THURSDAY, OCTOBER 19, 1916.

REMINISCENCES OF RAPHAEL MELDOLA.

Raphael Meldola: Reminiscences of his Worth and Work by Those Who Knew Him, together with a Chronological List of his Publications, MDCCCLXIX–MDCCCCXV. Edited by James Marchant. Pp. xv+225. (London: Williams and Norgate, 1916.) Price 5*s*. net.

ALTHOUGH the late Prof. Meldola's oft-repeated warnings to the nation on the decline of our chemical industries would fully entitle him to a place among the prophets, yet it could not truly be said of him, as was stated of the earlier seers, that he was "not without honour, save in his own country," for in spite of the distractions and anxieties of the present troublous times, more than twenty of his friends and colleagues, men eminent in their respective professions, have already in a few months contributed in his memory their tributes of appreciation and respect. These reminiscences of Meldola's worth and work have now been collected in a convenient volume which includes a chronological list of his original papers and other publications.

The biographical memoir by Sir William Tilden serves to emphasise the many-sided character of Meldola's scientific activities. Not only was he a brilliant chemist of wide experience, with special knowledge of synthetic dyes, but he was also a practical astronomer and a first-rate biologist.

A glimpse of Meldola's early days is furnished by Miss Neumegen, whose father taught him from the age of seven to fourteen years. His first chemical lecture was delivered at the age of fifteen to an audience of schoolfellows, of whom Sir Isidore Spielmann was one. Reminiscences extending over a period of forty years are contributed by Sir Edward Thorpe. Some of the incidents recorded have their humorous side, and testify to Meldola's sense of fun and love of the whimsical. His surpassing merits as professor of chemistry are cordially depicted by his former pupils, Dr. M. O. Forster and Prof. W. J. Pope, and by his colleagues of the Finsbury Technical College, where he presided over the chemical department for thirty years.

Prof. Green deals sympathetically with the classification of his technical and scientific researches. The technical investigations were often of a pioneer character. They opened up new ground, but in many cases the harvest was reaped in other countries. The first oxazine dye, "Meldola's blue," was not introduced into commerce in England, but was manufactured in Germany, where it became the forerunner of the still more important gallocyanine blues. His study of beta-naphthylated rosaniline led to a sulphonic acid which has since acquired importance in cotton dyeing. The researches on azo-dyes, although ignored in England, were utilised profitably by the astute colour-makers of Germany. His scientific chemical work can be classified under eight headings, of which the most important are the studies on azo- and diazoamino-compounds, and on substitution in the naphthalene series. In recent years Meldola and his assistants were engaged in studying imidazole and quinone ammonium bases, these researches being still in progress when death overtook him last November.

Prof. Poulton, who edits the bibliography of published works, contributes also an essay on Meldola as a naturalist. This appreciation contains many interesting reminiscences, some of which are published for the first time. Although Meldola received numerous scientific and academic honours from British sources, it is significant that during his lifetime he was even more appreciated in France. Twice he was offered a decoration of the Legion of Honour, and one learns with amazement that on each occasion the Foreign Office forbade him to accept this distinction!

Where so many distinguished contributors have united in a labour of love to place on record their happy recollections of this great teacher's work and personality, it would be superfluous to add more than that all these praises are worthily bestowed as a last fitting tribute to a life of high ideals and great accomplishment. It may, however, be mentioned that in addition to his published works and the grateful remembrances of his pupils, Meldola leaves behind another memorial in the form of a unique collection of research chemicals. The writer and two other former students of Prof. Meldola have spent a portion of the summer recess in arranging and cataloguing this collection, of which the specimens represent every phase in his career as chemical investigator. The preservation and study of these historical substances will constitute another method of keeping his memory green in the school of chemistry which he inspired and adorned for many years.

G. T. M.

ANIMA ANIMANS.

The Breath of Life. By John Burroughs. Pp. xi+295. (London: Constable and Co., Ltd., 1915.) Price 5*s*. net.

TWO ideas struggle for mastery in the mature reflections of this lover of nature and poetry: the one the super-mechanical and super-chemical character of living creatures, the other the continuity of natural processes and the universality of natural law. Living organisms transcend machinery; they are so persistent, insurgent, constructive, and inventive; but they are not possessed by any extraneous entelechy. They are solidary with the inanimate, though the creative energy or "procreant urge" finds freer expression in them than it does in crystal or star. It is a modernised hylozoism to which the essays composing this volume give beautiful expression: "The psychic arises out of the organic, and the organic arises out of the inorganic, and the inorganic arises out of—what? The relation of each to the other is as

intimate as that of the soul to the body; we cannot get between them even in thought, but the difference is one of kind and not of degree." There is much in the volume about the wonders of the inorganic domain, especially under the eyes of modern chemists and physicists, but the refrain is always what Tyndall called "the mystery and the miracle of vitality." Thus, to mention half of the fascinating studies, we have discussions of "The Breath of Life," "The Living Wave," "The Baffling Problem," "Scientific Vitalism," and "The Vital Order."

It is not easy to describe the life of the bee-hive without the postulate of psychical organisation, what Maeterlinck called the Spirit of the Hive; so to Burroughs it appears necessary to recognise a more than physico-chemical unity of the organism, in which the cells are the bees, and thus he speaks of the Spirit of the Body. But this vitality is potential in all matter, though it finds opportunity to manifest itself with emphasis in protoplasm. Vitality begins in the inmost sanctuary of the molecules, "but whether as the result of their peculiar and very complex compounding or as the cause of the compounding—how are we ever to know?" The striking essay entitled "A Bird of Passage" develops the idea that life plays a very small part in the total scheme of things, "the great cosmic machine would go on just as well without it." Yet it is only in the highest expressions of life that the total scheme of things acquires any meaning at all. And the author ends with the thought, which he knows to be beyond science, that there is a kind of universal mind pervading not only living matter, but the stuff of which the whole world has been spun. As the reader is warned in the preface, there is considerable reiteration in the course of the essays, but with a writer like Burroughs the impression left is that of music with a recurrent theme.

J. A. T.

DIOPHANTINE ANALYSIS.

Mathematical Monographs. No. 16, *Diophantine Analysis.* By R. D. Carmichael. Pp. vi+118. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1915.) Price 5*s.* 6*d.* net.

THE remarkable thing about Diophantine analysis is that, although it is quite respectably old, it is still in that stage where the amateur is on an equal footing with the professional. If it be true, as we are inclined to think, that Fermat's last theorem admits of a Diophantine proof, this is as likely to be discovered by a schoolboy as by a professor steeped in all the lore of modern analysis.

Prof. Carmichael's book is welcome because it gives, either in the text or in the examples, a great deal of the actual results hitherto obtained; and the author has done something towards sorting out these results and adumbrating a real theory. In this respect chap ii. (on multiplicative domains) is the most valuable. Chap. v. gives a brief but up-to-date account of what is known about Fermat's last theorem. Important sections are those which treat of Fermat's methods of "descent" and of "double equations"; these, at any rate, are definite processes capable of extension to various cases.

The weak point of the book, in our opinion, is that the author never looks at a problem from a geometrical point of view. Of course, in the last resort, geometry is irrelevant; but in research it is very valuable. For instance, let $F(x, y, z)$ be a homogeneous cubic; then from the theory of curves we can conclude that if $F=0$ has an integral solution (x_1, y_1, z_1), it has a sequence (x_n, y_n, z_n) of integral solutions, which in most cases corresponds to a compact set of points on the curve $F=0$. The proof of this is most easily obtained from elliptic functions; there ought to be a purely Diophantine proof, but the difficulty is that we have to estimate the "nearness" of a solution (x', y', z') to a solution (x, y, z), and (x_2, y_2, z_2) in the sequence is not generally "near" to (x_1, y_1, z_1) in the geometrical sense. Again, if we have a unicursal surface, such as that given by the parametric equations,

$$x=\frac{a(\lambda\mu+1)}{\lambda+\mu}, \quad y=\frac{b(\lambda-\mu)}{\lambda+\mu}, \quad z=\frac{c(\lambda\mu-1)}{\lambda+\mu},$$

whence $x^2/a^2+y^2/b^2-z^2/c^2=1$, this suggests corresponding Diophantine theorems. Then, too, we have to consider solutions which, though not integral in the ordinary sense, are integral in certain algebraic fields; for instance, if $2\rho=-1+i\sqrt{3}$, then $(25-6\rho,\ 1-9\rho,\ 8+30\rho)$ is a solution of $x^3+7y^3-z^3=0$, which is integral in the field (ρ), although it is not so in the field (1). In the latter field we have the solution (1, 1, 2); the reader is left to discover whether there are any other ordinary integral solutions, and if so, how many.

There are numerous exercises in the book which ought to stimulate the reader; some of them are practically suggestions for research. As a rule, it is unfair to expect a mathematical writer to give exact references to the sources of his examples; but in this case we wish Prof. Carmichael had been a little more definite, because in this subject even a short note on a very special problem may possibly contain the germ of an important discovery. As an instance of what we mean, Eisenstein's proof of the irreducibility of $(1-x^p)/(1-x)$, when p is prime, is based on a theorem of his which must surely admit of some generalisation. To find whether any given polynomial is irreducible or not is practically such a laborious task (though theoretically possible) that special theorems like Eisenstein's are always welcome.

We hope that this book will have a wide circulation among mathematicians of all ages and capacities; it is rather a disgrace to the moderns that in this field they have added so little to the work of that great triumvirate, Diophantus, Fermat, and Euler.

G. B. M.

THREE TEXT-BOOKS OF PHYSICS.

(1) *A Manual of Practical Physics.* By H. E. Hadley. Pp. viii+262. (London: Macmillan and Co., Ltd., 1916.) Price 3*s*.

(2) *Text-book of Mechanics.* By Prof. Louis A. Martin, jun. Pp. xviii+313. Vol. vi: *Thermodynamics.* (London: Chapman and Hall, Ltd., 1916.) Price 7*s*. 6*d*. net.

(3) *An Intermediate Text-book of Magnetism and Electricity.* By G. F. Woodhouse. Pp. x+264. (Sedbergh: Jackson and Son, 1916.) 6*s*. net.

IT is always of interest to study text-books written by those engaged in teaching, and to note the special points which their experience as teachers leads them to emphasise.

(1) Mr. Hadley, who is principal of the School of Science at Kidderminster, is the author of a number of excellent works on physics, and the present small volume gives further proof of his ability as a clear exponent of physical principles. The book is suitable for the upper classes at schools where practical physics forms, as it should do, part of the science course. It is scarcely correct to say that it covers the work necessary for a present-day intermediate course, as many of the experiments described are qualitative rather than quantitative, and some are more suitable for the teacher to demonstrate in front of his class than for the students themselves to carry out. A noteworthy feature is the simple apparatus required for most of the work—the determination of the centre of gravity of a wickerwork basket suggests a new use for the editorial wastepaper basket!

It is open to question whether it is desirable to retain the definition of specific heat as a ratio (p. 116). In actual practice what is required most frequently is the "thermal capacity of unit mass," which is expressed in calories per gram per degree. Unless this is used the "dimensions" of an ordinary heat equation are incorrect. We may note in passing that for the same reason the value of a latent heat should be expressed, not in calories (p. 122), but in calories per gram. It has been pointed out in NATURE (vol. xcv., p. 427) that the British use of "specific" is hopelessly inconsistent, and it is only necessary to compare the definition of specific resistance on p. 225 with that of specific heat to appreciate the absurdity of our present nomenclature. A new term to denote the thermal capacity of unit mass of a substance is much to be desired.

A series of observations with an ammeter and a tangent galvanometer is followed by the remark: "This demonstrates that the current is proportional to the tangent of the angle of deflection." As the tangent galvanometer is an absolute instrument, it is obvious that no such result can be proved by its use.

(2) Prof. Martin has produced a useful text-book on thermodynamics for engineering students. It forms the sixth volume of a series by the same author. Without going into excessive detail the writer has succeeded in giving a remarkably clear outline of the essentials of the subject. Although the treatment is elementary, differential equations are used throughout, their meaning being explained in such a way as to lead the student forward step by step. A large number of numerical exercises are provided throughout the work and at the end of the book. British thermal units are alone employed. The diagrams are very good, and the typography is such as to give every assistance to the student in his study of the subject.

(3) The "Intermediate Text-book of Magnetism and Electricity," by Mr. Woodhouse, senior science master at Sedbergh School, combines practical instruction with theoretical discussion. A large number of simple experiments described in the text may be carried out by the student with no great outlay in apparatus. The author is probably right in saying that the electrolytic definition of the unit of current is more readily grasped by the average student than the electro-magnetic, but we are of opinion that greater emphasis should be laid on the distinction between the practical definitions of electrical units (the so-called international units) and the absolute definitions. The book would be much improved by a careful revision: the style is frequently curt and sometimes inelegant. Many students have been penalised in examinations for giving as the second law of electrolysis: "The weight of an element deposited is proportional to the electro-chemical equivalent." The strength of a magnetic field is not measured in dynes (p. 53), but in dynes per unit pole or gausses.

We strongly endorse the opinion of the author that all students of physics should learn the calculus. A portion of Appendix I. is devoted to explaining, briefly, the principles and method of differentiating and integrating simple quantities. Several well-known text-books of physics are marred by attempts to evade the use of the calculus. It is far better to adopt the author's plan and devote a little space and time to introducing the elements of the calculus than to employ tedious and unnecessary investigations which are only differentiation or integration in disguise. Appendix II. contains a description by Mr. J. W. Shepherd of a wireless set which, in more favourable days than the present, may be set up by the student who has obtained permission from the Postmaster-General. H. S. A.

OUR BOOKSHELF.

Le Climat de la France: Température, Pression, Vents. By G. Bigourdan. Pp. 135. (Paris: Gauthier-Villars et Cie.) Price 4 fr.

THIS publication, dealing particularly with temperature, pressure, and winds, is rather a compilation than otherwise, free use being made of the original scientific discussions by M. Angot. Temperature observations made in France go back to the middle of the seventeenth century, but, as in other countries, the early observations were made with imperfect instruments, and the exposure was often bad, the results in consequence being unsatisfactory. There are only fourteen

stations in France at which the observations cover a period of fifty years, from 1851–1900, but fairly long periods are given for fifty-eight stations which constitute the principal values dealt with. Mean temperature charts are given for each month, and there are also seasonal charts for winter, summer, and for the year. Diurnal range of temperature is also dealt with. Barometric pressure is treated in a very similar manner to the temperature, and mean pressure charts are given for all months and for the year. A chapter is devoted to the disturbances of the atmosphere, and a detailed description is given of the general movement of cyclonic and anticyclonic systems. Maps are given showing the prevailing winds and the resultants for the four seasons of the year. M. Bigourdan provides a good *résumé* of the climate of France in about 130 pages, and the information is expressed in a popular manner, although its scientific accuracy is all that could be wished. The numerous charts enable the reader to obtain the several meteorological factors for any part of France.

The Psychology of Relaxation. By Prof. G. T. Patrick. Pp. viii+280. (London: Constable and Co., Ltd., 1916.) Price 5*s.* net.

ON the further side of the Atlantic one of the world's great peoples has been swept away by a passion for wild and crazy amusement; on this side the others are locked in the bloodiest war the world has seen: these are the phenomena, at first sight antithetically diverse, which Prof. Patrick brings together in his study of "relaxation." With them he sets the craving for alcohol, constantly rising in spite of prohibitive legislation, and—*longo intervallo*—the habits, widespread if not omnipresent, of laughter and profane language. In the author's view all these forms of human behaviour are, at bottom, illustrative of a single principle. The activities and relations of civilised life imply the upbuilding and functioning of extremely complex mental mechanisms, full of tensions, restraints, and inhibitions. To maintain these always in operation is an impossible task. From time to time, therefore, the complexes break up, and man falls back with relief into conduct expressive of simpler mental structures organised and consolidated in the far distant days of the race's childhood: he plays, he laughs, he swears, he fights. Alternatively, he seeks the same end—the temporary dissociation of his too complex mental mechanisms—by means of the narcotic power of alcohol.

Prof. Patrick finds much to say in defence of his thesis—even for his rather startling view of war as a gigantic "rest-cure"—and says it very well. The cautious reader will, however, feel that he has pressed a sound principle of interpretation much too far—that he has brought into clear relief one factor in the phenomena he analyses, but at the expense of neglecting others of equal significance. Still, *his* factor is undoubtedly one of great importance, and his exposition of its *rôle* is both informative and pleasant to read.

T. P. N.

LETTERS TO THE EDITOR.

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Elasticity and Entomology.

IN NATURE for June 22 (vol. xcvii., p. 340) there appeared an interesting letter under the above heading from the pen of Prof. Bryan. Perhaps I may be permitted to contribute some further remarks on the same subject, although my distance from the centre of Empire must necessarily entail a long delay before publication.

Unfortunately, the method of setting insects upon "Continental" pins does not appear to be "old-fashioned," for a large number of specimens received by me from all countries (excluding England, where, on the other hand, the insects are often set too low) are set in this obnoxious manner. In dealing with the same I always handle them by placing the forceps upon them under the insect, at a point only slightly above the level to which they are to be driven into the cork. Even so, the danger of vibrations, causing loss of antennæ, etc., cannot wholly be obviated. After many years' experience I have come to the conclusion that the shorter pins of English make, be they "silvered," "gold," or black, are in every way preferable to the long German pins. The insect should, however, be set at least half-way up the pin, and not so low down as is necessitated by the construction of many of the peculiar "curved" setting-boards still in use in England.

Using the numbers of the well-known "Kirby and Beard" make of pins, out of the following numbers which I have in use every day, viz. 1, 3, 5, 8, 15, 17, and 19, Nos. 1, 3, 5, and 8 may be classed as *stout*, and can be relied upon never to bend when inserted into cork or "lino," unless handled extremely roughly. Nor, so far as I can see, is there any deterioration in the elastic quality of such pins over a period of at least twenty years. On the other hand, Nos. 15, 17, and 19 must be classed as *slender* pins, and can never be relied upon, for certain, not to buckle under the pressure necessary to place the insect firmly in the cabinet. As all the smaller kinds of insects must be set upon one or other of these pins, or upon the even smaller silver-wire pins known as "caps," I have come to the conclusion that the only safe plan in all these cases is to use the Polyporus strips first suggested by Lord Walsingham—who, I believe, found this fungus growing in Merton Park, and ingeniously turned it to entomological use. As these strips are now sold by at least one firm in Australia, no doubt they are easily obtainable in England. A short piece of the strip is cut off and placed on a No. 8 pin, as shown in the illustration; the finer pin carrying the insect is gently inserted into the other end of the strip. The label may then be placed on the larger pin, below the strip, *facing upwards*, so that it can be read without moving the insect. I have a series of a new species of Coniopterygid, expanse only 3 mm., and the smallest Neuropterous insect known to me, set in this manner upon "caps," and they look extremely neat in the cabinet.

Returning to the subject of vibrations, might I suggest the use of a very simple expedient to obviate the constant breaking-up of the abdomen in those insects with long or fragile bodies, such as dragon-flies? This is the process of bristling, which I have used with success for years, but which I have never

seen adopted in the setting of specimens received from my brother entomologists. For large species the "bristle" should be a true hog's bristle of the kind obtainable at curriers'; for smaller, a stiff horse-hair. The "bristle" is sharpened by a diagonal cut with the scissors, and is then inserted between, and a little in front of, the mesocoxæ, and is run down to near the end of the abdomen, care being taken not to damage the appendages, and allowing a little space over for shrinkage during drying. It is then cut off close to the thorax. Even the soft-bodied Perlidæ can be much improved by this method.

R. J. TILLYARD.

Hornsby, N.S.W.

Early Use of the Word "Blizzard."

IN a communication to NATURE of June 22 (vol. xcvii., p. 341) Mr. Miller Christy states that the first appearance of the word "blizzard" in "permanent literature" was in 1885, when he used it in his work, "Manitoba Described," and that the description of the phenomenon therein by Mr. Thompson Seton was the earliest ever published.

As one of the American meteorological specialities, the blizzard has always received attention by the Canadian and United States Weather Bureaus. The very earliest use of the word has not yet been ascertained, but it has been found in current use as the name of the storm Mr. Christy describes, at least as early as 1867. In that year the *Dakota Republican* published, at Vermilion, Dakota, an account of the blizzard that suddenly approached that town, and called the storm by *that name as one in common use* when applied to a sudden change from warm and balmy weather to a blinding snow with cold north-west winds.

The earliest known description of "blizzard" phenomena seems to have been that by Henry Ellis in his account of his visit to Hudson's Bay in the *California* in 1746, and his winter at York Factory. However, Ellis did not apply the name "blizzard" to the storms he described.

Brief notes on the name "blizzard" will be found in the *Monthly Weather Review*, Washington, December, 1898, p. 562; January, 1899, p. 18; and December, 1914, p. 692.

The name "blizzard" for "a cold-wave gale with very low temperature and fine driving snow" is recorded by C. A. Lounsberry as being in use in Dakota, Iowa, and Minnesota as early as 1865. The *American Meteorological Journal*, July, 1886, pp. 112–14, quotes an excellent description of the blizzard by Mr. Lounsberry in the *Northwest Magazine*.

OTTO KLOTZ.

Dominion Observatory, Ottawa, October 2.

THE FUTURE OF THE ZINC-SMELTING INDUSTRY IN GREAT BRITAIN.

IN 1913 the world's production of the metal zinc, or, to give it its trade name, spelter, was 985,142 English tons (2240 lb.). Of this Great Britain produced 58,298 tons, *i.e.* 5·9 per cent. On the authority of Moulden,[1] however, it may be stated that "probably not more than 31,290 tons were 'primary' spelter in the sense of being extracted from ores, the balance of 27,008 tons being the result of treatment of by-products, galvanisers' ashes, hard-spelter, etc." In the same year Great Britain imported 145,004 tons of spelter, which, at the average ruling price, "ex ship," represents a total value of 3,291,772*l.* In other words, this country in the year before the outbreak of war was producing—even including "secondary" metal—only 30·1 per cent. of its spelter requirements. The galvanised iron industry absorbed about 60 per cent. of the above production, the manufacture of brass from 20 to 25 per cent., while the remainder was used for the manufacture of sheets, alloys other than brass, etc.

The bulk of the spelter imports was obtained from Germany and Belgium, each of them a large producer of the metal, and each of them a large importer of zinc ore from the most important zinc mine in the British Empire, at Broken Hill, Australia. This ore consists of an intimate mixture of argentiferous galena and blende occurring in a gangue chiefly composed of rhodonite, quartz, and garnet. It is treated by concentration and separation processes so as to give two main products, a lead ore and a zinc ore concentrate, the latter containing about 46–48 per cent. of zinc with certain values in lead and silver. The output of zinc concentrates before the war was about 500,000 tons annually. Apart from the ore which was smelted at Port Pirie, and about 20,000 tons which were sent to England and smelted at the Sulphide Corporation works at Seaton Carew, "the whole of the zinc concentrates in the past has been sold under long-term contracts to smelters in Belgium and Germany."[2] The Germans had acquired a controlling interest in the most important Belgian works, and, according to Moulden, utilised this control to make money, which they did by passing the greater part of their concentrates on to the Belgian works for smelting. "Of the total Australian output Belgium smelted at least 75 per cent. and Germany only 14 per cent."[3]

On the outbreak of war in August, 1914, the following situation arose:—

(1) Germany was unable to take delivery of Broken Hill concentrates owing to the command of the seas which Great Britain immediately obtained and has ever since held.

(2) The Belgian works, which soon fell into German hands as a result of the military invasion, were equally unable to receive their share of the concentrates.

(3) Australia thus lost nearly all her market for zinc concentrates.

(4) Great Britain was deprived of by far the greater part of her imports of spelter.

Great Britain thus found herself in the anomalous and dangerous position that, with the command of the seas and an immense supply of zinc ore in the Empire, there was, owing to the lack of smelting works, no prospect of converting it into metallic zinc; and zinc as a constituent of cartridge brass is an indispensable munition metal. It is, of course, obvious that such a situation should never have been allowed to arise, and it will naturally be asked why should not all

[1] Le Neve Foster Prize Essay. Journal of the Royal Society of Arts, 1916, p. 526.

[2] Smith, "The Development of the Spelter Industry." Journal of the Institute of Metals, No. 2. 1916.

[3] Journal of the Royal Society of Arts, 1916, p. 528.

the Broken Hill concentrates have been treated in the British Empire. The answer is that they could have been, they should have been, and perhaps they may yet be.

The effect of the above situation was felt more quickly in Australia than in Great Britain. The mines, deprived of the greater part of their market, had to curtail production very considerably, and it is to their credit that, in order to minimise hardships among their labouring population, they continued to produce considerably more ore than they could for the time being dispose of. It was not until the spring of 1915, when the Ministry of Munitions was created in this country, and it was realised upon what a gigantic scale it would be necessary to manufacture cartridges, shells, etc., that the extent of the shortage of zinc became apparent. Moreover, the zinc famine was not confined to Great Britain. France could produce nothing like her requirements, Russia and Italy still less, Belgium and Serbia none at all.

With one accord the Allied countries turned to the United States of America, the largest producer of zinc in the world, and it is no exaggeration, but the simple truth, to say that that country saved the situation. Her zinc smelters have been very highly paid for their services. For many months Great Britain was obliged to pay more than 100*l.*, and sometimes 125*l.*, a ton for metal which normally costs between 22*l.* and 25*l.* But the dominating fact is that no other nation could have come to the rescue in the way the United States did. In 1913 they produced 320,283 metric tons of zinc (2204·6 lb.); they consumed 313,300. The balance available for export was thus 6983 tons. In other words, the American smelters had practically no balance available, and had to create with the utmost rapidity conditions which would enable the very large demands of the Allies to be met. Mr. W. R. Ingalls, one of the greatest authorities on zinc smelting in the United States, estimates [4] that the spelter production in 1915 was 452,000 English tons, and that for 1916 an output of at least 714,000 tons seems assured. What these figures mean can be adequately appreciated only by those who know what is involved in the expansion of an industry where mining and ore-dressing operations, transport and assemblage of materials, erection and operation of furnaces, and, most difficult of all, the training of the necessary labour are concerned. Mr. Ingalls contents himself with remarking that "the manner in which our spelter production in 1915 was expanded is one of the romances of our industry."

Canada and Japan have increased their output of zinc to a considerable extent, but the augmentation of output in Great Britain and Australia has not been large. What is going to be the future of the zinc-smelting industry in this country? This is the question which has been exercising the minds of those who have the welfare of this industry at heart ever since the lamentable and dangerous situation at the outbreak of war was revealed. There is no doubt at all that Great Britain can become, and indeed ought to become, one of the greatest centres of production of spelter in the world. But is she going to, and are steps being taken to see that she shall? Certain considerations appear to bear on this question, and an enumeration of them may perhaps aid in presenting the situation as it appears to the writer.

(1) No zinc concentrates will be shipped to Germany in future. Australian legislation, confirmed by the House of Lords, has decided this. The Australian mine-owners will therefore have to find fresh markets for that proportion of their ore which previously went to Germany.

(2) Germany, in spite of the length of time that her own ore deposits have been worked, still has large supplies. She has also considerable zinc-mining interests in China, and before the war shipped zinc concentrates from that country. She will not fail to develop her trade in this direction after the war, and will continue to be an important producer of spelter.

(3) The United States zinc smelters will be very formidable competitors after the war. They have used their large profits wisely in making their plants efficient and up-to-date, and in accumulating large financial reserves. Their present rate of production is sufficient for more than 70 per cent. of the world's peace requirements before the war. They will have considerable tonnages of the metal available for export. They have very large ore supplies, not only of "straight" zinc ores, but of the complex ores in which zinc blende is associated with galena and other metallic sulphides, and which now constitute an increasingly important source of spelter. It is very unlikely, therefore—quite apart from the 10 per cent. *ad valorem* tariff to which zinc ores imported into the United States are liable—that Australian zinc concentrates will find a market in America.

(4) The Canadian Government is encouraging zinc smelting by granting bounties on zinc produced in Canada from Canadian ores. Australian concentrates are, therefore, not likely to enter Canada to any great extent.

(5) The future of the Belgian industry is quite uncertain, but it is much to be hoped that it will be re-established after the war, and in this case, as it will depend largely on imported ores, there may be a renewal of the contracts with the Broken Hill mine-owners.

(6) By virtue of the magnitude of its population, its transport facilities, markets, and the raw materials necessary for zinc smelting—apart from the ore itself—Great Britain is the most suitable country for the treatment of Broken Hill concentrates exported from Australia. The Swansea district is one of the most favourably situated places in the world for the production of zinc, and is the chief seat of the British industry.

The complete treatment of Broken Hill concentrates involves, however, more than the mere production of zinc. They are a potential source of (1) sulphuric acid, (2) zinc, (3) lead, and (4)

[4] *The Engineering and Mining Journal*, April 1, 1916.

silver, and should be worked up to produce all of these. This being so, it does not follow that the roasting of the ore for acid should necessarily be carried on at the same place as the smelting of the roasted material for the metals. Moreover, it is just the fact that this ore is a potential source of acid which renders it necessary for the bulk of the concentrates to be shipped from Australia, where the market for acid is limited, to a country like Great Britain, with nine times the population of Australia, and highly developed industries which can absorb the acid.

Stated broadly, if Great Britain is going to produce all the zinc needed for home consumption, the output of "primary" spelter will have to be increased at least fivefold. At present neither electrolytic zinc nor electro-thermally distilled zinc can compete commercially in this country with that obtained by distillation with coal in externally fired retorts heated by gas. Unquestionably the most difficult part of the problem is the training and organisation of the labour required for this process. Difficult though this is, it should be undertaken without delay, for America has shown that it can be done, and done rapidly when necessary. The establishment in this country of a zinc-smelting industry on a scale commensurate with its needs is most urgently required. There is no reason, if there is a proper application of organising ability, technical knowledge, perseverance, and resourcefulness—such as is now being exhibited on the British battle-front—why success should not be achieved. It would be an industrial victory of the first magnitude, and it would remove a peril in which this country was placed by the outbreak of war, which has been all too imperfectly realised, and should never be allowed to recur.

No reference has been made in this article to the possibility of assistance to be given by the British Government. As already mentioned, the Australian Government has dealt with the situation created there, and the Prime Minister, Mr. Hughes, is credited with having a very definite policy as to the future of the zinc mining and smelting industry, a policy in which Australia and Great Britain are immediately concerned. Whether and to what extent the statements relative to this which have appeared in the Press are trustworthy and authentic it is impossible to say. Some of them have been so inherently improbable that it is wisest to suspend judgment until the matter has been settled and an authoritative announcement made. There is every reason why there should be as little delay as possible in reaching a decision and acting upon it.

H. C. H. CARPENTER.

PROF. PIERRE DUHEM.

THE precise formulation of the fundamental principles of mathematical physics may be said to be the outstanding feature of the work of Pierre Maurice Marie Duhem, whose sudden death at Cabrespine (Aude) on September 14 was announced in NATURE of September 21.

Born at Paris on June 10, 1861, Duhem in due course graduated in science, and for many years past held the chair of theoretical physics in the University of Bordeaux.

Although for a considerable time a corresponding member of the Academy of Sciences, it was not until 1913 that the distinction of full membership was conferred on him

Unlike most physicists, who take as their starting-point the equations of reversible dynamics, Duhem commenced with thermodynamics, and his treatise on the Thermodynamic Potential, published in 1886, will always remain a classical work of reference on the subject. At that time the work of Willard Gibbs (1876–8) was beginning to attract attention to the potentialities of thermodynamics in relation to chemical theory, and Duhem became an early exponent of the new methods. In 1893 he published his "Introduction à la Mécanique chimique," which was followed in 1897–9 by a much more comprehensive work in four volumes, entitled "Traité élémentaire de mécanique chimique fondée sur la Thermodynamique."

A large portion of this work is in a high degree original. We may instance the detailed studies of ternary and other mixtures and the use of trilinear co-ordinates in this connection as one of the interesting features of the work, but perhaps the most remarkable sections are those dealing with false equilibria and explosions, in which the author abandons the limitations of "classical mechanics" and invokes the assistance of a retardation analogous to friction in explanation of the observed phenomena. About the same time also appeared his "Cours de physique mathématique," dealing with hydrodynamics, elasticity, and acoustics.

The more technical applications of Duhem's work on physical chemistry form the basis of his "Thermodynamique et Chimie," which appeared a little later, and has been translated into English. In 1911 Duhem endeavoured to unite thermodynamics and mechanics in a comprehensive treatise on energetics covering statics, dynamics, hydrodynamics, elasticity, and physical chemistry. In a series of smaller contributions, entitled "Recherches sur l'Hydrodynamique," Duhem gave a detailed discussion of certain aspects of the study of fluid motions.

If the properties of matter occupied so large a place in Duhem's work, electricity was by no means overlooked. A volume of 228 pages, published in 1902 (Paris: A. Hermann), is devoted to a critical and historic study of Maxwell's electric theories. About the same time appeared the volumes in commemoration of the twenty-fifth anniversary of the doctorate of H. A. Lorentz (1900), and the sixtieth birthday of Boltzmann (1904). To the former Duhem contributed a paper on Helmholtz's electrodynamic theories and the electromagnetic theory of light, while to the latter he presented in June, 1903, an important contribution on the problem of electric stability.

Historical studies would likewise appear to

have had considerable attraction for Duhem. On the origins of statics he published two volumes, but the crowning work of Duhem's later years would appear to be a work of ten volumes on the history of astronomy up to Copernicus, of which so far only four have appeared.

The writer of this notice visited Duhem at Bordeaux in 1901. He was a shortish man with a very pleasing manner, in which could be observed that element of preciseness which characterises his writings. It will readily be understood that a vast laboratory fitted with costly and complicated apparatus was not needed by a mathematical physicist like Duhem, and it was interesting to compare the simple equipments at Bordeaux with the rather less simple, but more dusty, pieces of apparatus used by another mathematical physicist, Ludwig Boltzmann, at the dingy buildings in the Türkenstrasse at Vienna. But if Duhem did not indulge in superfluous luxuries, he made the best use possible of all the essential apparatus, and on the occasion of the visit he demonstrated the then newly discovered properties of radio-active substances with the same care and attention to detail that are so noticeable in his theories.

If Duhem did not concentrate his main efforts on the discovery of new phenomena or the measurement and re-measurement of physical constants, he has at least played an equally important part in the advancement of our knowledge by evolving order out of chaos, and uniting isolated portions of mathematical physics in the form of a connected and logical theory.

G. H. BRYAN.

NOTES.

A MEETING to consider the steps to be taken to raise a memorial to the late Sir William Ramsay will be held at University College, London, on Tuesday, October 31, at 4.30 p.m. Invitations will be sent out on or about October 20. It will, however, greatly help in making the arrangements if all persons wishing to be present, including in particular scientific friends and former students of Sir William Ramsay, will send a postcard to the secretary, University College, London, intimating their desire. Those who thus apply will not be asked to reply to the invitation when issued. Further particulars of the arrangements for the meeting will be issued in a few days. After the meeting the director of the University College Chemical Laboratories, Prof. J. Norman Collie, will deliver a memorial lecture on "The Scientific Work of Sir William Ramsay," at 5.30 p.m.

THE annual Huxley Memorial Lecture of the Royal Anthropological Institute will be delivered on Tuesday, November 14, by Sir J. G. Frazer; the title of the lecture is "Ancient Stories of a Great Flood."

MR. H. G. NAGEL and Mr. A. D. Hall have been appointed members of the Government committee which is considering the question of the teaching of science.

WE learn through the *Electrical Review* that it has been decided, owing to the war, not to hold the Hobart meeting of the Australasian Association for the Advancement of Science, which had been arranged for January, 1917.

THE meetings of the London Mathematical Society will be held during the session 1916–17 in the rooms of the Royal Astronomical Society, Burlington House, W. They will not always be on the second Thursday of each month, as hitherto, but on dates and days announced by the council in the list just issued.

THE twenty-fourth "James Forrest" lecture of the Institution of Civil Engineers will be delivered on Tuesday, October 24, at 5.30 p.m., by Sir John Purser Griffith. The subject will be "The Development of Appliances for Handling Raw Materials and Merchandise at Ports and other Large Centres of Traffic."

THE death is recorded in the *Revue Scientifique* of Dr. Valentin J. J. Magnan, a leading French authority on mental disorders. Dr. Magnan was elected a member of the Paris Académie de Médecine in 1893, and became president in 1915. He was the author of "Leçons cliniques sur les Maladies mentales."

THE death is announced in action on September 28 of Capt. E. J. Smith, Duke of Wellington's Regiment. Before joining the forces, at the outbreak of war, he was senior science master at Sexey's School, Blackford, Cheddar. While in Gallipoli he was shot through the shoulder when in command of the snipers of his battalion. Later he commanded the Brigade Bombing School at Suvla Bay.

THE Hippurite from the chalk near Faversham, noticed in our last issue, has now been placed, with some other illustrative specimens, on exhibition in the Gallery of Fossil Reptiles at the Natural History Museum, since the galleries containing fossil invertebrates are closed to the public.

REPORTS from the Swedish expedition to Spitsbergen, noticed in NATURE for July 27 (p. 448), show that valuable work has been done, especially in the detailed mapping of the district. Besides conducting the investigations previously mentioned, the expedition has made several excavations in the old moraines on the shore, resulting in the discovery of deep-seated ice, many thousands of years old. How thick a covering of rock such fossil ice can support is a question worth solving. At any rate, deep borings have proved that it does not continue under the floor of the harbour. A Norwegian expedition to Spitsbergen, which has been investigating the Svalbard Company's coalfield, reports that it is of colossal size, containing, according to calculation, as many as 880 million tons. Norway's yearly consumption of coal is 2·8 million tons.

REPLYING, in the House of Commons, to a question by Mr. Ashley, M.P., on October 12, Mr. McKinnon Wood said:—"The direct savings resulting from closing the national museums and picture galleries to the public are estimated at approximately 50,000*l.* per annum, in addition to which a large economy results from freeing staffs, and in several cases accommodation, for purposes of immediate national importance at the present time." The sum named is that which was put forward by the Government when the proposal was first mooted, and, relatively small though it be, it is satisfactory to learn that this regrettable step has actually resulted in such direct addition to the National Exchequer. It must not, however, be forgotten that the museums in question had already forgone their purchase grants and had in other directions greatly reduced their expenditure, while continuing to perform, as exemplified in our last issue, important national services. It would be interesting to compare the actual expenditure on museum work at the present

time with the pre-war expenditure. In such a comparison the salaries of all employees now on war service would, of course, be deducted.

DR. J. S. FLETT, F.R.S., will deliver the Swiney lectures this year. The subject selected by the trustees of the British Museum, "The Mineral Resources of Europe," is very appropriate to the circumstances of the time. The lectures, twelve in number, will be delivered in the hall of the Royal Society of Arts, commencing on November 14. Dr. Flett will deal with the coal resources, petroleum, iron ores, copper, tin, lead, and the precious metals of all the European countries, and one lecture will be devoted to the salt deposits of Germany, France, and Great Britain, and to a general review of the mineral resources of the countries of Europe, and their importance in the world's trade and industry.

A REMARKABLY fine skull of the Cretaceous horned dinosaur, Monoclonius, has just been added to the remains of fossil reptiles exhibited in the Geological Department of the British Museum (Natural History). The specimen, which measures nearly 5 ft. in length, was discovered by Mr. W. E. Cutler in the Belly River formation of Alberta, Canada, and is interesting for comparison with the still larger skull of Triceratops from Wyoming, U.S.A., already in the museum. Monoclonius is peculiar in having the largest horn on the nose, only diminutive horns above the eyes, while its extensive bony frill over the neck is pierced by two vacuities and provided behind with a pair of remarkable forwardly directed prominences. The brain-case of the fossil is especially well preserved, and a plaster cast of the cavity shows the usual diminutive size of the brain.

WE regret to learn from the *Revue Scientifique* that Dr. Jean Boussac has died from wounds received in action in France. Dr. Boussac, who was born on March 19, 1885, was one of the most active and brilliant geologists of the younger French school, and had done much important work for the Geological Survey of France. He was especially interested in the Eocene Nummulitic formations, and had travelled extensively in Europe and Egypt while attempting to correlate these deposits. His stratigraphical researches led to interesting results in understanding and restoring the oceanography of Eocene times. He also undertook a revision of the species of Nummulites to facilitate their use in geological work, and made many valuable observations on the evolution of the shells of the Cerithiidæ. All Dr. Boussac's researches were characterised by marked originality, and his death causes a serious loss to geological science.

THE Norwegian explorer, Dr. Carl Lumholtz, has recently returned from a prolonged journey in the heart of Borneo. From the *Daily Chronicle* we learn some details of his work. After spending two months among the Murang Dyaks, he started on his journey to central Borneo in December, 1915. The route was from Banjermassin up the Barito and the Busang to the Müller mountains, thence by the Mahakkan river back to the coast. Dr. Lumholtz's work includes a new map of the watershed region of central Borneo and anthropological and photographic records of the Dyaks of the Upper Mahakkan. He has also brought back large ethnographical and zoological collections. The expedition reached Samarinda on August 22 this year.

A NEW expedition to tropical South America is announced by Dr. Hamilton Rice. In the *Geographical Journal* for October (vol. xlviii., No. 4) Dr. Rice says that he proposes to leave New York this month for Brazil, and to ascend the Amazon and Rio Negro to Santa Isabel, pushing on thence by steam launch to the Guainia. He hopes to reach the sources of the Guainia, which lies between the Papunaua branch of the Inirida and the Isana. Further, he proposes to survey and map the Casiquiari, which links the basins of the Orinoco and Amazon, and to solve some of the hydrographical problems of this region. Dr. Rice hopes to determine some longitudes with the help of wireless telegraphy, and to effect barometric determinations of altitude which will form the basis for a more accurate knowledge of the hypsometry of this part of South America than exists at present.

PROF. VINZENZ CZERNY, news of whose death, at seventy-four years of age, was received last week, was professor of surgery at Heidelberg University, and director of the Institute for Cancer Research in the same town. At the commencement of his career he showed for the first time that normal life was possible after extirpation of the stomach by operations on two dogs, one of which was alive and well five years later. Apart from his eminence as a surgeon, he will chiefly be remembered by his exertions in founding the Institute for Cancer Research at Heidelberg, of which he was the first director, a task to which he brought all the energies of an enthusiastic and generous personality. He was president of the International Conference on Cancer Research held in Paris in 1910, under the patronage of the President of the French Republic.

BY the death, in Edinburgh, of Dr. James Burgess, at the age of eighty-four, India has lost a veteran archæologist. Arriving in India before the Mutiny days, he was engaged in educational work at Calcutta and Bombay. But his bent for archæology led him to found the *Indian Antiquary*, which, since 1872, has taken a leading part in antiquarian and linguistic research. In 1874 he was placed in charge of the Archæological Survey of Western India, and at the close of his official career he had held for three years the post of director of the Archæological Survey of India. His original work was chiefly confined to his careful survey of the antiquities of Gujarat, and he published useful monographs on Elephanta, Somanath, Junagadh, and Girnar. He was closely associated with the great architect and antiquary, James Fergusson, and collaborated with him in the work on the "Cave Temples of India." It was near the close of his literary career that he undertook a new edition of Fergusson's standard "History of Indian and Eastern Architecture," with somewhat disappointing results. It is on his work as a careful and energetic field-worker in the survey of Indian antiquities that his reputation mainly depends.

THE death on September 11, at the age of twenty-five, of Second-Lieut. Archibald W. R. Don, while on active service abroad, deprives the scientific world of one who showed exceptional promise. He was the fourth son of Mr. and Mrs. R. B. Don, of Tealing House, Forfarshire, and The Lodge, Broughty Ferry. Educated at Winchester and Trinity College, Cambridge, he won a major scholarship at the latter, and graduated first class in the Natural Sciences Tripos in 1912. He was much loved and respected in a wide circle of undergraduates and senior members of the University, where his great influence was ever exerted for good. He devoted his attention to geology early in life, but determined to follow the profession of medicine, and after leaving Cambridge entered at St. Bartholomew's Hospital. He intended, however, to pursue the study of his favourite science during his leisure hours, and

had already written, with Dr. G. Hickling, a paper on the problematical *Parka decipiens*, which was read before the Geological Society, but is not yet published. He obtained a commission in the Black Watch in December, 1914, and while on service at home and abroad collected geological specimens for the Sedgwick Museum.

THE council of the Chemical Society has arranged for three lectures to be delivered at the ordinary scientific meetings during the session 1916–17. The first of these lectures, entitled "Alloys of Copper and Tin, Aluminium and Gold," will be delivered on January 18 by Col. C. T. Heycock, F.R.S. On March 15 Dr. Horace T. Brown, F.R.S., will lecture on "The Principles of Diffusion: their Analogies and Applications"; and the third lecture, entitled "Some Main Lines of Advance in the Domain of Modern Analytical Chemistry," will be given on May 17 by Mr. A. Chaston Chapman. The ordinary scientific meetings commence at 8 p.m. In order to afford facilities to fellows for meeting each other informally, the council has again arranged to hold three informal meetings during the session, on October 19, 1916, and on January 11 and May 10, 1917. The council will gladly welcome any offers of assistance from fellows willing to show experiments and apparatus at these meetings, and such offers should be made to the assistant secretary not later than the Monday previous to the meeting.

THE gift of the Wright aeronautical patents to the British nation has caused some comment in the Press. Without in any way underestimating the magnificent pioneer work of the brothers Wright, it must be admitted that the majority of the ideas covered by their patents are now out of date. One of the main patents is connected with the warping of the wings, and the interconnection of the warp and rudder controls. At the present time warping has been almost entirely superseded by the use of wing flaps, which are more effective aerodynamically, besides being much easier to design from a mechanical point of view. Patents connected with automatic stabilisers are also useless, for machines can now be built which are inherently stable, both longitudinally and laterally, so that the necessity of an automatic stabiliser is removed. The Wrights themselves seemed to think that such a stabiliser was unnecessary. The action of the Wright Company in accepting 15,000*l.* compensation instead of proceeding with their action against the War Office for infringement was highly laudable at a time when the co-operation of all aeronautical firms was so much needed. It seems doubtful, however, whether the gift of their patents to the nation will produce any great benefit at the present stage of the development of aeronautics

THE thirteenth memorandum of the Health of Munition Workers Committee, which has just been issued, deals with juvenile employment. It is pointed out that the hours of work are extremely long—sixty hours a week—and that in many cases this limit has been exceeded, and the weekly hours have been extended to sixty-seven hours, or even longer. The long hours of work react unfavourably on the health of the workers, not only owing to the physical strain involved in the work, but also because the limited opportunities for recreation often lead to deterioration of character. These harmful effects are clearly more liable to occur in the young, whose development is still incomplete and whose character is not yet formed and stable. The committee recommends the abolition of Sunday work, and, except in special circumstances, of night work. It does not feel justified, however, under the present conditions, in suggesting the limitation of the hours of work to less than sixty hours weekly for those under sixteen, and sixty-five hours for those above sixteen years of age. A further excellent suggestion is the appointment of visitors, whose work is directed to improving the physical and moral welfare of the boys in factories by organising facilities for recreation, by personal supervision, and by direct association with the boys; this plan has already been adopted in at least one factory.

THE Secretary of State for India has authorised the Indian Committee of the Imperial Institute to inquire into and report on the possibilities of extending further the industrial and commercial utilisation of Indian raw materials in this country and elsewhere in the Empire. The committee has already commenced its work and has appointed a number of sub-committees to deal with the more important groups of materials, to consider the results of investigations and inquiries already conducted by the Imperial Institute, and to obtain the views of leading merchants, manufacturers, and other users of the raw products of India. One of the important aspects of the committee's work will be to suggest openings for the employment of those Indian materials which before the war went to enemy countries. The Indian Committee of the Imperial Institute includes Lord Islington (Under-Secretary of State for India), Sir Marshall Reid (member of the India Council), Prof. Wyndham Dunstan (director of the Imperial Institute), Mr. L. J. Kershaw (secretary, Revenue and Statistical Department, India Office), Sir John Hewett (formerly Lieutenant-Governor of the United Provinces), Mr. G. B. Allen (of Messrs. Allen Bros. and Co. and Messrs. Cooper Allen, Cawnpore), Mr. Yusuf Ali (late Indian Civil Service), Sir R. W. Carlyle (lately member of the Viceroy's Council), and Sir J. Dunlop Smith. Mr. C. C. McLeod, chairman of the London Jute Association, is chairman of the committee, and the secretary is Mr. A. J. Hedgeland, of the Imperial Institute.

MR. F. R. ROWLEY, the curator of the Royal Albert Museum, Exeter, has contributed some valuable notes to the *Museums Journal* for October on objects preserved in arsenious acid glycerine jelly. His method is an adaptation of, and an improvement on, that devised by Prof. Delépine. The advantage of this method of preservation is purely one of convenience, since it affords a means of avoiding the introduction of spirit, or other fluid preservative, among dry preparations. The successful preservation of colour varies according to circumstances, but experiments with seaweeds have given extremely satisfactory results. So far, however, this medium has failed in regard to flowers.

THE relationship between the geographical distribution of megalithic monuments and ancient mines is discussed at length in an able essay by Mr. W. J. Perry in the Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1915–16. The author contends that the weaving of linen, the use of pearls, precious stones and metals, and of conch-shell trumpets, are all accompaniments of the megalithic culture, which had its origin in Egypt. Thence it spread through Europe to Britain, on one hand, and eastward through India and the East Indian Archipelago, and thence out across the Pacific by way of the Carolines, Solomons, New Hebrides, Fiji, and Easter Island to America. The agents in this distribution were the Phœnicians, and the part they played in this is discussed at length by Prof. G. Elliot Smith in an appendix to Mr. Perry's paper. Herein evi-

dence, which seems to be beyond dispute, is produced to show that the Phœnicians played the part of distributing agents of this culture, and not that of missionaries. The search for wealth was the underlying factor in this distribution, and provided the motive for the widespread travellings of these people. To assist in this search they employed expert gold-miners from the Black Sea and from Colchis, hence the megalithic monuments in the mining camps. That these two contributions will give rise to much discussion in the immediate future need scarcely be said, for the theme is one of first-rate importance; but there can be little doubt that the views they have so skilfully expressed will meet with general acceptance.

SPORADIC migrations of butterflies, moths, and dragonflies have long been known, and have generally been regarded as comparable to the similar migrations of locusts. But Mr. Howard J. Shannon, in the *Scientific Monthly* for September, under the title "Insect Migrations as Related to Those of Birds," has marshalled a host of facts which apparently show that certain North American species of butterflies, diptera, and dragonflies annually migrate southwards in the autumn, following well-defined routes corresponding to those taken by the birds of the same regions. The author does no more than hint at a return migration in the spring, expressing curiosity as to whether such migrants are of the same individuals which passed southwards in the autumn, or whether they represent a new generation, bred in the southern winter quarters. Some idea of the magnitude of these migrations may be gathered from the author's statements in regard to the monarch butterflies (*Danais archippus*), which, "in mingled myriads, move forwards . . . in swarms . . . forming veritable crimson clouds . . . miles in width and streaming backwards for equal distances . . . casting below them as they go perceptible shadows."

UNDER the modest title, "Notes on Some Palæozoic Fishes," Messrs. D. M. S. Watson and Henry Day have enriched the Memoirs and Proceedings of the Manchester Literary and Philosophical Society with a contribution of first-rate importance. They have described and figured in detail the skulls of Holoptychius, Glyptopomus, and Osteolepis, and the whole fish of Rhizodopsis. These studies have shown that the Rhipidistian skull is considerably more complicated than has previously been supposed, and that the short type of paired fin found in Eusthenopteron is older than, and has given rise to, the biserial "archipterygial" fin of Holoptychius. In Rhizodopsis and Glyptopomus they have given an account of the palate which considerably extends our knowledge of the structure of this region, and has a very important bearing on the problem of Amphibian ancestry. Further, they show that Ceratodus is derived by a process of specialisation and reduction from Dipterus, while Uronemus and Ctenodus are shown to belong to different lines of descent, and the conclusion is reached that *Dipterus valencennes* is the most primitive, as it is the oldest, known Dipnoan.

DR. C. A. BARBER, sugar-cane expert to the Government of India, describes, in a recent number of the Memoirs of the Agricultural Department of India (Botanical Series, vol. viii., No. 3), some results of the work done at the Coimbatore Cane-Breeding Station since 1912, when, for the first time in India, seedling canes were raised successfully. The object of the work is to produce canes for cultivation in northern India under field conditions possible to the Indian peasant. The work is therefore limited in its objective, and is also handicapped by unsuitability of soil, insufficient chemical assistance, etc.; but in spite of these difficulties substantial progress has been made and certain provisional conclusions of general interest have been reached. Special attention may especially be directed to the various devices adopted to save labour and simplify the laborious business of selection. Arising out of this aspect of the subject, the possible correlation of morphological characters with richness of juice has been specially studied, and already Dr. Barber is able to say that "from this study it would appear that the seedlings in any general collection, with higher sucrose content, would be marked out by rather narrow, short leaves, but with a relatively high leaf module, with canes that might be thick or thin, but with a leaning towards the thin side, rather long, but not very, and with a moderately high cane module." To this rule there are, however, many and notable exceptions, particularly in the case of definite crosses. It is clear from Dr. Barber's memoir that the initial difficulties experienced at Coimbatore have been successfully overcome to a considerable extent, and the results obtained in the next few years should be of great value to the Indian sugar-cane industry, which has a great deal of leeway to make up before it reaches the level attained in other tropical sugar-producing countries, both on the scientific and the manufacturing sides.

IN a paper read before the Franklin Institute in April Mr. C. J. Gadd, chief engineer of the American Iron and Steel Manufacturing Company, directed attention to the progress which has been made recently in the application of powdered coal to the heating of furnaces for metallurgical and other purposes. If slack coal is dried, pulverised until 83 per cent. of it will pass through a sieve with 200 meshes to the inch, and delivered to the furnace in this finely divided state, its combustion is completed while it is still in suspension, and as high a temperature is attained as with producer gas. From the experience gained with the apparatus used by the American company Mr. Gadd concludes that on further development powdered coal will entirely displace oil, tar, and producer gas in the fields in which they are now supreme. The paper is reproduced in the September number of the Journal of the Franklin Institute.

SOME definite evidence regarding the cause of the accident at the new Quebec Bridge on September 11 has now reached this country, and is dealt with at considerable length by *Engineering* and the *Engineer* for October 13. The accident occurred while the central span was being raised into position, and the whole of this heavy portion of the structure fell into the river. Facilities were given to the representatives of the *Engineering News* to inspect the parts which failed, and from their report it appears that one of the four rocker bearings which supported the central span whilst in course of construction gave way when the span had been raised about 30 ft. *Engineering* hesitates to criticise, since the St. Lawrence Company had sought the advice of many able engineers, but at the same time considers that the design of the rocker bearings was very unsatisfactory in view of the immense load of 1300 tons to be imposed on each. So soon as the span was lifted there was no longer any need for rocker bearings, as each corner of the great girder was suspended from the corresponding corner of one of the cantilevers quite freely. It was only during transit on the barge that the rocker bearings could serve any purpose. Once the lifting was commenced they were superfluous, and, as the event showed, an imminent source of danger.

OUR ASTRONOMICAL COLUMN.

FIREBALL OF OCTOBER 3.—A large number of additional observations have come to hand, and Mr. Denning writes us that the brilliant object was well observed as far north as Huddersfield and as far east as Hertford. Even at Huddersfield, where the observer was about 210 miles distant from the object, it exhibited a Venus-like lustre, and was followed until it disappeared in the mist very near the S.S.W. horizon. The new observations confirm, in general, the deductions already stated as regards the position and height of the fireball, but the exact place of the radiant point remains a little doubtful. With reference to the elevation at disappearance, this may have been less than thirty miles, for there are several observations indicating it at about twenty-four miles. The cloudy or misty condition of the sky at many places, however, hindered efforts at exact observation. Everywhere the spectators speak of the astonishing brilliancy of the object and admit that its startling aspect at first aroused fears of a calamitous sequel.

Erratum.—By a clerical error Launceston was mentioned instead of Seaton, East Devon, in NATURE, October 12, p. 116.

ANOMALOUS DISPERSION IN THE SUN.—The search for evidence of anomalous dispersion in the sun continues to attract considerable attention. Dr. Albrecht recently concluded that Rowland's measurements gave distinct indications of a mutual repulsion in close pairs of lines, such as is required by the anomalous dispersion theory. Mr. Evershed and Dr. Royds, however, have questioned the validity of this result, since it is not supported by data obtained at Kodaikanal by more direct methods (the *Observatory*, October, 1916). In agreement with Dr. St. John, Mr. Evershed finds that Rowland's separations were almost invariably overestimated; for eighteen pairs having a mean separation of 0·1920 according to Rowland, the Kodaikanal mean value was 0·1836. The tendency of Rowland was therefore to displace the violet components to the violet, and the red components to the red, thus simulating the effects of anomalous dispersion. Mr. Evershed considers that his results are decidedly against the view that anomalous dispersion is an effective agent in displacing solar lines.

Dr. St. John has also made an exhaustive examination of the cases included in Albrecht's list, and is strongly of opinion that the deviations are merely due to systematic errors in Rowland's measures of close lines (Proc. Nat. Acad. Sci., vol. ii., p. 458). He finds that the separations of pairs in the solar spectrum are identical with those obtained from terrestrial sources. "Within the limits of error, evidence of mutual influence is absent from the solar spectrum, and in so far as mutual influence is a necessary corollary of anomalous dispersion in the sun, evidence for it also is absent."

Experimental work bearing upon this question has been carried out at the Pasadena laboratory by Dr. A. S. King (Proc. Nat. Acad. Sci., vol. ii., p. 461). Anomalous dispersion effects in metallic vapours were obtained by the use of the electric furnace, in which a strong density gradient was produced by water-cooling the upper part of the tube. Tests for the mutual influence of lines were made on the mixed vapours of titanium, calcium, and chromium, in which certain lines of the two former elements fall well within the curved spectra given by the anomalous dispersion of chromium lines. When compared with the corresponding emission spectra of the mixture, and of the elements separately, the measures gave no evidence whatever of a mutual repulsion between close lines when anomalous dispersion is active.

THE VARIABLE STAR SZ CYGNI.—Extensive observations of SZ Cygni, covering the period from November, 1912, to August, 1916, have been made by F. C. Leonard (Mon. Reg. Soc. Prac. Astr., vol. viii., No. 5). The star is of the δ Cephei class, having a mean magnitude of 8·96 at maximum and 9·74 at minimum. The mean period is 15·10 days, with an interval of 6·6 days from minimum to maximum. Both range and period appear to be subject to slight variations. The star is stated to be of a reddish tinge, and to deepen in colour as the brightness diminishes.

FISHERIES INVESTIGATIONS AND DEVELOPMENT.

THE importance of utilising more fully the fisheries around our coasts was emphasised at the recent Newcastle meeting of the British Association, one day being devoted to papers and discussions on this and kindred subjects.

Prof. Herdman urged that with the view of making a rapid recovery from the effects of war, food-producing industries should be encouraged, and, among others, the inshore fisheries should be exploited. Shellfish cultivation, shrimping and prawning, whitebait and sprat fishing, and herring fishing and curing, if extended and exploited judiciously, would add to employment, increase the national food supply, and might lead to the establishment of permanent industries of a profitable nature. He illustrated by several instances how the transplantation of stunted mussels from an overcrowded area to suitable neighbouring areas resulted in the rapid production of mussels of good quality which were sold for eight to ten times the sum expended on their transplantation. As examples of local fisheries started recently, Prof. Herdman mentioned the winter sprat fishery in Morecambe Bay and the summer herring fishery in the Irish Sea.

Prof. Meek gave an account of the inshore fisheries of Northumberland, and pointed out what had been done to preserve them by legislation and to encourage them by such an attempt as that now being made to establish a mussel-bed large enough to supply the wants of the district. The importance to the nation of the fishermen of the smaller fishing stations has been emphasised during the present war. With the problem of the preservation and extension of the coastal fisheries is involved the economic consideration of better buying and selling, and also the social question of making life in the fishing village more attractive.

In his paper on the further development of the shell-fisheries Dr. James Johnstone dealt especially with the coasts of Lancashire, Cheshire, and North Wales, where such fisheries are of considerable actual value and of very great potential value. Here mussels and cockles exist in incredible abundance, though in certain areas a considerable proportion are always smaller than the specified legal size. Mussels are found to prefer shallow estuarine water of low salinity containing the drainage from cultivated land or from human communities. Dr. Johnstone dealt with the rationale of successful transplantation, and calculated that the yield in assimilable food substance of high nutritive value of a cultivated mussel-bed was probably greater than that of a similar area of land bearing a food crop. He pointed out that although mussels feed on contaminated material they can be cleansed, and regarded as pure, by placing them in an area where water coming in from the sea washes over them during the last hour of flood-tide for two to four days. Although it is practicable to develop the yield of the shell-fisheries to an enormous extent, it is difficult to see how this can be brought about without some

measure of State organisation for redepositing and cleaning the shell-fish. Dr. Johnstone considered briefly some of the administrative problems involved.

Dr. A. T. Masterman stated that in running sterile water mussels will, in three hours, cleanse themselves of sewage organisms which have been introduced into their mantle cavity and alimentary canal with food. Mussels may be relied upon to feed at night and at a suitably low temperature. It was found that chlorine in any form was not available as a direct sterilising agent, for its presence in the water in any appreciable quantity (0·5 per million) interfered with the normal functions of the mussel, and retarded the self-cleansing processes. Efficient sterilisation of sea-water can, however, be produced by the use of chlorine, and the following process of mussel purification has been devised at Conway by the Board of Agriculture and Fisheries. Into an upper tank river-water (80,000 gallons) is pumped and allowed to settle, and the clean water is run into a lower tank, together with sufficient hypochlorite solution to produce an initial strength of three parts per million. Sterilisation of the water is effected overnight. In other still lower, shallow tanks mussels, which have been thoroughly washed, scoured, and picked over, are placed two deep on grids. The sterile water is then passed into the mussel tanks, its surplus of hypochlorite being removed during its passage by addition of sodium thiosulphate. The mussels remain in the sterile water for at least one night, and are then washed and hosed. They are left in sterile water for another night, and are then ready for packing.

Dr. E. J. Allen referred to the account given by Prof. Herdman of the establishment of a fishery for sprats on the Lancashire coast, and expressed the hope that attempts would be made to establish in this country an industry for preserving these fish in oil, as had been done on a large scale in Norway. He thought that a great deal more might be done in the way of preserving fish if the matter were properly organised. There were often gluts, when large quantities of fish were wasted which might well be saved and made available as food.

In his account of the scales of fishes and their value as an aid to investigation Prof. Meek pointed out that it had been established by a wealth of observations that the physiological processes in fishes suffer a relapse in winter, and that the seasonal diminution in the rate of growth is recorded on the scales, as in other skeletal structures. This discovery has enabled investigators to state the rate of growth, the age-composition of samples, and other important correlated facts. The method was illustrated by photographs of the scales of the herring, bass, and several Gadoids and Pleuronectids.

Dr. Masterman stated that although the great majority of scales in a Gadoid fish, *e.g.* the haddock, show the same number of annual rings, it was possible to find a certain percentage with a smaller or greater number. In large samples of haddock from the Dogger Bank and other parts of the North Sea the scales showed evidence of active growth for two separate periods of the year, the explanation of which is obscure. In the salmon the determination of age is complicated by cessation of growth at certain periods, and also by destruction of the edge of the scale at spawning. As a general rule, the zones on the scales of fishes are an expression of variations in growth dependent upon seasonal changes, but the interpretation of individual cases is full of pitfalls.

Dr. E. C. Jee reviewed the fluctuations of the herring, mackerel, and pilchard fisheries off the south-west coasts in the light of seasonal variations of hydrographical factors. The landings of herring, mainly at Plymouth in December, appear to be heavier in those years in which the sea-temperature is below the normal, but are also dependent in some way upon the preceding summer maximum. During the years 1904–11 (inclusive) the landings of mackerel, which are caught chiefly in May, seem to be correlated with the sea-temperature of that month. For the years 1905–10 (inclusive) the yields of the pilchard fishery fluctuated in the same manner as the magnitude of the seasonal salinity ranges. These are probable measures of the strength of the Atlantic current, which was therefore stronger in those seasons which were followed by a more successful pilchard fishery.

J. H. A.

BITTER PIT.[1]

THE disease of apples (and pears) known as bitter pit manifests itself externally by depressions of the surface of the fruit and internally by patches of discoloured and dead tissue. It is a disease which may make its appearance whilst the fruit still hangs on the tree, or it may declare itself in the fruit-room and even in cold storage.

This disease has been, and still is, the cause of great loss to growers. Thus it has happened not infrequently that whole consignments of apples shipped from Australia to England have developed the disease so severely as to have become unsaleable. Hence it is not surprising that so progressive a community as the Commonwealth of Australia should have instituted, with the co-operation of the State Governments, a special research into the nature of the disease, its remedy and prevention. This research, endowed for a period of four years, was entrusted to Prof. D. McAlpine, and the fourth and final report now issued testifies to the assiduity and thoroughness with which both Prof. McAlpine and his colleagues have prosecuted their inquiries. As is pointed out in the introduction to the report, when the investigations which it summarises were begun bitter pit was regarded as a mysterious disease. It is associated with the presence of no parasite, nor is it a consequence of puncture by insects of the skin of the fruit. Ewert had, it is true, advanced evidence in support of the view that bitter pit is a result of the local toxic action of copper-containing spray fluids. That hypothesis has not, however, met with general acceptance.

Our knowledge of the ætiology of this disease being so vague, we turn with interest and curiosity to learn the results of Prof. McAlpine's inquiries; but it must be confessed that although we discover much valuable and interesting information in this large and admirably illustrated volume, we fail to find the revelation of the mystery. The symptoms of the disease are described in detail; evidence is brought forward that severely pruned trees yield more pitted fruit than is produced by lightly pruned trees; that nitrogenous manures appear, albeit often to no considerable degree, to increase the pitting of fruit; that certain varieties are more resistant and certain others more susceptible to the disease—in fine, we learn much that is useful and suggestive, but of the cause or causes of bitter pit we are no wiser after than before the perusal of this monograph. We insist on this point with some emphasis because we think that it should have been made clear at the outset of the report, instead of which we find it there claimed that the research has been brought to a successful issue.

[1] "Bitter Pit Investigation. The Experimental Results in Relation to Bitter Pit, and a General Summary of the Investigation." By D. McAlpine, appointed by the Commonwealth and State Governments of Australia. Fourth Report, 1914–15. Pp. 178+70 figures and coloured frontispiece. (Melbourne: The Government Printer.)

That Prof. McAlpine has made a definite and valuable contribution to our knowledge of this pathological problem will appear presently, but this is only an added reason why he would have done well to make it perfectly clear that the main problem still remains to be resolved. To conclude that the "immediate cause" of the disease is "the concentration of the cell sap" (p. 75) is not to discover a cause, but to use words the meaning of which is at least as obscure as the nature of bitter pit. Moreover, if quick-acting nitrogenous manures, which lead to sappy growth, encourage bitter pit, how may that disease be attributed to concentration of sap?

Perhaps the most valuable part of Prof. McAlpine's studies is that which demonstrates the possibility of preventing the outbreak of bitter pit in cold-stored apples. As the result of experiment, he shows that if apples be stored at a temperature of about 30° or 32° F., and if fluctuations beyond these limits be prevented, no bitter pit manifests itself during a period sufficiently prolonged to transport the fruit from Australia to Europe. This is a great gain, and the practical results accruing from it should not only pay for the cost of this elaborate investigation, but encourage the Commonwealth to promote further investigations into the origin of the disease.

A point of some interest on the scientific side of the problem is the fact that starch persists in the broken-down tissue of the pitted region of the apple pulp, whence it is concluded that the incipient but invisible stage of the disease occurs in the pre-ripening phase, or at all events during the phase in which starch gives place to sugar. This is plausible, but the opposite view is not precluded that the starch of the bitter pit arises as a result of a reconversion of sugar. In favour, however, of the view that bitter pit develops, although it is not apparent, at an early stage is the evidence obtained by subjecting suspected apples to X-rays, as a result of which it is claimed, and the claim is supported by photographs, that prospective pit areas appear on the radiographs.

Prof. McAlpine is hopeful that the loss due to bitter pit may be ultimately prevented by breeding pit-resistant varieties. It is a work worth undertaking, but nevertheless is not to be undertaken lightly, for it may prove a long business.

F. K.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE president, Prof. W. S. Boulton, delivered his address on Wednesday, September 6, to a good audience, and was followed by Prof. G. A. Lebour, who described the general geology of the rocks round Newcastle.

The Permian formation, which forms such a large part of the surface geology in the neighbourhood, received special treatment at the hands of Dr. D. Woolacott, who has made it a detailed study, and brought order out of the complicated bedding He shows that the Middle Permian Beds consist of a fossiliferous, unbedded reef formation, which ran parallel to the coast of the Permian sea, and on each side of which are well-stratified, unfossiliferous limestones, which were formed in waters permeated with calcium sulphate, which afterwards formed gypsum beds. The concretionary formations found in the various beds were lucidly dealt with.

During the meeting Dr. Woolacott took the geologists to see several typical sections of the Permian beds, and exhibited interesting evidence in proof of his contentions.

The important questions of the underground mapping of prominent coal seams were dealt with by Mr. Wickham King in his plexographic model of the South Staffordshire thick seam, by Dr. G. Hickling in diagrams of the Black Mine coal of Lancashire, and by Prof. W. G. Fearnsides in maps of the Barnsley Bed.

In the afternoon a special joint meeting with Section K was held to receive the report of the Research Committee appointed to investigate the Old Red Sandstone of Rhynie, Aberdeenshire, and to hear a paper by Dr. R. Kidston and Prof. W. H. Lang describing the very interesting fossil remains found in that deposit. The present paper dealt only with one of these, *Rhynia gwynne-vaughani*, which is the oldest known peat. The plants, which were rootless and leafless, and grew crowded together, consisted entirely of a system of cylindrical stems, attaining a height of 8 in. or more, and ranging in diameter from 1 to 6 mm. The stems bore small hemispherical projections, from some of which lateral branches were developed. The aerial stems had a thick-walled epidermis with stomata, a cortex, and a simple central cylinder. Large cylindrical sporangia, containing numerous spores, were found in the peat. They were evidently borne terminally on some of the leafless aerial stems.

On Thursday there was an important joint discussion with the members of Section B, which dealt with the investigation of the constitution and classification of coal. A combined geological and chemical study was recognised by all speakers as an essential to success. There was also general agreement as to the need for more systematic and careful selection of samples, for the separate investigation of the various constituent elements of seams, and for the microscopic examination of the specimens analysed. The great national importance of the work was also emphasised. The discussion was opened by Prof. G. A. Lebour, followed by Prof. W. A. Bone, Prof. P. F. Kendall, Prof. P. P. Bedson, Dr. J. T. Dunn, Mr. D. Trevor Jones, Dr. Marie C. Stopes, Dr. G. Hickling, Prof. W. G. Fearnsides, and Prof. W. Boyd Dawkins.

At the close of the discussion Dr. J. W. Evans gave a suggestive description of a method of representing geological formations and structures in black and white on maps. Mr. Leonard Hawkes described the Tertiary acid volcanic rocks of Iceland. In places this acid series is at least 2000 ft. in thickness, and consists of tuffs, sphæro-like liparites, and obsidians, The eruptions were similar to those of post-Glacial times. The uneroded character of the liparite lavas shows how rapidly the successive basalts which submerged them were poured out. Since the close of the Tertiary volcanic period enormous denudation has obtained, and the varying resistance offered to erosive agents by acid and basic rocks has produced remarkable topographical effects.

Dr. Alexander Scott gave the results of an extensive examination of the Arran pitchstones, describing four groups varying from non-porphyritic glasses with abundant microlites of hornblende, to a more basic type with scarce phenocrysts, but with abundance of pyroxene microlites. An attempt had been made to determine the cooling histories from an examination of the field relations and the microscopic structures of the various types, and also to indicate the conditions which were responsible for such a large development of glassy intrusive rocks.

On Friday a joint meeting was held with Section E, to hear a paper by Dr. Albert Wilmore on the Northern Pennines. The structure of the range and its gaps with the intervening rock-blocks were described. The effects of the fault and fold systems on the scenery were dealt with, and many interesting problems which still leave scope for careful investigation were pointed out.

A paper was contributed by Prof. W. G. Fearnsides and Dr. P. G. H. Boswell on the occurrence of refractory sands and associated materials in hollows in the surface of the Mountain Limestone district of Derbyshire and Staffordshire. Then Dr. P. G. H. Boswell dealt with the geological characters of sands used in glass manufacture, which gave interesting and important glimpses of the new efforts being put forward to supply our present economic necessities. The report of the committee appointed to investigate the flora of the Lower Carboniferous Beds of Gullane described the finding of a petrified flora in 1914, the most important form of which was Pilys. Many examples of this fossil plant were found, some with bark, and one, a branch tip, still clothed with needle-like leaves. These enabled the connection between leaf and stem to be determined, and much light had been thrown on the stem-structure of the genus. The whole assemblage of plant types exhibited a close similarity with the flora of the Pettycur Limestone in Fife. W. L. C.

THE BRITISH ASSOCIATION AT NEWCASTLE.

SECTION F.

ECONOMIC SCIENCE AND STATISTICS.

OPENING ADDRESS (ABRIDGED) BY PROF. A. W. KIRKALDY, M.A., B.LITT., M.COM., PRESIDENT OF THE SECTION.

The Need for National Organisation.

As the war developed there has been a growing tendency to demand organisation in every sphere of national life. The striking successes scored by Germany have been universally, and probably rightly, ascribed to thoroughness of organisation and complete preparedness before provoking the conflict. As a consequence, a comparison has been made between English and German military policy, greatly to the detriment of the former. And, not content with this, further comparisons have been made, with the result that, if one believed all that was printed in the newspapers or accepted what passes in private conversation, we should be led to believe that rule of thumb has been the leading British characteristic. It has been forgotten that Germany has for many decades prided herself on her Army, even as England has relied on her Navy. One has been a great military Power; the other equally great at sea. The test of war has proved that Germany was a very difficult country to oppose by land, but that in naval matters England is supreme. The economist, however, has to go further and investigate into those matters which are connected with his science—namely, the production, the distribution, and the consumption of wealth. Can it be said that the want of organisation and other faults of our military system are typical of what has been going on in the industrial and commercial sphere? I for one cannot bring myself to accept the truth of this. Had our economic interests been carried on under so-called War Office principles we could not have built up the great position we occupy as world traders. What, then, are the facts? To answer this question one should remember the leading facts connected with our industrial development. This brings out some points which the superficial observer inevitably misses. For upwards of a century our industries have been gradually developing, and the progress has on the whole been along healthy lines—each decade has seen some advance more or less great.

German attention to industry and commerce is much more recent. She was able to benefit by our experience, nor was she slow in doing so. The agitation for Tariff Reform and Colonial Preferences is a proof that several years before the war broke out some Englishmen were awake to the fact that a new condition had come into existence, and that, if we were to preserve our advantageous position, we must take careful stock of newly arisen factors in world-trade. For Germany was not the only one, nor perhaps the most serious, of these factors. The United States of America, from the time of the Civil War, had bent her energies to the work of internal development. Having concentrated on this for nearly forty years, she began to expand a world-policy, both political and commercial. Japan, too, emerged with unexpected suddenness into the arena. Thus, as the nineteenth century drew to a close, the economic interests of England required careful and earnest attention. The fiscal controversy undoubtedly had the great and important effect of waking English traders out of the lotus-eating condition into which they were in danger of sinking. All our principal, and many of our less important, industries were carefully reviewed, with results that can be realised by a study of the annual statistics published by the Board of Trade. There was, however, a very subtle policy being pursued, which required very minute knowledge and wide experience to grasp. It was our proud boast that we left trade free and untrammelled, that we believed in the health-giving effects of open competition. It needed the stern lesson of the war to make known how this generous policy could be utilised to our detriment by a rival commercial nation. The facts as to the exploiting of the mineral resources of the Empire, as to how the dye and colour industry and various by-product industries have been developed so that certain vital trades almost passed under foreign control, came to light only just in time.

It became plain, as these facts leaked out, that we needed a better system of industrial and commercial intelligence. There was also a lack of unity of working among our principal industries incompatible with the growing interdependence which has been a marked feature of modern economic life.

Hitherto, apparently, it has been no one's business to survey comprehensively the resources whence our raw materials are drawn. Even those resources within the Empire have been nervelessly left to be exploited by the first-comer, and the mask of an English name has enabled foreign capital and energy to divert some of our valuable minerals to foreign countries, whence we have been compelled to purchase them at unnaturally enhanced prices. Sufficient of the facts have been made public to warrant the demand for reconstruction and improved organisation of those departments responsible for the national trade.

It would be most unwise as well as ungenerous to attempt to blame our Board of Trade. That department has, on the whole, worked hard and well for British interests. But it is both wise and necessary to criticise the policy that has overweighted this one Government department. And although there should be very careful consideration before either recommending or making a drastic change, attention ought to be given to the frequently expressed opinions of both chambers of commerce and individual traders in favour of the creation of a Ministry of Commerce. To this Ministry there might be transferred some of the functions of the Board of Trade, whilst at the same time the new Ministry might be responsible for maintaining that general survey over trade and commerce without which any organisation we may attempt would be incomplete.

Industrial Organisation.

The organisation that has grown up with the development of our industries includes two very important but unequally developed sets of organisation. The industrial army of labour force of this country includes all those who either organise industry or take any part, however important or however humble, in its working. From the captain of industry, or *entrepreneur,* as our brave Allies call him, down to the humblest weekly wage-earner, we have a labour force which ought to be looked upon as one and indivisible. In connection with this force we now have two sets of organisations the interests of which some people consider to be antagonistic. I would emphasise the fact that these two are really one force, their main interests are identical, and they can best serve these interests by striving to minimise differences and by doing all that is possible to work in harmony.

Though theoretically one, the labour force has internally developed two sets of organisations. Manual labour has its trade unions; the organisers of industry have their associations; British trade unions have a fairly long history behind them, and may be said to be in advance of any similar unions the world over. But the fact that of recent years there has been a tendency for small unofficial sections of given unions to kick over the traces and disregard the policy and agreements of their leaders shows that perfection of organisation has by no means been attained.

Employers' associations are of more recent formation, nor have they so far attained to anything like the same completeness. Both organisations, especially the employers', are in need of further development. It is scarcely for the economist to show how this can be effected. He can point to imperfections and make suggestions—only those conversant with practical working facts can formulate a practical policy. The most patent defects of these associations are due to the very virtues of their members. The individual British business man is unexcelled by the business man of any other country. In times of rapid transition and crisis he has again and again shown his leadership. He knows his business thoroughly, and as a working unit he has taken a very high place. But one of the most marked developments of modern trade is a growing interdependence of industries. Hand in hand with this we have become familiar with another phenomenon, the amalgamation of businesses of various dimensions into one great company or corporation. This phenomenon is common to both commercial and manufacturing interests. It is as marked among banks as among steel and iron companies. The comparatively small manufacturer or business man is giving place to bigger and inclusive organisations. These two and somewhat parallel developments are making a new demand on the individual. He and his predecessors exemplified individualism; the new stage upon which we have entered demands a modification of the old policy. Business, like everything else, is subject to evolution, and evolution on healthy lines can only be obtained by grasping fundamental facts and applying experience in accordance with economic laws. There need be nothing revolutionary about the required changes in our business organisation. We merely have to note what has already occurred, mark healthy tendencies, and clear away or prevent obstructions to natural growth. Our past history amply justifies us in pursuing this policy without uncertainty as to the result. Our entire industrial history is one of the best examples of steady, and on the whole well-ordered, evolution. We have shown our ability to adapt ourselves to the needs of the moment. As a race we are healthily conservative without being reactionary. That is to say, we know how to preserve what is good in the old and amalgamate it with the new. In other words, our organisation enjoys that useful quality of elasticity which enables us to keep abreast of the times.

Bearing this in mind, where are the defects of our business man, and to what does he need to give attention in order to come into line with the most recent requirements?

As I have just said, our business man's qualities emphasise his defects. For generations our business men have worked as units, and individualism has become almost second nature. The call now is that the individual shall sink a part of his personality and become, so far as one side of his activities is concerned, a member of an association. We have had employers' alliances, federations, and associations. Some have failed, some have managed to keep afloat, others have had a certain amount of success. None have hitherto quite attained to what is required. To the onlooker it would appear that when our employers meet as an association there is a lack of sympathy among the members, and if this should persist it would be fatal. Each individual knows his own business; he does not know, and perhaps it would be true to say he does not care to know, his neighbour's concerns. At any rate, as a result there is a lack of cohesion, there is a lack, too, of that co-operation which is required if the association is to be really successful and accomplish the objects for which it has been formed. This working in co-operation, the large organisations of capital, and the working together in associations, are comparatively new things to our business community. Time and experience will put things right; at present we have not accustomed ourselves to a newly developing condition of affairs. Our business men, then, need to focus their attention on these early ailments of the movement and get them removed as soon as possible.

A second group of defects arises indirectly but almost inevitably from that which has just been considered. Some alliances, rings, and associations have failed and come to an end. And in certain cases the cause has been unmistakable, for there has been a lamentable want of loyalty, and even in some cases it must be said honesty, to the agreements entered into by the association.

Only to mention one group as an instance of this—the New Trades Combination Movement, which caused quite a considerable stir during the late 'nineties of last century, especially in the Midlands, among the metal trades. Articles appeared in the journals, and a book[1] was written explaining the movement and great hopes were entertained that a new era had opened out before both Capital and Labour. But all ended in a failure. There was for a time a kind of Syndicalism—a syndicated industry enabling employers to increase their profits, and the workpeople to earn abnormally high wages. So long as competition could be kept out of the market, things went swimmingly and a specious prosperity developed. But the consumer was being exploited—the increased prices charged for such goods as metal bedsteads gave would-be competitors and unscrupulous members of the alliance their chance. The cheap wooden bedstead, however, made its appearance on one hand, and on the other there were such things as secret discounts and commissions, and this special alliance ended in failure. The history of that short, but industrially instructive, movement has yet to be written.

1 "The New Trades Combination Movement." E. J. Smith (Rivingtons, 1899).

Its cardinal facts should be known to those who now have an opportunity for shaping the industrial future of this country.

Three lessons stand out from this experience :—

(1) We must learn to work together in association.

(2) All members of an association must be absolutely loyal and honest to their engagements, either written or implied.

(3) Such associations must be regulated or the community will be exploited.

Nor is it impossible to suggest a method by means of which this may result. When employers' associations have justified themselves it should be possible to obtain State recognition for them, and it would be practical politics, when both employers' associations and trade unions have developed to the point at which both merit State recognition, to enforce under penalty agreements made between them on all those, either employers or workpeople, who wished to work at the industry within the area under the recognised organisations. Thus it would not be necessary to make membership compulsory; self-interest would be the extent of the pressure.

Turning to workpeople's unions, we also find defects which require removing. The policy of union has been practised among the workers for upwards of a century, and for at least half that time with well-marked success in certain directions. In the first instance it was the aristocracy of labour that realised the advantage of collective action, but, notably since the late 'eighties of last century, efforts have been made to extend the policy to all grades of labour. Hence the ailments which have to be noted are rather more mature than those affecting employers' associations. Success in certain directions has perhaps led some of the more ardent spirits to expect more from their unions than working conditions allow. The experience of old and tried leaders has led them to adopt a more cautious policy than the young bloods are inclined to accept. Hence there has been a want of loyalty, different, it is true, from that met with among employers, but equally disastrous if persisted in to the object in view.

All the men in a given industry should be members of the union, provided that the union is well organised and ably administered. This should, however, be the result of self-interest and a regard for the good of fellow-workers, rather than of compulsion; how that may be attained has been suggested. Perfection of organisation will come when workpeople not only realise the real possibilities of collective action, but are prepared to follow lovally leaders who have been constitutionally elected. The leaders are in a better position to know the facts of the case immediately under review, but if their leadership has been found faulty there should be adequate machinery for replacing them with men who command the confidence of the majority of the members. When agreements have been entered into, the terms should be implicitly observed, even though they may turn out to be less advantageous than was expected. Periodical revision would make it possible to rectify mistakes or misapprehensions. But it cannot be too strongly emphasised that for both sets of organisation the great factor making for smooth and satisfactory working is absolute loyalty to the pledged word. A large employer of skilled labour writing to me on this point said :— "In my opinion no industrial harmony can exist between employers and employees until trade unions through their executives can compel their members to adhere to and honourably carry out all agreements entered into with the employers. . . . In fact, until a more honest code of morals exists on both sides no improvement can be looked for."

Further, there is a need for a more complete and authoritative central authority, both for individual industries and for federated trades. The machinery for this exists, it merely requires development. When the local and central machinery has been perfected, the right to *strike,* which, in common with the right to *lock out* as a final resource, should be jealously maintained, would be carefully regulated, and would only be resorted to as the considered judgment of the most experienced men on either side. It should be impossible for either an individual association or a section of it to order a strike or a lock-out on its own responsibility.

What, then, do I consider should be the main outline of industrial organisation? Employers should be organised into :—

(*a*) Associations of one trade in a given district.

(*b*) National associations of one trade.

(*c*) Local federations of trades.

(*d*) National federations of trades.

Of these, (*b*) and (*d*) should be organised under a system of representation.

Workpeople should have unions and federations corresponding to those of the employers, and in both cases the national federations should be carefully organised councils, who would enjoy a large measure of authority, tempered by the necessity to win and preserve the confidence of their electors. From these two representative bodies there could be elected an industrial council as a court of appeal, representative of the whole industrial activity of the country, and so far as these various bodies were approved by the State they would enjoy far-reaching powers.

Approval by the State should depend on the observance of moderation and working in conformity with carefully devised regulations. For the State in this matter would be the representative of the consumer and of the national interest. Without this you get something not very far removed from Syndicalism, but under careful regulation abuses might be avoided.

At the head of the organisation there would be a real industrial council representing the industry of the country. The industrial council established in the year 1911 has never had a fair chance to show its mettle. It was established at a critical time; perhaps the Government did not feel justified in throwing a great responsibility on an untried body. Nevertheless, it exemplified a very wise policy, and one regrets that it has not been tested, for even now both employers and workpeople feel that some such council is preferable to State interference, and there is a clearly articulated distrust on both sides of official arbitration.

We do not need at the present juncture to attempt a new experiment. Our old system, whatever its failings, has been tried and proved sound. Its elasticity has been its salvation, and it is capable of still further evolution without calling for drastic changes. The improved organisation that is now suggested would contain nothing that is new or untried. It would consist of natural developments of what already exists. Employers and workpeople have organised themselves into associations and unions, some of these have developed federations of similar or even of unconnected interests; and both parties have their national congresses, or at any rate the germ of them. The demand now is that the organisations already in existence be perfected, and that those perfected organisations shall in all their agreements be loyally and honestly supported by their members. Success depends on absolute loyalty to the pledged word.

Here we have a practical policy suited to the needs of this critical stage in our history. The ideal organisation has yet to be formulated, but what is here proposed would form a definite step in advance, and

the very elasticity of the system would be a good augury for the future.

A committee of this association has been investigating for the past two years into the extent to which women have recently replaced men in industry. A certain amount of exaggeration exists as to the number of women who have entered our factories or undertaken services left vacant by men who have joined the Forces. The total number is, in round figures, about 600,000, as against five million men who have joined either the Navy or the Army as a consequence of the war.

The entry of large numbers of women into industry has been viewed with a certain amount of alarm by the men; and trade unions have naturally stipulated, where possible, that these women shall receive the same rates of pay for the same work as the men, and that when the men return the women shall give place to them.

That there was little ground for alarm as to the influx of women can be realised by a consideration of a few facts and figures. The majority of men who enlisted were workpeople of one sort or another; of these, unhappily, some have been killed in battle or have been rendered incapable for work. Even so, the majority will come home requiring occupation. What opportunities will they find?

To answer this question at all satisfactorily it is necessary to consider some determining factors. Thousands of men have left indoor occupations and their accustomed town life and have been trained, drilled, and disciplined under open-air conditions. They have lived, worked, and fought in the open country in some cases for many months. The new experience has had potent effects. Physique has improved, the outlook on life has changed, in many cases new hopes for the future have been formed. Inquiry shows that there is a division of opinion as to the extent to which disbanded members of the Forces will decide on making a radical change in their mode of life. Yet the experience of what occurred after the South African War warrants us in assuming that considerable numbers will only return to indoor occupations and town life if there be no alternative. It is too soon yet to form an opinion as to what opportunities there will be for land settlement. But it is known that offers will be made, both at home and in various parts of the Empire. A moderate estimate of those accepting these offers, and of our losses of killed and permanently disabled, would be at least one million. Then we shall undoubtedly require, at any rate for some years, a much larger standing Army. Even on a peace footing this at a moderate computation may be put at a million men. These two figures, and neither of them errs on the side of exaggeration, will absorb two million men who will be permanently lost to the old occupations.

Moreover, there is good ground for anticipating that if the war concludes before our resources are unduly strained, and there is every prospect that it will, there will be a period of good trade. We have to restore our own depleted stocks of goods, our mercantile marine demands a large amount of new tonnage, railways and other transport services will require much new equipment. Turning to the Continent, parts of France, Belgium, and other of the Entente countries will need reconstruction works of considerable proportions, and in this work we shall play a great part. World markets, too, have been kept short of many manufactured goods. We shall be in a position both to finance and carry on a greatly extended system of industry and commerce, for not only is our banking system prepared to face this, but our man force has been greatly improved, and our industrial equipment to a great extent remodelled.

Reverting to the somewhat thorny question of the women who have been engaged on what were men's occupations, I see no cause for alarm. Many women came forward from motives of patriotism, and will gladly resume their former state. The question, I believe, will rather be how can we obtain the labour necessary to cope with the post-war demand.

The new equipment of our factories will place us in a position to increase very greatly our ouput, and this should enable us not only to face a possible labour shortage, but if the recommendations made by this section of the association meet with a favourable response, our labour force should enter upon a new period of prosperity consequent on a remodelling which has been rendered possible by a reorganisation of our industrial machinery. This new epoch for labour would include higher wages, shorter hours, and better working conditions. To effect these salutary advances both employers and employed need to exercise sanity of judgment, frankness in mutual discussions, and a recognition of the fact that the prosperity and material well-being of each is bound up in a common effort to maintain and develop our industrial and commercial position.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The term has opened with a greatly reduced number of undergraduates. Exact figures are not yet forthcoming, but they will certainly be small. The current issue of the *University Gazette* contains the names of 312 members of the University who have lost their lives on active service during the last three months, all but a very few having been killed in action. The usual lists of lectures, demonstrations, and laboratory work have been issued by the heads of the various science departments. The programme published by the School of Geography includes lectures by the acting director on geographical method and on the distribution and economic geography of primitive societies; by the demonstrator, on regional geography of the British Isles; and by Messrs. Spicer and Kendrew, on land forms and climate. Practical classes will also be held. The Committee for Anthropology has arranged for lectures on physical anthropology, ethnology, theories of totemism, and primitive archæology. These will be given by Prof. A. Thomson, Miss Czaplicka, Mr. H. Balfour, and Dr. Marett. Demonstrations and informal instruction on a large variety of subjects connected with anthropology are also announced.

THE widow of Prof. Gwynne Vaughan has presented to the Botanical Department of the University of Glasgow the collection of more than 2000 slides, in mahogany cabinet, belonging to her late husband, and the originals of all his published memoirs.

A SPECIAL course of short lectures is to be given by Mr. E. F. Etchells to the Junior Institution of Engineers on alternate Friday evenings, beginning on October 20. The subjects are:—"A Commonsense Notation for Engineers," "The Practical Use of Units in the Evaluation of Formulæ," "How to Memorise Formulæ," "Logic of the Differential and Integral Calculus," and "Practical and Illustrative Examples of the Application of the Newer Concepts."

THE Joint Matriculation Board of the Universities of Manchester, Liverpool, Leeds, and Sheffield conducts a matriculation examination which ensures one

common standard for entrance to the separate universities. The various universities are represented on the board, and about five practical teachers are co-opted, so that the schools and universities are kept in touch with one another. According to the *Morning Post* of October 13, Birmingham University is to be included in the operations of the board, and thus another step is taken in the direction of securing a uniform standard for entrance to a university. We also learn from our contemporary that the Vice-Chancellor of Liverpool University, who is the chairman of the Joint Board, stated at a special meeting of the Liverpool University Court on October 12 that the University authorities at Bristol proposed recently that the Bristol University should be included in the scheme, but a final decision had been postponed until after the war.

AN address by Sir Henry A. Miers on "The Place of Science in Education" is printed in *Education* for September 15. In outline the views expressed may be summarised as follows:—In elementary schools science can be little more than common-sense thinking about, and intelligent interest in, the ordinary events of everyday life, the main aim being to encourage a feeling of the necessity for personal trial and effort in understanding what is seen and done. In secondary schools there should be a systematic course of experiments, especially in the physics and chemistry of ordinary life, in order to encourage a habit of reasoning from what has been observed. This systematic course should be preceded by an introductory course dealing with scientific facts and ideas. All the work here outlined should precede the division of the school into "moderns" and "classics." On the modern side real scientific training is obtained from the laboratory work which becomes essential, but on the classical side science might well deal with general principles through the history of science and discovery, the whole subject being taught in language of a literary character freed from technical phraseology. Such a scheme involves the teaching of general elementary science in the preparatory schools.

IN the *Fortnightly Review* for October the subject of science and the *rôle* to be assigned to it in the curriculum of the higher schools and universities is considered in a suggestive article entitled "Education To-day and To-morrow," by Mr. P. E. Matheson. Reference is made to the manifesto issued a few months ago pleading for a larger infusion of scientific knowledge into the public service, and it is suggested that whilst the critics have made good their complaints of serious defects in our war administration some of the criticisms are to be met by other means than educational reform, as, for example, the conversion of men of business to the belief that scientific research pays. Mr. Matheson admits that unless we have more science in the schools we shall perish. But it is declared that we are up against faults of character and a disbelief in the value of disciplined intelligence. Yet we cannot hope for a cure for these defects either in respect of employers or of persons in the higher service of the State unless it be through the schools and as a result of systematised training, not only in languages, history, literature, and mathematics, but also in the facts and potentialities of scientific knowledge, together with the due training of hand and eye, and accompanied by those formative agencies which promote self-reliance and sterling character. The article is a welcome indication of a more liberal attitude towards the claims of science in the schools and universities.

THE annual congress of the Textile Institute, which met at Leeds on October 13, was in the main concerned with the question of scientific research in the application to the needs of the textile industry. Much has been done of late years in the encouragement of research in the great textile schools of Manchester for cotton goods, and in those of Leeds and Bradford for woollen and other animal fibres, but there is still to lament the indifference of manufacturers to the fruit of such research and to the importance and value of skilled, scientific labour. Dr. Sadler, in welcoming the delegates, pleaded for better appreciation on the part of manufacturers, and for a higher scale of remuneration for those engaged in research in our universities and in the technical colleges attached thereto. When shall we have an English example such as that of the firm of Zeiss, in Jena, which in the course of years has contributed considerably more than 100,000*l.* to the University of Jena as a mark of its appreciation of the value of the scientific assistance it has received therefrom? It is not merely in the adoption of ingenious mechanical contrivances to displace hand labour and so to increase production, the invention of which is shared by the textile-producing nations, but the question goes far deeper than this, in the closer investigation of the fibres with a view to their more successful treatment; in the discovery and scientific manipulation of new fibres, even to the production of artificial fibres; and in the skilful adaptation of material, hitherto regarded as waste, to the production of saleable goods. In the latter aspect of the question the superior chemical training and skill of our foreign competitors on the Continent have enabled them to compete most seriously with important branches of our textile trade, especially in respect of the dyeing and finishing of textile goods. The future of the coal-tar industry was the subject of an address by Prof. A. G. Perkin, who maintained that the production of synthetic dyes, in which Germany had outdistanced this country so completely, was due to the neglect of the manufacturer, the chemist, and of the technical schools. We needed, said Mr. J. H. Lester, of Manchester, a better organisation of industrial education, research and co-operative agencies of all concerned on scientific lines, in order to ensure the maintenance and progress of our industries. There was not, said another speaker, Dr. M. O. Forster, a sufficient supply here of well-educated, clear-brained, intelligent young men of sound character and real perseverance in the chemical world.

THE attention which is being directed to educational topics in the public utterances of men distinguished in various forms of national activity is, it may be hoped, an indication that the importance of a sound and well-balanced system of national education in this country is beginning to be understood. On October 11 Lord Haldane delivered the first of a series of lectures on after-war problems, arranged by a joint committee of Birmingham University and the Workers' Educational Association. He said it was his wish to devote his remaining days to being a missionary on the great question of education. We remember, however, that though, when president of the British Science Guild, he was an advocate of increased attention to education and science by the State, he did little, when he possessed political power, to see that the nation was given the fullest scientific and educational equipment. In his address on October 11 he maintained that what we want is training, and it is the mental training of the future generation that is going to count. When peace comes, he continued, we shall hear no more in Germany about 16-in. guns, but a great deal about continuation schools. The Germans are training up a generation of skilled workmen with whom we cannot compete. We must take care to train the children of our working classes in at least as good a way as the Germans

have been able to train theirs. Mr. L. A. Legros also referred to education in his presidential address to the Institution of Automobile Engineers on October 11. Never, he said, in the history of engineering has the ignorance of science by the politicians, the military, and other authorities been so openly displayed as in the early stages of the war, and never has it proved so costly in time, in life, and in material. How many lives and how many millions of pounds, he asked, would the country have been saved if as much study in time and thought had been expended on science as on classics by our law-makers and law-givers? He pleaded that science should be given its proper place in education, and that due care should be exercised in providing suitable training for those women who, as mothers and teachers, would have charge of the earliest training of our future men.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 25.—M. Camille Jordan in the chair.—E. **Belot**: The origin of the rotations and revolutions in the forward or backward sense, as well as the origin of cometary orbits.—J. **Guillaume**: Occultations of the Pleiades, observed on September 16, 1916, with the 16-cm. Brünner equatorial of Lyons Observatory.—M. **Boll** and L. **Mallet**: Determination of the practical constants of the Coolidge tube. The Coolidge tube is very stable, and the X-radiation can be maintained for a long time constant, both as regards emissive power and degree of penetration. It is easy to change from hard to soft rays and the reverse. The practical yield is of the same order as other focus tubes for soft rays. The radiation from a Coolidge tube is not appreciably more homogeneous than that of other tubes.—J. **Bougault**: The acidylsemicarbazides. A general account of their physical and chemical properties as a group.—P. **Paris**: *Sphaeromicola topsenti*, a new genus and species of Ostracod.—A. **Lumière**: The comparative action of antiseptics on pus and on pure cultures. The experiments were carried out with three disinfectants of different types—phenol, sodium mercury-phenol-disulphonate, and sodium hypochlorite. These were allowed to act under similar conditions upon the concentrated pus, culture of the pus, and a pure culture of the predominating staphylococcus from the pus, and also upon 1 per cent. dilutions of these. The albuminoid substances present in the pus attentuate slightly the bactericidal effect of phenol; this action is a little more marked with the mercury compound, and becomes very important with the hypochlorite.—R. **Wurtz** and E. **Huon**: The variolisation of heifers immunised against the vaccine.—Em. **Bourquelot** and A. **Aubry**: The biochemical synthesis of α-propyl-*d*-galactoside with the aid of a ferment contained in air-dried low yeast.

BOOKS RECEIVED.

A Census of New South Wales Plants. By J. H. Maiden and the late E. Betche. Pp. xx+216. (Sydney: W. A. Gullick.)

Vorschläge zur geobotanischen Kartographie. By Dr. E. Rübel. Pp. 14. (Leipzig: Rascher and Co.) 1.50 francs.

Catalogue of Scientific Papers. Fourth Series. 1884–1900. Compiled by the Royal Society of London. Vol. xv. Pp. vi+1012. (Cambridge: At the University Press.) 2*l.* 10*s.* net.

Joseph Pennell's Pictures of the Wonder of Work: with Impressions and Notes by the Artist. Pp. lii. (London: W. Heinemann.) 7*s.* 6*d.* net.

Transactions of the Royal Society of Edinburgh. Vol. l., part iv. Session 1913–14. (Edinburgh: R. Grant and Son.) 22*s.*

Checklist of the Recent Bivalve Mollusks (Pelecypoda) of the Northwest Coast of America from the Polar Sea to San Diego, California. By Dr. W. H. Dall. Pp. 44. (California: Southwest Museum.)

Arboreal Man. By Prof. F. Wood Jones. Pp. x+230. (London: E. Arnold.) 8*s.* 6*d.* net.

The Migrations of Fish. By Prof. A. Meek. Pp. xviii+427. (London: E. Arnold.) 16*s.* net.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Trials on a Diesel Engine, and Application of Energy Diagram to obtain Heat Balance: The late Lieut. Trevor Wilkins; presented by Prof. Burstall.

TUESDAY, OCTOBER 24.

ZOOLOGICAL SOCIETY, at 5.30.—Notes on the Development of the Starfishes *Asterias glacialis* O. F. M., *Cribrella oculata* (Linck) Forbes, *Solaster endeca* (Retzius) Forbes, *Stichaster roseus* (O. F. M.) Sars: Dr. J. F. Gemmill.—Studies on the Anoplura and Mallophaga, being a Report upon a Collection from the Mammals and Birds in the Society's Gardens.—Part II.: B. F. Cummings.—Two New Species of Cestodes belonging respectively to the Genera Linstowia and Cotugnia: Dr. F. E. Beddard.—Notes on a Collection of Heterocera made by Mr. W. Feather in British East Africa, 1911–13: Lt.-Col. J. M. Fawcett.—The Structure and Function of the Mouth-parts of the Palæmonid Prawns: L. A. Borradaile.—Heude's Collection of Pigs, Sika, Serows, and Gorals in the Sikawei Museum, Shanghai: A. de C. Sowerby.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—James Forrest Lecture: The Development of Appliances for Handling Raw Materials and Merchandise at Ports and other Large Centres of Traffic: Sir John Purser Griffith.

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