NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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WASTE-PAPER AND PAPER-WASTE.

The Recovery and Re-manufacture of Waste-paper: A Practical Treatise. By J. Strachan. Pp. vi+158. (Aberdeen: The Albany Press, 1918.) Price 12*s.* 6*d.* net.

ONCE upon a time certain of the peradventurous amongst the Scandinavian folk, perceiving that the countries affected to more intensive civilisation demanded much paper and raw material therefor, saw and seized the opportunity for conversion of the chief but perishable glory of their incomparable landscapes, by way of paper *et similia,* into the imperishable equivalent of gold!

Thus it has come about that millions of tons of coniferous wood are now represented by equivalent ounces of the "heavy" yellow metal or values so expressed, and the primary paper-making industry is dependent upon the pine forests of the world. It has also come about that "waste-paper," a byword of the old order, and the concern primarily of scavengers, has taken a strong, if secondary, position in the new order of industrial values, and of sufficient importance fully to justify the publication of the manual before us. The author, in his short "Introduction," puts the matter to be treated in its exact perspective relative to the primary industry of paper-making, and his treatment of the subject in 150 pages of text is lucid, comprehensive, and designedly "practical." This is as it should be, seeing that the re-manufacture of papers and boards involves no technical or scientific principles outside those of the primary manufacture. At the same time, under the author's treatment the volume is a valuable commentary upon and further elucidation not only of the primary manufacture in relation to principles, but also of the paper trade in relation to the uses and values of its products.

The latter is the subject-matter of the very "readable" part i., which deals with the collection or recovery of old papers, classification, grading, and valuation. Part ii. deals with re-manufacture in three sub-sections, (*a*) mechanical treatment, (*b*) chemical treatment for removal of ink and colour, and (*c*) "Miscellaneous," which concerns the manipulation of waste-paper stock and mill control.

As stated, these sections involve a technically critical appreciation of the standard mill operations and their quantitative bases—that is, in relation to fuel and water consumption and yield—and, therefore, any student of technology might usefully read these as complementary to the study of an ordinary text-book dealing rather with principles.

One point we note. While giving full attention to loss of material in working up, and classifying these losses in terms of "loading," "short fibres," "sizing," and ink substances, the author omits to note a rather important factor of loss. It is a general experience conformable with the chemistry of cellulose and ligno-cellulose that successive working involves progressive degradation of material, both into water-soluble and alkali-soluble compounds. We should doubt, therefore, whether the percentage figures which the author gives would be found to hold, seeing that this factor of loss is ignored. Generally speaking, this invisible loss is one difficult of control, and, even in the best-regulated mills, can only be estimated to a certain degree of approximation. It is, however, a very important factor.

Lastly, the author deserves a compliment for the trouble he has taken in putting out the book on a representative paper made from old—that is, re-worked—papers, and for setting out the data of its composition and qualities in full technical terms in his appendix to chap. xxv.

One word in regard to Mr. Hall Caine's preface. He considers the British paper-maker "receptive of ideas," and so he is; but conversion of ideas into effective, industrial potentials is, we suggest, quite another order of "idea"—to use his word. We should say that the British paper-makers are quite capable of much bigger

things than they have ever done, but we think they will have to undergo a certain discipline of conversion, and forget a good deal of interior competitive struggle, and of the outlook connoted thereby, before they qualify for the premier position in the world's markets.

THE CONSTITUTION OF COAL.

Monograph on the Constitution of Coal. By Dr. M. C. Stopes and Dr. R. V. Wheeler. (Department of Scientific and Industrial Research.) Pp. 58+plates iii. (London: H.M.S.O., 1918.) Price 2*s.* net.

IT is not too much to say that this monograph forms the most important contribution to our knowledge of what coal is, that has yet appeared; the problem has been tackled in the right spirit and by workers with the right kind of experience—namely, by a palæobotanist and a chemist working in conjunction. They themselves define the object of their research as an attempt "to discover what the present actual structure of a bituminous coal most usually is," and they further define what they understand by coal in the following words: "Ordinary coal is a compact stratified mass of 'mummified' plants (which have in part suffered arrested decay to varying degrees of completeness), free from all save a very low percentage of other matter." They themselves admit that this definition is not satisfactory; in particular it suffers from lack of precision, as much depends upon the sense in which the words "very low percentage" are used; it evidently includes lignite, which is perhaps intentional, but it also must include peat, which it was probably intended to exclude.

The monograph naturally falls into two main parts, dealing respectively with the chemical and the structural aspect of coal. The former discusses in much detail the composition of the various component parts that have been more or less completely identified, and relies mainly upon its division into two distinct types of compounds, distinguished as the "cellulosic" and the "resinic," the distinction being based essentially upon the solubility of the latter in pyridine, first discovered by Bedson.

In the latter portion much weight is given to the work of Lomax, which showed that ordinary bituminous coal is a humic accumulation in which, not chiefly wood, but leaves, twigs, fructifications, and other plant fragments preponderate, the term "humic" being used to indicate that the accumulation consisted of the largely undecayed mixed organs of plants. The various distinguishable plant remains are described and discussed, the most important being the woody cells, bark, including cork cells, cuticle, spore-coats and spores, seeds, and soft-walled tissue; it is shown that, with the exception of resin, the cell contents of the plants are but imperfectly preserved in coal.

The authors summarise their researches by stating their opinion that coal consists essentially of a conglomerate of morphologically organised plant tissues, of plant substances devoid of morphological organisation, of the comminuted degradation products of both of these, and of "ulmins" produced therefrom. But it may fairly be said that the value of the work lies not only in the results already attained, but also in the numerous indications that it affords of the directions along which future researches upon this highly complex subject should be conducted. It is to be regretted that the printing has been very badly done, and that numerous clerical errors have been allowed to escape the proof-readers. H. LOUIS.

ANALYSIS AND GEOMETRY.

(1) *Elementary Mathematical Analysis.* By Prof. J. W. Young and F. M. Morgan. Pp. xii+548. (New York: The Macmillan Co., 1917.) Price 11*s.* net.

(2) *A Course of Pure Geometry, containing a Complete Geometrical Treatment of the Properties of the Conic Sections.* By the Rev. Dr. E. H. Askwith. New edition. Pp. xi+284. (Cambridge: At the University Press, 1917.) Price 7*s.* 6*d.* net.

(1) THE aim of Messrs. Young and Morgan is very clearly explained in their preface. Their book is intended for first-year students in universities and colleges, and, without in any way neglecting practical methods and applications, they have properly laid stress upon fundamental ideas such as "function," "continuity," and so on. Thus the student is prepared in due time for more abstract and delicate theories, and preserved from the risk of becoming a mere calculating-machine.

The contents of the book are arranged in five parts. The first is introductory; it deals with the idea of a function and its geometrical representation, and gives a sketch of the theory of rational operations in algebra. Part ii. considers elementary functions, including the simply periodic ones; it also gives a chapter on computation, in which there is an account of the slide rule, and concludes with a chapter on implicit quadratic functions. Part iii. contains the elements of analytical geometry as applied to the straight line, circle, and conic sections. Part iv. comprises chapters on algebraic manipulation, tactic, the binomial theorem, complex numbers, polynomials, theory of equations, and determinants. Part v. deals with functions of two variables, and gives the elements of analytical solid geometry. Finally, there are a set of useful tables, and a detachable page from which a rudimentary slide rule can be constructed.

The present reviewer has lately been giving lectures on similar, not to say identical, lines; the agreement in aim, choice of topics, and extent of treatment has been practically complete. It is an encouragement to find one's ideas of a suitable elementary college course so independently and strikingly confirmed. We believe that treatises of this kind will greatly help to establish a right

system of teaching mathematics, not only in colleges, but also in schools, where antiquated methods are still too prevalent.

There is one omission in the book which is regrettable; the authors do not discuss the theory of *dimensions*. This is a much more important matter than it might be thought, especially when the student works geometrical exercises with numerical coefficients, so that the dimensions are partly latent. Far too often even an honours student fails to note that his answer must be wrong, because it does not satisfy the test of dimensions; and it is needless to emphasise the value of the theory in physics.

Typographically the book is all that could be desired, except that we should have preferred old-face figures in the tables. The diagrams are numerous, attractive, and well printed.

(2) The new edition of Dr. Askwith's elegant work differs from its predecessor mainly in defining the conic sections in the Greek way as sections of a cone. The earlier chapters (i.–viii.) on the triangle, circle, cross-ratios, etc., make this method easy, with one notable exception; unless we discuss complex points and lines by a purely geometrical method (such as that of v. Staudt), we are not justified in treating every figure consisting of a conic and a line as being projectively equivalent to a figure consisting of a circle and a line. This is the weak point of Dr. Askwith's book; it is not clear whether he is appealing, in the last resort, to algebra, or relying upon the exploded "principle of continuity." In other respects the treatise fully deserves the favourable reception which it has obtained.

G. B. M.

OUR BOOKSHELF.

Association: A Story of Man for Boys and Girls. By Edward B. Cumberland. Pp. 32. (Published by the author at "Le Chalet," Penn, Bucks., 1918.) Price 2*s*.

FOR nearly thirty years Mr. Cumberland has been headmaster of William Ellis School at Gospel Oak, and in convinced obedience to the founder's testament has been (since 1889) teaching "social science" to boys of ages from eight to eighteen—a remarkable record of pioneer work on lines which are sure to be widely followed in the near future. In other ways, too, with its early physics laboratory (1890) and its specially built geography room, the school has been in the front line, and we would heartily congratulate Mr. Cumberland on what he has achieved in spite of conditions often far from encouraging. He has expressed some of his ideals in an interesting little book which he calls "Association." The title refers to the author's reasoned belief that one of the factors of human progress has been association, co-ordination, the multiplying of inter-relations. He illustrates this in a retrospect of the ascent of man, and by showing how the individual finds himself and realises himself, both in body and mind, as an active social person.

The booklet seems to us better suited for adults than for boys and girls, for it is very tersely written. We cannot even refer to the many wise things that are said about home and school, work and play, town and country, civics and Nature-study; but the two dominant ideas are: (1) that "knowledge of Earth and its story helps to make man fitter for life on it, and also to raise him above it"; and (2) that the open secret of progress is to enter into more and more complex associations for noble ends, rising from school and family to community and city, and from nation to humanity. The booklet is an intensely personal document, revealing a fine purpose. There is a tiny fly in the ointment in the suggestion (on page 9) that "creatures that crawl" should be regarded with disgust.

Memoir of John Michell, M.A., B.D., F.R.S. By Sir Archibald Geikie. Pp. 107. (Cambridge: At the University Press, 1918.)

SIR ARCHIBALD GEIKIE has done a further service to British science in reviving the memory of John Michell, and in directing attention to his work in various fields. Geologists are familiar with Michell's name in connection with Jurassic strata, and especially with the "Lyas" that he traced from Somerset to Lincolnshire. It is unfortunate that this ancient quarryman's term should suggest, in its modern form, a pseudo-classical origin. Michell, after his retirement from the rectory of St. Botolph's, Cambridge, and from his brief tenure of the Woodwardian professorship of geology, continued, as rector of Thornhill, "those important investigations in physics and astronomy with which his name will always be associated." He died in 1793, before the experiment that he had designed for determining the earth's density could be carried out; but his apparatus came, through Wollaston, into the hands of his friend and correspondent Cavendish, who improved it in detail, and ungrudgingly acknowledged Michell as its originator. A long and interesting letter from Michell to Cavendish on the strata near Grantham is here published for the first time. In his frequent journeys from Thornhill to London he made observations at his halting-places, such as Greetham on the old North Road, and one feels that he would have hailed the work of his successor, William Smith, as confirming much that he had seen. In 1760, while still at Cambridge, he contributed a paper on earthquakes to the Royal Society, in which he urged that the initial shock is propagated by wave-motion through the earth.

This admirably printed and attractive work raises pleasant memories of the times when the "learned leisure" of our country clergy was often devoted to scientific culture. The divorce of clerical duties from collegiate fellowships, however desirable on both sides, has undoubtedly reduced the endowments of research. G. A. J. C.

LETTERS TO THE EDITOR.

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

German Naturalists and Nomenclature.

I TRUST that the great majority of naturalists will read with approval the following sentence in Sir George Hampson's paper on "Pyralidæ," published in the Proceedings of the Zoological Society, 1918 (p. 55):—"No quotations from German authors published since August, 1914, are included. 'Hostes humani generis.'"

I have heard it argued that as we owe much to the industrious researches of German naturalists in the past, it would be discourteous to show any prejudice against accepting their assistance in the future towards that extension of knowledge which we all desire.

It may be remembered by those who were present at the meeting of the International Zoological Congress at Monaco in March, 1913, how persistently the representatives of German scientific societies endeavoured on that occasion to dominate the discussions, especially on the subject of the rules of nomenclature, and insisted that the names habitually employed in Germany should receive the sanction of long usage, to the exclusion of all attempts to trace out the literary history of each species and to preserve for it the name bestowed by the first author who described or figured it. The attempt was one which, had it been successful, would have obliged the naturalists of other countries to accept German nomenclature and place themselves thus far unreservedly under German regulations and restrictions. In the Catalogue of Lepidoptera, published in 1871 by Staudinger and Wocke, precedence is improperly but deliberately assigned to German names in preference to earlier ones given by French authors.

Now, as to the question of discourtesy, what will be the position at some future Zoological Congress? Are American, English, French, or Italian naturalists to be expected to meet Germans and to join them in friendly discussion on the various questions that may arise? Considering that before the war every man, woman, and child in Germany, with scarcely an exception, was intent upon war, as has been amply demonstrated by the evidence of innumerable witnesses, it is impossible to dissociate the mental attitude of the population of that country, by no means excepting the highly educated and scientific classes, from the world-conquering aspirations of their rulers, or from the barbarous atrocities committed by them in pursuit of that national ideal. A conspicuous instance is that of a certain learned professor with whom I was on terms of friendship, who was honoured by the Universities of Liverpool and Dublin, and delivered lectures in London under the auspices of the London University, turning out eventually to be a German spy engaged in fomenting rebellion in Ireland and antagonism to England and her Allies in the United States. If an individual in any community commits murder or robbery, or is even plausibly suspected of swindling or cheating at cards, the unavoidable and universally recognised penalty is that no man with a grain of self-respect will ever again associate with him, shake his hand, or converse with him in friendship.

Let us trust that for the next twenty years at least all Germans will be relegated to the category of persons with whom honest men will decline to have any dealings.

It should be fully understood that this is no measure of vengeance. We do not honour thieves by vows of vengeance; we desire to punish them. Any German who may be permitted to attend an international zoological congress in the near future should be made to feel extremely uncomfortable by the urgent necessity of at least partial *camouflage*.

If Sir George Hampson's suggestion by example should be adopted and followed, it could add but a small measure to the punishment which must inevitably form part of any conditions that will be attached to a public peace when granted by dictation, not by negotiation, to the offending nation.

None but a German would use the German language by preference for scientific descriptions of species or genera; thus any inconvenience that might arise from a general refusal on the part of others to accept descriptions worded in German could fall only upon those who have inflicted far more than mere inconvenience upon the world beyond them.

To those Germans, if any there be, who are honestly well disposed, and who put the interests of science before the greed for world-domination, it can be no hardship to publish their descriptions in the English or French language, with which the great majority of their scientific workers are more or less intimately acquainted.

Inestimable damage has been done during the war to historical monuments and priceless works of art. The Germans in Italy were found to have instituted a complete organisation on the Austrian front for securing valuable pillage in the course of the expected advance on Venice; fourgons, under the charge of specially appointed officers with adequate staff, were in readiness to convey to Germany the pick of the art treasures which they believed they would find at their mercy. Collections in various branches of natural history have suffered damage or destruction among other objects. In Russia the paid agents of Germany have brought about, or at least connived at, the wanton destruction of treasures innumerable; some of the finest entomological collections in the world were in Russia, in Belgium, and in Rumania. I would urge that it is the plain duty of the Allies to insist not only that all objects removed shall be replaced, but also that equivalent value in kind shall be rendered for everything destroyed or damaged, and this should apply to specimens illustrating the study of natural history (best represented in value by original author's types), as well as to pictures, statues, and other objects of art or antiquity, for the selection of which from German museums special commissioners should be appointed. WALSINGHAM.

6 Montagu Place, Portman Square, W.1,
August 29.

The Value of Insectivorous Birds.

THE reflections in a letter to NATURE (August 15) on shortcomings in the administration of the Wild Birds' Protection Acts, in so far as they relate to the eggs of the lapwing, which, it is stated, appear on the prohibited lists of only eight Scottish authorities, are now happily at variance with the facts. Far from such being the state of the case, at the present time and for more than ten years past no fewer than twenty-eight—out of thirty-four—Scottish county councils have protected the eggs of this bird, after certain dates which permit of only the first layings being taken for food purposes.

As regards the skylark, the taking of eggs is altogether prohibited, not by twenty-three authorities in

England and Scotland, as stated, but by twenty-eight county councils in Scotland alone, and this also has been the case for more than ten years.

WM. EAGLE CLARKE.

The Royal Scottish Museum, Edinburgh.
August 26.

A Mistaken Butterfly.

THE following observation will be of interest in connection with those related in NATURE, vol. xcv., 1915.

At Pennant Hills, near Sydney, on March 24 last, I noticed an interesting case of colour-attraction for a butterfly. A lady was standing talking to two other persons on the footpath opposite my house. She was wearing a plain brown straw hat, fixed with a hat-pin having a light blue porcelain knob about half an inch in diameter. A butterfly (*Papilio sarpedon*) kept flying about the knob as if fascinated, and followed the lady closely when she went up the footpath to the house, flying away only when the lady entered the house.

I watched it for quite five minutes, during which time the butterfly never went more than a few inches from the lady's head, and always returned to the blue knob, apparently trying to alight thereon. The lady several times brushed at the insect with her hand to drive it away.

THOS. STEEL.

Sydney, New South Wales.

FERTILISERS AFTER THE WAR.

IN view of the great increase in the facilities for making sulphuric acid, attempts have naturally been made to find an outlet for the new production after the war, and a Departmental Committee appointed to go into the subject has recently examined the possibility of an additional production of fertilisers, which before the war absorbed some 60 per cent. of the acid made. The report of the Committee (Cd. 8994, 1918) has already been discussed in these columns from the point of view of sulphuric acid production: it remains now to consider the effect on fertilisers. The report is very short and does not include the statistical data necessary for a full discussion of the problem: fortunately these can be collected from other sources.

Prior to the war the total consumption of artificial fertilisers in this country was something above 1,000,000 tons per annum, made up approximately as follows:—

	Estimated pre-war consumption in United Kingdom. Tons per annum	Estimated annual value. Pre-war prices £
Farmyard manure	37,000,000	11,000,000
Nitrate of soda	80,000	920,000
Sulphate of ammonia	60,000	750,000
Cyanamide (nitrolim) and nitrate of lime	10,000	110,000
Superphosphate	600,000	1,650,000
Basic slag	280,000	560,000
Guano	Say[1] 25,000	250,000
Bones	,, 40,000	200,000
Others	,, 10,000	100,000
Total	1,105,000	4,540,000

[1] No good estimate can be made of the amount of guano, bones, and other materials used as fertilisers.

At the same time the areas under the various crops in the United Kingdom were as follows:—

	Million acres in the United Kingdom
Wheat, barley, oats	7·67
Potatoes	1·21
Swedes, turnips, mangolds	2·28
Other arable crops	1·55
Temporary grass	6·61
Permanent grass...	27·35
Total	46·67

This distribution of land and consumption of fertilisers gave the following amounts of food:—

	Quantity obtained: millions of tons			How utilised: millions of tons	
	Home-grown	Imported	Total	Eaten by human beings	Eaten by animals
Cereals	6·5	10·4	16·9	5·2	9·2
Potatoes	4·8	0·7	5·5	5·5	—
Other roots (estimated) ...	44·5	—	44·5	—	44·5
Grass (estimated as hay) ...	6·0	—	6·0	—	6·0
Other foods:—					
Sugar, fish, etc.	—	—	3·4	3·4	—
Cake, straw, etc.	—	—	6·3	—	6·3
Animal food:—					
Dairy produce (mainly milk)	4·7	0·5	5·2	5·2	—
Meat	1·8	1·2	3·0	3·0	—
Total ...	122·3	12·8	144·8	22·3	120

The experience of the war has shown that this type of production is not really the most satisfactory to the nation as a whole, as it leaves us far too dependent on foreign countries for supplies of wheat. On the other hand, a system of husbandry that produces much wheat is unsatisfactory to the farmer because of the possibility that heavy crops in the Argentine or North America or elsewhere might pull down prices to unremunerative levels. The risk may, in fact, never materialise, but it has been burned into the farmers' minds by the low prices of the nineties of the last century. In consequence, before the war wheat-growing was diminishing in this country, and grass was increasing.

Under the double stimulus of high prices and Government action farmers have during the war broken up more than 3,000,000 acres of grass land and thus added considerably to the area under cereals, particularly wheat and oats. The breaking up of the grass land has led to the production of much more food in the country and necessitated the use of more fertilisers. It is officially stated that we now produce breadstuffs sufficient for forty weeks per annum, whereas before the war we produced only enough for ten weeks. This does not, of course, mean that we produce four times as much food as formerly; the breadstuffs are not quite the same as they were; but it does show that we go a long way towards feeding ourselves.

The scientific problems involved are more

straightforward and less controversial than the political and economic problems. If food production is wanted it can be done so far as scientific problems are concerned. The political and economic problems lie outside our present scope; they have been fully discussed in Lord Selborne's report on rural reconstruction. During the war these problems have, in fact, been largely solved, and in the view of Lord Selborne's Committee the increased production could be permanently maintained.

Assuming this were done, then, it would be necessary to put on a permanent basis the present rearrangement of areas under crops. Various schemes have been submitted. Broadly speaking, they involve the maintenance in arable cultivation of the three and a half or four million acres now taken off permanent grass and adding it to corn, thus extending the rotation from four courses to five, or from five to six. The interposition of a corn crop in this manner is quite possible in practice on two conditions—the land must be kept clean and fertilisers must be used. A reasonable dressing to use for cereals in these circumstances would be 1 cwt. of sulphate of ammonia or nitrate of soda and 2 cwt. of superphosphate per acre. This would not give a measure of the total consumption of fertiliser necessary, because the taking out of 4,000,000 acres of permanent grass would necessitate the improvement of the remainder in order that the same quantity of grass might be grown; an average dressing per acre of 1 cwt. of basic slag would be a reasonable application here. Two estimates are given in the report:—

Estimated Post-war Consumption.

	Pre-war consumption:	Sir T. H. Middleton's estimate:	Sir Charles Fielding's estimate:
	tons per annum	tons per annum	tons per annum
Sulphate of ammonia...	60,000	—	360,000
Superphosphate	743,000	1,367,000	1,643,000
Basic slag	263,000	892,000	1,463,000

It is improbable that the production of basic slag would ever attain the high figures quoted here, while, on the other hand, much greater quantities of superphosphate can be made even than the 1·6 millions required on Sir Charles Fielding's estimate. Some of the slag would therefore in practice be replaced by superphosphate.

Of the two sets of figures Sir T. H. Middleton's is the more likely to be realised. Estimates for sulphate of ammonia are difficult to make because to a large extent, and yet not altogether, sulphate of ammonia is replaceable by, and can itself replace, nitrolim or calcium cyanamide and nitrate of soda. It would not be difficult to make a reasonable guess at the total amount of combined nitrogen the farmers of the United Kingdom might be expected to use, but it is impossible to forecast the way in which they will take it. Thus we might assume the following distribution of crops and consumption of fertilisers:—

	Area		Fertilisers used: tons	
	Total, million acres	Manured, million acres	Superphosphate and basic slag	Nitrogen expressed as sulphate of ammonia
Wheat, barley, oats	11·2	3·0	300,000	150,000
Potatoes	1·5	1·5	150,000	75,000
Swedes, turnips, mangolds	2·6	2·6	390,000	130,000
Other arable crops	1·6	0·9	90,000	45,000
Temporary grass	6·0	2·0	200,000	50,000
Permanent grass	23·8	12·0	600,000	20,000
Total	46·7	22·0	1,730,000	470,000

Here all the combined nitrogen is expressed for convenience in the form of sulphate of ammonia, but it must be understood that other compounds can be used also. This leads to the conclusion that 470,000 tons of sulphate of ammonia (or the equivalent of nitrolim and nitrate of soda) and 1,730,000 tons of phosphates (superphosphate and basic slag) could be utilised annually in the United Kingdom—figures, however, which are below those of Sir Thomas Middleton in so far as phosphates are concerned.

However, all these estimates are necessarily hypothetical; no one knows what will happen after the war. Unless the great political and economic problems involved are satisfactorily dealt with we may yet see the land going back to grass in spite of all our endeavours.

E. J. RUSSELL.

THE VALUE OF THE HERRING AS FOOD.

THE report for 1917 of the Lancashire Sea-fisheries Laboratory is chiefly devoted to a paper by Dr. J. Johnstone on the dietetic value of the herring. It is not necessary to emphasise the present importance of this subject, for the fact is now well known that in the days before the war a small proportion only of the herrings landed in this country was consumed by our own population, a proportion which Dr. Johnstone estimates at as low as 20 per cent. The Government Departments responsible for fishery questions are fully alive to the possibilities which will occur after the war for utilising the fish which were previously exported, and so adding substantially to the national food supply. Already steps are being taken with the view of placing these fish on the market in a more attractive and palatable form than the salted or pickled herrings which constituted the bulk of the exported article, and if the public once realises the food value of the fish the whole supply might well be retained at home.

Dr. Johnstone's analyses of the flesh of the herring have been made chiefly on fish from the Irish Sea, and as the most novel feature of his results is the clear and definite way in which he shows that the composition of the flesh varies very greatly in samples of fish taken at different seasons and in different states of development, it becomes important that analyses of a similar kind should be carried out in other fishery regions, especially in connection with the

great herring fisheries of the North Sea. As an example of the extent of this variation the following figures from Dr. Johnstone's paper may be quoted (p. 31):—

Manx Summer Herrings: Fisheries of 1916 and 1917.—Composition of the Flesh of the Fish: Monthly Means.

	Date			
	May, 1916	May, 1917	Aug., 1916	Aug., 1917
	Condition			
	Virgin	Virgin	½-Full	Full
Water	75·0	68·5	48·4	43·5
Oil	2·5	5·4	31·5	36·6
Proteid	21·1	19·7	16·5	15·7
Ash	2·3	3·3	2·3	2·9
Total	100·9	96·9	98·7	98·7
Energy values (calories)	1100	1330	3608	3943

The most striking variation is in the fat, which rises from about 2½ per cent. at the beginning of the season to more than 36 per cent. in August, when the fish are not far from the spawning phase. After spawning has taken place a great reduction in the percentage of fat occurs, spent fish obtained in September, 1914, showing a reduction to about 9 per cent.

In addition to many analyses of fresh herrings the paper contains similar figures for cured fish of various kinds, pickled herrings, kippers, bloaters, and red herrings. A few samples of sprats were also analysed.

It must be clearly stated that the figures given apply only to the "flesh" of the herrings, including the skin (*minus* scales). The author makes the curious statement that "from the point of view of dietetics it is only the flesh that matters," But surely the roes and milts of "full" herrings are about the best and most nutritious parts of the fish, and the value of the fish as food will not have been adequately dealt with until we have figures in which these are included in their due proportions.

Amongst other aspects of the question discussed by Dr. Johnstone are the effects of cooking and the chemical effects of salting herrings, as well as a number of physiological matters, such as the locus of the fat, the nature of the fat, and the seasonal metabolic phases. The paper is one of great interest, and it is to be hoped that the subject will be followed up. E. J. A.

THE METALLIFEROUS ORES OF THE IRON AND STEEL INDUSTRY.[1]

IN June, 1917, the Department of Scientific and Industrial Research published a report dealing with the metalliferous raw materials of the iron and steel industry of the United Kingdom, the Allies, and the neutrals. Its object was to collect and summarise in a form which can easily be consulted as much information as possible from the principal literature pertaining to the sources of iron ores, and other metalliferous ores accessory to the metallurgy of iron and steel; to describe their composition and character, giving analyses where possible, together with indications as to the geographical position and the accessibility of the minerals. The report did not claim to give the results of independent researches, but merely to provide for the inquirer information for which he would otherwise have to search through a great variety of publications and monographs issued by technical and scientific societies and geological surveys. How useful this publication has been to the iron and steel industry is shown by the fact that the stock of copies was almost exhausted three months after publication.

It soon became apparent that the value and the scientific completeness of the report would be greatly enhanced if an account were given of the supplies of the ores in enemy countries also, and the issue of a new edition has provided the opportunity of adding this information. Some later statistics are also given, and various errors and omissions have been corrected. The second edition accordingly consists of three parts: (1) Notes on the iron ores of the United Kingdom and British dominions; (2) notes on iron-ore deposits in foreign countries; (3) notes on the ores of the principal metals, other than iron, used in the iron and steel industries. The last-named part describes the occurrence and composition of the ores of chromium, cobalt, manganese, molybdenum, nickel, titanium, tungsten, vanadium, and zirconium, and the principal uses of the special steels or ferro-alloys made from them.

The German steel industry is based upon, and was rendered possible only by, a discovery of two Englishmen, Sidney Gilchrist Thomas and Percy Carlyle Gilchrist. This discovery, which in their hands became also an invention, brought within the scope of economic development the vast supplies of phosphoric ores (Minette) of Lorraine and Luxemburg, and of the Salzgitter and Ilsede districts, which were thus made available for the manufacture of commercial steel on a great scale. As the industry grew its requirements were supplemented by imports from the Briey orefield in France, which is the main part of the same ore body which extends to annexed Lorraine and Luxemburg. These ores were all treated by the "basic" process. For the raw materials of acid steel and steel of special quality, Germany had to depend on imports derived mainly from Sweden, Spain, and Russia.

In May, 1915, a secret memorial, drawn up by six great industrial and agricultural associations in Germany, was presented to the Chancellor. A translation of this was published by the Comité des Forges de France in August, 1915, and from it the following quotation is taken: "Concerning France . . . besides the iron-ore region of Briey, it would also be necessary to acquire the coal region in the Departments of Nord and the Pas de Calais; the security of the German Empire imperatively requires the possession of all the Minette mines, including the fortresses of

[1] "Report on the Sources and Production of Iron and other Metalliferous Ores used in the Iron and Steel Industry." (H.M. Stationery Office.) Price 2s. net.

Longwy and Verdun, which are necessary for their defence; the possession of the vast quantities of coal, and specially of the bituminous coal, which abounds in the North of France is no less important than the acquisition of the iron-ore mines."

Not long after the outbreak of war the German steel industry was beset by serious difficulties owing to the fact that the imports of manganese ore, one of the essential accessories, were cut off, and it was predicted by more than one authority in this country that the shortage of this ore would cause a crisis in, and the eventual stoppage of, the German steel industry. Confident predictions were made as to the date beyond which, for this reason, the war could not be continued by Germany. These predictions entirely failed to take into account the very considerable deposits of manganiferous iron ore contained in the German Empire. In 1911 2¾ million tons of such ore containing less than 12 per cent. of manganese, and 288,000 tons containing between 12 and 30 per cent., were mined. These constituted, therefore, important sources of production when the pinch came. There is good reason for thinking that about ten months' stocks of high-grade ore were present in the country at the outbreak of war, and these were greatly augmented by the confiscation of supplies found in Belgium and North-east France. The mines producing high-grade ore were stimulated to the utmost activity; means are said to have been devised for recovering the slag produced at the ferro-manganese blast furnaces, and also from basic-steel slag. By the desulphurisation of blast-furnace coke certain economies in manganese are considered to have been effected. There is to-day no evidence that Germany is in serious difficulties with regard to steel production owing to the cutting off of external sources of manganese ore.

In pre-war times Russia produced more manganese ore than any other country. In 1913 the output was 1,175,000 tons; most of this was exported and went through the Dardanelles. How heavily this industry was hit by the war is shown by the fact that in 1915 the production is stated to have been only 9750 tons. India, much the largest source of supply within the Empire, was a close competitor of Russia, and, apart from a drop of output in 1915, production has been well maintained. Much of the Russian export went to the United States of America, and the iron and steel industry in that country has been placed in considerable difficulties in consequence. For a time the deficiency was made good by imports of the high-grade ores mined in Brazil. With the acute shortage of ship tonnage which now exists, however, a most urgent appeal has been made to the iron and steel manufacturers in the United States to utilise home sources of ferruginous manganese and manganiferous iron ores.

The Department of Scientific and Industrial Research is to be warmly congratulated on the publication of a report which gives in a well-arranged and lucid form just the information it set out to collect and systematise. It is to be hoped that it will become one of its standing publications, and that from time to time new editions with the most up-to-date information will be issued. H. C. H. CARPENTER.

PROF. BERTRAM HOPKINSON, F.R.S.

THE death, in a flying accident on August 26, of Col. Bertram Hopkinson, C.M.G., F.R.S., professor of mechanism and applied mechanics in the University of Cambridge, is a grievous loss to science and the nation. Born in 1874, the eldest son of Dr. John Hopkinson, F.R.S., he inherited not a little of his father's scientific insight and genius for bringing science to bear on practical matters. This hereditary aptitude was fostered by close contact with his father's mind in early life; he was his father's frequent companion in work as well as in play. Bertram lived at home, attending St. Paul's School until he went to Trinity, where he took the Mathematical Tripos. An unlucky illness compelled him to take an ægrotat degree in the First Part; but he showed his quality in the Second Part, when he was placed in the First Division of the First Class. He then read for the Bar, devilling in a well-known counsel's chambers, and had been "called" when the tragic death of his father, along with a younger brother and two sisters, while climbing near Arolla in 1898, changed the current of his life. He boldly took up his father's business as a consulting electrical engineer, in association with his uncle, Mr. Charles Hopkinson, and Mr. Talbot, a former assistant. With them he carried out various tramway undertakings during the next four or five years.

In 1903 Hopkinson was elected professor of mechanism and applied mechanics at Cambridge, in succession to the present writer. To many the appointment of so young and comparatively unknown a man must have seemed surprising, but those who knew Hopkinson were confident that the electors had made a wise choice. It was entirely justified by the result. In Hopkinson's hands the Cambridge School of Engineering prospered exceedingly, going from strength to strength in numbers, in academic and professional repute, and, above all, in activity as a centre of research. Hopkinson was himself devoted to research, and could inspire his pupils with a like ardour. In some instances a pupil's name appears as joint author of the published paper; in others the pupil was himself left to complete and publish the work.

No one, I think, can read Hopkinson's papers without being reminded of those of his father. There is something of the same freshness of outlook, the same penetration and grasp, the same personal detachment, the same directness in attack, the same unconventionality in method, the same avoidance of side issues and concentration on the essence of the problem. It is impossible to do more here than give the briefest indication of

their general scope. One group deals with elastic hysteresis in steel and the endurance of that metal under repeated cyclic variations of stress. For these experiments he designed an ingenious "fatigue-tester" to apply alternations of pull and push at a rate as high as 7000 per minute by using electro-magnetic action to maintain the vertical oscillation of a heavy armature attached to one end of the test-piece. Another important group of papers deals with gaseous explosions. His researches in this subject have done much to clear away earlier misconceptions and to bring out features in the process of explosion that had been overlooked. They disposed of wrong ideas about "after-burning," but at the same time showed how far from uniform is the condition within a closed combustion-vessel at the moment when the maximum pressure is attained.

As joint secretary with Sir Dugald Clerk of the British Association Committee on Gaseous Explosions, as well as by his own experiments, Hopkinson did much to advance our knowledge of an intricate problem. He applied similar methods of inquiry to the analysis of what occurs in an internal-combustion engine; in this connection his optical indicator is of great service. During the years immediately before the war he was engaged in studying the pressure produced by the detonation of high explosives and by the impact of bullets. For this he devised methods of measurement which were admirably simple and effective. They were described in a Royal Institution lecture in 1912, and more fully in the Philosophical Transactions of the Royal Society for 1914. Hopkinson also edited a reprint of his father's scientific and technical papers, and wrote for it a short memoir, which was published in 1901.

On the outbreak of war he threw himself with characteristic vigour into national service, to the exclusion of all other interests. At Cambridge he had been a keen promoter of the Officers Training Corps. He first undertook R.E. duty at Chatham in order to relieve others for active service. Later he was engaged for a time at the Admiralty on work of a kind quite new to him, which he attacked with conspicuously good effect. He had the satisfaction of seeing an invention, which he made to meet one of the bigger difficulties of the war, promptly tested, adopted, and officially recognised. Concurrently with this he acted as secretary of a committee set up by the Royal Society to assist the Government, a position which brought him into touch with many other war questions and with the men busied in them. His attention began to be directed to the equipment of aircraft, and soon he became absorbed in this task, accepting a position in what is now the Royal Air Force. There, perhaps as never before, he found his opportunity. His powers were acknowledged and turned to full account; he received promotion, and the range of his authority was enlarged. He revelled in his work, put everything aside for it, was unsparing of himself. He knew well that flying, especially for a man no longer young, meant a serious risk; but he felt that the risk had to be taken if the work were to be well done. So he flew, from one air station in England to another, or even to France, generally as his own pilot.

All who knew Hopkinson esteemed him for a man of strong character and sane judgment, of unswerving straightness in thought and action, with a rare freedom from egotism or self-seeking or any pettiness. But it was only in the intimacy of the domestic circle that one learnt what a wealth of affection lay behind his reserve. In 1903 he married the eldest daughter of Mr. Alexander Siemens; she survives him with seven daughters. His family life was an ideally happy one save for the calamity of 1898 and for the death of his brother Cecil, a young man of like tastes and of the finest promise, who died last year of a wound received in Flanders. In claiming them both, the War has taken of our very best.

J. A. EWING.

NOTES.

THE Società Italiana delle Scienze (detta dei XL) has awarded the natural sciences gold medal for 1918 to Prof. Filippo Eredia for his work in meteorology. This is the first time that, in Italy, studies in the field of meteorology have been rewarded in this way.

A TELEGRAM received at the Meteorological Office on August 26 from the Director-General of Observatories in India states, with reference to the Arabian Sea and Bay of Bengal, that the monsoon is normal, and that no cyclonic storm has occurred.

WE regret to note that *Engineering* for August 30 records the death of Engineer Rear-Admiral Francis Henry Lister. Admiral Lister was well known in the Service, and was closely identified with the construction of machinery in the contractors' works, not only for the Navy, but also for several ships ranked as auxiliaries to the Navy, including the *Mauretania* and *Lusitania*. His age was fifty-six years, and he had given thirty-nine years to the service of his country in the Navy. He was a member of the Institution of Naval Architects and of the Institution of Mechanical Engineers.

THE principle that every large industrial firm should have its own research laboratory appears to have been accepted more generally in America than it has been in this country, and as a consequence a large proportion of our knowledge of the working of such laboratories comes from American sources. In the August issue of the *Scientific Monthly* there is, for example, a valuable paper on research and industry by Dr. P. G. Nutting, the director of the Westinghouse Research Laboratory at East Pittsburgh. Dr. Nutting points out that in addition to technical research, such as the testing of the materials received and produced, the elimination of works troubles, and the starting of new processes, it is necessary to carry out scientific industrial research on basic principles, and on their relations to the more obscure and fundamental works troubles. He considers that the best preparation for industrial research as a profession is a thorough grounding in principles, followed by research sufficient to justify the award of a doctor's degree in the best American universities.

A ROYAL Commission has been appointed "to consider and report whether it is advisable to make any changes in the denominations of the currency and

money account of the United Kingdom with the view of placing them on a decimal basis, and whether, if an alteration of the present system is recommended, it is desirable to adopt with or without modification the proposals embodied in the Bill recently introduced into the House of Lords by Lord Southwark or some other scheme, and in the latter alternative to make specific recommendations for consideration by Parliament." The members of the Commission are:—Lord Emmott, Lord Southwark, Lord Faber, Lord Ashton of Hyde, Lord Leverhulme, Sir R. V. Vassar-Smith, Bart., Sir J. Larmor, Sir G. Croydon Marks, Sir A. W. Watson, Mr. J. W. Cawston, Mr. S. Armitage Smith, Mr. C. Godfrey, Mr. J. Bell, Mr. J. Burn, Mr. H. Cox, Mr. G. Hayhurst, Mr. T. McKenna, Mr. G. Marks, Mr. J. F. Mason, Mr. A. Smith, Mr. G. M. Smith, and Mr. G. C. Vyle.

ALTHOUGH a reinforced-concrete barge of 400 tons has been in use on the cross-Channel service for some months, the vessel launched on August 24 at Lake Shipyard, near Poole, is the first 1000-ton reinforced-concrete sea-going barge completed in the United Kingdom, and forms one of a fleet of similar vessels at present in course of construction at Admiralty extension shipyards in different parts of England, Scotland, and Ireland. From an illustrated article in *Engineering* for August 30 we learn that there are now eight 1000-ton barges on the slips at the Lake yard, which was laid out to suit this class of work by Mr. Anthony G. Lyster, of Sir John Wolfe Barry and Partners. When finally completed, the slipways will provide accommodation for the simultaneous building of sixteen vessels ranging up to 2500 tons dead-weight carrying capacity. The vessels under construction were designed by Mr. E. O. Williams, the hull in every case having a double bottom and double sides. It is interesting to know that the experience gained in the building of this pioneer vessel has already resulted in the introduction of various improved methods of procedure. The vessel was constructed to the classification of the British Corporation for the Survey and Registration of Shipping.

THE death is announced of Prof. Henry Shaler Williams, of Cornell University, U.S.A. Prof. Williams was born at Ithaca, N.Y., on March 6, 1847, and graduated at Yale in 1868. His early inclinations were towards biology, and his first paper, in 1872, made a comparison between the muscles of the chelonian and human shoulder-girdles. Soon, however, he turned to the study of fossils, with special reference to their use in stratigraphical geology, and in 1879 he was appointed professor of palæontology in Cornell University. In 1886 he became professor of both geology and palæontology in the same university, and in 1892 he succeeded James D. Dana as Silliman professor at Yale. In 1902 he returned to Cornell, and in 1912 he retired from active service, with a pension under the Carnegie Foundation. Prof. Williams devoted his attention chiefly to the invertebrate fossils found in the Devonian formations of the eastern part of North America, and published an important series of memoirs on the correlation of these rocks and faunas in the Bulletin of the United States Geological Survey. At the same time he detailed the results of his researches, especially on brachiopods, in other papers, and in 1895 he produced a most useful and original handbook entitled "Geological Biology, an Introduction to the Geological History of Organisms." He was among the pioneers in the modern methods of studying fossils, and most industriously tested their value in the sphere which he made his own.

THE death of Dr. Robert Saundby on August 28, at the age of sixty-eight, leaves a gap in the ranks of contemporary leaders of British medicine. From his first appointment as pathologist at the Birmingham General Hospital in 1876 until his retirement from the University chair of physic in 1917, when he became emeritus professor, Dr. Saundby devoted himself to medical problems in their scientific aspects, especially in regard to abnormal states of the urine in renal disease and diabetes, and to disorders of the stomach and digestive system. His works on "Renal and Urinary Diseases" (fourth edition, 1900) and on "Diseases of the Digestive System" (second edition, 1907) embody the scientific knowledge and clinical experience of a physician who pursued in the laboratory the studies begun in the wards of a large hospital, and was well acquainted with the writings of other workers in the same domain. Besides these monographs, Dr. Saundby made considerable contributions to medical literature in the form of articles and scholarly addresses. The scientific attitude of his mind was strongly reflected in his clinical work and in his lifelong interest in research. To the last he was receptive of new ideas, and his readiness to test such new methods or findings within his province as attracted his critical faculty kept him continuously abreast of his times. But Dr. Saundby was more than a clinician, and his books on "Medical Ethics" (second edition, 1907) and on "Old Age: Its Care and Treatment" (1913), as well as the distinguished positions to which he was elected by his fellows, bear witness to his strong personality, sound judgment, and versatility. Throughout his career as a consulting physician in busy practice Dr. Saundby's energy and public spirit were further displayed in other fields of professional interest. He was a strenuous supporter of the British Medical Association, holding the office of chairman of the council and becoming president of the association in 1911. He was also a member of the General Medical Council, and at the Royal College of Physicians he was Harveian orator in 1917, lecturing on the congenial theme of "Harvey's Work Considered in Relation to Scientific Knowledge and University Education in his Time."

CONSIDERABLE interest was taken last week in the demonstrations of "reading by ear" at the British Scientific Products Exhibition. The original construction of Dr. Fournier d'Albe's "type-reading optophone" was described in NATURE for September 3, 1914. This construction has recently been modified by replacing the Nernst lamp by a small drawn-wire lamp, and by arranging the whole apparatus in such a manner that any ordinary book or newspaper can be inserted and read without cutting it up into pages or columns. The demonstrations consisted in taking an ordinary book of clear type, opening it at random or at a page chosen by the audience, and asking the blind pupil to read a few words or lines on that page. By a curious coincidence the first words thus read were "in the light." The reader, a girl of nineteen blind from early infancy, was the first blind person to read by ear. She read an unknown page of print without assistance after twenty lessons of one hour each, spent in learning the alphabet and in deciphering words of gradually increasing length. The only letters which offered any real difficulty were *c*, *o*, *p*, and *q*. The Roman alphabet is less suitable for optophone reading than either the Gothic or the Russian alphabet, and it might easily be re-designed so as to increase its legibility. But even as types are now, they are sufficiently legible to make all the literature printed clearly in them freely accessible to the blind through Dr. Fournier d'Albe's very ingenious

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Further particulars may be obtained from the undersigned, by whom applications, with testimonials (which need not be printed), must be received on or before Monday, September 16, 1918.

D. J. A. BROWN,
Registrar.

University College,
Cathays Park, Cardiff,
September 2, 1918.

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A. C. BOYDE, Secretary.

Education Office, Darlington,
August, 1918.

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invite applications for the CURATORSHIP of the NATURAL HISTORY and ANTIQUARIAN MUSEUMS, PERTH. Salary £200 per annum.

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For other Official Advertisements see pages ii *and* iii *and page* ii *of Supplement.*

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instrument and by the exercise of reasonable practice in distinguishing the sounds associated with letters and words.

ON the linguistic side the Bureau of American Ethnology, according to its thirty-first report, for 1909–10, published in 1916, was specially engaged, under the superintendence of Dr. Franz Boas, in bringing nearly to completion the first volume of the "Handbook of American-Indian Languages." The most important work on the first volume was a thorough revision of the Algonquin sketch by Dr. W. Jones, which she has nearly completed. Miss Densmore is analysing about 500 songs collected from a representative number of localities, which will form a scientific musical study of primitive song. The remainder of the volume of the report is devoted to an exhaustive account of Tsiinshian mythology, based on a series of texts recorded by Mr. H. W. Tate.

MR. F. B. C. BRADLEE contributes to the Historical Collections of the Essex Institute (vol. liv., No. 2, April, 1918) a paper on the Salem Iron Factory, which possesses more than local interest. The first ironworks of any importance were started at Lynn, Massachusetts, in 1643, and the first iron pot made in New England was cast in that foundry in the same year. The Danvers ironworks and rolling mills were founded by Nathan Read, of Salem, whose ancestors came from Newcastle-upon-Tyne. He was born in 1759, and two works were started in 1796. He was the inventor of one of the first machines, and perhaps the earliest, for cutting and heading nails in one operation. Mr. Bradlee in his paper publishes a number of early documents which are of value as a record of this industry in the United States.

DESPITE the prevalence of war conditions, the Geological Survey of New Zealand continues its handsome series of bulletins with Prof. Jas. Park's memoir on "The Geology of the Oamaru District, North Otago" (1918). This is the typical area for the Oamaruian series, and the Ototara stage is now rescued from what the author calls the "hyphenated" Cretaceo-Tertiary group of former classifications. Everything in the district above the Palæozoic schists is now classed as Miocene or Pleistocene. At the base of the Ototaran strata near Peebles pillow-lavas occur, which were evidently poured out as submarine flows during the deposition of the fossiliferous limestone. The ample lists of molluscs and brachiopods, by Mr. Suter and Dr. J. A. Thomson respectively, establish the Miocene, and probably Middle Miocene, age of the Oamaruian series.

THE controversy regarding the relation of magic to religion is again raised in a vigorous manner by Mr. N. W. Thomas in a paper entitled "Magic and Religion: a Criticism of Dr. Jevons" (*Folk-lore*, xxviii., 259), in the same journal, vol. xxix., part 2. Dr. Jevons asserted that we should reserve the term "magic" "exclusively for the proceedings which excite the disapproval of the community," which, as his critic points out, includes under the head of "magic" not only all crime, but also offences against etiquette. "To frame an adequate definition of magic, it is necessary to survey the whole field of primitive rites and to group the facts according to their natural affinities without regard to the terminology of the reporter. In only too many cases the native view cannot be discovered; failing some knowledge of the language, the observer falls back on his own preconceptions, and while we get a good account of the details of a rite, we get none of the atmosphere with which the native mind surrounds it."

THE peoples of Austria are statistically considered by Mr. B. C. Wallis in a paper in the July issue of the *Geographical Review* (vol. vi., No. 1), which is accompanied by several excellent maps in colour. Three of these maps show respectively the relief of the land, the density of population, and the distribution of nationalities. The last map illustrates the patchwork of races of which Austria consists, and shows clearly that in most of Austria the inhabitants are not of Teutonic race, and that there is no race characteristic to Austria like the Magyars to Hungary. Czechs, Poles, Ruthenians, and Rumanians form 50 to 95 per cent. of the population in different parts of northern Austria. From Carinthia and the Tyrol southwards Italians and Slavs are the predominating races. This leaves a comparatively restricted area, comprising principally the mountains of the centre and the Danube valley, in which Germans predominate. Mr. Wallis believes that if the principle of nationality is given due consideration in the final settlement, the outlooks of Germany eastward and towards the Mediterranean will be barred, and that the Germans of Austria will be separated from the Prussians by the Czechs. The best lands of Austria will no longer be in German hands. The paper raises many interesting issues, and contains many facts essential to any understanding of the settlement of the Austrian question.

AN account of the amphibians collected by the American Museum Expedition to Nicaragua in 1916 appears in the Bulletin of the American Museum of Natural History, vol. xxxviii., pp. 311–47. Though, of necessity, very technical in character, it yet contains some noteworthy observations in regard to the life-histories of these animals, especially in relation to coloration and structural variations. A good instance of the latter is furnished by a tiny tree-frog, no more than 16 millimetres in length. New to science, and designated *Hyla chica*, this little creature displays a striking range of variation in regard to the digital expansion used in climbing, and a no less marked reduction of the webs of the toes. *Agalychnis helenae*, another small tree-frog, showed chameleonic changes of colour which were not, apparently, due to changes in the intensity of the light. Finally, stress is laid upon the profound alterations of colour which take place in specimens preserved in spirit.

THE annual report for 1917 of the New Jersey Department of Conservation and Development insists on the abolition of all legislation framed for the protection of deer and rabbits within the boundaries of the State; and this because of the depredations of the deer, which, driven out of the forest by fires caused by deer-hunters, raid the crops of the farmers. It is contended that material interests of great value are being sacrificed to sport. But, judging from the report, hunters in this State are accorded a surprising licence. Strenuous efforts are urged to drain some 300,000 acres of marshland, now infested with mosquitoes, in order that they may become available for cultivation; and for this work it is suggested prison-labour should be employed. The forest fire service report, included in this volume, proves interesting reading, if only for the insight it affords into the management of large forests in view of our own afforestation schemes.

THE collection of sea-anemones made by the *Terra Nova* Expedition is described by Mr. T. A. Stephenson (British Antarctic *Terra Nova* Exp., 1910, Zool., vol. v., No. 1, pp. 1–68, 6 pls., 1918). Fifteen genera, all belonging to the Actiniina, are represented, each by a single species. The author describes as new five

genera and eleven species. Seven species were obtained in the vicinity of McMurdo Sound, and two of these were also taken in Ross Sea. All these were dredged from deep water, and most of them have a thick, stiff body-wall. The remaining eight species were collected in New Zealand, off Rio de Janeiro, off the Falkland Islands, and at South Trinidad Island. A careful description is given of each species, and, thanks to the excellent preservation of the material, an account of the histology of most of them is added. In the examples of Leptoteichus, Bolocera, and Cymbactis the author found numerous zooxanthellæ in or around the gonads, and in Phymactis the greater part of the mesoglœa of the mesenterial filaments is crowded with small zooxanthellæ.

We have recently received three additional parts of vol. v. of the Scientific Reports of the Australasian Antarctic Expedition, 1911–14. In part ii. (5 pp.) Miss Mary J. Rathbun gives an account of the crabs which are referable to three species, two of which are well-known species of Halicarcinus and Nectocarcinus. The third is a megalops stage of large size, taken off Macquarie Island, and described as *Marestia mawsoni*, n.sp. In part iii. (48 pp., 15 pls.) Prof. G. S. Brady reports on the Copepoda from the tow-nettings; fifty-three species are noted, twenty-five of which are described as new. The species fall into thirty-eight genera, six of which are new. Several of the more prevalent Antarctic forms in the collection were previously known only from Giesbrecht's descriptions in his report on the collection made by the *Belgica*. These seem to be purely Antarctic species, while a few others, *e.g. Calanus propinquus*, seem to be almost cosmopolitan in distribution. In part iv. (11 pp., 2 pls.) Prof. Brady gives an account of the Cladocera and of the Ostracod family Halocyprida.

The diminution of foreign imports into India has forced the Forest Department to exploit local sources of supply. Home-grown timber is now largely used for industrial purposes. Indian walnut has lately replaced the European variety for rifle-stocks; Chir pine has been found equal to that of Oregon for gun-carriages, and Himalayan spruce is little inferior to the famous Sitka variety for the manufacture of aircraft. Materials for paper are being successfully utilised, and tar for the Calcutta jute industry is being distilled in the Punjab. A solution of gum from *Bauhinia retusa* has been successfully used as a binding material for making charcoal briquettes. On the whole, the efforts of the Forest Department to utilise indigenous resources have been well conceived, and promise to be financially successful.

The Geological Survey of Great Britain, in the sixth volume of its special reports on the mineral resources of the country (1918, 7*s*. 6*d*.), describes the occurrences of refractory materials, including dolomite. Dr. J. W. Mellor has furnished tests of many of the samples. One of several interesting points is the present demand for calcined dolomite as a lining for converters or for the beds of open-hearth furnaces in steel manufacture. The rock should be a compact, nearly pure dolomite—that is, with some 21 per cent. of magnesia. Silica should not exceed 2 per cent. The manufacture of silica bricks from ganister and quartzite is also described. The crushed rock is usually bound by an addition of some 1·5 per cent. of lime during grinding, and the moulded bricks are fired at a temperature of about 1500° C.

We have received from the Palæontological Laboratory of Yale University a collection of reprints detailing the results of the recent activities of Prof. Charles Schuchert and his associates. They are very varied, ranging from notes on the Palæozoic rocks in the Grand Cañon of the Colorado to the evolution of Palæozoic corals and the function of the so-called sacral brain in dinosaurs. One paper by Prof. R. S. Lull (from *Amer. Journ. Sci.*, May, 1918) is a welcome contribution to our knowledge of the footprints of Carboniferous land vertebrates. The animals which made these prints are still unknown, but they seem to have been very bulky, small creatures with sprawling legs, having broad, stumpy feet and four toes in front, five toes behind. The absence of any trace of the tail shows that the body was carried clear of the ground.

Meteorological tables giving the mean values in 1917 for the several elements at Falmouth are published in the "Report of the Observatory Committee of the Royal Cornwall Polytechnic Society," and some notes of interest are added. The minimum barometer reading for the year, 970·0 mb. or 28·645 in., was recorded on August 27; it is the only instance that the minimum pressure has occurred at the observatory in the month of August. Air temperature had a mean of 49·4° for the year, which is the lowest since observations were commenced in 1882; the next lowest annual mean was 50·2° in 1888. From January 14 to February 3, a period of eighteen days, the maximum temperature only once reached 40°, apparently an unprecedented circumstance in the district. The total rainfall was 36·21 in., which is 9·58 in. below the average of the forty-five years, 1871–1915. The minimum fall in any month was 1·83 in., in December, which is the lowest record for that month, and is in marked contrast to 11·14 in. measured in December, 1915. Bright sunshine registered 1632 hours during the year, which is 132 hours fewer than the mean for the thirty-five years 1881 to 1915. In an easterly gale on January 27 the height to which the water washed the cliffs is stated to be unprecedented so far as is known. A table of sea temperature values is given, and as the means at the station are now available for about forty years, the results are of considerable value. Some improvement might probably be made by comparing the sea temperature mean for the several months with the corresponding days of air temperature, instead of with the means of air temperature for the several months, and the maximum and minimum comparisons seem also open to question. The new scale values are not systematically used, but this is probably a matter of time, as with many other observatories.

The manufacture of synthetic indigo in Germany is still considerably hampered through shortage of raw materials (*Zeitschrift für angewandte Chemie*, June 21). The recent discovery of a practical source of acetic acid in calcium carbide has given new life to the industry by securing supplies of one of the most important raw materials. The relatively high prices for synthetic indigo have favoured the cultivation of the indigo plant in Eastern countries. Two large factories in the United States have commenced the manufacture of artificial indigo.

Dagens Nyheter, Stockholm, reports that it has been decided to install a high-power wireless station at Karlsborg. The range is 5000 km., and the masts will be 210 m. high, and weigh only 25 tons. The radiating system is formed of 60 phosphor-bronze wires 450 m. long. A balancing antenna is provided, consisting of a bronze wire 1 mm. thick, suspended 5 m. above the ground over the entire area of the station. The energy will be supplied from the generating station at Trolhättan, and an emergency generator is installed at the station.

A REMARK in NATURE of August 22, p. 493, referring to the use of Moissan's electric furnace for the production of pure substances, and stating that these "rendered possible the practical achievements of Sir Robert Hadfield and other great steel-makers," needs correction for the sake of historical accuracy. Sir Robert Hadfield's epoch-making experiments, which led to the production of his famous manganese steel, were made in 1882, and neither for this nor for the other valuable iron alloys invented by him was he indebted to Moissan's work. It was not until ten years later that Moissan turned his attention to high-temperature research, and by the preparation of chromium, tungsten, molybdenum, uranium, and many other metals in a fused form and high degree of purity enriched our knowledge of the chemical and physical properties of these elements.

IN accordance with its usual practice of late years, the Royal Meteorological Institute of the Netherlands has issued copies of the most disturbed magnetic curves obtained at De Bilt during 1916. The records cover seven sheets, and deal with twelve separate periods, each of thirty hours. There are traces in each case of D (declination), H (horizontal force), and V (vertical force). The D and H scale-values were practically constant throughout, the respective equivalents of 1 mm. of ordinate being 1·06′ and 3·4 γ, but the equivalent of 1 mm. in the V curves varies from 1·14 γ to 3·31 γ. Some of the disturbances were of considerable amplitude, but none at all outstanding. There are several good examples of "sudden commencements." The largest movement of this kind in H occurred on August 26, and was decidedly oscillatory. The usual tendency for the evening hours to be more disturbed than the forenoon is pronounced. Also, in nearly every case the value of V is enhanced in the late afternoon, up to at least 10 or 11 p.m., and depressed in the early morning hours. This is especially well illustrated in the two sets of curves numbered 2 and 3, which cover the sixty consecutive hours commencing at 7 a.m. on March 8. On most occasions short-period oscillations are prominent in the D and H curves during at least part of the storm. On some occasions, notably on November 12, these were of considerable amplitude, especially in H.

OUR ASTRONOMICAL COLUMN.

INFRA-RED STELLAR SPECTRA.—Some interesting experiments on the photography of stellar spectra in the extreme red have been made by Dr. P. W. Merrill, of the Bureau of Standards, Washington (Scientific Papers, No. 318). The actual tests were made at the Harvard College Observatory, where use was made of the 24-in. reflector, combined with objective prisms of different dispersions. The plates were sensitised for the red by staining with dicyanin, and pinaverdol was added when it was desired to photograph the yellow and green in addition. A large number of spectra of typical stars was obtained, with exposures ranging from 5 to 112 minutes, reaching in some cases as far as λ870, and showing the atmospheric absorption bands B, *a*, and A. Several examples are reproduced, and it is clear that results of considerable value to astronomers and physicists may be obtained in the future by this method. Among other results of interest Dr. Merrill has found a new absorption band in the spectra of the M stars at wave-length 760, which he has proved by laboratory experiments to belong to the titanium oxide series; in Mira there is possibly still another band between 810 and 820. In stars of class N new bands have been found at 692, 708, and 723, and these differ from the characteristic bands of carbon in degenerating towards the less refrangible part of the spectrum; it is suggested that they may possibly be due to cyanogen. The great contrast in energy distribution in the different classes of stars is very strongly emphasised by the extended range of observation. For classes B and A the blue portion is much the stronger; at class K the blue and red are about equal; while for classes M and N the red is the stronger.

MOUNT WILSON OBSERVATORY REPORT.—Although the director has been called upon to devote nearly all his time to the organisation and work of the National Research Council, the research activity at the Mount Wilson Observatory appears to have been so far well maintained. The report for 1917 refers to many subjects of the highest interest and importance, and it is only possible to mention a few developments to which attention has not previously been directed. The 75-ft. spectrograph has been adapted for visual observations in conjunction with the 150-ft. tower telescope, and the magnetic polarities of an average number of forty sun-spots were determined on each day of observation, besides measurements of the strength of field in a large percentage of these spots. Further tests of the presence of free electricity in sun-spots were also made, but, as in previous years, Stark effects were not observed, and the results were negative. The interesting results obtained by stereoscopic combinations of H_α images of the sun have been extended, and the method has been found extremely valuable in the study of prominences projected on the disc, and in showing their connection with the dark flocculi. Systematic work on the solar rotation is being continued with the greatest refinements, and it is hoped eventually to determine whether the suggested variations in the period are real, or depend upon instrumental conditions and personal equation. Stellar and nebular investigations continued to increase in several directions, and work on the parallaxes, proper motions, magnitudes, and distribution of the stars has been very fruitful. Of exceptional significance in the theory of stellar evolution is the definite conclusion that the intrinsically fainter stars move more rapidly than the brighter ones, irrespective of their distances from the sun. To facilitate the experimental work, which is so fundamental for the interpretation of celestial spectra, the physical laboratory in Pasadena has been enlarged to nearly double its former area, and additional equipment has been provided. Good progress was also made with the 100-in. reflector, the dome and mounting having been essentially completed, and the great mirror safely conveyed to the top of the mountain; it is expected that the telescope will be ready for test observations during the autumn.

THE DEVELOPMENT OF NEW INDUSTRIES.

A FACT brought to light at the British Scientific Products Exhibition, organised by the British Science Guild at King's College, is the dependence of industrial development upon the intelligent application of scientific knowledge and method. In most of the industries represented at the exhibition it is shown that the resources exist and that they merely await the application of the results of scientific research for their proper development, and the introduction of patient and persistent effort to turn these industries into successful commercial undertakings. The case of timber furnishes an example of our pre-war dependence upon supplies from abroad, when, in point of fact, the bulk of our demands could have been satisfied by home or Colonial supplies. For a long time it

was impossible to make the successive Governments of this country realise that the afforestation of waste lands was a question of national importance. Since the war, however, the attitude of those responsible for the government of the country in regard to this question has changed considerably. The losses due to the submarine, and the shortage of steamship accommodation, have appreciably diminished the imports of timber, with the result that we are now turning to home sources to make up for the deficiences.

The two problems that will have to be solved before we can depend entirely upon our own resources were set out by Mr. E. P. Stebbing in a lecture which he delivered at King's College. The questions are (*a*) where to get the timber we shall require during the next forty years, and (*b*) the immediate afforestation of the waste lands in the United Kingdom. Mr. Stebbing expressed the opinion that we should have to rely upon Canada and Russia for our future supplies of soft woods. He disapproved of small tentative schemes of afforestation. This, in his view, would not enable us to depend upon the major portion of our supplies of home-grown timber, and he expressed the further opinion that unless the afforestation problem is conceived on bold lines, it would result in a useless waste of money.

Just as in the case of timber and other metallic materials the bulk of our supplies can be obtained by the development of the natural resources of the Empire, so in the case of metallic materials can our independence be firmly secured. The example of tungsten furnishes a striking and instructive illustration of the neglect to utilise the resources of the Empire or to work in our own territory the minerals won under the British flag. Under the stress of war conditions the importance of tungsten as an essential ingredient in the manufacture of tool-steel and as a corner-stone of modern engineering is now fully realised in this country. Much still remains to be known about the properties of this element and its uses, and Mr. Julius L. F. Vogel has performed a public service in presenting an account of tungsten at a lecture at King's College, where there are also a number of specimens of the metal to be seen. The problem of preparing pure tungsten, although one of commercial importance, was considered too small to justify a separate establishment for the industry, with the result that it was left to certain German chemical and metallurgical works to deal with the problem. Complete investigation laboratories were equipped, well-fitted works erected, and ample funds provided to develop a suitable process and put it into operation, and before long steel-makers were offered tungsten powder containing 95 to 96 per cent. of pure tungsten practically free from deleterious impurities. In course of time a still higher grade tungsten was supplied, containing up to 99 per cent. of the pure metal. Attempts to establish the manufacture of tungsten in this country resulted in the production of an article of satisfactory quality, but the scale of manufacture, local conditions, and intermittent ore supply made competition with the powerful German producers impossible. If the tungsten industry has at last been permanently established in this country, it is due in no small measure to the efforts of Mr. Vogel, who is prominently connected with the works at Widnes, which have been delivering tungsten since July, 1915, without intermission.

Even in the development of sources of energy for our industry there is immense scope for the application of scientific knowledge and method. We know, for example, that one cubic foot of water per second falling 11 ft. will develop one horse-power in any modern turbine. What use can be made of this energy? Mr. A. Newlands, engineer-in-chief of the Highland Railway, showed in the course of a paper read at the exhibition not only that the development of our water resources will provide us with the energy that we require, but also that its proper development is to some extent bound up with the reorganisation of our industrial life. Cheap power and a greatly extended use of it are imperative necessities, and the continued neglect of the water-power possibilities of this country is a very serious economic waste. In the latest Census of Production Report it is shown that while the total horse-power of industrial engines in the United Kingdom is approximately ten and a half millions, of this only 178,000 h.p., or 1·6 per cent., is represented by water-power. In the opinion of Mr. Newlands, we could easily draw upon water for one to one and a half million horse-power, or more than 10 per cent. of our requirements. A comparison of the percentage of available water-power utilised in Great Britain with that of other countries furnishes a very impressive reminder of the undeveloped state of that industry here. Germany utilises 43·4 per cent. of the water available and capable of development; the United States, 24·9 per cent.; France, 11·6 per cent.; Great Britain, only 8·3 per cent. It is estimated that while there is available for development from water-power in Great Britain 10·9 h.p. per square mile of area, only 0·91 h.p. is actually used.

Mr. Newlands is of the opinion that the place of water-power in industry lies in the utilisation of it so far as possible in territory where industrial activity can be re-created or where none has existed hitherto. This raises a very important sociological problem which it is desirable that our men of science and engineers should consider seriously. The energy derived from water-power can be transmitted electrically over large areas, and made available where practicable for the varied requirements of agriculture, both in field operations and in farm buildings. Here it would help to eliminate much of the drudgery of this important industry, while at the same time coming into service for the purpose of rural transport. As to industries, it is only necessary to mention the manufacture of aluminium, the electro-chemical industries, and the fixation of nitrogen to show what enormous possibilities exist in the development of these industries by the application of large power supplies which would be made available by the utilisation of water. The saving of coal, too, through the development of our water-power resources is an item the importance of which cannot be over-estimated. But this is not the only consideration, for it has distinct and far-reaching possibilities and advantages of its own; and if, as is generally believed, we must enormously increase our national production to re-establish our national position, the utilisation of water-power will be necessary.

While considering the development of resources in this country, attention must be given at the same time to the development of the resources of other parts of the Empire. We have already mentioned the case of tungsten, but there is another example of a field which awaits the application of science, and that is in the resources of West Africa. A comparison of recent statistics presented by Mr. R. E. Dennett in a lecture delivered at the exhibition does not make very cheerful reading. Up to the first six months of 1914 nearly all West African copra went to Germany. From the same territory Germany took nearly half the production of cocoa, more than two-thirds of the palm kernels, about one-eighth of the palm-oil, half of the hides, one-third of the mahogany, more than half of the ground-nuts, more than one-third of the shea-nuts, and the whole of the palm-kernel cake; in all, nearly half of the total exports from the West African Union

went to Germany. The explanation of this is simple. In addition to enterprise, the Germans investigated scientifically the best methods of converting these articles into foodstuffs, etc., and, as Mr. Dennett has pointed out, "we should be greater fools than even the Germans now consider us to be if we did not take every precaution in the future to deprive the German Government of the power to procure West African products with the view of making war upon us again." For it must be remembered that not only are many of these products suitable as foodstuffs; they are also absolutely essential for the manufacture of war material. Of the many instances given by Mr. Dennett of the utilisation of these materials, a good example of the advantage of science is shown by the utilisation of waste cotton-seed as a driving power. He said:—

"In the centre of Africa, where cotton-seed is of little value owing to costly transport, the obtaining of power for driving a ginnery or any other machinery is of great importance, as the further you get into the interior, the more costly coal becomes. On the other hand, cotton-seed is, to all intents and purposes, a waste product in such places, and may well take the place of coal. The power is obtained, not from the oil, but from the seed itself, which is composed of carbonaceous matter. Cotton-seed cake or damaged cotton-seed unfit for crushing purposes is equally good material.

"Cotton-seed gas plants are composed of a brick-lined furnace, in which the seed is burnt on a grate. The air is drawn through the fire and CO_2 is produced, this afterwards being reduced to CO. The gas is then cooled and cleaned and the tar extracted by means of a centrifugal device, which causes all heavy matter to be expelled. A plentiful supply of water is needed for the cleaning process. A suction-gas plant produces exactly the amount that the engine requires. Compared with the steam-engine, the fuel used per b.h.p. is about one-half, the actual amount of coal being in the region of about 1·5 lb. per b.h.p. per hour, and cotton-seed about 4 lb. per b.h.p., including stand-by losses. The labour required to operate a gas plant is also considerably less than that required for a steam-engine of similar size."

Regarding cotton-seed as a possible edible oil to compete with coconut or palm-kernel oil, Mr. Dennett said:—"Cotton-seed oil can now be treated with hydrogen and so converted into a solid fat, and thus hardened it is already largely used to make compound lard, which in some cases contains no lard properly so-called. In this way many of the twenty-three West African oils may also possibly be used in the manufacture of margarine."

THE BRITISH GLASS INDUSTRY.

GLASS is prominent in many parts of the British Science Guild's Exhibition at King's College. It is one of those commodities to which little thought was given while 80 per cent. of our requirements were imported from abroad; but we learn to appreciate things which we have to make for ourselves, and we are learning also something of the extraordinary range of the varieties of glass and the multiplicity of uses to which it is put. In some form or other we find it in use in nearly every section of the exhibition, and we read about it in the admirable "Articles on Recent Developments" in the catalogue. In the first—referring to "Key Industries," by Prof. Gregory—we learn of the vital national importance of glass for optical and scientific purposes; and in that on "Optical Instruments," by Mr. S. D. Chalmers, that most of the types of optical glass which were formerly imported are now made in this country. Dr. Turner contributes an encouraging account of the recent development of "The British Glass Industry" generally, showing how the initial impulse came from our chemists, and how it was followed by the establishment of the Department of Optical Munitions and Glassware Supply of the Ministry of Munitions; by the foundation of the Department of Glass Technology in the University of Sheffield, with the assistance of the Department of Scientific and Industrial Research, the Ministry of Munitions, and the manufacturers; and, finally, by the formation of the Society of Glass Technology—now an important and thriving industrial association. Mr. Chapman Jones, in his contribution on "Photography," tells us of the efficiency of the cameras employed by the Air Force; and Prof. Boswell deals with the all-important subject of "Glass-making and Refractory Sands," relating how optical glasses and laboratory ware are being made successfully from British deposits.

The exhibition includes the productions of many enterprising firms which have taken up new branches of the industry. We may note especially the remarkable range of glass apparatus for chemical and bacteriological work, of which the manufacturers' associations have combined to make a most creditable display. These are practically all productions undertaken during the war, in the face of very adverse and discouraging conditions, and they bear evidence of steady improvement in both quality and technique. In optical glass Messrs. Chance Bros., Ltd., who have, most fortunately for us, kept the industry alive in the country for seventy years, present a striking exhibit of interesting specimens; while the Derby Crown Glass Co. has also entered the field in this essential "key" industry, and shows samples for various purposes. In a separate room the members of the British Lampblown Scientific Glassware Manufacturers' Association exhibit nicely finished thermometers of many kinds, as well as other graduated scientific apparatus. Messrs. Ackroyd and Best and Messrs. Moncrieff show miners' safety-lamp glasses, and the latter firm also gauge-glasses and other important requirements for acid-plant and munition purposes. We must not omit to mention the exhibits of "Vitreosil" plant of the Thermal Syndicate, and the models of transparent quartz-glass apparatus shown by the Silica Syndicate, both excellent examples of industry thoroughly British from their inception.

In connection with the revival of the British glass industry represented in the exhibition, the following quaintly worded passage from a little volume on "The Arts and Manufactures," by William Enfield, "assisted by eminent professional gentlemen" (London: Printed for Thomas Tegg, No. 111, opposite Bow Church, Cheapside, 1809), is of interest:—

"It is to be greatly regretted, that the very important manufacture of glass, should not be so cultivated and encouraged in Great Britain as to prevent totally the importation of foreign; whereas, from the production of sand, lead, and coals, in our own country, we may make the best sorts of glass much cheaper than can be done elsewhere; we yet, however, take looking-glass plates of France, to the amount of a very considerable sum; some window-glass of the Dutch; and the German drinking-glasses for water, with gilt edges and ornaments, are now coming again extremely into fashion. The causes of this demand for foreign commodities, which are, or might be better, and cheaper manufactured here, are various; and the displaying of them not being a proper part of our business at present, we shall wave [*sic*] it, and only intimate, that the tax laid upon glass (against all the principles of good policy) has greatly corroborated

them, as well as checked a growing exportation of some articles, which would probably, in time, have been of very great consequence to our commerce."

The window-tax was abolished in 1851, and house duty substituted for it. The tax no doubt affected glass production generally, but, in any case, it is quite time that we made an endeavour to supply our own requirements, and every effort should be made to assist our manufacturers to attain that object.

HIGH-TEMPERATURE APPLIANCES.

DURING the war period, when industries are being conducted on more scientific lines, when in every detail of operation the utmost care must be exercised, the exact control of temperature becomes imperative in processes of such paramount importance as metal pouring, annealing, hardening, etc. Within recent years the methods of pyrometry have reached a high order of accuracy. Many pyrometers, too, combine with moderate accuracy a simplicity and a robustness of construction which eminently adapt them for works' use, and their rapidly extending application is as important a feature of modern progress as the attainment of the highest accuracy in a limited number of instruments. In a works recently instanced no fewer than 50,000 high-temperature determinations are made weekly with electrical and optical pyrometers, this work fully engaging the attention of sixty assistants.

Progress of this nature can scarcely be adequately reflected in an exhibition such as that arranged by the British Science Guild at King's College, and the pyrometer exhibits cannot be said to be fully representative of modern work. The enormous demand for such instruments no doubt precludes their availability for exhibition purposes. In every case their installation results in a marked improvement in the quality and uniformity of products, and economies thus effected soon cover the cost of installation.

Among the exhibits relating to the control of temperature, one of some interest is an electrical thermostat developed at the National Physical Laboratory by Messrs. Haughton and Hanson. In this apparatus an accurately controlled temperature may be maintained over prolonged periods, as is often required in metallurgical research. Thus 1000° C. is maintained to within 1° C.

Many industrial operations exceed temperatures at which thermo-electric and resistance pyrometers are available. Radiation and optical pyrometers are then in demand. For works' purposes direct readings are desirable, and this condition is easily attained. The wedge pyrometer exhibited by the Optical Pyrometer Syndicate is of a simple type, capable of being placed with safety in the hands of an intelligent workman. By means of a small telescope the image of the hot body emitting visible rays is focussed through a wedge-shaped prism of dark glass, the prism being adjusted until the image just disappears. The instrument is calibrated so that the position of the prism indicates the temperature under observation. Ordinarily arranged to cover a temperature difference of 400° C., a wider range of 800° C. is possible, and thus a pair of instruments with ranges of 550°–1300° C. and 1250°–2100° C. respectively, safely cover the temperatures of a wide range of operations.

A gratifying feature of the pyrometers now in use is the large proportion of British manufacture. This achievement is due to the close co-operation of those familiar with high-temperature research, thoroughly acquainted with the essentials of design and the limitations of the various types of instruments, with the manufacturers who are responsible for the accurate reproduction of the designs of the experts. The time is surely not far distant when the few special forms of instrument emanating from Germany will have been entirely replaced by improved forms of British manufacture.

Turning now to the range of furnaces in which many types of operation essential to technical work are carried out, the extensive use of gas heating is well known. For fuel economy, clean and perfect combustion, and exact control of temperature, gas-heated furnaces present many advantages for both melting and tool-makers' purposes. The latter furnaces are frequently of the twin muffle type. One example is shown by the Monometer Manufacturing Co., and is designed for hardening high-speed steel. A feature of the furnace is the patent automatic heat regulator to give close and continuous control of the temperature in both chambers. The furnace consumes town gas with air at 2-lb. to 4-lb. pressure. The same firm also shows a ladle furnace and a die-casting machine, each fitted with a self-acting heat regulator, by which the desired temperature can be controlled. Fuel economy is thus effected, and the prevention of overheating—and with it the many errors consequent thereon—is ensured. The Davis Furnace Co. has on exhibit a portable tool-makers' outfit, which includes an oven capable of attaining a temperature of 1350° C.

The requirements of modern thermal operations are opening up the possibilities of electrically heated furnaces. These carry the advantages of compactness, simplicity of design, and the great ease with which exact temperature control can be effected. An example is seen in the Wild-Barfield muffle furnace manufactured by Messrs. the Automatic and Electric Furnaces, Ltd., and used for hardening and similar operations. Furnaces of the salt-bath type are also in use, and are fitted with pyroscopic detectors, compensators, and galvanometers.

Among other exhibits of thermal interest may be noted amorphous carbon electrodes of large diameter and more than 6 ft. in length, with screwed ends which admit of a continuous feed. Electrodes of this type are extensively used in electro-metallurgical operations such as the manufacture of calcium carbide and ferro-alloys. Messrs. Hadfields, Ltd., exhibit a large temperature chart indicating many of the important metallurgical temperatures based on the latest available data.

WATER-POWER AND ITS UTILISATION.[1]

THE World's Present Power Demand.—It is impossible to estimate, with any pretensions to accuracy, the power now being used in the various countries of the world.

Independent estimates,[2] based on such data as are available, tend, however, to show that it is of the order of 120 million h.p., made up approximately as follows :—

World's factories, including electric lighting and street railways ...	75	million h.p.
World's railways	21	,, ,,
World's shipping	24	,, ,,
Total	120	,, ,,

This includes all steam-, gas-, and water-power.

[1] Abridged from the Preliminary Report of the Committee of the Conjoint Board of Scientific Societies appointed "to report on what is at present being done to ascertain the amount and distribution of water-power in the British Empire."

[2] "The World's Supplies of Fuel and Motive Power," Hawksley Lecture Inst. Mech. Engineers, 1915, Sir Dugald Clerk. "Natural Sources of Energy," A. H. Gibson: Cambridge University Press, 1914.

Of the 75 million h.p. used for factories and general industrial and municipal activities, a rough approximation of the most probable distribution would appear to be :—

—	United Kingdom	Continental Europe	United States	British Dominions and Dependencies	Asia and S. America
Millions of h.p.	13	24	29	6	3

An estimate by the Dominion Water-Power Branch of the Canadian Department of the Interior outlines the hydraulic situation of the various countries as follows :—

Country	Area (square miles)	Population (Latest available figures)	B.-horse-power available (1915 estimate)	B.-horse-power developed (1915 estimate)	Per cent. utilised	Horse-power per sq. mile of area	
						Available	Developed
United States ...	3,026,600[1]	92,019,900[2]	28,100,000	7,000,000	24·9	9·3	2·31
Canada "A"[3] ...	2,000,000	8,033,500	18,803,000	1,735,560	9·2	9·40	0·86
Canada "B"[4] ...	927,800	8,000,000	8,094,000	1,725,000	21·0	8·74	1·83
Austria-Hungary	241,330	49,418,600	6,460,000	566,000	8·8	26·8	2·34
France	207,100	39,601,500	5,587,000	650,000	11·6	27·0	3·14
Norway	124,130	2,302,700	5,500,000	1,120,000	20·4	44·3	9·02
Spain	194,700	18,618,100	5,000,000	440,000	8·8	25·7	2·27
Sweden	172,900	5,521,900	4,500,000	704,500	15·6	26·0	4·08
Italy	91,280	28,601,600	4,000,000	976,300	24·4	43·8	10·7
Switzerland ...	15,976	3,742,000	2,000,000	511,000	25·5	125·2	32·0
Germany ...	208,800	64,903,400	1,425,000	618,100	43·4	6·8	2·96
Great Britain ...	88,980	40,831,400	963,000[5]	80,000	8·3	10·9	0·91
Russian Empire[6]	8,647,657	182,182,600	20,000,000	1,000,000	5·0	2·3	0·12

[1] Excluding Alaska (area about half million sq. miles).
[2] 1911 census+12 per cent
[3] Canada "A" : 2,000,000 sq. miles taken as the area treated in the Conservation Commission's estimate of available water-power, and the area which we may expect to see fairly thickly settled during the next few decades. This includes the area indicated by "B" and the 8,000,000 population of "B." The area of the whole Dominion is 3,729,750 sq. miles. The powers given are a 1917 estimate.
[4] Canada "B" refers to the presently most thickly populated portion of the Dominion.
[5] The estimate for Great Britain is almost certainly much too high.
[6] A recent estimate by the Ministry of Ways of Communication (*Electrical Review*, February 22, 1918).

From this it appears that between 15 and 16 millions of the world's industrial horse-power is at present developed from hydraulic resources. The following table shows approximately the hydraulic power developed in the various regions, and also the ratio of this to the total industrial horse-power, excluding railways :—

—	United Kingdom	Continental Europe	United States	Colonies
Millions of h.p. ...	0·08	6·5	7·0	2·0
Percentage of total industrial h.p.	0·6	27·0	24·0	33·0

Perhaps the most interesting feature of these tables is the extremely small proportion of available hydraulic power developed in the United Kingdom. It is the most backward in this respect of all the countries listed, except Russia, and its 8·3 per cent. compares very unfavourably with the 43·4 per cent. of Germany.

Nitrogen Fixation.—In the utilisation of atmospheric nitrogen for the production of nitric acid and the manufacture of nitrates, great developments have taken place during the last decade, and in Norway alone more than 400,000 e.h.p. is now absorbed in its production. The world's annual consumption of nitrogen in its various combinations is about 750,000 tons, representing a value of about 50,000,000*l*., and this demand is increasing yearly. Four-fifths of this supply has been produced hitherto from natural nitrate deposits, but in view of the rapid depletion of these deposits, and of the diminution in the fertility of most of the great wheat- and cotton-growing areas of the world, the production of artificial fertilisers by one or other system of nitrogen fixation must, in the near future, become a question of national importance.

At the present time the world's consumption of fertilisers amounts to close upon 6,000,000 tons per annum, and this will probably be doubled within the next twenty years. To-day the efficiency of the electrical production is low, amounting in the case of calcium nitrate to about three-quarters of a ton per e.h.p.-year. By adopting the cyanamide process the consumption of energy may be cut down to about one-fourth, but even in this case the production of the equivalent of 12,000,000 tons of fertilisers per annum would require 4,000,000 continuous e.h.p.

It is estimated that the 200,000,000 acres of arable land in Canada alone may ultimately require some 10,000,000 tons of nitrates per annum to maintain their fertility, and this in itself would necessitate the absorption of an appreciable portion of the whole hydraulic energy of the Dominion.

Cost of Hydraulic Power.—An examination of some 120 European installations shows that for large installations of upwards of 10,000 e.h.p. the minimum cost of the hydraulic works is 8·4*l*. per h.p. installed, and the maximum 79·6*l*. per h.p. For the majority of the installations the cost lies between 25*l*. and 45*l*. The cost of the electrical generators, switchboards, etc., and transmission lines also varies greatly, ranging from 1·25*l*. to 28·4*l*. per h.p., while the cost of the turbines ranges from 4*l*. to 8*l*. per h.p. The working costs vary between 1·3*l*. and 6·8*l*. per e.h.p.-year, with an average value of 3*l*. From these figures it appears that on the average, making an allowance of 15 per cent. for interest and depreciation the cost per e.h.p. per annum is in the neighbourhood of 10·5*l*.

In many installations, however, the cost is very much less than this. The Ontario Power Company, for example, is able to supply power to the Hydro-Electric Commission of Ontario at 1·8*l*. per e.h.p. per

annum. It is estimated that many of the large powers in Canada can be developed at a total cost, including all generating machinery and transmission lines, ranging from 12*l.* to 20*l.* per e.h.p., in which case the cost per h.p. per annum should not exceed 2*l.* to 3*l.*

Resources of Canada.—Canada is exceptionally fortunate in the extent and distribution of its water-powers. Extending over a belt of several thousand miles in length, from Alaska to Labrador, and over a width of several hundred miles, there is an almost continuous network of lakes and rivers.

The following table shows how general is the distribution of water-power throughout the Dominion :—

Province	B.-horse-power		Per cent.
	Available	Developed	
Nova Scotia	100,000	21,412	21·4
New Brunswick ...	300,000	13,390	4·5
Prince Edward Island ...	3,000	500	16·7
Quebec	6,000,000	520 000	8·7
Ontario	5,800,000	789,466	13·6
Manitoba	3,500,000	76,250	3·1
Saskatchewan		100	
Alberta		32,860	
British Columbia ...	3,000,000	269,620	9·0
N.W. Territories, Yukon	100,000	12,000	12·0
	18,803,000	1,735,598	9·2

Resources of Australia.—Though comparable in area with the United States, there has yet been no notable hydro-electric development in Australia. Except on the east coast, the topography is too flat or the rainfall too low to provide the necessary conditions. Some of the large irrigation schemes are capable of being utilised for power production, but the aggregate of such possible power is small.

The only possibilities of considerable powers are to be found in the rivers draining the Great Dividing Chain of the east coast.

The aggregate power suggested as being capable of economic development in the Great Dividing Chain is as follows :—

Australian Alps	300,000 to 500,000	h.p.
Blue Mountains	25,000 to 50,000	,,
New England Range ...	200,000 to 500,000	,,
Cairns district	100,000 to 250,000	,,
Total	625,000 1,300,000	

Conclusions.

The main conclusions to be drawn from the evidence available to the committee are :—

(1) That the potential water-power of the Empire amounts in the aggregate to at least 50 to 70 million horse-power.

(2) That much of this is capable of immediate economic development.

(3) That, except in Canada and New Zealand, and to a less extent in New South Wales and Tasmania, no systematic attempt has as yet been made by any Government Department to ascertain the true possibilities of the hydraulic resources of its territories, or to collect the relevant data.

(4) That the development of the Empire's natural resources is inseparably connected with that of its water-powers.

(5) That the development of such enormous possibilities should not be left to chance, but should be carried out under the guidance of some competent authority.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Institution of Naval Architects' Scholarship for 1918 has been awarded by the Council to Mr. H. W. Nicholls, of Chatham Dockyard. The scholarship is of the value of 100*l.* per annum, and is tenable for three years.

A COPY of the calendar for the session 1918–19 of the McGill University, Montreal, has been received. Its 377 pages give very full details of the varied courses of instruction provided, not only for graduation in the more ordinary university faculties, but also for non-graduate students desiring to study other branches of learning. It is possible here to refer only to a few of the expedients adopted to assist needy students of ability. Particulars are given of loan funds which have been established for the purpose of aiding students who, upon the completion of their second or later year's work, require assistance to enable them to finish their course of study. Satisfactory arrangements are made to secure the eventual repayment of the loans. The provision of scholarships, exhibitions, and prizes is on a generous scale, and the needs of every class of student seem to have been thought of, and means taken to give due recognition to excellence in whatever line of work has been followed.

THE prospectus of the University courses in the Municipal College of Technology, Manchester, for the forthcoming session describes fully the facilities which the college offers for systematic training in the principles of science and art as applied to mechanical, electrical, municipal, and sanitary engineering, as well as to architecture, the building trades, the chemical and textile industries, and to photography and the printing crafts. Not only does the college provide the necessary courses for students who desire to graduate in the faculty of technology, but it caters liberally for more advanced study and research. A new degree of Doctor of Philosophy has been instituted with the object of encouraging research among suitable graduates from approved universities. It is interesting to note in this connection that the governing body of the college is prepared to award a limited number of research scholarships in technology, each of a value not exceeding 100*l.* The prospectus gives full particulars also with regard to the entrance scholarships available at the college.

A NEW departure is announced by the Royal School of Mines, which is now a constituent part of the Imperial College of Science and Technology, in the institution of a new associateship of the school in mining geology. The curriculum has been designed under the guidance of a number of the leaders of the mining world in England, who constitute the advisory committee of the school, and also in consultation with many successful mining geologists and mining engineers. The students receive, in the subjects essential to them, the same training as the regular mining students of the school, comprising, for example, surveying, principles of mining exploitation of mines, and mine sampling and valuation, but in addition they spend practically an entire year on the branches of geology and mineralogy specially applicable to mining, concerning which much knowledge has been acquired and published in recent years. In addition to a grounding in the necessary parts of mineralogy and petrology, special attention is devoted to structural, stratigraphical, engineering, and mining geology. The course is an eminently practical one, and comprises work in the laboratory and in the field, the latter including not only instruction and practice in geological surveying, but also a series of visits

under guidance in order to study areas chosen as illustrating different types of mineral deposits. The course has also been so arranged that it can be taken in a post-graduate year by those who have already completed the associateship in the subjects of mining.

THE main heads of the School Teachers' Superannuation Bill, which Mr. Fisher hopes to introduce in the House of Commons in the autumn, have been published as a Parliamentary paper (Cd. 9141). The Bill will bring within one comprehensive system of State pensions, on a non-contributory basis, both certificated and uncertificated teachers in elementary schools, as well as the teachers in all other schools aided by the Board of Education, including those training colleges which are not departments of universities. The benefits will consist of annuities, together with lump sums, for those who retire at the age of sixty or later after thirty years of service, and for those who retire disabled after ten years' service; and of gratuities payable on the death of a teacher in service after five years of service. No difference will be made between the sexes in the conditions of pension, except that in order to provide for women teachers leaving the profession to be married and afterwards returning to it, provision is made for the substitution of twenty years' service for thirty as a condition of pension in such cases. Pension service will, as a rule, cease at sixty-five. Service to be pensionable must be full-time service in schools which are grant-aided at the time of service, or in secondary schools which, though not grant-aided at the time, become grant-aided within five years of the passing of the Bill. Power is reserved to the Board of Education, however, to reckon as pensionable service a limited amount of service in certain other schools rendered before the commencement of the operation of the Bill. Other matters dealt with in the Bill include medical examination for future teachers before admission to recognised service and the power to withhold or reduce benefits in case of misconduct.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 12.—M. P. Painlevé in the chair.—J. **Boussinesq**: Confirmation of the principle of the approximate theory of punching for a thick block.—G. **Bigourdan**: The observatories of the Harcourt College, to-day the Lycée Saint-Louis.—H. **Douvillé**: The strata containing Orbitoids in North America.—E. **Ariès**: The saturated vapour pressures of bodies containing a large number of atoms in the molecule. The formulæ developed in previous papers for substances containing from one to eight atoms in the molecule are now applied to pentane, hexane, heptane, and octane, and the calculated vapour pressures compared with the experimental results of Young and of Young and Thomas.—J. **Comas-Solà**: Stereoscopic studies of stellar currents. Two pairs of negatives, taken 1912–18 and 1916–18, have been examined by the stereoscopic method, and show that for stars of the first ten magnitudes a proper motion in the form of a current is general.—G. **Fayet**: The third appearance of the periodic Borrelly comet. This was seen at Nice on August 6–7.—M. **Baillaud**: Note on the same. Positions given for August 7 and 10.—R. **Combes**: The immunity of plants with regard to the immediate principles which they elaborate. The saponine of *Agrostemma githago* (agrostemma-saponine) in concentration as low as 1 : 10,000 behaves as a poisonous substance for the roots of plants not producing this glucoside (pea, buckwheat, radish), but exerts no toxic action even with a much higher concentration, 1 : 100, on the roots of *Agrostemma githago*.—J. **Dumont**: The aqueous reserves of the soil in periods of drought. Determinations of moisture in soil after drought were made at depths from 0 to 80 cm. from the surface, and for different crops with and without manure.—F. **Maignon**: The influence of fats on the toxic power of the food proteins: their *rôle* in the utilisation of nitrogenous materials. Applications to therapeutics.

SYDNEY.

Royal Society of New South Wales, June 5.—Mr. W. S. Dun, president, in the chair.—C. D. **Gillies**: The spine mode of *Centropyxis aculeata*, Stein. Material for the investigation of the spine variation in the test of this Rhizopod was obtained from six different localities in Queensland. It was found that the spine-frequency polygons were unimodal, and that the empirical mode varied from 3–5. From May, 1916, to December, 1917, material was collected at monthly intervals from the Brisbane Botanic Gardens. The modal value of the polygons was 3, hence for this locality the mode is a constant.—R. W. **Challinor**, E. **Cheel**, and A. R. **Penfold**: A new species of Leptospermum and its essential oil. From evidence accumulated over a period of six or seven years, including the cultivation of a number of plants and the chemical investigation of the essential oil, which is shown to consist principally of the two aldehydes, citral and citronellal, the authors have proved that at least one more of our native tea-trees is new to science, and give the name *Leptospermum citratum* to this new species.—C. **Laseron**: Notes on some Permo-Carboniferous Fenestellidæ, with description of new species. The fossil polyzoa of Australia, though abundant in many formations, are as yet but little known, and this paper deals with ten more or less common forms in the Permo-Carboniferous rocks, mostly in the Hunter River district. Six new species and several old types are described.

July 3.—Mr. W. S. Dun, president, in the chair.—J. H. **Maiden**: A contribution to a history of the Royal Society of New South Wales. The earliest recorded effort to form an improvement society was in the year 1818, when Judge-Advocate Wylde's attempt to form an agricultural society failed because Governor Macquarie demanded the admission of emancipists. In December, 1821, Governor Brisbane formed a scientific club under the name of the Philosophical Society of Australasia. Some of the papers read were printed by Barron Field, while the bronze plate at Kurnell celebrates the foundation of this society and the jubilee of Capt. Cook's visit. This was succeeded by the agricultural society in the following year, which also became a horticultural society in 1826. The author showed the direct descent of the Royal Society of New South Wales from the Australian Philosophical Society, founded January 19, 1850. On July 30, 1855, it was resuscitated under the name Philosophical Society of New South Wales, and received its present title on December 12, 1866.—Prof. H. S. **Carslaw**: Note on the theory of a simple progressive tax, and its bearing on the Federal income-tax schedules. This paper dealt with the system of tax in which the amounts paid on each successive pound form an arithmetical progression, and incidentally showed that without material change in the incidence of the tax such a system could be substituted for the complicated schedules of the Federal Income-Tax Acts.

MELBOURNE.

Royal Society of Victoria, June 13.—Mr. J. A. Kershaw, president, in the chair.—J. T. **Jutson**: The sand ridges, rock floors, and other associated features at Goon-

garrie, in sub-arid Western Australia. This paper deals with the westerly trend of the lake basins, the cutting back of the hard, rocky bluffs, and the development of parallel sand ridges with well-marked intervening valleys, running in an east-west direction. This latter feature has not before been discussed in detail.—R. A. **Keble**: The significance of lava residuals in the development of the Western Port and Port Phillip drainage systems. The older and newer basalts of Victoria flowed down the valleys, partly occupying or completely submerging them. Subsequent erosion took place on the softer flanking rocks in the case of the confined lava-fields. In the case of the extensive lava-fields erosion proceeded along the pre-basalt watersheds, since they were the first to be exposed by vertical erosion, and afforded the line of least resistance. It is submitted that it is possible to reconstruct from these data the pre-basalt stream systems.—F. **Chapman**: The age of the Bairnsdale Gravels, with a note on the included fossil wood. The sheet of gravel covering the uplifted coastal plain of the Victorian coast from the hill-ranges of South Gippsland on the west to Cape Howe on the east is described, and shown to be of Wernikooian (Upper Pliocene) age. Its terrestrial origin is proved by the physiography of the surrounding country and the nature of the deposits, whereas, if of marine origin, the sand would have been largely removed by continuous tidal action. The included fossil (silicified) wood is referred to two types of Eucalypts, the nearest allies of which are yellow box (*Eucalyptus melliodora*) and white stringy bark (*E. piperita*). The wood is derived from an older formation, Kalimnan (Lower Pliocene) or even Janjukian (Miocene).

CALCUTTA.

Asiatic Society of Bengal, July 3.—J. N. **Rakshit**: The isolation of porphyroxine. A solution of opium in lime-water is shaken up with ether, and the ethereal extract dried over calcium chloride and evaporated; the residue thus obtained is washed with boiling petroleum, dissolved in dilute hydrochloric acid, filtered, the filtrate made alkaline with sodium bicarbonate, again filtered, and the alkaline filtrate extracted with chloroform. On evaporation of the chloroform extract crude porphyroxine is obtained, which, when crystallised from alcohol, gives the pure alkaloid as a pinkish-brown powder.—M. N. **Saha**: A new theorem in elasticity. From the equations of motion of an elastic system, a new theorem has been deduced expressing the difference between mean kinetic and potential energies. The theorem is analogous to Clausius's Virial theorem in the kinetic theory of gases, and appears to be of great promise for the relative estimation of kinetic and potential energies in various cases of vibration.—M. N. **Saha** and S. **Chakravarti**: The pressure of light. A series of experiments which were recently carried out at the Sir T. N. Palit Laboratory of Science for demonstrating, and qualitatively estimating, the pressure of light has been described. The apparatus is a modification of Hull's apparatus for measuring the pressure of light, and is so designed that all disturbing effects have been eliminated. Previous workers used the arc as the source of light, but this being very unsteady, a tungsten filament lamp of 3000 c.p., which gives almost as intense a light as the arc and is absolutely steady, has been used. The observed and calculated pressures are in good agreement.—G. de P. **Cotter**: The geotectonics of the Tertiary Irrawaddy basin. It has been found necessary, through recent field work in the Minbu and Pakokku districts, to modify previous ideas of the Tertiary history of Burma. The author believes that there is no unconformity, except of an entirely local character, between the Pegu and Irrawaddys of the Irrawaddy basin. The supposed unconformities of Yenangyat and Minbu are partly to be explained as missing beds cut out by fold faults. There is evidence of Pleistocene and recent upheaval in the Irrawaddy basin.—E. W. **Vredenburg**: Considerations regarding a possible relationship between the charnockites and the Dharwars. Attention is directed to the possibility of regarding the charnockites as metamorphosed representatives of the igneous members of the Dharwars.—E. W. **Vredenburg**: Note on the occurrence of *Dolium variegatum*, Lamarck, at Maskat, with considerations on its geographical distribution at the present day and in former geological times. *Dolium variegatum*, Lamarck, hitherto known as a recent shell only from Australia, has been noticed in the Indian Museum amongst a collection of shells from Maskat. In a fossil condition it is known from the Upper Tertiary of Java and of the Makran, indicating that its distribution, discontinuous at the present day, was continuous in former geological times.

BOOKS RECEIVED.

Organic Chemistry for Advanced Students. By Prof. J. B. Cohen. Second edition. 3 parts. Pp. viii+366; vii+435; vii+378. (London: E. Arnold.) 54*s*. net.

An Introductory Treatise on Dynamical Astronomy. By Prof. H. C. Plummer. Pp. xix+343. (Cambridge: At the University Press.) 18*s*. net.

Alternating-current Electrical Engineering. By P. Kemp. Pp. xi+494. (London: Macmillan and Co., Ltd.) 17*s*. net.

A History of Chemistry. By Prof. F. J. Moore. Pp. xiv+292. (New York: McGraw-Hill Book Co.; London: Hill Publishing Co., Ltd.) 12*s*. 6*d*. net.

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