THURSDAY, FEBRUARY 22, 1917.

PLANT PHYSIOLOGY AND TERATOLOGY.

(1) *Botany: a Text-book for Senior Students.* By D. Thoday. Pp. xvi+474. (Cambridge: At the University Press, 1915.) Price 5*s.* 6*d.* net.

(2) *The Principles of Plant-Teratology.* By W. C. Worsdell. Vol. i. Pp. xxiv+269+plates xxv. (London: The Ray Society, 1915.) Price 25*s.* net.

(3) *Some Recent Researches in Plant Physiology.* By Dr. W. R. G. Atkins. Pp. xi+328. (London: Whittaker and Co., 1916.) Price 7*s.* 6*d.* net.

(1) MR. THODAY'S text-book is intended primarily for use in connection with the Senior Cambridge Local Examinations, but it is hoped that it may prove of more general service to teachers as well as to scholars in the upper forms of secondary schools. Since the author brings to bear on his task not only his experience as a teacher, but some years' experience as an examiner, he should be in a fair way to succeed. A good text-book is one of the factors which may bring success in these examinations, but the efficient teacher and adequate provision in the school curriculum are also factors which cannot be eliminated.

However, our concern is with Mr. Thoday's book, and we congratulate him on his achievement. It is different from other text-books. There is a certain refreshing originality of treatment in dealing with the common objects of the examination syllabus, and the matter is well and clearly written; it is, in fact, a readable text-book. The point of view is the physiological one; the vegetative organs of the plant are approached and studied as structures adapted for carrying out the life-functions of the plant; form and structure are subservient to function. The rigid morphologist will feel that an opportunity has been missed. Experimental work falls naturally into place in the subject-matter, and good use is made of matters of common observation in Nature and plant-life. In the chapters dealing with classification the author has worked out the characters of some of the best-known British families of flowering plants by reference to commonly occurring genera and species, and the various grades of relationship are used to illustrate the ideas of evolution and variation. The last section, entitled "Plants in relation to their Environment," contains a good chapter on trees and a short introduction to the study of plant associations. Text-figures are sufficiently frequent and good; many of them are new.

(2) The plant morphologist will find food for thought in plenty in Mr. Worsdell's volume on "The Principles of Plant-Teratology." In 1869 the Ray Society issued the late Dr. Maxwell Masters's work on "Vegetable Teratology"; this was for many years the standard work on the subject, and is even to-day the book to which one naturally turns for easy reference in matters teratological. Mr. Worsdell does no more than justice when he expresses himself as "in some degree indebted to Dr. Masters for facts and ideas." "The present work," he states, "is intended to present the subject in more scientific fashion and in quite a new form, both as regards the mode of treatment and the large number of additional facts." The author's position may be briefly summarised as follows. The work is not a mere descriptive tabulation of interesting and curious freaks, but a contribution to the evolutionary origin of plant-organs, of which there are three categories only, root, stem, and leaf, although in reality the stem is non-existent, being composed of leaf-bases. Comparative and teratological, as contrasted with developmental and anatomical, are the only trustworthy methods of morphological investigation. Many abnormalities are progressive in character, not reversions; they are of great importance for the interpretation of structures of doubtful nature. All structures, whether normal or abnormal, are regarded as purposive rather than fortuitous in their origin. They are originated and maintained by the action of a regulative vital force, and not by mere chemico-physical energies: the dynamic teleological or vitalistic position is upheld as against the mechanistic or materialistic one. This is enough to indicate Mr. Worsdell's point of view and to show that the author invites severe criticism from the more orthodox plant-morphologists. Moreover, one cannot but feel that the insistent and somewhat aggressive emphasis of matters of theory does to some extent detract from the value of what is otherwise a useful piece of work. It is for this reason not a safe book to put into the hands of the non-critical student.

Mr. Worsdell has been for many years studying plant-abnormalities at first hand, and the present volume embodies the results of his investigations so far as concerns the non-vascular plants and the vegetative organs of the vascular plants. Abnormalities described by previous writers are also recorded and discussed, while frequent bibliographical lists supply a large number of additional references. The chapter on fungi is a short one, and deals with the various abnormal developments of the sporophore of the cap-fungi. A similar remark applies to the bryophytes; a few pages are devoted to adventitious shoots and protonema formation; and there is a short account of "double" sporogonia. The root of the vascular plant is less prone than any of the other organs to deviate from the normal form, and its aberrations occupy only a few pages. The greater part of the book deals with the stem and the leaf. The second volume will deal with the flower. A useful feature is the large series of photographic plates, twenty-five in number, at the end of the volume; there are also a number of rather crude figures distributed through the text. The typography is clear, and there is a useful subject-index.

(3) Dr. Atkins, in his handy little volume on some recent researches in plant physiology, aims

at presenting to senior students and investigators the results of recent work in a few of those branches which are at present attracting attention. It is supplementary to the text-books, and should prove of great value to those whom the subject more nearly concerns. The value of the work is enhanced by the author's choice of material, since he has selected those subjects with which he was specially familiar and on which he was able to write with a first-hand knowledge. Starting with the classic researches of Brown and Morris, the author deals in the first two chapters with the carbohydrates of the leaf in relation to photo-synthesis and with the methods of estimating carbohydrates in plant extracts. This is followed by short chapters on the carbohydrates of the cellular cryptogams. Other chapters deal with osmotic pressure and its relation to plant distribution, and to morphological variations; the permeability of protoplasm and of other organic membranes; and the magnitudes of osmotic pressures and electrical conductivities in plants. A chapter on the functions of the wood is followed by an account of the plant oxydases and their relation to pigmentation, and the final chapter is on the oxydases in relation to plant pathology and to technology. At the end of the volume there is a bibliography classified under the headings of the subject-matter adopted in the text.

WORKS ON CIVIL ENGINEERING.

(1) *American Civil Engineers' Pocket-Book.* Editor-in-chief, M. Merriman. Third edition, enlarged. Pp. ix+1571. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 21*s.* net.

(2) *Parks and Park Engineering.* By Prof. W. T. Lyle. Pp. viii+130. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 5*s.* 6*d.* net.

(3) *Masonry Dam Design, including High Masonry Dams.* By Dr. C. E. Morrison and Orrin L. Brodie. Second edition, revised and enlarged. Pp. ix+276. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 10*s.* 6*d.* net.

(4) *Earth Pressure, Retaining Walls, and Bins.* By Prof. William Cain. Pp. x+287. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 10*s.* 6*d.* net.

(1) THE "American Civil Engineers' Pocket-Book" has already established an enviable reputation for trustworthiness and completeness, which is well maintained in the third edition. A new section of ninety-six pages on river and harbour works has been added, whilst important additions have been made in the other sections. The scope of the book is wide, each subject being written by a specialist in the particular branch dealt with, although the treatment is simple and requires a minimum of previous knowledge.

Valuable features of the book are the numerous examples worked out where concise and accurate description would otherwise be difficult. Although the question of cost varies enormously with time and locality, the tables of prices of works executed will add greatly to the use of the volume.

In view of the importance of the subject to makers and users of machinery, it is somewhat disappointing to find only one short paragraph devoted to hardness tests of metals. We also think that it is time some of the work which has been carried out lately upon struts and columns should be incorporated.

This pocket-book is one which is probably destined to form a standard reference-book for every civil engineer.

(2) It is now generally recognised that amongst the best investments for an urban community is the provision of parks and recreation-grounds. Indeed, in several recent cases the actual appreciation in value of surrounding property following upon the transformation of waste land to this purpose has been greater than the outlay. A very readable book upon the subject of parks and park engineering has been written by Prof. W. T. Lyle, of Lafayette College, which, although dealing with the American aspect of the case, will be found useful by members of public bodies responsible for the planning of our cities and towns. The first chapter of the book deals with the acquisition of parks and their lay-out. Other chapters are concerned with the survey and design, while interesting and instructive articles on labour and contracts and construction should prove of great assistance to the non-professional man, and also to young and inexperienced engineers of construction. In his preface the author points out that "the art of the park engineer, though a specialty, is, however, not a narrow specialty. He must be proficient in matters pertaining to the acquisition of lands, and be well versed in a great variety of engineering operations, such as earth excavation, masonry, waterworks and sewerage construction, road building and lighting, and occasionally the construction of steel and reinforced-concrete bridges. He must also be a good expert witness." The scope is very wide, and can only be superficially treated in one volume. The book will undoubtedly fill a useful place and serve as an introduction to more specialised works on construction.

(3) During the last few years there has been considerable discussion amongst engineers as to what methods should be adopted and what assumptions made in the design of high masonry dams. The subject is of extreme importance, since we have, on one hand, large expenditure of money in providing margins of safety above those really necessary, and, on the other, the fact that failure must be rendered impossible. The most recent methods of calculation and design are very ably treated in Morrison and Brodie's "Masonry Dam Design," the second edition of which has just been published. In the revision the authors have amplified a number of points which were treated very shortly in the

earlier edition. Chapters on the overfall and arched types of dam have been added, and an excellent series of cross-sections of typical masonry dams, arranged chronologically, forms an appendix. The method of analysis followed is that due to Wegmann, used for the first time in connection with the design of the new Croton dam. The authors have amplified the analysis by a consideration of the uplift due to water penetrating the foundations or the horizontal joints of the masonry, and also by taking into account the ice-thrust exerted against the up-stream face of the dam when the reservoir is frozen over. The latter portion of the book is devoted to the problems of tension in the vertical sections near the toe, to which attention was first directed by L. W. Atcherly. Appendices i. and ii. contain the mathematical theory of arch dams. The book is one which should occupy a place in the library of all designers of masonry dams.

(4) Probably one of the most difficult problems which the engineering designer has to face is that concerned with the pressures which may exist at the back of retaining walls. Many mathematical theories have been evolved which assist materially in solving the problem, but the infinite variety of physical conditions met with in the earth's crust render exact calculations impossible in many cases. This difficulty is undoubtedly responsible for the comparatively small amount of experimental work available. The book on earth pressures just issued by the professor of mathematics in the University of North Carolina deals with the theory of soil pressures, covering a wide range of physical properties of earth, from those of Rankine, where the soil is assumed to be devoid of cohesion and subjected to no other external force than its own weight, to cases where surcharging and cohesion are taken into account.

Both analytical and graphical methods are employed, and the work is comprehensive in scope. The last chapter is devoted to a consideration of bin theory, the ordinary hopper-bin containing coal or ore and the deep bin such as those met with in grain silos being dealt with in an adequate manner. The stresses in wedge-shaped reinforced-concrete bins, such as occur frequently in the toes, heels, and counterforts of retaining walls, form the subject of an appendix, whilst some experiments made by the author on model retaining walls at the limit of stability are dealt with in Appendix ii. The book well repays the reader. It ought to serve a useful end.

THE GEOLOGY AND SUPPLY OF MINERAL OIL.

Principles of Oil and Gas Production. By Prof. B. H. Johnson and L. G. Huntley. Pp. xv+371. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1916.) Price 16*s.* net.

THIS book should be of especial usefulness owing to its combination of practical information, including branches of the subject not usually considered in general text-books on oil-mining, and its clear and accurate statements of scientific principles. The twenty-three chapters may be divided into three groups: the first is devoted to the chemistry, physical qualities, and geology of oil and natural gas; the second includes eleven chapters on the development and management of oil and gas wells; and the third, consisting of one chapter which occupies nearly a third of the book, gives a most useful summary of existing knowledge of the oil and gas fields of North America.

The most striking feature of the first division of the work is its clear expression of the reaction from the school which held that the one determining factor in oil geology is the folding of the beds. It is no doubt true that the folding has often largely determined the distribution of the oil, and is the best guide in the economic development of the field. There are, however, numerous cases in which the rocks are not folded, yet the concentration of the oil into pools is due to the factors which elsewhere drove it into the arches of the folds. The authors therefore devote especial attention to the texture of the beds, to the variation in the range of those most suitable for oil storage, and to the forces which have compressed the oil into pools. The authors discuss the origin of mineral oil, and firmly reject the inorganic theories. They recognise the wide range of oil throughout geological time, but that Cambrian and pre-Cambrian rocks are unlikely to contain it in commercial quantities. Important oilfields occur in the Ordovician and in all later systems.

In an interesting chapter on folds the authors urge more general agreement in the meanings of the terms "homocline" and "monocline," and set a good example of concession, as Prof. Johnson abandons his previously advocated use of "monocline" for beds with a uniform dip in one direction. He now accepts Daly's term "homocline" for a bed with one dip, and "monocline" in its more familiar sense for a one-limbed fold. Horizontal beds the authors describe as "aclines"—a perhaps unnecessary term. They introduce the term "chute" for the pitch of a minor fold, which is very different from its usual use in mining geology. The chapter on the laws and leasing of oil lands appears to be a clear synopsis of the American law; it quietly explains how to avoid by suitable terminology the legal decision that the oil or gas under a tract of land cannot be sold. They point out, too, that the oil and gas industries are hampered by anti-trust laws, which in some cases prevent reasonable economic co-operation and necessitate wasteful expenditure.

Perhaps the most valuable section of the book is the description of the oilfields of North America. It is illustrated by an excellent geological map of the continent and numerous diagrams of the special fields. The literature on them appears well up to date. The authors describe the fields, ranging from that of Lima-Indiana, which is unique as yielding its produce from Ordovician beds, to the still more remarkable oilfield among the salt-

domes of Louisiana. They show that the most recent work has confirmed the hypothesis that these salt-domes occur at the intersection of two rectangular series of fractures. The Calgary field, which created a fever of speculation in south-western Canada, is more than once quoted as illustrating that the predominance of light oils is a discouraging feature as an indication that the oils have travelled for some distance. They refer to the present investigations to check Höfer's theory that the geothermal gradient rises most rapidly in oilfields, but they regard it, even if verified, as a not very hopeful method of prospecting.

The final chapter is on the oil market and future supply. All through the book may be recognised the tacit assumption that the days of an oilfield are short and that a period of declining oil production is not far distant. Then, say the authors, will be the day of the oil shales, of which there are large quantities, which can then be more profitably worked. They remind us, however, that there is not likely ever to be an absolute failure of oil for purposes for which it is indispensable. So soon as oil production begins to decline the price will rise, and its employment will be restricted to the purposes for which oil alone can serve. It will no longer be squandered on uses for which there are more enduring reserves of alternative materials. J. W. G.

OUR BOOKSHELF.

Wisconsin Geological and Natural History Survey. Bulletin No. xxxvi. *The Physical Geography of Wisconsin.* By Dr. Lawrence Martin. Pp. xxii + 549. (Madison, Wis.: Published by the State, 1916.)

THE "Educational Series" to which this work belongs is "primarily designed for use by teachers and in the schools" (p. 486), and the cloth-bound volume of 549 pages, with abundant maps and illustrations, is "sent on receipt of 15 cents" (7½*d.*) to those who are sufficiently keen to ask for it. Wisconsin, like Canada, places no bar to the spread of educational information collected by the State.

Dr. Martin is careful to explain technical terms as they arise, but he writes for the advanced teacher, who will appreciate the details shown in his well-selected maps. The romantic history of Indian, French, and American Wisconsin is bound up with the geographical position. To this day (p. 12) the most valuable articles manufactured in the State are "the products of the wood-working industry, which come from the soil." In many ways, even in the abundance of lakelets in the north (p. 388), we are reminded of Finland, where the soils depend also to a large extent on glacial transport. But Wisconsin has some 40 in. of annual rainfall, distributed under the extremes of a continental climate, and the wind-weathering that forms pinnacles and rock-tables in the driftless areas does not imply continuous aridity. On the west we come across the broad sweep of the Mississippi, flowing below Prescott between isolated bluffs, which are in reality the extremities of divides cut through by the young and dominant stream. We are grateful to the author for the sympathetic record on p. 170 of Black Hawk's heroic stand on the Mississippi bluffs in 1832. The human, and thus the humane, touch can never lie far from the geographer. GRENVILLE A. J. COLE.

The North Staffordshire Field Club. Jubilee Volume, 1865–1915. Edited by S. A. H. Burne, J. T. Slobbs, and H. V. Thompson. (Published by J. and C. Mort, Stafford.) Price 7*s.* 6*d.*

AN immense amount of good and useful scientific work has been accomplished during the last fifty years in the United Kingdom by local natural history and archæological societies. Not only have these bodies stimulated local research, but by affording means of publication they have been of inestimable service to science in placing on record accounts of local discoveries, co-ordinating methods of study, and enabling the embryo student to try his prentice hand at authorship.

The North Staffordshire Field Club is a typical society of the kind, and having attained its jubilee, it has just issued a commemorative volume, which consists of a sufficiently full record of the work performed by the members during the fifty years of its existence, compiled by the president, together with an account of the work done in the various sections by the respective chairmen. The work of the club is organised in sections, and is carried on by means of monthly excursions under approved leaders during the summer, and the reading of papers and debate at evening meetings during the winter, and it must be admitted that the results of the fifty years' work are an unqualified success. It is not permitted to everyone to live to see the full fruition of their pioneer work, but the fates have been kind enough to Mr. W. D. Spanton to permit him to live not only to see his offspring successful, but also to act as president on the fiftieth anniversary of the club he was instrumental in founding.

Having now reached maturity, it behoves the club to consider itself more seriously and to extend its work. For example, the histories of Roman and Saxon Staffordshire have still to be written. Botany and zoology include much more than the mere listing of finds, and the annual volumes would be better if shorn of the many platitudes which still add to their bulk, but not to their usefulness.

Macmillan's Graphic Geographies. The British Isles. By B. C. Wallis. Pp. 32. (Macmillan and Co., Ltd.) Price 9*d.*

THE beginner in geography is here provided with a combined atlas and text-book. The simply worded lessons, in which the human note is predominant, are supplemented by four coloured, full-page, orographical maps and twenty-four further maps in black and white. The exercises at the end of the lessons, and the occasional test-papers, will supply the teacher with the material necessary to secure the active co-operation of the pupil throughout the course of instruction.

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.*]

Impending Developments in Chemical Enterprises.

ATTENTION has already been directed in the columns of NATURE to the sporadic manner in which capital is being diverted into certain branches of industrial chemistry. The shortage of dyes, drugs, and other fine chemicals has rendered this form of manufacturing enterprise very lucrative even to comparatively small capitalists. The commercial success attending these undertakings is a proof in itself that these manufacturers are supplying the essential needs of the community, and to this extent their efforts are entirely praiseworthy. It must, however, be conceded that the multiplication of small businesses engaged in producing the same article will sooner or later lead to competition of a particularly wasteful and disastrous kind, and this clash of internecine interests will become most pronounced at the cessation of hostilities, precisely when all productive energies should be nationalised against external competitors. This danger is not absent even in the larger chemical enterprises, and it is evident that there are great difficulties ahead in the most fundamental of all chemical manufactures, namely, the production of sulphuric acid. At present the explosives factories cannot have too much of this essential chemical reagent, and large plants for producing it have been erected all over the country. Sulphuric acid producers have been circularised recently by the managing director of a firm of acid-makers, who insists on the urgent need for co-operation among this group of industrialists in order to prevent the absolute chaos which must arise in the sulphuric acid trade at the conclusion of peace if manufacturers are not more closely associated. Certain of the remedies proposed are somewhat drastic. It is proposed that Parliament should consent to legislation "whereby the entirely wasteful introduction of capital by superfluous and speculative parties without experience in the trade would be prohibited until the merits of the proposition had been examined by a committee of expert manufacturers in conjunction with expert Government representatives." So far as this inhibition is directed against new capital unaccompanied by new ideas something may be said in favour of legal restrictions. But, on the other hand, the history of human invention has always manifested the self-sacrificing obstinacy of the inventor, a characteristic which has mainly benefited, not the individual himself, but the community. One can foresee the short shrift which an inventor, inexperienced in the trade, but with a revolutionary process, would receive at the hands of a committee consisting of manufacturers interested in maintaining the *status quo*, and Government officials looking forward to an honoured age of pensionable retirement received as the guerdon of a policy of masterly inactivity. Such agencies might possibly prevent some waste of capital; they would, however, be much more likely to expatriate inventive genius.

KRYPTON.

Science in Public Schools.

PERHAPS you will kindly allow me once more to correct your correspondent. Clifton College was not in advance of Rugby, either in the date, or in the extent, of the teaching of science, but closely followed Rugby in both. Your correspondent gave 1867 as the date for the general introduction of science for the whole school at Clifton. I have before me the lists of the Rugby classes in 1866. Out of 48 Sixth Form boys 24 learned science; of 133 Fifth Form, 60; of 155 Upper Middles, 155; of 135 Lower Middles, 135; of 30 Lower School, none. Clifton College never exceeded this proportion.

It is the fact that under Dr. Temple Rugby took the lead.

JAMES M. WILSON.

Formerly science master at Rugby, and headmaster of Clifton College.

The Nature of Growths in Colloidal Silica Solutions.

DR. BASTIAN has described certain experiments in this journal[1] in which he claimed to have synthesised from sterile colloidal solutions living bodies which were capable of reproducing themselves. Considerable weight is lent to Dr. Bastian's demand for independent investigation by the undeniable fact, that since the earth cooled, life has already once been synthesised from its inorganic constituents. In spite, therefore, of the inherent improbability of Dr. Bastian's results, I decided to repeat his experiments. Since the best criterion of life is the ability of organisms to reproduce themselves in sterile media, this test was employed throughout; and it is hoped that the resulting experiments, taken in conjunction with recent work in the same field,[2] may help to decide whether these "organisms" are in reality alive or merely colloidal simulacra.

Because of the great importance attached to the particular sample of sodium silicate employed, I procured two of the samples used by Dr. Bastian himself, as well as a third preparation—a 0·01 per cent. colloidal solution—specially made for me by Grübler. More than a hundred of the same tubes as used by Dr. Bastian were filled with his two solutions, and were sterilised at various temperatures from 100° C. to 130° C., and for various periods of time.

After they had been kept in the incubator for about two months they were exposed to a northern light for from two to three years. In order to examine the tubes the necks were cut with a white-hot glass point, and elaborate precautions taken to ensure sterility while transferring some of the centrifugalised deposit to the subcultivating media. At the same time films were made from each deposit and examined microscopically. The precautions mentioned consisted in carrying out all operations under cloths steeped in disinfectant and in an atmosphere that had been sprayed with a steam atomiser containing 4 per cent. lysol.

Three fluids were employed for the subcultures: (*a*) ordinary nutrient broth, (*b*) Dr. Bastian's ammonium tartrate and sodium phosphate solution, and (*c*) "tryptic broth," a special medium recently described by S. W. Cole and the writer. This medium contains a considerable amount of tyrosine, as well as other amino-acids, and was adopted after Dr. Bastian had stated that the presence of tyrosine very greatly increased the growth of his "organisms."

The subcultures were incubated for two periods of ten days, first at room temperature, and then in the incubator, but only one tube out of the hundred showed a visible growth, even under the microscope. I have no doubt that this growth was due to an accidental infection during the process of subcultivation, because the tube was one of a few that were opened soon after they had first been sealed, and without the elaborate precautions afterwards used. I am, more-

[1] NATURE, January 22, 1914, p. 579.

[2] Benjamin Moore and J. A. Webster, Proc. Roy. Soc., B. 693, p. 163, October, 1913; and Benjamin Moore, Proc. Roy. Soc., B. 609, p. 27, July, 1915.

[3] *Lancet*, July 1, 1916, p. 9.

over, acquainted with the morphology and some of the cultural characteristics of this organism, which is a frequent source of contamination in my laboratory. Further, a number of similar bacilli were found in the smears from the other deposits, but in every case they were dead and quite incapable of growth. In many of these smears circular bodies were also visible, often very suggestive of torulæ. They varied so much in shape and size, however, that though some specimens were indistinguishable from living organisms, others were clearly irregular plates of silica which were capable of absorbing the usual stains.

As a result of these experiments I am forced to conclude that the remarkably lifelike bodies described and photographed by Dr. Bastian are due to the deposition of silica round minute nuclei or on the detritus of dead organisms, in the manner described by Moore and by Paine.[4]

I am quite at a loss to discover an explanation of the results of A. and A. Mary,[5] whose original paper I have been unable to read, unless they are due to lack of sufficiently stringent precautions, as in the case of the contamination mentioned above; for when the greatest care is exercised, tubes prepared in this manner will still be absolutely sterile even after an interval of three years. H. ONSLOW.

Biochemical Laboratory, Cambridge.

Stability in Flight.

ALTHOUGH I am quite incompetent to hold any opinion on problems in human aeronautics, I venture to submit that the inference drawn by Prof. D'Arcy Thompson from the flight of certain birds (p. 409) does not agree with accurate observation, and may prove misleading.

Prof. Thompson's proposition is that long tails are disadvantageous to safety and stability in windy weather, and that birds of skilful or agile flight are equipped, "on the whole, with small tails and comparatively small and narrow wings." No such generalisation can stand in the face of facts. One has but to watch the evolutions of flocks of two of the commonest British birds—the rook with a long and broad tail, the lapwing with a shorter one, and both with remarkably broad, rounded wings—to admire their perfect mastery of flight in stormy weather.

Prof. Thompson describes the pigeon (species or variety not defined) as "a splendid flyer for mere distance," but indifferent in manœuvring because of its "large, rounded wings." No species of pigeon known to me has rounded wings; all have them long and pointed, and as for "sudden and acute changes of course," the pigeons in St. Paul's Churchyard have inherited a remarkable faculty in that respect from their "blue rock" ancestors, which had to thread their way at top speed through narrow sea-caves. Moreover, one variety—the tumblers—are perpetually "looping the loop," notwithstanding their long tails.

Coming to birds of prey, Prof. Thompson classes the kestrel with the buzzard as a broad-winged hawk, and remarks that falconers despised both. But the kestrel is a true falcon as testified by the dark iris, the notched maxilla, and the long and pointed wing (the second and third primaries being the longest). It is true that falconers had little use for the kestrel, not because of its inferior wingmanship, for it has few rivals in power and dexterity of flight, but because it preys chiefly on mice, beetles, and other diminutive ground game. But the goshawk and the sparrow-hawk are Accipitrinæ, with broad, rounded wings, the fourth and fifth primaries being the longest. Falconers greatly prized the goshawk for its prowess in flight, and the sparrow-hawk is distinguished by extraordinary agility and quickness in turning when in pursuit. Two opposite types of bird may be noted as having long tails and superb powers of flight, viz. the kite and the nightjar, the latter taking all its prey on the wing.

Lastly, when Prof. Thompson suggests that the outstretched legs of a heron act "as a very useful counterpoise to the long neck and bill," he seems to have forgotten that this bird does not fly with outstretched neck like a swan or a mallard. The heron extends its neck in rising from the ground; but so soon as it is fairly on the wing it tucks back its neck and rests its head between its shoulders, thereby reducing to a minimum the lengthened axis which Prof. Thompson regards as "contributing very materially to the creature's longitudinal stability."

Monreith. HERBERT MAXWELL.

I WILL give in to Sir Herbert Maxwell so far as to say that some of my examples might have been better chosen; I will go further and admit that my kestrel was clearly not a case in point. On the other hand, Sir Herbert throws more responsibility on me than I ever undertook, and he sweeps aside all the qualifying and questioning words with which I was careful to safeguard my letter: not that I wanted to hedge or hide behind these, but simply that my object was to suggest an inquiry, not to lay down the law. As to the mechanical advantages of short tails compared, *caeteris paribus*, with long tails, I made no assertion and laid down no proposition; but certain learned mathematicians had done so, bringing forward their proofs, and the naturalist has no right to dispute such abstract and theoretical demonstrations. When Galileo showed the mechanical advantages of a hollow pillar he adduced the straw and the quill as exemplifications of the principle; and the mere fact that so many trees and so many feathers are not hollow at all gives the naturalist no sufficient right to question it. I directed attention to the fact that Prof. Bryan and Dr. Brodetsky, after demonstrating a principle, had stopped short of inquiring whether it could be illustrated by, or recognised in, the case of the living flying organism; I considered that there were many cases in which it could be so recognised, and I am of that opinion still. We must not forget that "*caeteris paribus*" is an essential condition of our comparison, and that this condition we can only seldom and approximately fulfil. Moreover, we are dealing only with differences of degree, with grades of excellence. No one doubts that the rook flies extremely well, and for that matter every flying bird is marvellous in our eyes; but for all Sir Herbert may say to it, I don't believe that a flight of rooks can approach a flock of sandpipers, in the particular qualities of grace, dexterity, and precision of movement.

As to the heron and its long neck, it would almost seem to me as though Sir Herbert had gone out of his way for the sake of fault-finding. I never said the heron flew with its neck stretched out; I said it flew with its legs stretched out. Why, I was brought up in my boyhood within a couple of miles of a heronry, and saw the birds every day of my life! But the heron *has* a long head and a long neck, and they have to be carried somehow; and it is somehow by help of the long legs that they have to be counterpoised and balanced. The slender bill, narrow body, and long, thin legs make up a sort of long, narrow, axial framework associated with the machinery of flight. I was surely entitled to suggest, or to surmise, that this extended axis (a little like a witch's broomstick) might have a notable influence on the motions of the bird,

[4] *Annals of Botany*, vol. xxx., No. cxix., p. 383, July, 1916.
[5] *Le Médecin* (Brussels), October 31, 1913, and January 15, 1914.

and to inquire, as I did, of the experts whether this were so, and what the actual effect might be expected to be. D'ARCY W. THOMPSON.

February 1.

Alpine Strain in the Bengali People.

IN the concluding paragraph of a short notice of my book, "The Indo-Aryan Races," part i., published in NATURE, November 23, 1916, the reviewer writes:—

"The author might with advantage return in his next venture to the original problem of the origin of the Bengalis. He should probably discard Risley's theory of Mongoloid infusion in favour of some early entry of an Alpine strain. If he can establish this doctrine he would do useful service to Indian ethnology" (p. 227).

This is exactly what I have endeavoured to do in chap. ii., entitled "Indo-Aryans of the Outer Countries." After giving my arguments for discarding Risley's classification of the Gujratis, Marathas, and Coorgs as Scytho-Dravidian in type, and the Bengalis and Oriyas as Mongolo-Dravidian, I trace the broad-headed elements among these peoples to one common source, the *Homo alpinus* of the Pamirs and Chinese Turkestan (pp. 65–71), and later on try to reconstruct the history of the gradual migration of the Alpine invaders from Central Asia over Gujarat, Deccan, Bihar, and Bengal (pp. 75–78). How far I have succeeded in my attempts is for others to judge. I may take this opportunity of adducing fresh evidences relating to the presence of *Homo alpinus* in Central Asia and of Alpine strain in the Bengali people. In his account of "A Third Journey of Exploration in Central Asia, 1913–16" (from the *Geographical Journal* of August and September, 1916, p. 29), Sir Aurel Stein writes of the bodies of men and women dug out of graves in the ruins of the Lon-lan site:—

"It was a strange sensation to look down on figures which, but for the parched skin, seemed like those of men asleep, and to feel brought face to face with people who inhabited, and no doubt liked, this dreary Lop-nor region in the first centuries A.D. The features of the heads closely recalled the *Homo alpinus* type, which, judging from my anthropometric records, worked up by Mr. T. A. Joyce, still supplies the prevalent element in the racial constitution of the indigenous population of Chinese Turkestan, and is seen in its purest form in the Iranian-speaking tribes near the Pamirs."

During the last Christmas holidays, while excavating an old monument near Balurghat, in the Dinajpur district in Bengal, I and my colleagues of the Varendra Research Society had an excellent opportunity of comparing different ethnic types in Bengal. Every day there was a large gathering of men, including high-caste Hindus, Musulmans, Rajbamsis, Mundas, and Santals. The Rajbamsis of the locality are easily distinguished from the rest by their Mongoloid physiognomy, and the Rajbamsis, Mundas, and Santals are all distinguished from the other Hindus and Musulmans by scanty hair on the face. It is, therefore, not possible to explain the origin of the bulk of the Bengalis from an admixture of Mongoloid invaders like the Rajbamsis of Varendra and the Mundas, Santals, and other allied tribes classed by Risley as Dravidian and myself as Nisada. Two other elements in the Indian population, the Hindusthani and the Dravidian of southern India, are both long-headed. So, to explain the presence of broad-heads among the Bengalis, we may very well postulate an Alpine strain. The newly discovered Aryan languages of Turkestan will throw fresh light on the problem.

RAMAPRASAD CHANDA.

Varendra Research Society, Rajshahi, Bengal.

SHAKESPEARE'S ENGLAND.[1]

"SHAKESPEARE'S England" is a very remarkable book, and a credit to our time. It could have been produced in no other. Indeed, it could only have been produced within the last few years, so much is it the outcome of the research in ever so many directions which has been going on of late. It is sad, of course, that it should make its appearance in the middle of the great war, and yet there is something fine and fitting about this. It does not to-day jostle with a motley crowd of ephemeral, flimsy, and flashy tributes. And it has a solemn majesty and solidity which make it worth while, even at such a time, and in virtue of which it will survive even these heavy troubles.

As the first words of the preface justly say, the description of "Shakespeare's England" was a task worth carrying through, even if Shakespeare had never lived. But it is also a contribution of great importance to the understanding of Shakespeare. If Shakespeare was in one sense "not of an age, but for all time," in another he was most essentially of his age. He is emphatically Elizabethan. He could not have been what he was, or written as he did, either a very little earlier or a very little later; either in the days of Wyatt and Surrey, or in those of Milton and Marvell; either in the storm of the Reformation, or in the storm of the Civil War; either before the Tudor expansions, or after the Stuart disillusionments.

To understand him we require to understand his age, and though even a complete knowledge of that marvellous time will not give us Shakespeare, yet it will greatly aid, condition, and correct our ideas of him. And these two remarkably ample and learned volumes tell us how full and exhaustive our knowledge must be. They form, perhaps, the greatest tribute ever paid to Shakespeare. They are wonderfully complete and, for what they give, wonderfully cheap.

To produce them, the labour of a host of specialists has been laid under contribution. All the greater and lesser arts and sciences are dealt with in turn: Theology, Law, Medicine, Poetry, Music, Painting, Acting, Dancing. "The Court, the Camp, the Schools," the Navy, the Army, Sport, Learning and Commerce, Heraldry and Coinage, Rogues and Vagabonds, Bulls and Bears (not of the Stock Exchange, it is true, but of the ring), Astronomy, Astrology, Alchemy—each has its chapter or its section. The illustrations, which are abundant, are excellently chosen and reproduced, and are in themselves at once a delight and an illumination. *Ex pede Herculem.* One of these appears with this article.

It is not possible within the compass of a brief review even to indicate or inventory half of the wealth to be found in this ample thesaurus. Readers of NATURE will perhaps turn to what is said of the Sciences and of Medicine, of Agriculture and of Gardening. If Bacon had really

[1] "Shakespeare's England: An Account of the Life and Manners of his Age." Vol. i., pp. xviii + 546. Vol. ii., pp. x + 610. (Oxford: At the Clarendon Press, 1916.) Price, two vols., 25s. net.

written Shakespeare's plays, we might perhaps have expected even more under some of these heads, while we should have expected less under others. But it is just because Shakespeare is Shakespeare that we get so much under all. Nothing seems to escape his "bland and universal eye" or his world-embracing interest.

Medicine, as all know, plays a large part in Shakespeare. He is acquainted with the "congregated College"—*i.e.* the College of Physicians—brought into existence by Wolsey and Linacre only some fifty years before his own time. He was a contemporary of Harvey. His own son-in-law was a distinguished physician with a large

In the realm of Zoology Shakespeare seems to have been specially interested in birds. Picturesque creatures, even if imaginary—the phœnix, the unicorn, the salamander, the basilisk, and the cockatrice—naturally find favour with him, as with all poets. Specially interesting and masterly is Sir William Thiselton-Dyer's account of Shakespeare's knowledge of Plants. If Shakespeare introduces a plant, he says, he does it "with faultless inspiration born of observation which no art can supply." England has always possessed a traditional botany, and Shakespeare is here characteristic of England. If he used any book it was probably the "Niewe Herball" of

FIG. 1.—An alchemist at work. By Pieter Breughel, 1558. From "Shakespeare's England."

and "genteel" practice. It is interesting to be told that mental disease is handled by Shakespeare more skilfully than any other, though it will be no surprise to those who remember their Hamlet; but he shows also a large acquaintance with both maladies and remedies of very varied kinds. His love of technical terms anticipates that of Rudyard Kipling himself.

In Astronomy he was still dominated, it seems, by the Ptolemaic system, and he knew neither that of Copernicus nor that of Bacon, who had his own theory—which Mr. Knobel pronounces to be "mere futility." Alchemy was much encouraged by Queen Elizabeth, but Shakespeare shows only a superficial acquaintance with it.

Henry Lyte of Lyte's-Cary. But, as Canon Ellacombe points out, he is curiously distinct from his contemporaries in the use he makes of popular, not literary, botany.

But there are two portions which all must read. Fortunately they come first, and are not likely to escape attention: Sir Walter Raleigh's Preface on the Age of Elizabeth and the Poet Laureate's noble prefatory Ode.

"The age of Elizabeth, the most glorious and in some ways the most significant period of English history," so Sir Walter Raleigh writes of it. What was it like? We of all men ought to understand it. Our hope is we may come to do so yet more fully. For it was the age of the

Armada and its sequel, an age of menace and peril, of intrigue and then of openly attempted invasion, followed by victory and safety and peaceful expansion. Shakespeare's boyhood knew the first, his flowering and fruiting time coincided with the second. May our young folks find the same experience! That is the theme of Dr. Bridges's Ode. It is a stately, original piece, severe, yet full of chaste beauty, a true British "Pindaric," with the massive masonry and the large, firm ornament of Pindar.

The second movement, to which the first leads up, is splendidly and surprisingly effective. Suddenly towering before us, it seems to scale up and up, higher and higher still, into the empyrean of speculation and philosophy. Then, by a swift but easy turn, it comes to earth again and closes on a quiet, strong, human note, neither exaggerating nor belittling, neither fulsome nor faint-hearted, but just, true, beautiful:—

But ye, dear Youth, who lightly in the day of fury
Put on England's glory as a common coat,
And in your stature of masking grace
Stood forth warriors complete,
No praise o'ershadoweth yours to-day,
Walking out of the home of love
To match the deeds of all the dead.—
Alas! Alas! fair Peace,
These were thy blossoming roses,
Look on thy shame, fair Peace, thy tearful shame!
Turn to thine isle, fair Peace; return thou and guard it well!

A cry of the heart, an invocation natural to our time, it will hereafter be its monument and memorial, and no unworthy one. It will wear well, with the book it graces so fitly to-day.

HERBERT WARREN.

THE FUTURE OF FRENCH METALLURGY.

THE October, 1916, issue of the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* contains the reprint of three lectures delivered under the auspices of that society by Dr. Léon Guillet, the distinguished French metallurgist.

The first lecture is a comparative study of the metallurgy of iron and steel in France and foreign countries; the second deals similarly with the metallurgy of the principal industrial non-ferrous metals; and the third treats of the application of science to metallurgical industry. It appears from Dr. Guillet's summary that in 1913 France's position in reference to world output was as follows:—Fourth in steel, eighth in copper and lead, fifth in zinc, fourth in nickel, and second in aluminium production. Her output of tin is very small indeed.

It is natural that considerable anxiety should be felt in France as to the future of her iron and steel production, which is much the most important of her metal industries. By the Treaty of Frankfort, which followed on the Franco-German War of 1870–71, Germany obtained, as is well known, the province of Alsace and the greater part of Lorraine. It is not, however, so well known that the particular frontier adjustment ultimately adopted in the latter province was based very largely on the evidence furnished by an exact knowledge of its mineral resources possessed by the German Government. As a result of it Germany obtained nineteen iron-mine, sixteen coal-mine, and fourteen other mine concessions, together with the most famous metallurgical establishments of the Moselle basin, and there is little doubt that it was anticipated that a blow was thus being struck at French iron and steel metallurgy from which it would never recover. So little, however, did Thiers realise this that, in addressing the National Assembly, he said:—"Du Fer, il y en a partout en France, d'aussi bon qu'en Suède, et la prospérité de l'industrie métallurgique dans l'Est est une *pure illusion* qui ne durera pas éternellement."

As a result of these frontier rectifications a considerable proportion of the vast "minette" iron-ore deposits which had hitherto been entirely in French territory, apart from the small quantity in Luxemburg, passed into German hands. As their name indicates, they were regarded not merely as worthless, but actually with contempt. This was principally owing to their very high phosphorus content, which rendered them insusceptible of conversion into steel by the acid process, the only one at that time known. In 1878, however, Thomas and Gilchrist, two Englishmen, invented and introduced the "basic" process, by which steel can be dephosphorised. The importance of this discovery to Germany cannot be overrated. It immediately rendered available for steel production the immense resources of "minette" ores which had passed into her hands, and in the highly phosphoric basic slag, which is a by-product in the steel production, she obtained a most valuable agricultural fertiliser. Statues erected to Thomas and Gilchrist in Düsseldorf prove that the German steel manufacturers recognised their debt to these men.

Since 1878 the commercial exploitation of the "minette" ores in French Lorraine, annexed Lorraine, and Luxemburg has proceeded very actively. These deposits constitute by far the largest source of iron and steel production in Europe. Dr. Guillet states that in 1912 the Meurthe and Moselle basin produced 90·7 per cent. of the French iron-ore minerals; in the same year 78·9 per cent. of the German and Luxemburg iron-ore production was derived from the "minette" ores under their control. Had the Thomas-Gilchrist process been invented eight years earlier there is little doubt that the boundary between France and Germany in the Lorraine "minette" area would have been drawn still farther west.

These facts throw considerable light on the course adopted by Germany at the beginning of the present war. By invading Belgium and pressing on through north-east France in the early weeks of the campaign, the German army *obtained possession of that part of France which*

produces upwards of 70 per cent. of the steel of that country. That army was brought to action and defeated at the battle of the Marne, but, owing to the trench war which developed shortly afterwards, it remained in possession—*and still does*—of by far the greater part of that particular area in France which produced steel before the war. In other words, Germany, though defeated in a military sense, achieved a metallurgical victory of stupendous value. Metallurgists have never been in any doubt why Germany invaded France through Belgium. By obtaining possession of nearly three-fourths of the French production of steel, Germany struck a blow from which it must be considered as very remarkable that France was able to recover. The price in blood has been terrible; in money, enormous. But under M. Albert Thomas, the Minister of Munitions, a new steel industry has been created. Ores in the fields remaining to France have been exploited to the utmost, new works have been erected, and the most modern methods adopted. The results are such as to elicit the highest admiration for the way in which, under the stress of necessity, very great difficulties have been overcome.

Can it be wondered at if France is deeply anxious as to the future of that portion of Lorraine which was annexed by Germany in 1871? If she recovers it she obtains almost complete possession of the most important iron-ore deposits in Europe that are being worked at the present time, a source of enormous wealth both in steel and in phosphate fertiliser. Thereby also she becomes second in the list of the steel-producing countries of the world, with most pregnant consequences to her future as an industrial nation.

Limits of space do not permit any reference to the other metallurgical industries with which Dr. Guillet's lectures deal. They will repay study by those who are interested in the future of French metallurgy.

H. C. H. CARPENTER.

THE DEVELOPMENT OF BRITISH OIL-SHALE RESOURCES.

THE rapid expansion in the use of liquid and gaseous fuels during recent years, as a result of the introduction of the internal-combustion engine and the replacement of coal by oil and gas in many of the industries, has easily kept pace with the world's production of these materials. There is no doubt that this production will continue to expand for some time as new sources are tapped in excess of those which are giving out; but it is equally certain that the world's needs will continue to grow enormously. Thus the production of hydrocarbon fuels is becoming a more and more vital factor in the industries as their utilisation is extended, and those countries which are well favoured in the possession of fuels of these types are extremely fortunate.

Although the British Isles have been plentifully endowed with coal and iron, our resources in free liquid and gaseous fuels are poor in the extreme; one might almost say they are non-existent. However, if there are practically no commercial supplies of free hydrocarbons, there are abundant stores of materials from which these fuels can be produced, and it is our business to see that these resources are developed to the utmost and with rigid economy in the near future. There is no doubt that the day is not far distant when an important step will be taken in the conservation of our coal supplies; the present wasteful method of burning in open fires will be abandoned, and the energy of the coal will be utilised in the form of oil, gas, coke, and other valuable products. Similarly the large areas of peat, at present of so little value, are immense reservoirs of energy which will be utilised in the same way. But it is to the question of the extent and utilisation of our oil-shale resources that attention is here directed.[1]

Oil-shales—that is to say, shales which when subjected to destructive distillation will yield oil and gas (as well as other products like ammonia)—have been worked in Scotland for more than fifty years. It is not our intention to follow the history of the industry through its various vicissitudes; it is the future that matters. This Scotch shale industry has maintained its own, and is producing almost 2,000,000 barrels of crude oil per annum. Yet when we realise that the world's output of oil in 1912 was approximately 351,000,000 barrels, the smallness of Britain's quota becomes painfully obvious. The shale bands which form the source of the products in Scotland occur in the Lower Carboniferous of the Lothians, and the ultimate extent of the producing areas is limited. No great expansion of the output in the future can be foreseen, and it behoves us to look farther afield.

A survey of the geological column will suggest some of the measures of the Carboniferous, as well as the Jurassic beds of the North of Scotland as possible oil-producers, but at present the most probable horizons lie in the Kimmeridge shales of England. These series of shales extend as a belt of discontinuous outcrops from Dorsetshire to Yorkshire, varying in thickness up to 1000 ft. or more. Eastward and south-eastward they dip gently under the overlying Upper Jurassic and Cretaceous horizons, so that, apart from the effects of early Cretaceous erosion, which has locally removed the series, they extend as a broad sheet under the eastern and south-eastern counties. However, it is only a very small proportion of the whole thickness which is economically valuable as a possible source of oil, probably not more than 12 ft.; and, in addition, the lateral extent of these rich beds is at present unknown. They have been located over more or less widespread areas in South Dorsetshire and West Norfolk, and have been proved in some of the Wealden borings; but in each case the lateral extent of the proved area is limited not so much because the shales do not exist farther afield as that they have not been

1 "The Norfolk Oil-Shales." By W. F. Leslie. Read before the Institution of Petroleum Technologists on October 17, 1916.

traced. The horizons are not conspicuous lithologically, and it is not easy to detect them except in a country of good exposures—a feature which is not usually found in areas covered by Kimmeridge Clay.

The lateral extent of these oil-shales is certainly greater than the present evidence will allow us to assert with any definiteness, but they will probably be found to vary in richness when traced along their strike and dip, and, in addition, the unconformably overlying Lower Greensands will have eliminated them in certain areas. But when the technical difficulties in the purification of the oil have been overcome, there is every prospect of an industry of important dimensions springing up in Dorsetshire and West Norfolk, and perhaps being linked up by similar industries in Berkshire, Oxfordshire, etc.

The one great drawback, which is at present prohibitive to the general use of this Kimmeridge shale oil, is the abnormal percentage of sulphur present. This exists in a very stable form, and has baffled the commercial attempts to eliminate it; but there is little doubt that a solution will be found, and it is suggested that it will probably lie in changed methods of retorting. The fact that the shale yields upwards of 60 gallons of oil per ton, more than twice the average yield in Scotland, indicates that when the difficulty of the sulphur content has been overcome it will become an important asset in the economic development of the country. V. C. I.

NOTES.

A BOARD of Fuel Research has been appointed by the Committee of the Privy Council for Scientific and Industrial Research on the recommendation of their Advisory Council. Sir George Beilby will act as director of the new organisation, and be assisted by the Hon. Sir C. Parsons, Mr. R. Threlfall, and Sir R. Redmayne as members of the board. By arrangement with the governors of the Imperial College of Science and Technology, Prof. W. A. Bone will be retained as consultant to the Board of Fuel Research under the Department of Scientific and Industrial Research, continuing to hold his chair at the Imperial College.

SIR ARTHUR LEE has been appointed by the President of the Board of Agriculture Director-General of Food Production; the Hon. E. G. Strutt and Mr. A. D. Hall will, for the period of the war, be additional Agricultural Adviser and Scientific Technical Expert respectively, and the Duke of Marlborough has been appointed Joint Parliamentary Secretary to the Board of Agriculture, representing the department in the House of Lords. All the posts named are unpaid.

THE Board of Trade is taking possession of all the coal mines in the United Kingdom for the period of the war, and a new department is being set up to control the mines and to deal with production, output, distribution, finance, wages, and the price of coal. Mr. Guy Calthrop, general manager of the London and North-Western Railway Company, has been appointed head of the new department, and is designated Controller of Coal Mines. He will be assisted by Sir R. Redmayne, H.M. Chief Inspector of Mines, and an advisory committee consisting of persons selected to represent coal-owners and coal-miners. Mr. Walker, the Deputy Chief Inspector of Mines, will act as Chief Inspector for the period of the war.

SIR BAMFYLDE FULLER has undertaken the charge of the department of the War Office which is dealing with the supply of timber for the use of the Army; the control of the use of timber in the United Kingdom with the view of effecting economy in its use for all purposes; the regulation of the purchase of such timber as may be imported from sources outside the United Kingdom, whether on Government or private account; and the stimulation of the felling of timber in the United Kingdom. Sir B. Fuller will be assisted by an Advisory Committee, composed of timber merchants chosen by the Timber Federation, and by others representing firms of repute which do not belong to the federation. The address of the department is Caxton House, Tothill Street, Westminster.

SIR ROBERT HADFIELD is succeeding the Rt. Hon. H. E. Duke, K.C., M.P., as president of the Society of British Gas Industries.

WE regret to learn of the death, on February 17, at the age of sixty-seven years, of Mr. George Massee, formerly of the Royal Botanic Gardens, Kew.

FROM Königsberg comes the news of the death of Dr. Friedrich Hahn, who occupied the chair of geography at the University there. He was born in 1852, began his academic career at Leipzig in 1879, and went to Königsberg in 1885. Hahn was a great traveller, having visited Australia, Polynesia, and Africa. He was a prolific writer, his principal work being the great collection, "Die landeskundliche Literatur der Provinzen Ost- und Westpreussen." Among his other books may be mentioned "Ueber Aufsteigen und Sinken der Küsten" (1870), "Inselstudien" (1883), "Die Städte der norddeutschen Tiefebene" (1885), and "Topographischer Führer durch Nordwest-Deutschland" (1895).

A MEETING of the Refractory Materials Section of the Ceramic Society will be held at the University, Leeds, on March 13 and 14, when the following papers will be read:—"The Dressler Kiln," Mr. Dressler; "The Spalling of Magnesite Bricks," Dr. J. W. Mellor; "A Process of Manufacturing Heavy Fireclay and Similar Articles," Mr. B. J. Allan; "Geology of Clays of Central Yorkshire," Prof. Kendall and Mr. Gilligan; "The Use of Zirconia as a Refractory Material," Mr. J. A. Audley; and "Temperature Measurements on Clay Works Practice," Prof. Cobb.

MR. A. CHASTON CHAPMAN will deliver a lecture, entitled "Some Main Lines of Advance in the Domain of Modern Analytical Chemistry," to the Chemical Society on March 15, and Dr. Horace T. Brown will lecture on "The Principles of Diffusion: their Analogies and Applications" on May 17. The following changes in the officers and council of the Chemical Society for 1917–18 have been proposed by the council:—*President*, Prof. W. Jackson Pope; *New Vice-Presidents*, Col. A. Smithells and Prof. Sydney Young; *New Ordinary Members of Council*, Prof. H. C. H. Carpenter, Prof. A. Findlay, Prof. A. Harden, and Dr. T. A. Henry.

SIR ALFRED KEOGH, Director-General of the Army Medical Service, presiding at a lecture at the Royal Institute of Public Health on February 14, stated that in France at that moment there were only five cases of enteric fever and eighteen cases of paratyphoid fever, with seventy or eighty doubtful cases. He attributed this result to inoculation, and the general

good health of the Army to good food, in addition to careful sanitation. The health of the Army at all our fronts to-day is better than the ordinary health of the Army in peace-time.

THE Amsterdam correspondent of the *Times*, in the issue for February 15, directs attention to the declining birth-rate in Germany. In the week ending December 30 the number of births in Berlin was 376, and in Amsterdam 331, although the population of the former city is only 80,000 short of three times that of Amsterdam. In Leipzig, with a population 50,000 more than that of Amsterdam, the births are less than half those in the latter city. The marriage-rate in Berlin has also been declining, while the death-rate has increased.

IN 1813 Dr. Matthew Baillie and Sir Everard Home, "being desirous of showing a lasting mark of respect to the memory of the late John Hunter," endowed an oration, to be called "the Hunterian oration," now given biennially, on the anniversary of Hunter's birthday, February 13. The orator for the present year, Surgeon-General Sir George H. Makins, took as his subject "The Influence Exerted by the Military Experience of John Hunter on Himself and the Military Surgeon of To-day." In 1760 Hunter went as surgeon on the staff to Belleisle and Portugal, and was on active service for two years. At a later date he recorded his experience in two lectures on "The Treatment of Gunshot Wounds." The orator contrasted the surgical practices there recorded with the methods which surgeons have been led to adopt in the present war, concluding that modern experience had, in the main, justified the principles adopted by the great surgeon. Hunter recognised that there was in every wound a strong natural tendency to heal, and that the surgeon's attitude must be expectant. In the present war, however, experience had justified the operative, not the expectant, treatment of gunshot injuries of the abdomen and of the skull. In concluding, the orator drew an interesting comparison between Hunter and his great successor—Joseph Lister.

FEW races are more influenced by the belief that they are surrounded by numbers of malignant spirits than the people of Korea. To their influence they attribute every ill, all bad luck, official malevolence, loss of power or position, and especially sickness. According to a bulletin of the Smithsonian Institution recently published, these spirits are divided into two classes: demons, self-existent malcontent spirits of departed impoverished people who died in distress; and spirits whose natures are partly kindly, which include the ghosts of prosperous and good people; but even the latter appear to be easily offended and are extraordinarily capricious. To cope with these demons and spirits two classes of sorcerers are employed—fortune-tellers, known as Pansu, and the Mutang, usually a woman, who claims the power of being possessed by, and of controlling, the spirits. Many of the Pansu are blind men, perhaps owing to the common belief among primitive peoples that those who have been deprived of physical sight possess an inner spiritual vision. The paper concludes with a full account of the methods employed by these two classes of officiants.

THE Congress of Archæological Societies issues the report for 1916 of the Committee on Ancient Earthworks and Fortified Enclosures. Vandalism, due to carelessness or ignorance, is always to be feared and must constantly be guarded against. By the vigilance of local archæologists the danger to earthworks and other remains in the neighbourhood of Stonehenge, due to military operations, has been averted. A more serious problem arose regarding the protection of Cannington Park Camp in Somerset, owing to mining operations. "This case," the committee observes, "brings out forcibly a weak point in the Ancient Monuments Consolidation and Amendment Act, viz. that there exists no power to give compensation, or to acquire a site, where the destruction of an earthwork or other ancient monument would be to the pecuniary advantage of its owner or tenant. It remains to be seen how far the Legislature will be willing in such a case to put in force the compulsory power of preservation that now exists."

THE Smithsonian Institution has recently issued a bulletin describing the collection of Sioux songs by Miss Frances Densmore. "The Indians," she writes, "do not keep a regular rhythm throughout a song, but frequently alternate double and triple measures in a way that appears absolutely erratic, yet the song as a whole will have rhythmic completeness: in other words, the rhythm makes sense." Some of the most interesting songs recorded by her have this irregularity of measure-lengths, and she has found, by analysing the structure of about 600 songs, that the melodic form was connected with the idea. This she has followed with a test of the rhythm, by which it has been found that the peculiar alternating of the double and triple measures, into which the songs are divided, expresses the idea of the song. In developing this theory Miss Densmore has been assisted by Signor Alberto Bimboni, an Italian composer and conductor, with whose aid about 1100 Indian songs have been recorded on the specially constructed phonograph which she takes into the field.

ALL who were privileged to claim the friendship of the late Capt. F. C. Selous will applaud the fine appreciation of his achievements as a naturalist and Empire-builder, by Mr. Abel Chapman in *British Birds* for February, than whom none knew, or understood, him better. Mr. Chapman reviews both Selous's work in Africa and his hunting expeditions in various parts of Europe, Asia Minor, and North America, in all of which he added materially not merely to our knowledge of the birds and beasts of the country, but also to its geographical features, a fact which has been generally missed by those who have contributed obituary notices to the Press.

IN our issue of January 11, on p. 376, it was stated that the Bill for the introduction of protective measures designed to save some of the more interesting birds of Malta from extermination had been, at least temporarily, shelved. We are glad to be able to say that in making this announcement our correspondent was mistaken. A letter has just reached us from the Lieutenant-Governor's Office pointing out that the regulations issued in October last by the Government, designed to protect birds against wanton and senseless destruction, are actually in force. What was shelved was a motion for the appointment of a Commission to study and suggest amendments to the regulations. Since the object of the motion was to undo what the Government had done, the defeat of the scheme will cause the greatest satisfaction to all interested in the protection of birds.

THE report of the Department of Fisheries of the Province of Bengal and Bihar and Orissa deals, among other matters, with the scientific investigation of the fishes of these parts of India. The deputy-director, Mr. Southwell, points out that "the real development of the fisheries of the province depends almost wholly upon scientific research." Reference is made to a

number of papers giving the results of inspections, statistical inquiries, and investigations into fish parasites and diseases. The fresh-water fishes are of particular importance, and a good deal of work relative to the life-history of the Indian carp and other species has been undertaken and is in progress. Artificial cultivation of the carp has been carried on for some time, and arrangements have been made for the distribution of fry. Considerable difficulty has been experienced with regard to the best practice of obtaining the fertilised eggs of the species cultivated, and these difficulties are the object of investigation. So far, little has been done with regard to the marine and estuarine species of fishes, and there do not appear to be opportunities for the active prosecution of research in this direction. Some attention is being directed to the possibility of developing the fresh-water mussel fisheries by cultural methods. Co-operative work with regard to distribution is also mentioned in the report.

THE ravages produced in the olive crop in Italy by the attacks of the fly *Dacus oleae* caused Dr. F. Silvestri to initiate a series of investigations on the parasites of this insect, with the view of thus checking the destruction. The *Atti dei Lincei*, xxv. (2), 11, contains a preliminary note on the extension of these observations to India. Previously they were undertaken in the Italian colonies of Erythrea and Tripoli, where they resulted in the discovery of the hymenopterous parasite known as *Opius concolor*. The Indian observations were made in conjunction with the Government entomologist, Mr. T. B. Fletcher, and although the first samples yielded no flies, further investigation showed the existence of a fly and a parasite differing from those found in the Italian colonies. The Indian fly is now described by Dr. Silvestri under the name *Dacus oleae*, var. *asiatica*, and differs only in colour from the African form, but the new parasite is considered to be a fresh species, to be called *Opius ponerophagus*, as it possesses morphological differences in the shape of the discoidal and second cubital cells of the wings and elsewhere.

FROM the annual report of the Department of Agriculture, Uganda, for the year ended March 31, 1916, it is interesting to note that the coffee on the plantation has shown a marked improvement. The leaf disease due to the well-known fungus, *Hemileia vastatrix*, which was causing some anxiety, appears to be well in hand owing to the measures taken by the officers of the department. The prevalence of the disease shows marked fluctuations, the commencement of an outbreak coinciding with the beginning of the rains about the end of February, and its termination with the drought. From August, 1915, to February, 1916, there was a long spell of partial immunity.

THE annual report of the Agricultural Department, St. Vincent, for 1915–16 is a record of steady progress. In addition to the usual work, experiments on cotton-breeding are being made at the experiment station, which, if they can be fully carried out, should yield valuable results. Plants possessing resistance to angular spot and boll-rot have been selected, and an effort is being made to breed from them resistant strains. Selection for lint characters is also being undertaken. Should varieties be produced capable of resisting the attacks of the cotton stainer—the main cause of boll trouble—the cotton yield would be nearly doubled. Work of this kind emphasises the great need for the establishment of properly equipped agricultural research stations in the tropics in order that plant-breeding experiments needing many years of careful research may be undertaken without interruption and hindrance.

A USEFUL publication on medicinal plants has been published as Bulletin No. 78 of the West of Scotland Agricultural College. The cultivation, drying, yield, and prices of the various herbs are considered in the opening pages at sufficient length, and particular attention is paid to those suitable for Scotland. This is followed by a list of hardy herbs, trees, and shrubs used in medicine. The list is very well compiled, the botanical and common names and natural family of each plant being given, then its duration—annual, biennial, or perennial—the part used occupies the next column, then the time when it should be collected, and, finally, general information as to its soil requirements, situation, etc. This and Miss Teetgen's recently published book on "Profitable Herb Growing and Collecting" should be studied by those who are interesting themselves in the growing and collecting of medicinal plants.

THE Board of Agriculture and Fisheries has issued an order, dated January 15, which came into force on February 1, with regard to the wart disease of potatoes. It is forbidden to plant potatoes on any land on which potatoes affected with wart disease have been grown during the previous year, unless such planting be duly authorised by the Board or the local authority. A person convicted is liable to a penalty not exceeding 10*l.*, unless he can prove to the satisfaction of the court that he was unaware that affected potatoes had been grown on the land in a previous year.

THE thirtieth annual report of the Liverpool Marine Biology Committee, drawn up by Prof. Herdman, and dealing with the work of the Marine Biological Station at Port Erin for the year 1916, shows that the usual Easter vacation course in marine biology was carried on and was attended by fifteen students, that five research workers have occupied tables, and that in the fish hatchery nearly eight millions of plaice larvæ were hatched and set free. The curator (Mr. Chadwick) records observations on the rapidity with which specimens of the brittle star *Ophiocoma nigra* react to the presence of food; they detected in 15 seconds the presence of a small piece of mussel suspended out of their reach in the water of the table-tank on the bottom of which they were living. Mr. Chadwick has directed attention in previous reports to the obstruction of the pipes supplying the aquarium caused by the growth therein of various invertebrates. In the present report he notes two tube-building Polychætes—a single large specimen of *Sabella pavonia* and a vigorous colony of *Salmacina dysteri*—as the causes of such obstruction, and remarks that, although the colony of Salmacina had grown in the absolute darkness of the interior of the pipe, the worms were deeply tinged with the bright orange-red pigment characteristic of the species. He records the presence on one occasion of hundreds of large specimens of *Aplysia punctata* among seaweeds which thickly strewed the area between tide-marks and had been thrown ashore by a fresh westerly breeze. The report also contains an interesting address (32 pp.), given to the Biological Society of Liverpool by Prof. Herdman, on Sir Wyville Thomson and the *Challenger* expedition.

MANY years ago the late Prof. O. C. Marsh obtained from the Cretaceous rocks of Colorado, U.S.A., the hind foot of a running dinosaur constructed like that of a young struthious bird. He named the reptile accordingly Ornithomimus. A nearly complete skeleton of a closely related new genus, Struthiomimus, has now been received by the American Museum of Natural History from the Cretaceous Belly River Formation of Alberta, Canada, and is described by

Prof. H. F. Osborn in the Museum's *Bulletin* (vol. xxxv., art. xliii., January, 1917). Instead of being a raptorial carnivore, as at first seemed probable, it proves to be one of the strangest and most unexpected of dinosaurs, and represents an entirely new group. The jaws are toothless and must have been sheathed in narrow, horny beaks, much like those of an ostrich; but the quadrate and other bones of the skull preserved are distinctly dinosaurian. Compared with the trunk, the head is remarkably small, for although the skull is only one-third longer than that of an ordinary ostrich, it is attached to a backbone more than 13 ft. in length. The long and powerful neck must have been as flexible as in a bird. The small fore limb is long and slender, with three clawed fingers closely pressed together and of nearly equal length. On the whole, it suggests functions like those of the fore-limb of a sloth. The reptile could obviously run rapidly on its three-toed hind-limbs, with the raised forequarters balanced by the long tail. Its habits are very difficult to determine, but Prof. Osborn thinks that it lived much like an ostrich, on a mixed diet, with little power of grasping living or actively moving prey. This conclusion is interesting, for Struthiomimus and Ornithomimus bear many close resemblances to the typical carnivorous dinosaurs, with which they must have had a common ancestry.

A "CATALOGUE of the Collection of Meteorites" in the Field Museum of Natural History at Chicago is given by the curator, Dr. O. C. Farrington, in Publication 188 of that museum (Chicago, 1916, Geol. Ser., vol. iii., pp. 231–312). It is interesting to recall that two other catalogues of meteorite collections, namely, those at Washington and Calcutta, were also published during the latter part of last year. The Chicago collection was greatly augmented in 1912 by the purchase of the famous Ward-Coonley collection, which had already absorbed the large private collections of Mr. J. R. Gregory, of London, and of Count Simashko, of Petrograd; and since the last catalogue of 1903 it has been almost trebled in size. Containing representatives of 657 falls and a total weight of 7566 kilograms (about 7½ tons) of meteoritic material, it now ranks as the foremost collection in the world. The present catalogue gives particulars of the individual specimens, arranged alphabetically under the geographical names of the falls. A few general notes pointing out prominent features of the collection are also given. The largest mass is the Quinn Cañon (Nevada) iron of 1450 kg. The Cañon Diablo (Arizona) iron is represented by 122 individuals, the largest weighing 460 kg., and the total weight being 2306 kg. The Forest City (Iowa) shower of stones is represented by 722 complete individuals, ranging in weight from 3 to 4308 grams. There are some inconsistencies in the transliteration of Russian geographical names, Germanised forms of which seem difficult to eliminate. For example, Government Saratov appears correctly on p. 295, but on p. 288 as Saratowsk, the latter being the German rendering of the Russian adjectival form.

THE Paris correspondent of the *Times*, in the issue for February 10, describes what France has achieved in "war chemistry." Before the war France obtained her coal-tar products—benzene, toluene, xylene, naphthalene, anthracene, phenol, etc.—from Germany, and there was only one factory in the country capable of producing certain colouring matters. Since the latter and explosives have the same starting point, viz. the nitration of hydrocarbons, the position was extremely grave. As quickly as possible nitration plant was laid down in many new works, both private and belonging to the State, arrangements were made for the supply of enormous quantities of benzene and toluene, and shells were soon being manufactured in ever-increasing numbers. France's position as regards sulphuric acid will be excellent; in fact, there may be a difficulty in utilising all that produced. From the product of the phosphate mines of Tunisia and Algeria, together with the superabundant sulphuric acid, it will be possible to supply French farmers with cheap superphosphate, and also to compete in the foreign markets. The Germans probably knew, when in May, 1915, they first made use of asphyxiating gases as a weapon of war, that liquid chlorine was not produced in France. But within a year several works had commenced liquefying the gas. After the war these works will be established, and can be employed for the manufacture of bleaching powder, certain colouring matters, and various pharmaceutical products which France has hitherto had to import.

AN article appears in the *Quarterly Review* for January, under the title "Aircraft Politics in War Time," which gives an exceedingly clear account of the causes and results of the attack on Government-designed aeroplanes which was started by Mr. Pemberton Billing in July, 1916. The writer traces the real cause of this attack to the position in which manufacturers were placed by the rapid changes in the type of machines required. These changes were directly consequent upon the experimental work done at the Royal Aircraft Factory and at the National Physical Laboratory, and prevented the "trade" from making arrangements for repetition work in quantity, thus reducing efficiency from the commercial point of view. The article in question gives strong support to the excellence of the machines designed at the R.A.F., and quotes the case of the "Fokker" to show how easily wrong conclusions as to a machine's performance can be drawn in a moment of excitement. The "Fokker," when captured and tested by our own men, proved inferior to our own machines of similar type in all particulars, and was found to be thoroughly unstable. This is not surprising, since it is well known that the question of aeroplane stability was not understood in Germany as it was in this country at the time war broke out. The progress that has been made since the war started, in regard both to stability and to general aerodynamics, has been truly astonishing, and this scientific progress has had much to do with the altered relations between the "trade" and the Government designers which now exist. Far from discrediting experimental work in aeronautics in favour of the "rule of thumb" method, the private firms are now only too eager to obtain the results of such research and to use them to the utmost in their new designs. The article devotes a considerable amount of space to the purely commercial relations between the private manufacturer and the Government, but it is, nevertheless, well worth reading by those interested in the scientific development of aeronautics.

OUR ASTRONOMICAL COLUMN.

THE SPECTRA OF CEPHEID VARIABLES.—The detailed results of an extensive series of spectroscopic observations of twenty Cepheid variables have been published by Dr. Shapley (*Astrophysical Journal*, xliv., 273). The data indicate that regular changes in spectral type accompany the periodic variations in light, and constitute one of the general and fundamental properties of variable stars of this class. It is somewhat disconcerting to read that, in spite of the great number of observations of the magnitudes of such stars, no really precise information as to maximum magnitude and range of variation is yet available. The data,

however, are sufficient to show that the earlier spectral types are associated with the shorter periods. Among the twenty stars in question, the earliest type at maximum is that shown by RS Boötis, which is B8, passing to Fo at minimum. The most advanced type at maximum is shown by U Vulpeculæ, which is F7, and passes to G5 at minimum. The periods of these two stars are respectively 0·377 day and 7·990 days. No Cepheid variable hitherto observed has failed to show variability of the spectrum, and it is probable that all the variables of this class are subject to similar periodic disturbances of the radiating surfaces. Dr. Shapley has previously stated his reasons for rejecting attempted explanations which are based on a supposed binary character of the Cepheid variables, and for regarding the variations as arising from pulsations in a single body.

DAYLIGHT PHOTOGRAPHY OF STARS.—Some interesting experiments on the photography of stars in daylight have been made by Messrs. A. F. and F. A. Lindemann (*Monthly Notices*, R.A.S., vol. lxxvii., p. 140). Following the indications of a theoretical investigation as to the greatest contrast between sky and star, the photographs were taken on panchromatic plates through red filters, which only transmitted light of wave-length greater than 6700 A. With the 6-in. refractor employed, it was found possible in this way to photograph stars down to third magnitude, at distances of 20° or 30° from the sun. It is thought that in a fine climate it might be possible to photograph stars even fainter than first or second magnitude when quite close to the sun. The object of the experiments was to ascertain the practicability of testing, without an eclipse, the slight deviation of a ray of light by the sun's attraction which is indicated by Einstein's theory.

REPORT OF THE CAPE OBSERVATORY.—The report of H.M. Astronomer at the Cape of Good Hope for the year 1915, which has recently been received, indicates that the work of the observatory was carried on in all departments with but little interference from war conditions. Besides the usual meridian observations with the reversible transit, 118 parallax stars were under observation with the 8-in. transit circle, with an average of five comparison stars for each. Photographs of the sun, supplementing those obtained at Greenwich, were taken on no fewer than 315 days. The arrangements made for the daily transmission of a wireless time-signal for the use of shipping in South African waters proved very satisfactory.

THE THEORY OF ISOSTASY AS APPLIED TO THE QUATERNARY OSCILLATIONS OF SEA-LEVEL.

IN view of the publication by the Geological Survey of Canada of a very important paper[1] dealing with the application of the theory of isostasy to the Quaternary oscillations of sea-level, it seems desirable to give here a short *résumé* of the theory, and to point out to what extent the newly recorded observations tend to place it on a firmer basis.

It will be recalled that this theory ascribes the raised and tilted shore-lines, which are found around the centres of glacial dispersal, to the sinking in of the earth's crust beneath the pressure of the ice-sheets and its subsequent recovery when the ice has melted away. The depression and recovery were greatest at the centres of dispersal, where the ice was thickest, with the consequence that the shore-lines are highest near these centres and descend gradually towards the margins of the glaciated districts. Before they actually reach these margins they pass beneath the present sea-level, so that there are no Late Glacial *raised* beaches in the peripheral part of the glaciated districts. The shore-lines which were formed during the retreat of the ice from these areas are all beneath the present sea-level.

Now the occurrence of this state of things in connection with all the Quaternary ice-sheets is very strong evidence of a general lowering of the ocean-level during the glaciation. Moreover, calculations based on the quantities of water which must have been bound up in these ice-sheets, and so removed from the ocean, seem to indicate that this cause is quite adequate to produce the observed effects.

We have, therefore, in seeking for an explanation of the Late Glacial changes in the relative level of land and sea, two factors to deal with. The first is the local isostatic recovery of the earth's crust, the second is the general raising of level of the ocean due to the melting of the ice-sheets. According as the first or second of these factors predominated, there occurred either emergence or submergence in the isostatically affected areas.

This appears to be the explanation of the curious fact established by W. C. Brøgger in the Christiania region, that the first change of level after the retreat of the ice was one of submergence, which, at a somewhat later stage of retreat, gave place to emergence. That this is the course of events to be expected from the interplay of the two factors mentioned is apparent from the following considerations.

(1) At the period of deposition of the earlier Late Glacial marine deposits from which Brøgger drew his conclusions, about one-third to one-half of the total retreat of the ice margin had been accomplished; and it is roughly at this stage of retreat, when the climate had already considerably ameliorated, and there was at the same time a large body of ice still in existence, that the most rapid return of water to the ocean is to be expected.

(2) Brøgger has clearly established that the isostatic recovery progressed with a wave-like motion from south to north along the Cattegat, following up the retreating ice-margin. This seems to indicate that the recovery took some time to get under way, and did not attain its maximum rate until the neighbourhood was altogether clear of ice.

At this particular period of retreat, therefore, it would be natural to expect that the rise of the ocean level might be, for a time, faster than the isostatic recovery, and submergence would result. Later, when the isostatic recovery had gathered pace, and the amount of water returning to the ocean from the waning ice-sheets had become gradually less, we might expect the isostatic recovery to get the upper hand and give us progressive emergence.

Now the best test of the validity of this theory is its applicability to the isostatically affected areas of the British Isles and North America. Unfortunately in the British Isles the highest Late Glacial shore-line is only 100 ft. above the present sea-level, and within this small vertical range evidence of the kind utilised by Brøgger is not to be expected. In North America, until the appearance of the paper above mentioned, no investigation such as would bring to light a relation of this nature appears to have been placed on record. Johnston now brings forward evidence, of a nature similar to that adduced by Brøgger, to show that the Late Glacial changes of sea-level in the Ottawa valley were precisely the same as those established for the Christiania region, namely, that the sea first rose on the land as the glaciers retreated, and that it was not until a later date that emergence supervened. Moreover, he makes a further point of great importance

[1] W. A. Johnston: "Late Pleistocene Oscillations of Sea-level in the Ottawa Valley." Geological Survey of Canada. Museum Bulletin, No. 24, September 15, 1916.

in establishing the isostatic theory on a firm basis. This point, for which there is no direct evidence in the Norwegian case, is to the effect that the tilting of the Great Lakes region was in progress before and during the rise of the sea in the Ottawa valley, for, presumably from a comparison of contemporaneous ice-margins, it is concluded that "the Ottawa valley must have been, in part at least, occupied by the ice-sheet during the existence of Lakes Iroquois and Algonquin, and at least a small amount of uplift affected the region at the foot of Lake Ontario during the life of Lake Iroquois. Uplift also affected the northern portion of the Great Lakes region, and probably included the upper portion of the Ottawa valley near Mattawa during the existence of Lake Algonquin, and while the ice-sheet still occupied the upper portion of the Ottawa valley." Further, it is not a case of alternating elevation and depression, "for the result of investigations by numerous geologists of the raised beaches of the Great Lakes region has shown that differential uplift took place almost continuously as the ice withdrew."

We have thus direct proof that a district which was rising relatively to those around it was nevertheless undergoing submergence beneath the level of the sea. This remarkable phenomenon can have but one explanation, namely, that the isostatic recovery and the general rise of the ocean-level were in progress simultaneously, and that for a time the latter was the more rapid. Norway up to the present has only supplied a measure of the difference of these two motions. To presume their concerted action was a leap in the dark. Canada has now produced unexpected evidence of their individual existence.

There is now but one thing wanting to make the analogy between the isostatic phenomena of America and Europe perfect in every detail, and that is the discovery of a shore-line corresponding to the "Early Neolithic" or "Littorina-Tapes" raised beaches of Great Britain and Scandinavia. This should represent in the south a distinct resubmergence, and in the north a pronounced check or slowing down in the general emergence. W. B. WRIGHT.

PLANT DISEASES.

THE *rôle* played by insects in the spread of plant diseases is well brought out in the case of the collar-rot of rubber trees (*Hevea brasiliensis*), recently investigated by Sharples (Bull. 25, Dept. of Agriculture, Federated Malay States, 1916). The disease is caused by the fungus *Ustulina zonata*, as Brooks (Bull. 22, F.M.S.) has already shown. Sharples finds that at the time when the trees in a young rubber plantation are thinned out, at the age of about six or seven years, attacks by boring beetles (*Xyleborus parvulus*) become very common. He shows that these insects easily enter trees the bark of which has been injured by the falling of one tree against another. Attacks by the above-mentioned fungus usually quickly follow the beetles which enter rubber trees, the tracks of the insects being convenient ports of entry for the wound-parasite, *U. zonata*. At the time of thinning a large amount of suitable food material for the fungus is available in the form of soft rubber wood. Owing to the increased development of the fungus under these conditions in conjunction with the greater prevalence of borer attacks during the same period, it follows that the thinning-out stage is the most dangerous one in the life of a plantation as regards the attacks of this fungus on rubber trees.

To No. 10 of the twelfth volume of the *South African Journal of Science*, published in May of the present year, Dr. Ethel M. Doidge contributes a paper on the occurrence in South Africa of *Bacterium campestre*, the organism which causes the black-rot disease of the cabbage and other cruciferous crops. This organism had formerly been recorded only from Europe, America, and New Zealand, but Miss Doidge's investigations showed that the disease caused by it was quite common in the neighbourhood of Pretoria. The most interesting point about the communication is that it seems clear that the organism in the case under consideration was introduced into South Africa on cabbage seed which came from England. From cabbage seeds imported by the nurseryman to whose premises the diseased plants first observed by Miss Doidge were traced, the organism was isolated and its virulence proved by the successful artificial inoculation of two healthy cabbage plants. It was suggested nearly twenty years ago by Stewart in America that this disease was probably disseminated by seedsmen, but actual proof was then wanting. Soon after this the organism was isolated by Harding from the surface of cabbage seed produced by diseased plants in Long Island; and now Miss Doidge has shown that by such means the disease may be carried from one continent to another. Soaking suspected seed for fifteen minutes in 1 : 240 formalin or in 1 : 1000 mercuric chloride is recommended as a suitable method of treatment.

The cause of the serious disease of the potato known as the "Blattrollkrankheit" (leaf-roll disease) has been a matter of considerable controversy. The earlier investigators regarded the disease as being due to the choking of the wood-vessels of the plant with fungus mycelium. Recent researches, however, have shown that plants suffering from the choking of their vessels (*hadromycosis*) are not to be confounded with those affected with the true leaf-roll disease in which mycelium is absent. Quanjer, in 1913, found necrosis of the phloem to be a characteristic symptom of true leaf-roll in Holland; and in his most recent publication (*Med. van d. Rijks Hoogere Land-, Tuin- en Boschbouw-school*, Deel x., Wageningen, 1916) this author claims to have proved that the disease is due to a transmissible virus. Since attempts made to infect healthy potato plants by means of injections of the sap of diseased plants did not succeed, it might be thought that the claim is not justified. However, successful transmission of the disease was brought about in grafting experiments both with stalks and with tubers. Further evidence in favour of the virus is claimed to be afforded by the failure to isolate any parasitic organisms from affected plants, by the method of spread of the disease, by the uncertain results of selection as a means of raising healthy stocks of plants, and by the infection of healthy plants when transferred to diseased surroundings either through the agency of the soil (in which it is believed that the virus is often present) or from neighbouring diseased plants. It would seem that further research is necessary in order to supply absolutely convincing proof of the virus theory of the origin of this disease. Should it turn out to be a correct one, this disease, which has already made its appearance in some parts of Great Britain, will probably become more or less widespread in a few years unless some measures are taken to check it. The publication referred to is published in both the Dutch and the English languages.

COAL AND ITS ECONOMIC UTILISATION.[1]

THE economic importance of coal we perhaps realise. It is the only raw material we produce in great quantity; the value of our total mineral output in 1913 was above 160,000,000*l.*; of this the value of the coal at the mine was above 145,500,000*l.*

Our output of coal and our home consumption in

[1] Abridged from the Howard Lectures delivered before the Royal Society of Arts on November 27, December 4, and December 11, 1916, by Prof J. S. S. Brame.

the year 1913, a period undisturbed by domestic troubles or by the war, touched high-water mark in production and in consumption, with an output of 287,430,000 tons, of which 189,000,000 tons were retained for home use. The number of employees was 1,110,884, which gave an output per head of 259 tons.

In 1914 the output fell to 265½ million tons; in 1915 to 253 million tons. The demand for coal, however, increased with the enormous activity in the production of munitions, but the home consumption in 1914 was 184½ million tons, and about the same figure for 1915. It was therefore the export trade which suffered.

In the period of forty-two years, from 1873 to 1914, we have raised 8,206,243,000 tons, and exported 2,012,796,000 tons, or more than 24½ per cent. The value of the coal raised was equal to more than 84 per cent. of the value of our whole mineral output.

The questions arise naturally, What stocks have we? What inroads have we made on them? and How long will the stocks last? The last is too highly speculative and has too little real bearing on the question of economy to justify more than mention of the insuperable difficulties of making such an estimate.

Estimates of stock can, however, be made with some approximation.

The following estimate was made by the Royal Commission (1905), the figures being in million tons.

Estimated Coal Reserves, Royal Commission, 1905.

	Not exceeding 4000 ft.	From 4000–10,000 ft.
Proved	100,914 ...	5,239
Unproved	40,721 ...	—
Totals ...	141,635 ...	5,239

A few words may prove of interest about the Kent field, which was not included in the above estimate, and is of particular interest to us in London and of wider importance because of its geographical situation in relation to the North Sea and the Channel.

From borings which have gone to 2500 ft., Prof. H. S. Jevons considers it is established that over an area of 150 square miles the total thickness of the seams (of 18 in. and above) is from 30 to 40 ft. If the area is no greater than this—and there is reason to believe it is much more extensive—the reserves would be some 6000 million tons.

The composition of one class is very close to the average composition of the high-class Welsh smokeless coals. If the burning qualities of the coal are as good, and the seams are workable, the occurrence of such coal so conveniently situated in relation to several important naval bases may prove a valuable asset to the Royal Navy.

Comparison may be made between our reserves and those of other countries.

Of the European reserves, Germany possesses 54 per cent. of the whole; Great Britain 24 per cent.; Russia and Austria-Hungary about 7·6 per cent. each; and France 2·1 per cent.

Of the world's probable reserves, North America can claim nearly 69 per cent., of which approximately 40 per cent. lies in the United States. Asia comes next with 17·3 per cent., leaving Europe a poor third with about 10·5 per cent.

Not only are we exhausting our supplies at a far higher proportionate rate than our nearest commercial rivals, but we are retaining for our home use a much smaller proportion of the output.

It is clear that if Great Britain is to maintain her place among the great nations she must remain a great manufacturing centre, and this depends entirely on cheap fuel. The necessity for economy in place of waste is apparent, and enormous economies are undoubtedly possible.

One very important and very difficult question is that of export. It cannot be denied that in our export trade we have, to a large extent, developed our industrial greatness. But we must look at this question of export on a wider front than the immediate present or the immediate future. If, as our political economists tell us, our export is essential to our well-being, we must realise that it is at the cost of bringing the day rapidly nearer when industries will be hampered by dear coal—in other words, mortgaging the interests of posterity in the interest of the present and possibly a few succeeding generations.

The suggestion which has been made for the re-imposition of a duty on export coal, the proceeds from which should be applied to the investigation of our coals and the development of schemes for the more economical utilisation of the coal we consume, would appear very sound.

As Prof. H. S. Jevons so aptly puts it: "Englishmen must take heed in the future to rely less upon exploiting our vast stores of national wealth, and more upon the resources which scientific skill and practical education can place at our disposal."

The economic use of coal is closely associated with the question of the by-products—ammonium compounds and the tar—many important chemical industries being dependent on the latter, whilst the small quantity of nitrogen in coal—averaging about 1·4 per cent.—furnishes our principal supplies of ammonia compounds. The sulphate of ammonia alone is a most important material as a fertiliser, and its importance to agriculture can scarcely be over-estimated. In the increased production of home-grown foodstuffs, generally admitted to be a pressing question, it must undoubtedly prove an important factor. It is one of the romances of science that by means of sulphate of ammonia we are actually returning to plant life nitrogen derived from a previous vegetation which flourished millions of years ago.

The tar is the most important of the by-products obtained, and certainly no substance has yielded so many valuable products for the service of man. All the vast number of beautiful dyes, of valuable drugs, disinfectants, flavouring essences and perfumes, and photographic developers are the outcome of the work of the chemist on the raw materials furnished by the tar.

Benzene, the most important of the hydrocarbons obtained from the tar, has proved a valuable fuel for motor engines. In addition to that derived from the tar, further quantities may be obtained by washing the gas with heavy oils which dissolve the benzene and yield it up again on distillation.

The importance of benzene as a fuel in lieu of petrol is very great; ample supplies of such a home product would do much to check artificial prices for petrol. It has been estimated that it would be possible to produce annually some twelve million gallons from gas-works and sixty million gallons from coke ovens, if all coal were treated in recovery plant.

Benzene is also employed for cleaning purposes (cloth, fabrics, etc.), and quantities are now converted to synthetic phenol (carbolic acid), from which picric acid (lyddite) is prepared.

Another hydrocarbon closely allied to benzene is toluene, for which there is a great present demand for conversion into trinitrotoluene (T.N.T.), the powerful high explosive. Quantities are now obtained by oil scrubbing of the gas and also synthetically from benzene.

Phenol (carbolic acid) can be extracted directly from the light oil and carbolic oils by washing with caustic soda; also the closely allied cresylic acids. All yield high explosives on nitration.

Consideration may now be given to the more economical utilisation of our coal, and the natural course will be to deal first with wastage in production. In the past coal-mining has been characterised by the little regard which has been paid to wastage of good coal, often, of course, through financial considerations.

Many of the losses in mining coal are unavoidable—for example, by reason of the small dirty coal produced—but a great deal of really good coal is often wasted because it does not pay to bring it to bank.

With the introduction of coking plants, of briquetting plants, and of sizing and washing plants, the amount of small coal wasted has been very materially reduced, and the increased price for such prepared coals has proved an important factor in the economy of coal.

Turning now to economy in use, with our present knowledge of methods of getting power from coal, the best utilisation we are likely to effect (by gasification and use directly in gas-engines) will be about equal to 20 per cent. of the available energy.

Economy in operating can be obtained by more attention to combustion, and the combination of the purchase of coal on a scientific basis with scientific control of combustion leads to very considerable economies.

In the whole scheme of coal economy it will obviously be desirable to employ the form of plant which gives the highest thermal efficiency, for by such plant the lowest fuel consumption will be attained; but many other considerations besides thermal efficiency will be taken into account. It was to gaseous fuel that the Royal Commission (1905) looked for the realisation of enormous economies in coal consumption. Since that date, however, the steam turbine has developed and, although inferior as a heat-engine to the gas-engine, has proved a more serviceable power unit for large-scale power production than the gas-producer and gas-engine. For power production and distribution as electrical energy on a large scale the turbine has practically completely supplanted the gas-producer in the opinion of engineers.

Producer-gas plants with gas-engines, however, have their proper sphere in the economy of coal, and have contributed very largely to economy. Another important point is that a class of coal totally unsuited to use for steam raising can be employed in a producer, so that good steam-raising coal is economised.

The introduction of suction gas plants has also been a great advance, because such plants have almost invariably been installed in place of moderate and small-sized steam plants, the latter being notoriously inefficient as power units.

There are two very important industrial operations where great saving is possible, even although considerable progress has been made in reducing this waste. These are the waste of heat in blast-furnace and coke-oven practice.

The available surplus power from blast-furnaces amounts to a very large figure. Approximately, for every ton of iron produced, 150,000 cub. ft. of gas of a calorific value per cubic foot of 90 to 100 B.Th.U. are obtained. After heating the blast stoves and operating the plant with gas-driven engines, a surplus of 65,000 cub. ft. may result, this being equivalent to an output of about 650 b.h.p.

The surplus gas available in coke-ovens per ton of coal carbonised is about 5000 cub. ft., and its calorific value about 550 B.Th.U. per cub. ft., so that a coke-oven plant carbonising 400 tons per day and giving the above amount of surplus gas will, with the consumption of 21 cub. ft. per b.h.p., operate a power plant with an output of 4000 b.h.p. per hour.

Surplus coke-oven gas is being utilised as a source of power for the supply of the collieries, or in connection with a "waste-heat" scheme, in admixture with producer gas for steel-making, and as supplementing the supply of coal gas in the neighbourhood.

In the field of fuel economy, great as savings would be which can be realised by individual action, they are small as compared with what might be realised by collective action throughout a district, and the extensive scheme which has been in operation on the North-East Coast for some years is an object-lesson in what can be accomplished.

The underlying principle is to have a uniform collecting and, therefore, distributing electric system. Waste heat from coke-ovens and blast-furnaces, and exhaust steam from blowing engines (through low-pressure turbines), are utilised continuously at maximum electrical output, and the supply supplemented as necessary from steam-operated turbine sets at a limited number of stations.

The area covered by the scheme is 1400 square miles; the length of the district (north to south) is seventy miles; and the present total horse-power generated, 343,000. Collieries with an output of more than twenty million tons now depend on this supply, and show a saving of about 75 per cent. in coal consumption (equal to one million tons of coal); the suburban railways are supplied with electric power for eighty miles of single track; heavy freight haulage is carried out on fifty miles of track; tramway systems are supplied with current. In addition, lighting is provided in towns with an aggregate population of 700,000. Another important feature is the development of new industries, notably electro-chemical.

There can be no question that enormous economies are possible on similar lines in the great industrial centres, because existing conditions are generally favourable. There has been a natural concentration of industries and population in the vicinities of our coalfields; the principal sources of waste heat—iron smelting, with its complement, coke manufacture—have developed naturally in the same areas. There is the large demand for power for industries, for locomotion, and for the general supply of heat and light to a large population.

London is in a special and unique position as regards such a general-power scheme; it is far removed from coal-producing districts (at least, until there has been considerable development in Kent); it has an enormous population and big demands for power, although no large individual demands which compare with the big industrial concerns in the North; and enormous demands for lighting and domestic heating.

Waste heat is not available in the London area, and current would have to be generated at large stations situated below London, necessarily on the riverside, so as to secure the advantages of sea-borne coal and ample water supply. For the most efficient scheme I feel convinced that the gas companies and future low-temperature carbonising concerns will have to supplement the directly generated current, the former being linked in by utilising surplus coke in producers and the producer-gas in gas-engines coupled with generators, the latter through their surplus gas, to be mixed with poor producer-gas (possibly the coke-gas referred to). The gas companies already have their distributing system and market for gas; the low-temperature coke will find the best market in the country at hand.

In this way three important concerns, which would handle coal as their main raw material, could be linked up through the medium of the future uniform system of electricity distribution in the metropolis to the very great advantage of the community, providing cheap electricity and smokeless fuel, and retaining coal-gas with its many advantages.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—On February 20 Congregation took in consideration certain amendments to the statute establishing the status of advanced student, the preamble of which was passed on February 6. An amendment substituting the title of Doctor of Philosophy for that of Doctor of Letters or Doctor of Science, in the case of the degree to be obtained under the statute, was proposed by Mr. Ball, fellow of St. John's College, and Prof. A. C. Clark, Corpus professor of Latin. It was supported by Mr. Barker, fellow of New College, and opposed by Mr. Walker, fellow of Queen's, and Dr. Marett, reader in anthropology. On a division it was carried by eighty-nine to nineteen. Another amendment, proposed by Dr. Schiller, fellow of Corpus, and Dr. Grenfell, fellow of Queen's, which would have had the effect of abolishing a written examination for the new degree, was rejected by thirty-seven to fourteen. Under the former amendment the existing degrees of D.Sc. and D.Litt. will remain unaffected by the new enactment.

SIR JOHN BLAND-SUTTON has been appointed to deliver the next Bradshaw lecture at the Royal College of Surgeons of England.

DR. J. M. PURSER has been appointed Regius professor of physic in the University of Dublin, in succession to the late Prof. J. Little.

THE title of associate professor has been conferred by the council of the University of Liverpool upon Mr. J. Wemyss Anderson, lecturer in engineering design and drawing and in refrigeration, and dean of the faculty of engineering, in the University.

IT has been decided to make the erection of new science buildings for the University College of North Wales, Bangor, the North Wales memorial to men fallen in the war. The cost of the scheme will be 150,000*l*.

MR. D. M. FORBES, who died on December 13 last, has bequeathed to the University of Edinburgh his books relating to the Philippine Islands, and the residue of his property, which, with the property abroad, will amount, it is understood, to about 100,000*l*., for the purposes of education.

A NEW chair of "social providence and assistance" has been established in connection with the Collège de France, the funds for the maintenance of which will be provided by the Municipal Council of Paris and the General Council of the Seine. The teaching given from the chair will deal largely with sickness assurance, invalidism, old age, and infant protection.

THE following courses of lectures are announced for delivery at the Royal College of Physicians of London:—The Milroy lectures, by Dr. W. J. Howarth, on "Meat Inspection," on February 22, 27, and March 1; the Lumleian lectures, by Dr. G. A. Sutherland, on "Modern Aspects of Heart Disease," on March 13, 15, and 20; and the Goulstonian lectures, by Dr. C. H. Miller, on "Paratyphoid Infections," on March 22, 27, and 29.

THE Department of Agriculture and Technical Instruction for Ireland has issued its programme of summer courses of instruction for teachers to be held during the present year. With the exception of the course in rural science, which begins on August 7, all the courses will commence on July 3 and close on July 27. Teachers who attend the courses regularly and punctually will be allowed 3*l*. 10*s*. towards their expenses while living at the instruction centre, and third-class railway fare for one return journey. The courses are open only to teachers who are more than twenty years of age and engaged by local committees of technical instruction or in schools receiving grants from the Department. Among the subjects in which instruction is offered may be mentioned wool dyes and dyeing, internal-combustion engines, housewifery, hygiene and sick-nursing, manual training (woodwork), and rural science (including school gardening).

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 8.—Sir J. J. Thomson, president, in the chair.—Lord **Rayleigh**: The dynamics of revolving fluids. The fluid is supposed to be devoid of viscosity and the motion to be at all times symmetrical about an axis. In accordance with Kelvin's general theorem the circulation remains constant for each ring of fluid. In equilibrium the rings of fluid must be so arranged that the circulation is in cylindrical layers, and if the equilibrium is to be stable the circulation must increase outwards. An example is taken from fluid originally rotating like a solid and enclosed by coaxial cylindrical walls. If these close in, a simple vortex motion of increasing intensity is superposed, and the difference of pressures at the walls also increases. When the motion is in three dimensions, exact solutions are scarcely practicable, but some general considerations are appended, suggested by a recent paper of Dr. Aitken.—Prof. H. **Lamb**: The deflection of the vertical by tidal loading of the earth's surface. This subject has of late excited renewed attention owing to its bearing on observations of lunar disturbance of gravity. The present paper, after discussing a few typical problems, goes on to examine the effect of one or two considerations which have been hitherto left out of account, so far as the author is aware, in such calculations. In the first place, owing to the deformation of the surface and the altered distribution of density, an additional horizontal component of force on the pendulum is introduced. A more important point is that the action of gravity in resisting the deformation is ignored. It is true that the corrections involved are under certain conditions negligible, but they are of some theoretical interest, and it is found that at great distances from the load, and therefore in all cases of a widely distributed load, they may attain considerable relative importance. In attempting to estimate the effect of gravity it has been found convenient, in order to avoid difficulties not altogether of a mathematical kind, to limit the investigation to the case of incompressibility. In the first instance, also, the disturbance in the field of gravity has been neglected in calculating the strains. When the alteration of the field is taken into account a curious point arises. For mathematical simplicity the "earth" has been regarded, as is usual in such investigations, as flat and infinitely extended. It appears that in such a case the surface would be unstable, whatever the degree of rigidity, for disturbances exceeding a certain wave-length. This critical wave-length is, however, enormous, and reasons are given for the view that inferences can legitimately be drawn from the results as to the character of the effects actually produced.—C. F. **Brush** and Sir R. **Hadfield**: Spontaneous generation of heat in recently hardened steel. Steel specimens of different composition were hardened and then placed in Dewar vacuum jars so arranged as to have equal thermal insulating efficiency. These were placed inside an air-tight cylinder of thin copper embedded in granulated coke placed in another box surrounded by an air space and a further box. The special apparatus employed is fully described in the paper. Carbon steel, also nickel-chromium steel specially susceptible to hardening, and other steels were then quenched from hardening tem-

peratures, and when cold placed in the vacuum jars and the temperatures carefully recorded in the manner described in the paper. It was found that there was an evolution of heat of minute but appreciable quantity. As regards the bearing of this research as applied to industrial practice, whilst the rise of temperature is minute and may not have any direct bearing upon hardening results, the curious phenomenon noticed throws light upon the series stresses and strained condition of the material produced in large masses of steel during hardening operations.

Royal Microscopical Society, January 17.—Mr. E. Heron-Allen, president, in the chair.—The report of the council for the year was read.—E. **Heron-Allen**: Presidential address: Alcide d'Orbigny, his life and his work.

Mathematical Society, February 1.—Prof. H. M. Macdonald, president, in the chair.—Major **MacMahon**: (i) The significance of a certain algebraic fraction in the theory of distributions. (ii) The number of ways of pairing off the members of two identical sets of different quantities. W. H. **Salmon**: Curves of constant torsion. Informal communications were made by Lt.-Col. A. Cunningham and Messrs. E. H. Neville and L. J. Mordell.

BOOKS RECEIVED.

The Correct Arms of Kingston-upon-Hull. By T. Sheppard. Pp. vii+47. (Hull: A. Brown and Sons, Ltd.) 2*s*. 6*d*. net.

General Chemistry for Colleges. By Prof. A. Smith. Second edition. Pp. x+662. (London: G. Bell and Sons, Ltd.) 6*s*. 6*d*. net.

One Hundred Chemical Problems. By E. A. Mason. Pp. 8. (London: G. Bell and Sons, Ltd.) 6*d*. net.

Hawaiian Legends of Volcanoes (Mythology). Collected and translated from the Hawaiian by W. D. Westervelt. Pp. xv+205. (Boston, Mass.: Ellis Press; London: Constable and Co., Ltd.) 6*s*. net.

Herbert Spencer. ("Makers of the Nineteenth Century Series.") By H. E. Elliot. Pp. 330. (London: Constable and Co., Ltd.) 6*s*. net.

Chemical Bacteriology and Hæmatology for Practitioners. By Prof. W. D'Este Emery. Fifth edition. Pp. xiii+310+plates and figs. (London. H. K. Lewis and Co., Ltd.) 9*s*. net.

The Cambridge History of English Literature. Vol. xiv. Pp. xii+658. (Cambridge: At the University Press.) 9*s* net.

Life and Habit. By S. Butler. New edition. Pp. x+310. (London: A. C. Fifield.) 5*s*. net.

Memoirs of the Geological Survey, Scotland. The Economic Geology of the Central Coalfield of Scotland, including Parts of the Counties of Lanark, Stirling, Renfrew, Linlithgow, Dumbarton, and Edinburgh. Description of Area V. By C. T. Clough and others. (Edinburgh: H.M.S.O.: London: E. Stanford, Ltd., and others.) 4*s*. 6*d*.

Revision Papers in Arithmetic. By W. G. Borchardt. Pp. viii+156+xxxii. (London: Rivingtons.) 2*s*., with Answers.

The Pennatulacea of the *Siboga* Expedition, with a General Survey of the Order. By Prof. S. J. Hickson. 10 plates, 45 text figs., 1 chart+pp. x+265. (Leyden: E. J. Brill.) 13.50 francs.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 22.

ROYAL SOCIETY, at 4.30.—The Fossil Human Skull found at Talgai, Queensland: S. A. Smith.—The Magnetic Storm of August 22, 1916: Dr. C. Chree.—The Ordinary Convergence of Restricted Fourier Series: Prof. W. H. Young.

ROYAL INSTITUTION, at 3.—Memorial Art in History; Prof. E. S. Prior.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—The Origin and Growth of the Dry Lakes in Western Australia: J. T. Jutson.

FRIDAY, FEBRUARY 23.

ROYAL INSTITUTION, at 5.30.—Some Guarantees of Liberty: H. Wickham Steed.

SATURDAY, FEBRUARY 24.

ROYAL INSTITUTION, at 3.—The Pronunciation of Languages in General: Daniel Jones.

TUESDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—Strength and Structure of Metals: Prof. W. E. Dalby.

ROYAL SOCIETY OF ARTS, at 4.30.—Imperial Assets, and How to Use Them: Alfred Bigland, M.P.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—The Criminal in the Western Punjab. (Epidiascope): Major A. J. O'Brien.

WEDNESDAY, FEBRUARY 28.

GEOLOGICAL SOCIETY, at 5.30.—Fourth Note on the Piltdown Gravel, with Evidence of a Second Skull of *Eoanthropus dawsoni*: Dr. A. Smith Woodward.

ROYAL SOCIETY OF ARTS, at 4.30.—The War and Our Supply of Drugs: Francis A. Hocking.

THURSDAY, MARCH 1.

ROYAL INSTITUTION, at 3.—Memorial Art To-day: Prof. E. S. Prior.

MATHEMATICAL SOCIETY, at 5.30.

FRIDAY, MARCH 2.

ROYAL INSTITUTION, at 5.30.—Cellulose and Chemical Industry (1866–1916): C. F. Cross.

SATURDAY, MARCH 3.

ROYAL INSTITUTION, at 3.—The Pronunciation of English at the Time of Shakespeare. (Lecture II.): Daniel Jones.

CONTENTS.

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