internal student, of the Imperial College (Royal College of Science), for a thesis entitled "Studies in the Physiology of Parasitism: I.—The Action of *Botrytis cinerea*"; (2) Mr. Franklin Kidd, an internal student, of the Imperial College (Royal College of Science), for a thesis entitled "The Controlling Influence of Carbon Dioxide." *Psychology*: Miss Nellie Carey, an internal student, of University College, for a thesis entitled "Factors in the Mental Processes of School Children." *Engineering*: Mr. F. T. Chapman, an external student, for a thesis entitled "The Air-Gap Field of the Polyphase Induction Motor."

THE directors of British Dyes, Ltd., have promised to contribute 5000*l.* towards the scheme for the erection of a new chemistry department at Huddersfield Technical College for the development of advanced teaching and research in applied chemistry, referred to in NATURE of June 29, p. 373. Half of the contribution is towards the building fund and the remainder for scholarships and research.

THE Executive Committee of the City and Guilds of London Institute has appointed Dr. W. Eccles to the professorship of electrical engineering and applied physics at the institute's Technical College, Finsbury, rendered vacant by the death of Prof. Silvanus P. Thompson. Dr. Eccles is at present university reader of graphics at University College, and is the author of a work on "Wireless Telegraphy and Telephony," and numerous papers and inventions on subjects connected with electrical engineering.

THE issues of *Science* for June 30 and July 7 announce further gifts to higher education in the United States, among which the following are most important. Members of the Du Pont family, who are alumni of the Massachusetts Institute of Technology, have given 160,000*l.* for the extension and maintenance of the new buildings. Four other alumni have subscribed sums amounting to 40,000*l.* It is understood that an anonymous donor who has already made large gifts to the institute has undertaken to give five dollars for each three dollars subscribed by the alumni during the present year. The will of Mrs. Helen C. Julliard gives 10,000*l.* to the American Museum of Natural History, and 5000*l.* to Colorado College. Mrs. Russell Sage has given 15,000*l.* to Knox College of Galesburg, Ill., to make possible the securing of the amount to complete its 100,000*l.* endowment fund.

A COPY of the report of the Secretary of the United States General Education Board for 1914–15 has been received from New York. During the year grants were made to eight American colleges and universities amounting to 255,000*l.* towards funds amounting to 1,040,000*l.*, which were being raised by them. Reference is also made to grants totalling 550,000*l.* in the previous year to Johns Hopkins, Yale, and Washington Universities for the purpose of reorganising clinical instruction on the basis that the hospital and teaching staff in medicine and surgery may devote their entire time to the service of the hospital and medical school, withdrawing altogether from paid private practice. The scheme has not yet been inaugurated at Yale or at Washington; but at the Johns Hopkins University it had at the date of the report been in operation a year. The Board continued during the year under review to support rural schools in eleven southern States, professors of secondary education in eleven, and negro education in seven States. The report also states that the General Education Board has decided, by means of grants, to aid promising workers in the investigation of problems in educational theory and practice.

THE report of the council to the members of the City and Guilds of London Institute for the year 1915 has now been published. The continuance of the war has led to further modifications of the work of the institute. The absence of many members of the staff has thrown much extra work on those left behind, especially upon the heads of departments. The staff and some senior students have undertaken much new and original work in the design and manufacture of munitions of war. The institute's laboratories and workshops are being utilised for war work to their full extent. The roll of honour of past and present students and members of the staff of the City and Guilds College who have taken service in the Navy or Army had on November 10 last a total of 811: 514 commissioned officers and 297 non-commissioned officers and men. As a result of the abnormal conditions the work of the department of technology has suffered; the number of students in attendance at registered classes fell from 55,996 in 1913–14 to 47,050, while the number of candidates for examinations in technology in the United Kingdom was 15,623, as compared with 23,119 in the previous year. The report shows that the total amount of the donations and subscriptions to the funds of the institute since its foundation in 1878 to the year of the report (1915) was 952,773*l.*

THE first volume of the report of the U.S. Commissioner of Education for the year ended June 30, 1915, has been received from Washington. It is a volume of 780 pages, and, in addition to a full treatment of all grades of education in the United States, provides chapters on the condition of education in the chief countries of the world. A chapter on higher education in the States, by Mr. S. P. Capen, is of special interest. He tells us that the conviction that both higher and secondary education must be made more sound and serious has been reiterated in educational gatherings throughout the United States, and has been reflected in numerous intensive studies of college and university administration and standards. The organisation and management of State-supported institutions for higher education have, at the request of various legislatures, been critically investigated with a view to render their work sound and efficient. The question of academic freedom, too, has been widely discussed. Within the past two or three years there have been so many recurrences of disciplinary action directed by trustees and presidents of prominent institutions against professors reputed to hold unorthodox political, economic, or religious views that the question of academic freedom has become temporarily one of the foremost issues in university administration. As Mr. Capen says, upon its correct settlement depends not only the integrity of the universities, but, more remotely, the whole welfare of American education.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 29.—Sir J. J. Thomson, president, in the chair.—Prof. A. **Schuster**: The determination of gravity at sea. Dr. Duffield has recently described some preliminary experiments on the measurement of gravity at sea by means of a new method originally suggested by Hecker, and, in the main, consisting in balancing the pressure of a column of gas kept at constant temperature and that of a column of mercury the length of which can be indirectly determined. The results are very promising, but as the ultimate success of the method must depend on the elimination of errors due to unavoidable disturbances, it seemed advisable to discuss the theory of the apparatus a little more fully. The present paper deals more particularly with the effects of the forced oscillation of the mercury due to the vertical motion of the ship, but other sources of error are also considered.—Prof. J. **Joly**: The genesis of pleochroic haloes. Both uranium-radium and thorium haloes develop according to the same laws, certain internal structures appearing first in the form of ring haloes. The addition to these of the outermost feature due to RaC or ThC_2 appears at an early stage. Intermediate details then follow. It is clearly shown that some cause exists to modify the effects of the divergence of the rays outwards. Haloes derived from emanation of radium as primary substance have been identified; also what appear to be "reversed" haloes.—C. T. R. **Wilson**: Some determinations of the sign and magnitude of electric discharges in lightning flashes. Measurements have been made of the sudden changes produced in the potential gradient at a point on the earth's surface by lightning discharges, the approximate distance of the discharge being in many cases determined by timing the resultant thunder. The results of one thunderstorm (August 15, 1915) may be interpreted as indicating that the discharges were nearly all approximately alike, Q being about 33 coulombs and H of the order of 10 kilometres; the range of variation in the distances of the discharges was not quite sufficient to decide whether the discharges reached the earth's surface or not, but the value of Q is practically the same on either view.—S. **Chapman**: The kinetic theory of a composite monatomic gas: diffusion, viscosity, and thermal conduction.—Dr. T. **Goodey**: Further observations on protozoa in relation to soil bacteria. (1) Protozoa, especially amœbæ of the *limax* groups, and other larger forms, can lead an active existence and multiply in soil and exert a depressing effect on bacterial numbers. (2) It is probable that for a given soil a certain point must be reached in protozoal numbers before the depression in bacterial numbers is caused. (3) It appears to be necessary to add the protozoa to a treated soil in a small quantity of untreated soil to ensure their having a suitable medium in which to grow and multiply. Under these conditions it is shown that they can increase in numbers and depress the numbers of bacteria. (4) It does not appear to be possible to carry out mass inoculations of protozoa into a treated soil in such a way that they come into action and limit bacterial activity, and the explanation advanced to account for this failure is that the treated soil affords an unsuitable medium for the active trophic existence of protozoa.—Dr. Marie C. **Stopes**: New Bennettitean cones from the British Cretaceous. The present paper describes two new types of well-preserved fructifications of Bennettites in Britain. One is that of an entirely new species from the Gault; the other is from a Lower Greensand specimen, diagnosed from externals by Carruthers, but not hitherto described.—T. R. **Merton** and J. W. **Nicholson**: Phenomena relating to the spectra of hydrogen and helium. (1) A method has been found for the accurate determination of the photographic intensities of spectrum lines and the reduction of such intensities to absolute values by comparison with the continuous black-body radiation of the carbon arc. (2) A study has been made of the relative intensity distribution in the spectra of helium and hydrogen under different conditions of excitation. (3) It has been found that under certain specified conditions there is a transfer of energy from the longer to the shorter wave-lengths in any given series, and that, under such conditions, the associated series, and in particular the diffuse series, are relatively enhanced at the expense of the principal series. (4) It has also been found that the distribution of intensity found in certain celestial spectra can be approximately reproduced in the laboratory. (5) A study has been made of the separations of the components of lines of the Balmer series of hydrogen, and the mean values of the separations of the doublets constituting the lines $H\alpha$ and $H\beta$ have been found to be respectively 0·132 A.U. and 0·033 A.U. These values are consistent with the separations appropriate to a principal series, and the first is in precise agreement with the value deduced by Buisson and Fabry.—F. P. **White**: The period of a spherical resonator with a circular aperture. In a recent paper in the Proceedings of the Royal Society, Lord Rayleigh has carried the determination of the wave-length of the fundamental aerial vibration in a spherical vessel with a small circular perforation to a higher degree of approximation than was done by Helmholtz. The present communication employs Lord Rayleigh's method to obtain a still closer approximation to the wave-length.—Capt. S. R. **Douglas**: The *rôle* of the blood fluids in the intraleucocytic digestion. Rosenow came to the conclusion that the variation in the degree of digestion undergone by the micro-organisms after their ingestion by the leucocytes was due to a property of the serum which was quite independent of the opsonic power. Further, he concluded that the serum influenced the digestion of the ingested bacteria by acting directly on the leucocytes—not on the bacteria—stimulating them, so that they had greater digestive powers. The experiments, of which details are given in the present communication, confirm Rosenow's results as regards the blood fluids possessing the power of favourably influencing the digestion of bacteria ingested by the leucocytes, and that this property is quite independent of the opsonic power; but, contrary to his conclusions, these experiments definitely prove that the blood fluids act directly on the bacteria or on the red blood cells, preparing them for digestion by the leucocytic ferments. In addition to these conclusions, they show that heating normal serum to 60° C. for a few minutes completely destroys this property.

WASHINGTON, D.C.

National Academy of Sciences, June 15 (Proceedings No. 6, vol. ii.).—W. L. **Hart**: Differential equations and implicit functions in infinitely many variables. Three problems are handled: First, certain fundamental theorems concerning a type of real-valued functions of infinitely many real variables. Second, the problem of infinite systems of ordinary differential equations. Third, the fundamental problem of implicit function theory in this field.—Jacques **Loeb**: The sex of parthenogenetic frogs. Two frogs obtained by artificial parthenogenesis, one ten months old, the other thirteen months old, were found to be males, and the thesis that animals produced by artificial parthenogenesis are males is thus further corroborated.—J. A. **Harris**: De Vriesian mutation in the garden bean. The origin of the new race of beans seems most logically ex-

plained as a case of de Vriesian mutation. In this race the whole morphological organisation of the seedling has apparently been changed, and the race is characterised by a high degree of variability.—W. B. **Cannon**: Studies of ductless glands by the electrical method. The nerves distributed to the thyroid cells belong to the sympathetic, and not to the vagus, supply, and their effects are not indirect through alterations of blood flow. They are true secretory nerves.—E. B. **Wilson**: The distribution of the chondriosomes to the spermatozoa in scorpions. The chondriosome-material, having the same origin, fate, and (presumably) physiological significance, may be distributed to the germ-cells by processes widely different even in nearly related animals. In one of the scorpions the distribution is effected by a definite process of division, in the other by an operation that has at least the aspect of a hit-or-miss segregation, and one that gives only an approximate equality of result.—H. J. **Spinden**: New data on the archæology of Venezuela. Stone implements, including celts, pestles, etc., vessels and figurines of clay with painted and modelled decorations, personal ornaments of shell, nephrite, jet, and serpentine, as well as the petroglyphs and pictographs, occur in considerable quantity. The plastic art of Venezuela is one and the same with the "archaic art" already known in Central America and Mexico.—E. L. **Nichols**: Note on the phosphorescence of uranyl salts. For the only examples of luminescence which admit of detailed inspection, the spectrum of phosphorescence is identical with that of fluorescence, and it is suggested that this also applies to all phosphorescent materials. In spite of its great complexity, the luminescence spectrum of a uranyl salt is to be regarded as a unit, all its components decaying at the same rate after the cessation of excitation.—C. G. **Abbot** and L. B. **Aldrich**: The pyranometer: an instrument for measuring sky radiation. Two satisfactory types of this instrument, both derived in principle from the electrical compensation radiation instruments of the late K. Ångström, have been devised. Numerous others of the sky-radiation have been made. On fine days the sky-radiation alone received on a horizontal surface ranges from 0·07 to 0·13 calorie per square centimetre per minute.—M. B. **Porter**: Note on Lucas's theorem. A more general result than that obtained by Borel or Polya has been found.—H. S. **White**: A variable system of sevens on two twisted cubic curves.—G. H. **Parker** and E. G. **Titus**: The neuromuscular structure of sea anemones. There are four types of muscle action; they are of phylogenetic significance, and show that the neuromuscular mechanism of sea anemones is by no means so simple as originally supposed.—F. G. **Keyes** and W. J. **Winninghoff**: Change of the ionisation of salts in alcoholic solvents with the concentration. The present investigation on the conductance of sodium iodide and ammonium iodide in *iso*amyl alcohol and of sodium iodide in propyl alcohol was undertaken for two purposes: primarily to determine whether in these solvents, somewhat similar in nature to water, salts conform to the mass-action law at very small concentrations; and, secondarily, to test further the applicability of Kraus's empirical equation throughout the fairly wide range of concentration employed in the work.

BOOKS RECEIVED.

The Contingency of the Laws of Nature. By E. Boutroux. Translated by F. Rothwell. Pp. ix+196. (London: Open Court Publishing Company.) 5*s*. net.

Ruler and Compasses. By Dr. H. P. Hudson. Pp. 143. (London: Longmans and Co.) 6*s*. net.

The Emission of Electricity from Hot Bodies. By Prof. O. W. Richardson. Pp. vii+304. (London: Longmans and Co.) 9*s*. net.

The Animal Parasites of Man. By Dr. H. B. Fantham, Prof. J. W. W. Stephens, and Prof. F. V. Theobald. Pp. xxxii+900. (London: John Bale, Sons, and Danielsson, Ltd.) 45*s*. net.

The National Physical Laboratory. Report for the Year 1915–16. Pp. 80 + Figs. 7. (Teddington: W. F. Parrot.)

Measures for Avoidance and Extermination of Flies, Mosquitoes, Lice, and other Vermin. By Prof. H. Maxwell-Lefroy. Second edition. Revised for the Tropics. Pp. 17. (Calcutta and Simla: Thacker, Spink and Co.; London: Thacker and Co.) 1*s*. net.

Fire Protection for Passenger Ships. Pp. 44. (London: British Fire Prevention Committee.) 3*s*. 6*d*.

Geological Survey. Southern Coal-field. Maps and Sections. 10 maps. (Sydney: W. A. Gullick.)

Elements of Folk Psychology. By W. Wundt. Translated by Prof. E. L. Schaub. Pp. xxii+532. (London: G. Allen and Unwin, Ltd.) 15*s*. net.

British Forestry: its Present Position and Outlook after the War. By E. P. Stebbing. Pp. xxv+257. (London: John Murray.) 6*s*. net.

Commercial Egg Farming. By S. G. Hanson. Pp. 62. (London: Constable and Co., Ltd.) 1*s*. net.

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