THURSDAY, DECEMBER 6, 1917.

THE CO-ORDINATION OF RESEARCH.

IT is often said in political circles that the way to shelve a subject is to appoint a Royal Commission upon it. The Commissioners collect a large amount of evidence and present a report, but usually the matter ends with the publication of the Blue Book, and nothing is done to carry the recommendations into effect. The Royal Commission on Scientific Instruction appointed in 1870 is an example of this kind. The whole of the scientific instruction given in the United Kingdom from the elementary schools to the universities, and including the museums and scientific work recognised by Government, is surveyed in the report of this Commission, issued in ten parts from 1871 to 1895; and the nation has suffered incalculable loss by not giving heed to its recommendations.

We wonder whether the deliberations and reports of the numerous Committees appointed since the opening of the war to deal with scientific subjects will meet with a like fate; and we anxiously await a sign that the Ministry of Reconstruction intends to produce from the information with which it will be provided a coherent and ordered scheme of national development. Lack of the spirit of organisation and system in both industrial and educational matters has prevented us from taking the lead even when we possessed the necessary knowledge and men to do so. Little has yet been done to show that the Government realises its responsibility for united effort in scientific and industrial advance, and for correlating the work of its various advisory Committees.

We are reminded of this deficiency by a question put by Sir Philip Magnus to the Secretary of State for the Colonies. Sir Philip Magnus asked

"whether any efficient system of co-ordinating the research work now being conducted in the laboratories of our universities, in the National Physical Laboratory, and in the Imperial Institute is being or has been arranged, more especially with the view of bringing the results of such researches into close relation with fresh problems connected with our Colonial trade and with our productive industries in this country and in our Dominions overseas; and whether opportunities are afforded for placing at the service of our manufacturers scientific experts to advise them or to conduct in their factories special investigations; and, if so, under what conditions."

The reply given in the House of Commons on November 29 was as follows:—

"The important questions raised by the hon. member are too large for effective treatment by way of question and answer, but, as he is no doubt aware, the Committee of the Privy Council for Scientific and Industrial Research are in the course of their administration collecting information as to research being conducted in various places and different types of institution which cannot but facilitate the co-ordination of research work which the hon. member desires. Moreover, as he will have gathered from the annual reports of that department, similar organisations have come, or are coming, into existence in other parts of the Empire, which are in close relation with the Research Department in this country. As an example of what is being done in the Oversea Dominions, I would refer the hon. member to the report of the Commonwealth Advisory Council of Science and Industry and the recently published *South African Journal of Industries*, which may be seen in the Colonial Office library. This Imperial machinery will enable those who are engaged in our Colonial trade and in our productive industries to become acquainted with the problems arising in different parts of the Empire, and with the results of any researches now in progress either here or in the Dominions. The hon. member will be aware of the work of the Imperial Institute, which is always willing to put its expert advice at the disposal of manufacturers. As regards the final part of the question, the establishment of research associations, which is one of the main objects of the Research Department, is intended to place at the service of our manufacturers scientific experts who may advise them or conduct in their factories special investigations."

It cannot be said that the information provided in answer to Sir Philip Magnus's question throws much light upon the main subject of co-ordination of research work; it is merely a statement that various bodies are now concerned with research, but as to how far they are organised with common objects, or are co-operative, little is said. What we should like to know is whether the various Committees which have been appointed to deal with national and Imperial matters of scientific importance are working independently and whether their reports published or in preparation are being brought together to produce an organic scheme assigning definite work to different departments. We have not much faith in the influence of the recommendations of these Committees unless a directorate exists to survey them as a whole and to show how they can be carried into effect without overlapping. Either the Ministry of Reconstruction or the Department of Scientific and Industrial Research might fulfil this function, but, so far as we know, neither is doing it. There should be a single bureau of scientific intelligence, where any manufacturer or industrial research worker may obtain information as to the position of published knowledge upon the particular subject in which he is interested and the laboratories where the subject can be further investigated if necessary. In some large industrial works the head of any department can obtain such information through the works library, in which a staff exists to supply it. Something of the same kind is wanted on a national basis; and the most useful purpose the Department of Scientific and Industrial Research could perform would be to institute such a central bureau.

The institution of a great clearing-house for scientific facts and industrial needs would be of supreme value to national development. Intimate connection must be established between workers in the fields of science and industry in order to bridge the gap which exists between scientific investigation and industrial application; and a sure way of accomplishing this is through an efficient and easily accessible intelligence bureau. It is to what has been termed the science of the use of science that the Germans owe to a great extent the place they have attained in the industrial world, though they have often employed unscrupulous means to reach their end. Every large industrial concern should have its own information and records department, which should be planned on the same lines as the central bureau. A few months ago M. Paul Otlet, director of the International Institute of Bibliography at Brussels, published in the Bulletin of the French Société d'Encouragement pour l'Industrie nationale a scheme for an international bureau of this kind having as its functions the collection, classification, and dissemination of all information available which will tend to facilitate or develop industry. Without waiting for this scheme to be established, a beginning should be made with a national clearing-house having like intentions.

Something has been done in this direction at public libraries in different parts of the country. At Coventry, for example, the staff of the Central Library invites inquiries for information, whether made personally, or by letter, or by telephone, and lists of original papers and books dealing with particular technical subjects are issued in printed form and circulated widely among manufacturers and others interested in them. The Glasgow libraries are also issuing lists of works on various technical subjects; and the Library Association, in a report referred to last week (p. 257), points out that a national lending library of books suitable for giving assistance in scientific and technological research would be of the greatest advantage to technologists.

At the annual meeting of this association, held at the beginning of October, Dr. Addison, the Minister of Reconstruction, said that one of the features of the programme which appealed to him was this movement for the formation of technical and commercial libraries and for the setting up of research libraries to suit the particular needs and industries of various districts. It is, however, not sufficient to provide for local needs; there should also be a central library and bureau which would make the position of knowledge in any scientific or technical subject available to any inquirer. Such an institution could be made self-supporting after a time, for manufacturers would not hesitate to pay fees for information required by them to develop their industries. We look to Dr. Addison and the Advisory Council for Scientific and Industrial Research to provide this centralised means of assisting industrial development.

THE ORDER OF NATURE.

The Order of Nature. By Prof. L. J. Henderson. Pp. iv+234. (Cambridge, Mass.: Harvard University Press; London: Humphrey Milford, Oxford University Press, 1917.) Price 6s. 6d. net.

PROF. L. J. HENDERSON, of Harvard, is well known for his important experimental work in bio-chemistry. He is also the author of a previous book entitled "The Fitness of the Environment," in which the inherent fitness for life of the actual physical and chemical world is pointed out in detail. In the present work he has followed up and developed the same thesis.

The first three chapters, beginning with an analysis of Aristotle's distinction between "final" and "efficient" causes, are devoted to an historical survey of ideas on the teleological appearance, not only of organic structure, but of Nature as a whole, considered as a fitting environment for life. Up to the middle of the nineteenth century the fact of a teleological determination of Nature as a whole was admitted by nearly all leading thinkers, however variously this fact was explained. The same admission appears in some of Darwin's writings; but since the publication of the theory of natural selection the teleological conception of Nature has almost disappeared from scientific thought. It has come to be assumed that the reason why the physical and chemical environment appears to be specially fitted for life is simply that life has, by natural selection, been so moulded as to fit its environment. Against this conclusion the main chapters of the book are directed; and the argument is the more remarkable and original since the author accepts without question the theory of natural selection. His discussion of Spencer's conception of evolution is perhaps specially luminous.

The reasoning is based entirely on the general characteristics of life from the point of view of physical chemistry, and particularly from that of Willard Gibbs's analysis of the conditions of stability and variability of physico-chemical systems, living organisms being regarded as such systems. The difficulty in forming any clear conception at present of the physico-chemical origin of life, or of completely understanding life as a physico-chemical system, is fully acknowledged, but is passed by as presenting a problem which cannot yet be solved owing to the imperfection of existing knowledge.

The general scope of Prof. Henderson's argument, which is presented with much interesting detail, is as follows. The actual distribution of properties among the actual elements, and particularly carbon, oxygen, and hydrogen, is of such a nature as to give a maximum of freedom in the process of evolution.

So far as the known properties of matter are concerned, considering them both quantitatively and qualitatively, every other sensibly different distribution of the properties among the elements would involve great restrictions. Thus conditions are actually established (relatively to other imaginable arrangements of the properties of matter) for the existence of the greatest possible number, diversity, and duration of systems, phases, components, and activities. So it comes about that, in every physical respect, the process of evolution is free to produce more rather than less.

It cannot be that the nature of this relationship is, like organic adaptations, mechanically conditioned. For relationships are mechanically conditioned in a significant manner only when there is opportunity for modification through interaction. But here the things related are supposed to be changeless in time, or, in short, absolute properties of the universe. According to the theory of probabilities, this connection between the properties of matter and the process of evolution cannot be due to mere contingency. Therefore, since the physico-chemical functional relationship is not in question, there must be admitted a functional relationship of another kind, somewhat like that known to physiology. This functional relationship can only be described as teleological.

The author is content with the conclusion that the universe has a teleological arrangement in relation to organic evolution. He carefully avoids all theological inferences, and leaves us with teleological arrangement as an ultimate and mysterious empirical fact. Granted his initial assumption that what we call Nature is nothing but a physico-chemical universe in the sense at present currently accepted, we do not see how his general argument can be shaken. It is not only strikingly original, but also very cogent, and seems certain to exercise much influence on the general trend of philosophical thought in connection with natural science.

If we may offer any criticism of the argument it is this. The conception of a living organism in connection with its environment as a physico-chemical system in the sense of current physical chemistry fails to express the facts of biology. If we call it a system it is a system in which relationship to the whole determines both the constitution and the activities of the parts. These parts and activities, including biological environment, are a function of their relation to the other parts, and therefore to the whole: hence biology deals, not merely with the "efficient" causes of ordinary physics and chemistry, but also with what Aristotle called "final" causes. In biological facts teleology is revealed as immanent in Nature—as of its essence, and no mere accident, and as inherent in environment, and not merely in what we ordinarily distinguish as the bodies of organisms. It seems to follow that the detailed extension of biological conceptions to what we at present regard as the inorganic world can only be a matter of the further extension of knowledge. We have not at present the data for this extension: hence the teleological constitution of the inorganic world can only appear to us as a mysterious empirical fact, and cannot appear otherwise when we assume at the outset that the universe is composed of material units as eternal and unchangeable independent entities. The question inevitably raised by Prof. Henderson's book is whether this assumption is valid, and whether we must not look to the future penetration of physics and chemistry by conceptions akin to those of biology. In the latter case teleological reasoning will take a natural place in the physical sciences.

J. S. H.

HIGHER ALGEBRA AND DYNAMICS.

(1) *A First Course in Higher Algebra.* By Prof. Helen A. Merrill and Dr. Clara E. Smith. Pp. xiv + 247. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 6*s*. 6*d*. net.

(2) *Problems in Dynamics (with Full Solutions) for the B.A. Students (Pass and Honours) of the Indian Universities.* By Atma Ram. Pp. 245 + diagrams 16. (Anarkali, Lahore: Atma Ram and Sons.) Price 3*s*.

(1) OF these two books, the first is interesting as being the work of two American ladies who are colleagues in the same institution. Each of the authors is a Ph.D., and for this and other reasons we may surmise that they received a good part of their training in Germany. They are keenly interested in their subject, have studied its history, and are acquainted with some of its most recent aspects. Thus equipped, they have chosen for their main topics rational, irrational, and (ordinary) complex numbers, logarithms, theory of equations, and elementary calculus. Each chapter is headed by an appropriate quotation; there are a number of historical notes, and some references are made to more advanced text-books. All this is to the good, and the authors, on the whole, have carried out their programme successfully.

But, unless we are mistaken, this is their first book, and, like all first books, it has the inevitable faults of the beginner, the chief of these being a want of clearness, or a want of detail, just where they are most required. To illustrate this, we will turn to the chapter on the theory of equations. In their "proof" of Descartes' rule of signs they put down the usual $+$, $-$, $\pm$ diagram, and then say: "The original polynomial had five changes of sign, while the resulting one has at least six, even when the ambiguous signs are so chosen as to give the smallest possible number of changes. *A little reflection shows that this will always be the case,*" etc. The sentence we have italicised contains the fault referred to. The present reviewer learnt the theory of equations mainly from Todhunter's treatise; the immortal Isaac, in his old-fashioned, unemotional way, does not appeal to his readers' powers of reflection, but does his best to show that in his diagram, and any such, the last row of signs must have at least one more variation than the first. We doubt whether anybody could write, in a reasonable space, a better explanation than Todhunter's; nevertheless, it took us a good deal of reflection to appreciate it. A still more striking instance is in the discussion of Sturm's theorem (p. 219). Here we read: "*It will be seen,*" etc., followed by a statement of the theorem for a particular case. We learnt Sturm's theorem in the first instance from De Morgan's article in the "Penny Cyclopædia." The great Augustus does not say: "It will be seen . . ." (Did he ever say so, in this kind of way?)

One more example, of a rather different kind. Pp. xi–xiv contain a list of formulæ, etc., which the reader is supposed to know, and are given for reference. Under "Binomial Theorem" we have: "*Key number of term.* The number of factors in the numerator of any term, the number whose factorial occurs in the denominator, the exponent of x, and the number subtracted from m to form the exponent of a are always the same number, viz. $n-1$." Doubtless this would be lucid to the late Henry James, but it is not so to us, and we do not believe that it would be so to an average English student, except after a good deal of previous explanation.

Of actual mistakes we have found very few. P. 20 (top) the reasoning is so vague that a student might fairly argue that the proper formula is $n!-r!$ instead of $n!\div r!$; p. 23, in England, if the probability of an event is $3/7$, we say that the odds are 4 to 3 against it, but "odds" may have a different meaning in the States; p. 56, "a variable can have only one limit" is wrong as it stands; p. 79 (bottom) gives a very cryptic rigmarole for differentiating u^c; p. 108, *for* "a number" *read* "a fixed number," otherwise the whole argument breaks down; p. 115, the expansion of $(2-3x+4x^3)/(1-3x+2x^2)$ should be done by synthetic division, not by undetermined coefficients; p. 149, the notes about Napier's logarithms are incorrect (in particular, Napier's logarithms are not "natural" logarithms); p. 169, "i represents the positive square root of -1" is meaningless, especially the "positive."

(2) Prof. Atma Ram's book ought to be extremely useful to those who can use a collection of solved examples in the proper way. It is a sort of abbreviated "Walton" fairly brought up to date, the range being from elementary dynamics and kinematics to central forces, including planetary motion. So far as we have been able to test them, the solutions are all correct, sufficiently detailed, and often very elegant. The English is thoroughly idiomatic, and Prof. Ram is his own printer and publisher. Paper and typography are as good as many Indian Government samples; we wish that the quality could be improved all round.

G. B. M.

BIOLOGY OF WATER SUPPLIES.

The Biology of Waterworks. By R. Kirkpatrick. (British Museum (Natural History) Economic Series, No. 7.) Pp. 58. (London: Printed by order of the Trustees of the British Museum, 1917.) Price 1*s*.

SINCE men of science became more intimately associated with engineers in the management of waterworks, questions of animal and plant life in water supplies have been brought more into the foreground, and it is with the object of directing attention to the importance of these questions that the trustees of the British Museum have placed an exhibition in the South Kensington Museum and have published this pamphlet as a guide thereto.

The first section, dealing with the animals associated with water supplies, opens with an account of some experiments made in 1886 on the pipe-fauna of Hamburg, then supplied with unfiltered water from the Elbe. Examples of as many as fifty genera, representing most of the main groups of the animal kingdom, were obtained, and the author gives an interesting account of the life-history of some of the more important, showing how when once established they can rapidly spread to the whole of the system, and in some cases—for example, sponges and molluscs—cause grave restrictions to the flow of water in the pipes.

Under the second heading of "Plants in Waterworks" the author deals chiefly with algæ and bacteria. The former class, when present in excessive amounts, may cause serious choking of filter-beds, and sometimes give rise to unpleasant tastes and odours, but otherwise are an important factor in efficient filtration.

Ordinary bacteria, including those which cause water-borne disease, are not dealt with, but a very full account is given of the dreaded crenothrix or iron bacteria. Several water supplies, both in this country and abroad, notably Cheltenham, Liverpool, Berlin, and Rotterdam, have suffered from this pest, and the author describes in some detail the history of these visitations, which have had the effect not only of almost entirely choking the pipes, but of imparting to the water a deep red colour and an unpleasant odour.

In the last section the question of biology in relation to water purification is dealt with. The theory and practice of slow sand filtration, depending as they do on the formation of a biological film on the surface of the sand, are fully described, and the section concludes with a brief summary of the pioneer work of Dr. Houston on storage.

The pamphlet is profusely illustrated with diagrams and photographs, and is a most useful, interesting, and readable work.

OUR BOOKSHELF.

Laws of Physical Science: A Reference-book. By Dr. E. F. Northrup. Pp. vii+210. (Philadelphia and London: J. B. Lippincott Co., n.d.) Price 8*s.* 6*d.* net.

THOSE who at any time have had to look up the laws of some branch of physics rapidly must have felt very seriously the absence of any pocket-book of the type so much used by engineers in which those laws were briefly and clearly stated. They will be in a position to appreciate Dr. E. F. Northrup's book, in which the principal laws are summarised. In a book which so obviously fills a gap in our literature it is perhaps a little ungrateful to point out minor defects. The contrast between the thoroughness of the section devoted to current electricity and the incompleteness and lack of unity of some of the other sections is very marked. On p. 45, for example, the author speaks first of the "force" of a musical sound, and then of the "intensity" of a sound. On p. 47 the velocity of sound is given in terms of quantities expressed in gravitational units, while on p. 51, in another formula for the velocity, tensions are expressed in dynes and masses in grains (probably a misprint for grams). On p. 61 heat energy other than translatory energy is ignored, while on p. 68 many of the general properties of isothermal surfaces and of lines of flow are given as if they held for a point source only. While in magnetism there is a partial definition of unit pole, in electrostatics there is no definition of unit quantity of electricity, and formulæ are given sometimes with, sometimes without, the dielectric constant appearing. In the light section the laws of refraction include the statement that the incident and refracted rays are on opposite sides of the normal, while the laws of reflection contain no corresponding statement. Again, the relative sizes of object and image formed by a spherical mirror are stated on p. 168 as if the only possible objects and images were lines perpendicular to the axis of the mirror. In a second edition it is to be hoped that these defects will be remedied.

The Student's Handbook to the University and Colleges of Cambridge. Sixteenth edition. Pp. vii+703. (Cambridge: At the University Press, 1917.) Price 6*s.* net.

THE present edition of this useful handbook has been revised to June 30 last. Three important additions only have been necessary in this issue, namely, the regulations for the new English Tripos, the new regulations for the Modern and Medieval Languages Tripos, and certain modifications of the conditions under which prize exercises are to be sent in. The war has occasioned further temporary emergency legislation, and the part of it affecting undergraduates is duly recorded here. The book has been compiled from authentic sources, and its helpfulness to students at Cambridge is undeniable.

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.*]

Earthquake in Burma.

AN earthquake of some intensity was felt in parts of Lower Burma in the early morning of July 5 last, when the moon was in total eclipse. The only damage reported was at a famous pagoda at Pegu, a town forty-six miles distant by rail from Rangoon, an ancient structure held in great veneration by all Buddhists, and towering 324 ft. over all surrounding buildings. Its golden cone, or umbrella, studded with jewels to the value of many thousand pounds sterling, was shaken down, destroying several smaller pagodas at its base. Fortunately, there seems to have been no loss of life, for the fall happened about 4.40 a.m., when most people were in bed. On festival or fast days there are often thousands of visitors in the precincts of the pagoda, for worshippers come from hundreds of miles distant to this famous shrine, and though the population of the town is less than 20,000, there are often 150,000 there on such occasions. The pagoda trustees and Buddhist elders at once took steps and formed a committee to supervise the removal of the débris and to recover the valuable jewels which had fallen, and in this the civil and police officials rendered every assistance. The Lieutenant-Governor, directly he heard of the disaster, telegraphed to the Deputy-Commissioner:—"His Honour is much distressed to hear of the damage done by the earthquake to your beautiful Shwemawdaw Pagoda, and would be glad if you would kindly convey his sympathy to the pagoda trustees." The trustees wired the following reply:—"We thank his Honour most sincerely for his telegram expressing sympathy at damage done to our beautiful pagoda. Some valuables discovered among the débris."

The largest diamond, which was placed on the top of the golden umbrella, has not yet been recovered, and as Pegu has some thousands of non-Buddhists amongst its population, fears are entertained that many valuable jewels may get into dishonest hands.

The effect of the disaster has, of course, not been wholly bad for everyone. The Burma Railway has had its passenger service from all parts of its line strained to the uttermost. From 5000 to 10,000 people beyond the ordinary traffic are now daily arriving at the town. Taxi-cab and bullock-cart owners are making small fortunes carrying visitors to and from the railway station to the pagoda, situated about a mile distant. These visitors, of course, require food and lodging, so that money to an extent previously unknown, except in holiday or festival time, is now daily circulating in the place.

Pegu is a very ancient town, and was formerly the capital of an independent kingdom. It is mentioned by the first European travellers to Burma in the seventeenth century as a place of great wealth and very populous. It is now one of the largest rice-producing districts in Burma. It will not be very long before its famous pagoda is restored to all its former magnificence, for, although the Burmese are not very familiar or appreciative of co-operation in mundane transactions, all Buddhists are willing to spend money on such a work of "merit" as the restoration or rebuilding of a celebrated pagoda like the one at Pegu, and putting jewels or valuables at such a height in the air that nobody can see them. This characteristic seems all the more curious when one notices the hundreds of small, dilapidated pagodas all over the country. These, although they may have been built by their own relatives, the Buddhists usually allow to perish from old age and the effects of the climate, and if one inquires into the reason one gets for answer that such repairs would go to the "merit" of the original builder, not to the repairer. They therefore, if they had the money available, prefer to erect another small pagoda or religious building, when they would be acquiring "merit" for themselves. But when money has to be spent over a famous shrine like the one at Pegu, they seem to have a national, rather than a religious, motive in co-operating, and giving what they can afford—it may be a rupee, or a thousand rupees. Hence money for such an object is always forthcoming.

F. N. BURN.

42 Pyinmagon, Dalla P.O., Lower Burma.

THE NITROGEN PROBLEM.

UNDER this term we have come to denote a question of most pressing importance at the moment. It not only affects our present and prospective national welfare; our very existence as an Empire is directly and immediately concerned with it. This arises from its bearings upon war and agriculture. Nitrogen compounds are absolutely necessary to the manufacture of munitions; they are no less indispensable to the production of food. All nations, therefore, and, for obvious reasons, especially those which are locked together in a life-and-death struggle, are eager to solve it, and under the compelling strain of a dire necessity an extraordinary measure of success is attending their efforts. This is more particularly the case with Germany, owing to the special circumstances of her position, and to the fact that she and the other Central Powers are practically cut off from external supplies of combined nitrogen products.

That Germany should be so far in advance of other nations in this respect is due to her prior recognition, years ago, of certain factors by which, under the very conditions which she dreaded might arise, and which have, in fact, arisen, her actual existence as a nation might be imperilled. The whole history of her association with the nitrogen problem shows that under the semblance of a peaceful venture it was part of the great conspiracy by which she sought to dominate the world. Her first efforts were made in Norway, when she secured a controlling interest in that country's abundant supply of hydro-electric energy, and took the fullest advantage, as is her method, of other people's originality and pioneering efforts. As the problem evolved itself and the political situation became apparently clearer, in proportion as manufacturing processes passed beyond the experimental stage, the great combines, financial and industrial, at the back of the enterprise gradually unloaded their interests in Norway upon an unsuspecting world. It is doubtful whether the whole of the synthetic stages from atmospheric air to ammonia and nitric acid were in full working order at the time the Serajevo tragedy forced the Kaiser's hand; but, as the sequel has shown, they were so far advanced that under the stress of compulsion, aided by the financial support of the State and with no hampering commercial restrictions, they could be made to serve the necessity of the nation. We all remember with what a glow of pride Bethmann-Hollweg revealed to the world that Germany's chemists had at length solved the great nitrogen problem, and thereby secured, henceforth and for all time, as he said, her national security.

Owing largely to our command of the sea, our position, and that of our Allies, in respect to this matter is less acute than that of our enemies. At the same time, apart from the submarine menace, which is transitory, there are elements in the situation which require us to pay very serious heed to it. It would be the greatest possible folly on our part to neglect its study. For there can be no doubt whatever that this question of the fixation of nitrogen and the production of synthetic ammonia and nitric acid has come to stay. Matters of this kind have hitherto been considered as outside the business of the State. Government had no direct interest in them. They were subjects to be left to private enterprise and individual effort. But the circumstances of the time have changed much in our time-honoured and traditional view of the mutual relations of the individual and the State. Public opinion, under the hustling influence of the moment, now compels the State to accept responsibilities and exercise initiative to an extent hitherto undreamt of. Accordingly, a number of official bodies connected with the Government are engaged in the consideration of the nitrogen problem, and we are given to understand that a gratifying measure of success has already attended the systematic research work which has been undertaken at their instance. The attempt should now be made to co-ordinate this business with a view to economy of effort and to bring the whole to a common focus. Government Departments are too apt to encase themselves in water-tight compartments, and departmental jealousies are prone to interfere with unity of action.

We trust that, in view of the urgency and serious nature of the matter, no such trivial considerations will be allowed to operate. The Nitrogen Products Committee of the Ministry of Munitions, constituted more than a year ago under the auspices of the Munitions Inventions Department, is no doubt primarily concerned with the matter, for at the moment the question affects the prosecution of the war and is, therefore, of the first consideration, and every agency should be directed to that issue. In solving the problem as it affects war we incidentally go far to solve it as it affects peace and agriculture. The Comptroller of Munitions Inventions has just issued a report giving a general account of the action which has been taken by his Department in dealing with the subject, and he promises a more complete report based upon the work of the various sub-committees which have been instituted to deal with its several aspects.

We have already directed attention to the action which the United States has taken in connection with the same subject, even before its entrance into the war. A report to his Government by Dr. C. L. Parsons, which has recently been published, contains a mass of valuable information as the result of inquiries and visits to manufacturing plants in various European countries. As regards the account of the arc process of synthesising nitric acid, there is little that is not generally known to experts in this country. Its position as a permanent industry depends largely on local conditions, which are now well understood. Of the Haber process for the production of ammonia, to which the German Chancellor referred in such exulting terms, we have as yet no very precise information concerning plant construction and operation. The method is not at present at work as a manufacturing process outside Germany, and its post-war use in other countries will probably be restricted owing to the practically prohibitive royalty demanded by the Badische Company. It is, however, known to be a difficult, and even dangerous, process to work. Its technical control requires so high a degree of training and skill that Dr. Parsons is assured that if the Badische people were to lose their present staff many months would be required to train another. There can, however, be no doubt of its success. It was first commercially installed in Germany in 1913, when it was said to have produced 20,000 tons of ammonium sulphate. In 1914 this grew to 60,000 tons, in 1915 to 150,000 tons, and in 1916 to 300,000 tons. With the new works recently completed by the Badische Company the 1917 output will be equivalent to upwards of 500,000 tons of ammonium sulphate. As regards cost, it is stated that pure anhydrous ammonia can thus be produced in liquid condition at less than 4 cents per lb. If such is the case, the Haber method is the cheapest process yet known for the production of synthetic ammonia.

The cyanamide process for producing ammonia resembles the arc process of making nitric acid in requiring cheap power for its successful development. In special circumstances it may be able to hold its own with the Haber process, as seems to be realised in Germany, where the method has been subsidised by the Government. It is said that the 1917 German production of cyanamide will be not far short of 400,000 tons. Agrarian interests are endeavouring to induce the Government to establish a nitrogen monopoly to ensure the continuance of the cyanamide industry in Germany, in view of the competition of the Haber process and of coke-oven ammonia after the war.

As regards by-product ammonia and the cyanide process, and the methods of transforming ammonia into nitric acid, there is little in Dr. Parsons's report which is not now common knowledge. Naturally his conclusions and recommendations are more particularly applicable to the circumstances of America, but there is much in his arguments and in the details of his estimates of construction and of operating costs that will necessitate, and will doubtless receive, sympathetic attention in this country.

One fact clearly emerges from this consideration of the nitrogen problem. The combined efforts of the warring nations in seeking the means for their mutual destruction will inevitably ensure the future position of agriculture and the production of cheap food to those who come after us. Out of this evil at least this good will come.

SCIENCE AND OTHER HUMANISTIC STUDIES IN SCHOOLS.[1]

THE report edited by Sir Frederic Kenyon gives evidence of progress towards that agreement among educational experts which is necessary if the construction of a scheme designed for general adoption is to meet with general acceptance. A serious obstacle to this progress is "the great mass of ill-informed public opinion, which distrusts or despises all education, or measures its value by its immediate money-earning capacity." This remark, to be found on the first page of the report, is perfectly true; but it is equally true that another serious hindrance has been the obstinate refusal of so many of the supporters of the old-established classical system to yield ground and to recognise the claims of modern subjects, especially science, to any considerable share in the time, emoluments, and honours which have so long been the portion of the older studies. "The object of the present pamphlet is to record certain attempts that have been made to give a healthier tone to the discussion; to show that a large measure of agreement is possible, . . . and to bring the weight of this agreement to bear on the solution of the outstanding problems which have been the cause of bitter controversy in the past."

The starting point of the movement here described was a letter which appeared in the *Times* of February 2, 1916, in which the educational claims of science were put forward with considerable emphasis. This was followed by the meeting at the Linnean Society on May 3, which has been completely reported in a pamphlet entitled "The Neglect of Science." A rejoinder was published in the Press of May 4, 1916, signed by Lord Bryce and a number of other eminent persons. This letter, though containing some statements which were open to criticism, was conceived in a liberal and conciliatory spirit, which could not fail to have a good effect.

A movement was then begun with the object of securing co-operation among the principal bodies representing "humanistic" studies in their educational aspect, and a conference was held on June 17, 1916, in which representatives of the Classical, English, Geographical, Historical, and Modern Language Associations took part. The result was

1 "Education, Scientific and Humane." A Report of the Proceedings of the Council for Humanistic Studies. Edited by Sir Frederic G. Kenyon. Pp. 32. (London: John Murray, 1917.) Price 6*d*. net.—Committee on the Neglect of Science. Report for the Year 1916–17. (Hon. Sec 17 Grosvenor Road, Westminster, S.W.1.)

the passing of six resolutions, which were published in the Press at the end of August. Of these the most important are the following:—

(1) It is essential that any reorganisation of our educational system should make adequate provision for both humanistic and scientific studies.

(2) Premature specialisation on any one particular group of studies, whether humanistic or scientific, to the exclusion of all others, is a serious danger, not only to education generally, but to the studies concerned.

(3) Humanistic education implies the adequate study of language and literature, geography and history, which in each case should, at the appropriate stage of education, go beyond the pupils' own language and country.

With these resolutions the Teaching Committee of the Mathematical Association and the Committee of the Association of Public-School Science Masters expressed concurrence.

The circular drawn up by the Five Associations spoke of the possible formation of "some central council which could assume a larger responsibility and speak with a wider representative authority." No doubt the formation of such a council is eminently desirable, but it has not so far been brought into existence. The British Academy has appointed a committee which has developed into the Council for Humanistic Studies, the report of which is before us. But the Conjoint Board of Scientific Societies initiated by the Royal Society, with the president, Sir J. J. Thomson, at the head, besides the "Neglect of Science" Committee, which originated in the meeting of May 3, 1916, must not be forgotten. There is also the Education Reform Council inaugurated by the Teachers' Guild, and the report of which was reviewed in NATURE of September 27 last. This body has so far not been consulted by the other associations which have been conferring together.

A step in advance was undoubtedly achieved when a meeting on January 26 last was held between the Education Committee of the Board of Scientific Societies and the Council for Humanistic Studies, with Sir E. Ray Lankester in the chair. In the result it was agreed that more time must be found for the teaching of natural science, especially in the older and more famous schools, and that this time should generally be found at the expense of the classics. All agree in deprecating early specialisation, and it should be noted that this opinion applies to the classics as well as to science and modern languages.

Fortunately, while the experts are trying to make up their minds, some definite action has already been taken by the authorities. The Regulations for Secondary Schools, issued on April 19 last, require the curriculum to provide for satisfactory instruction in the following subjects: (1) English language and literature; (2) at least one other language; (3) geography; (4) history; (5) mathematics; (6) science; and (7) drawing. The report of the committee appointed by the Treasury to produce a scheme of examination for admission to the Civil Service, Class I., was issued on June 20 last. It affords very interesting reading and proposes new regulations of a very important character. The examination is to be divided into two parts. Section A, which must be taken by all candidates, includes the following forms of test: (1) Essay; (2) English; (3) questions on contemporary subjects, social, economic, or political; (4) general principles, methods, and applications of science; (5) translation from a foreign language; (6) a *viva voce* examination. To each of these subjects from (1) to (5) one hundred marks are assigned, and to the *viva voce*, to which the committee attaches great importance, three hundred marks. This is followed by Section B, which includes a great variety of optional subjects generally marked at the same maximum, except mathematics and engineering, which receive twice the number of marks assigned to the other subjects. The report of the Civil Service Committee concludes with a number of specimen examination questions, which are intended to illustrate the views put forward by the committee.

Then there is the Education Bill now before Parliament, according to which elementary education is to be compulsory up to the age of fourteen years. It provides for the establishment of continuation schools and for compulsory attendance at the same. Another clause introduces the interesting and novel proposal to give power to local authorities to afford aid to *research*.

Sir Frederic Kenyon's report contains much that deserves attention, and seems to invite comment, and we cannot do better than advise our readers interested in educational questions to obtain a copy. But they should also read carefully the report of the "Neglect of Science" Committee, which brings out more clearly the claims of the advocates of natural science.

NOTES.

A VERY remarkable statement was made to the Paris Academy of Sciences on October 1 by Prof. H. Vincent, who is director of the great Army Laboratory at Val-de-Grâce, one of the most beneficent institutions of France. He was responsible, in the early months of 1915 and afterwards, for the arrangements in the French Army for the protective treatment against typhoid. He gives the results in a short note with a graphic diagram. He contrasts the terrible havoc wrought in previous wars with the almost negligible death-rate from typhoid in the present war. A heavy incidence of typhoid began in November, 1914; it became much less during March–April, 1915. During this period, November, 1914–April, 1915, the protective treatment could not be effectively carried out at the front, because of the necessities of the war. From April, 1915, onward—except for one very small rise in the summer of 1915, due mostly to paratyphoid fever—the death-rate has been kept almost at *nil*. The line runs steadily along the bottom of the diagram, as one loves to see it. From August, 1915, onward the French Army has received protective treatment, not only against typhoid fever, but also against those two forms of paratyphoid fever which at present are called paratyphoid A and paratyphoid B. The results are magnificent. As Prof. Vincent says:—"For more than two years the French Army at the front has enjoyed a very remarkable state of sanitation; typhoid and the paratyphoid fevers no longer show themselves, save at a very low degree of frequency. And this, though all the conditions at the front are united to favour the outbreak, spread, and gravity of these diseases. Immense masses of men crowded at close quarters, in such number as one has never seen the like of in any war; incessant renewal of effectives; a long war, and almost ceaseless engagements; near contact of troops, and constant risk of infection from man to man, from patients or from germ-carriers; formidable and continuous contamination of the surface soil by the excreta of germ-carriers; breeding of flies, etc." Yet, in spite of it all, "these diseases may be considered as practically conquered." It is strange to think that one of our "anti-vivisection" societies has been trying to prevent the protection of our own men. Happily, it has failed; the latest returns show that 98 per cent. of them are protected.

IN its September issue the *Little Journal*, published in Boston, U.S.A., by the firm of A. D. Little, Inc., indicates what steps have been taken during the past three years to cope with the shortage of dyes in America. Before the war there were only five concerns producing synthetic dyes in the United States. Now, in addition to the coke-oven plants and special phenol makers, there are twenty-three firms producing direct coal-tar products or "crudes," sixty-eight makers of "intermediates," and ninety-eight factories in which the finished dyes are manufactured. Approximately 75 per cent. of the dyes needed by American consumers are now being turned out in the United States, and certain of these products are made in sufficient excess to be available for export to friendly countries, and especially to England. There is still a shortage in such old-established dyes as magenta, methylene-blue, auramine, and methyl-violet. American synthetic indigo is being produced, but not in sufficient amount for the needs of the U.S. Navy. At the end of three years there are "crudes" and "intermediates" in abundance. Two large undertakings, the National Aniline and Chemical Company and the Du Pont Chemical Company, which in chemical research are the peers of the great German factories, are embarking on the manufacture of indigo and other essential dyes. The Americans claim with confidence that their dye-producing firms have the talent, the organisations, the capital, and the will. With these factors in operation the missing 25 per cent. of dyes will soon be provided, and only the odds and ends will eventually be imported.

IN a lecture delivered before the London School of Economics on November 16 Mr. Sydney J. Johnstone gave an account of the localities within the British Empire where the chief key-metals, such as tungsten, molybdenum, thorium and cerium, vanadium, etc., occur. Tungsten is found chiefly in Burma and Queensland, and the Empire now furnishes about 35 per cent. of the world's production. The metal is now extracted in the United Kingdom. Molybdenum is also largely worked in this country, and adequate supplies are available from British Colonies and Dominions, especially Australia. Both these metals are of great value for special armament steels, and for the manufacture of high-speed tool steels, on which they confer the property of enabling the steel to retain its hardness when run red-hot. Thoria and ceria, the chief rare-earths in incandescent mantles, are being extracted from the monazite deposits of Travancore and Ceylon, which also contain lanthanum, erbium, didymium, yttrium, and other rare-earths. The monazite in these localities commonly contains about 10 per cent. of thoria, being twice as rich as the similar deposits in Brazil. Occasionally much richer minerals are found in limited quantities in Ceylon—for example, thorianite, which contains as much as 60–80 per cent. of thoria, and has been the subject of much study by the Scientific and Research Department of the Imperial Institute. Mesothorium is a by-product of the working of monazite. Another by-product, zircon, might, it is suggested, be applied for the same purposes as zirconia, *i.e.* the lining of furnaces and other vessels for which a highly infusible material with a low coefficient of expansion is needed. The chief key-metal which is absent, or found only in small quantities in the Empire, is platinum, which is derived mainly from Russia and Colombia. It is possible, however, that it might be obtained in fair quantities, together with palladium, as a by-product in the treatment of nickel-copper ores in Canada.

PROF. A. RIGHI, foreign member of the Royal Society, has been elected an honorary member of the Institution of Electrical Engineers.

DR. ARTHUR KEITH, conservator of the museum of the Royal College of Surgeons, has been appointed Fullerian professor of physiology at the Royal Institution.

WE notice with regret the announcement of the death on November 28, at Zomba, Nyasaland, of blackwater fever, of Mr. W. C. Mason, Imperial Entomologist, at thirty-three years of age.

PROF. T. B. WOOD, Drapers professor of agriculture in the University of Cambridge, is to be appointed a member of the Development Commission in succession to Mr. A. D. Hall, now Secretary to the Board of Agriculture.

MR. T. F. CLAXTON, director of the Royal Observatory, Hong-Kong, informs us that, in view of the world situation, it has been decided to discontinue sending the publications of the observatory to the United Kingdom, Europe, and India during the war.

THE death is announced in the *Engineer* for November 30 of Mr. James Buchanan, who was a partner in the well-known Liverpool firm of sugar machinery makers. He was associated with the executive of the Liverpool Munitions of War Committee, and undertook important Government contracts for munitions. He was a member of the Institution of Mechanical Engineers.

THE Committee on Science and the Arts of the Franklin Institute, Philadelphia, has recommended the award of the Elliott Cresson medal to Col. I. N. Lewis for his invention of the Lewis machine-gun, and proposes to recommend the award of the Howard N. Potts medal to Dr. A. E. Kennelly for his invention of the hot-wire anemometer and his application of this device to the measurement of convection from small heated wires; also that of the Howard N. Potts medal to Prof. L. Vessot King for his improved method and researches in hot-wire anemometry.

MR. J. C. MERRYWEATHER, who died on November 24, at seventy-seven years of age, was the principal member of the firm of fire-engine builders. Mr. Merryweather joined his father in the fire-engine business in 1864, and had a great deal to do with the introduction of steam fire-engines. Under his direction, his firm was the pioneer of the motor fire-engine. He was a member of the Institution of Mechanical Engineers, and received the honour of Commander of the Imperial Order of the Medjidieh in recognition of services rendered in connection with the fire protection of the Khedivial palaces.

WE referred in our issue of May 31 (p. 267) to a proposal to present the portrait of the late Prof. R. Meldola to the Royal Society and the Institute of Chemistry. The total sum received in response to this intimation, which was circulated only among Prof. Meldola's friends, was just above two hundred pounds, which has been paid to the artist, Mr. Solomon, for the portraits. Prof. E. B. Poulton informs us that the portrait presented to the Royal Society will be unveiled by Sir George Beilby on December 18, at 3 p.m.; and that presented to the Institute of Chemistry of Great Britain and Ireland, Russell Square, by the president, Sir James Dobbie, at 4.30 on the same afternoon. Prof. Poulton adds:—"I am sure that subscribers will feel a deep debt of gratitude to Col. S. J. Solomon, R.A., for the generous manner in which he has carried out their wishes, and produced a lasting memorial of a great man, and one that will co-operate with and complete the memories of his friends."

WE regret to announce the death of Mr. Charles Hawksley, on November 27, at seventy-eight years of age. An account of Mr. Hawksley's career is given in *Engineering* for November 30. He was born in Nottingham in 1839, and completed his education at University College, London, when he entered, as a pupil, the offices of his father, the late Mr. Thomas Hawksley, F.R.S. He was a partner with his father from 1866, and continued the business after his father's death in 1893. The firm was associated with waterworks engineering in Great Britain, and also practised in connection with gas undertakings and sewerage works. Mr. Hawksley was president of the Institution of Civil Engineers in 1901, and at the time of his death was a member of council of the Institution of Mechanical Engineers. His death will leave a gap in these institutions not easily filled. In 1907 Mr. Hawksley founded a lectureship of the Institution of Mechanical Engineers to commemorate the centenary of the birth of his father, and by a melancholy coincidence this year's lecture was delivered last Friday evening.

BY the death in action on September 28 of Major Harry Clissold, D.S.O., R.E., the world of education sustains a grievous loss. For more than twenty years Major Clissold was on the science staff of Clifton College, where he had himself been educated, and to which until the end of his life he ungrudgingly devoted his exceptional gifts. After taking a first class in the Natural Science Tripos at Cambridge, he became an assistant-master at Marlborough, but very soon returned to his old school. He at once threw himself wholeheartedly into all the interests and activities of school life, intellectual and athletic. This devotion to the interests of the school undoubtedly prevented him, as it has done so many others in similar positions, from making those contributions to scientific knowledge which were to be expected from his great ability and energy. When called upon to take command of the school contingent of the Officers Training Corps he somewhat reluctantly consented, and devoted all his spare time, including many of his holidays, to making himself as efficient as possible in his military duties. Thus, when in 1914 he was offered the command of a new field company of the South Midland Royal Engineers, he accepted it with alacrity. He went to France in April, 1915, in command of a field company, and served with such distinction that he was awarded the D.S.O. in the summer of 1916. Major Clissold's scientific knowledge and habit of mind made him a most valuable officer on the technical side, and his constant devotion to the welfare of his men caused him to be one of the most popular officers in the Army. The loss to Clifton is greater than can be described, and to a wide circle of friends in all parts of the globe the world is a darker and a poorer place by his death.

THE supplement to the forty-sixth annual report of the Local Government Board, containing the report of the Medical Officer for 1916–17, has recently been issued. In the general summary Sir Arthur Newsholme directs attention to the need for increased effort to save child-life. In 1914 the excess of births over deaths in England and Wales was 362,354, in 1915 it was 252,201. In 1916 the rate of infant mortality was the lowest on record; there were 29,073 fewer births and 54,099 fewer deaths than in 1915, with a result that the excess of births over deaths for the year was 277,227. Sir Arthur Newsholme expresses the opinion that there should be no insuperable difficulty in reducing the total deaths in childhood to one-half their present number.

SEVERAL articles of topical interest appear in the October number of the *Scientific Monthly* (vol. v., No. 4). Dr. Burgess writes on the applications of science to warfare in France. Prof. Graham Lusk discusses food in war-time. He points out that carbohydrates are the great food-fuels of the human machine. Based on their value in calories, proprietary cereal foods are very costly, and it would be a great advance if the value in calories were placed on every food package sold. Dr. Ida Pritchett describes specific preventive and curative therapy by means of serums with special reference to gas gangrene. She believes that an antitoxic serum can be prepared for this condition, and that there is every reason to hope that serum treatment will bring about a decrease in the incidence of, and fatalities from, gas gangrene due to war wounds.

IN *Man* for November Mr. J. Reid Moir describes a piece of wood from the Cromer forest bed which is believed to show traces of human workmanship. The flat end of it appears to have been produced by sawing, and at one spot it seems that the line of cutting has been corrected, as is often necessary when beginning to cut wood with a modern saw. Other examples of pieces of wood pointed by early man are known, and it is believed that Mr. Hazzledine Warren discovered a wooden stake or spear in the ancient implementiferous deposit at Clacton-on-Sea.

MR. NEIL M. JUDD, of the United States National Museum, has just returned to Washington after completing six months of archæological work in Arizona and Utah. He has been engaged in repairing and restoring Betatakin, or Hillside House, one of the most interesting cliff houses in northern Arizona, consisting of nearly one hundred rooms, built on the sharply sloping floor of a crescent-shaped cave. The presence of hidden springs, causing damage to the structure and leading to the accumulation of silt, has been dealt with, and the restoration has been conducted in the most conservative way. The age of Betatakin cliff house is still uncertain, and no definite results can be obtained until the examination of this and other neighbouring ruins has been systematically undertaken.

THE question of the character and origin of the local gods of Egypt is still obscure; but a paper by Prof. Flinders Petrie, published in *Ancient Egypt*, part iii., 1917, does much to clear it up. Prof. Petrie has collected the original records of these cults, and by marking the headquarters of each deity he arrives at important results. Ra appears in only one southern city, and his cult seems to have come from the north-east. The distribution of Mut, the mother-goddess, is decidedly eastern, while that of Amen is western. Set was certainly brought into Egypt by the desert road, as he had there two centres of the first class, and he was introduced by the Red Sea way to the Eastern Delta. The distribution of the Osiride triad indicates a settlement so early in the land that the worship was generally diffused. Prof. Petrie sums up his article thus: "The geography of the worship of the gods is thus seen to have a considerable value historically, as bearing on their origin and connections. When more complete research into the localities of various uncertain names may extend our identifications, it will be possible to get more light on the sources of Egyptian mythology."

ORNITHOLOGISTS will be grateful to Capt. Hugh Gladstone for his able summary of the life of John Hunt (1777–1842) which appears in *British Birds* for November. John Hunt's "British Ornithology" is a book of great rarity and some merit, but it seems never to have been completed, owing perhaps to the fact that late in life he emigrated to America. But Hunt's claim to a place of honour among British ornithologists does not rest alone on this work, the principal theme of the present communication, which is to be completed in a further instalment.

STUDENTS of bionomics will find much interesting matter in the *Scottish Naturalist* for November, wherein Dr. Eagle Clarke gives the first instalment of a study of the wild life in a West Highland deer forest. These mountainous tracts, he remarks, may be regarded as Nature reserves, retaining still much of their primitive wildness owing to the fact that it is beyond the power of man to effect any material change in the barrenness imposed by their physical conditions. The Corrour Forest, which he so sympathetically interprets, is of great extent, and lies amid some of the wildest mountain country in Great Britain. In his survey he divides the forest into three zones—the alpine, the sub-alpine, and the valley zone—giving an analysis of the fauna, resident and migratory, of each. Incidentally, of necessity, he describes the flora also, but only in its relation to animal life. In the same number the Misses Rintoul and Baxter record some extremely interesting observations on the autumn displays of some of our native birds. Records of isolated cases by E. Selous, J. E. Millais, and H. Eliot Howard can now be compared with the much more extensive collection here brought together, but their precise significance seems as elusive as ever.

THE *Journal of Agricultural Research* (vol. x., No. 4) contains a further important contribution by E. B. Hart, E. V. McCollum, and other colleagues to the question of the physiological effect on growth and reproduction of rations balanced from restricted sources. Previous work has indicated that a ration can be complete and efficient only when it contains protein of adequate quantity and quality, adequate energy, mineral ingredients in proper quantity and proportion, and two factors (vitamines) of unknown constitution which have been temporarily designated as "fat-soluble A" and "water-soluble B." Later work now indicates that to these must be added the important factor of direct toxicity. This can be wholly absent or so mild in its effects as to be entirely obscured when the other essentials of a ration are at an optimum adjustment; or with fair adjustment it may only reveal its effects when the ration is continued over a very long time and the animal involved in the extra strains of reproduction and milk secretion. Rations composed exclusively of wheat products (grain and straw) did not sustain growth with Holstein heifers. Such animals also failed to show œstrus and could not be bred. Marked pathological conditions resulted, such as blindness, feeble and emaciated condition, and abnormal excitability followed by collapse. The responsibility was found to be due in part to the inadequate salt mixture provided by the ration, and in part to inherent toxicity in the grain. By the use of maize stover or alfalfa hay as roughage in place of the wheat straw growth was sustained, but reproduction was only partially successful, weakness commonly appearing in the second gestation. Maize grain *plus* wheat straw allowed sustained growth, but at a slow rate. Additions of salts to this ration made it normal. Addition of wheat embryo to a maize ration caused disturbances, bringing about early abortions, thus indicating a high content of the toxic material in the wheat kernel.

THE report of the Government Cinchona Plantations and Factory in Bengal for the year 1916–17, being the fifty-fifth annual report, is, as usual, a very interesting and instructive document and a remarkable record of efficiency. From it we learn that the acreage under Cinchona has been increased to 2405½ acres, as against the 2295 acres under cultivation the previous year. Figures are given showing the profits of the undertaking during the period 1900–17. For an outlay of 44,84,100 rupees the Government has received 51,24,900 rupees, and has acquired entirely within the period 1905–17 additions to factory buildings, etc., which have quintupled the 1900 output, a large reserve of quinine, 2738 acres afforested with timber and fuel trees, the 2405½ acres of Cinchona, and a large output of other manufactured products, making a total return in cash and readily realisable assets of 1,17,66,634 rupees. Among other medicinal plants grown are Digitalis, *Chenopodium ambrosioides*, and Ipecacuanha.

WE welcome the first number of a new journal, *Psychobiology*, to be published bi-monthly by the Williams and Wilkins Co., Baltimore, U.S.A. (London agents, Cambridge University Press; price per volume, 23*s*. net), devoted to the field common to psychology and the biological sciences. It will concentrate attention on the interconnection of mental and physiological functions, holding firm to the conception of the organism as a unity. It is edited by Prof. Knight Dunlap, in association with Profs. J. J. Abel, W. B. Cannon, R. Dodge, S. I. Franz, H. S. Jennings, and G. H. Parker—a strong editorial board. In the first number S. I. Franz and K. S. Lashley show that in the white rat removal of large parts of the frontal portions of the brain does not greatly interfere with a learned reaction; D. I. Macht and S. Isaacs discuss the influence of some opium alkaloids on the psychological reaction time; R. Ogden and S. I. Franz deal with recovery from experimentally produced hemiplegia; Prof. J. B. Watson relates experiments which show that the delaying of the nutritive reward for thirty seconds after rats solved a problem box did not alter the learning process; and the editor suggests the theory that the effect of pleasure in "fixing" a reaction may be due to the liberation of a specific hormone, which need not necessarily come from a gland. The whole number is interesting, and we wish the new venture success.

THE outlook of chemistry in the United States, with special reference to the resources of this science in war and peace, is discussed by Prof. Julius Stieglitz in his presidential address to the American Chemical Society, published in *Science* for October 5. Prof. Stieglitz urges for the United States what has been advocated for this country—a declaration of chemical independence. From a chemist's point of view the first consideration necessary for this purpose is that the manufacturer should reckon the chemist "worthy of his hire." The tendency hitherto has been to treat the chemist merely as an employee instead of co-operating with him as a partner, and this almost invariably dampens his enthusiasm. Secondly, the adoption by the legislatures of a definite national policy as regards the establishment of independence in chemical supplies is advocated. This has already been inaugurated in the question of the fixation of atmospheric nitrogen. Thirdly, wise patent legislation is necessary. Applied chemistry is not wholly industrial: chemistry promises to be the guide, not only of physiologists, but also of bacteriologists, pathologists, and laboratory clinicians. Accordingly, it is essential that the chemistry departments of universities and colleges should keep up their output of men, and maintain a high standard of scientific quality. The great impetus which science has received from the war involves certain dangers. The chief of these is that superior research opportunities and financial returns will attract *all* the best men away from academic life. In the national interest professorial chairs must be occupied by the best men, and to ensure this salaries must be raised. The continued need for pure research untroubled by any possible industrial application of its results must not be forgotten. For chemistry in America a brilliant future is predicted provided that the chemist is given a "square deal," and that this science in the universities is placed on the plane occupied by law and medicine.

IN the week following November 20, the anniversary of the Cripplegate Fire, the British Fire Prevention Committee completed its first twenty years' work, which has been carried on entirely by voluntary effort. Among the activities of the committee may be mentioned the promotion of technical research, the initiation of legislation, by-laws, and regulations, the compilation of evidence on the subject of fires, and the preparation of literature and circulars of a precautionary character, more than 250 publications of this nature having been issued. The committee's recommendations have been endorsed by competent authorities in the United States, France, and Russia. Instances of co-operation with other countries are afforded by the organisation of the International Fire Prevention Congress, which was attended by 800 visitors, representing fifteen Governments and 200 municipalities and corporations from all parts of the world, and the International Fire Exhibition, at which a collection of historical and industrial exhibits was shown, and the lessons of many of the great conflagrations of the past decade were discussed. Apart entirely from the propaganda work in fire prevention and the extensive system of publishing trustworthy data, the committee established twenty years ago a complete testing station near Regent's Park for full-sized fire tests, without any encouragement or assistance from the Government whatever. With the advent of the war, which has severely affected professional men, it is unlikely that work of this kind can continue to be dependent solely on the voluntary effort and contributions of the technical professions concerned, and being of great national importance, the committee should be afforded the co-operation and assistance of those public departments which are now concerned in research work and have Treasury or special research funds available for it.

Engineering for November 30 contains an illustrated description of the standard propelling machinery for British standard ships. The main engines are triple-expansion, having cylinders 27 in., 44 in., and 73 in. diameter by 48-in. stroke. There are three boilers of the multitubular return-tube type, 15 ft. 6 in. diameter by 11 ft. 6 in. long, for 180 lb. per sq. in. working pressure, and working under Howden's system of forced draught. The outstanding features of the engine design indicate that it is of Clyde origin. All the designs, excepting the auxiliary machinery, were prepared by one firm, which had extensive experience in machinery for this size of cargo vessel, and were issued complete to various contractors. The advantages of manufacture to one common design were found of convenience in many ways. For example, one firm discovered defects in a soleplate casting; this was at once replaced by a similar casting from another firm, which did not require it immediately, thus preventing several weeks' delay. Orders for the auxiliary machinery, and for all small items, such as valves, branch pieces, etc., were placed with firms which specialise in such work, and furnished all these details ready to fit in place. The positions of the auxiliary machinery were so selected that all erection could be completed before the launch, thus simplifying greatly the amount of pipe-fitting which usually has to be done.

AMONG the forthcoming books of science we notice the following:—"The Education of Engineers," H. G. Taylor (*G. Bell and Sons, Ltd.*); "What Industry owes to Chemical Science," R. B. Pilcher and F. Butler-Jones, with an introduction by Sir G. Beilby (*Constable and Co., Ltd.*); "Synthetic Products," A. R. J. Ramsey and H. C. Weston (*G. Routledge and Sons, Ltd.*); "Elements of Graphic Statics," "Moving Loads by Influence Lines and other Methods," "Strength of Structural Elements," each by E. H. Sprague; "Estimating Steel Work for Buildings," B. P. F. Gleed and S. Bylander; "Machine Shop Practice," G. W. Burley; and "The Theory of the Centrifugal and Turbo Pump," J. W. Cameron (*Scott, Greenwood, and Co.*). *Messrs. Longmans and Co.* have in preparation for appearance in their series of "Monographs on Biochemistry":—"The Development and Present Position of Biological Chemistry," Dr. F. Gowland Hopkins; "The Polysaccharides," A. R. Ling; "Colloids," W. B. Hardy; "Physical Methods used in Biological Chemistry," Dr. S. G. Walpole; "Protamines and Histones," Dr. A. Kossel; "Lecithin and Allied Substances," Dr. H. Maclean; "The Ornamental Plant Pigments," A. G. Perkin; and "Chlorophyll and Hæmoglobin," H. J. Page.

OUR ASTRONOMICAL COLUMN.

ERRATIC CHANGES IN CLOCK RATES.—An interesting suggestion as to the cause of the sudden variations which are sometimes observed in the rate of the three standard clocks of the U.S. Naval Observatory has been made by Mr. W. A. Conrad (*Popular Astronomy*, vol. xxv., p. 522). It has long been noticed that the rates are subject to sudden fluctuations, and that the three clocks usually vary in the same direction at the same time, and by almost equal amounts. As the temperature and pressure controls appear to be beyond suspicion, such changes have hitherto been attributed to imperfect determination of instrumental constants. In seeking the cause of a very bad jump in the rates of the three clocks in February, 1917, it was found that many jumps were coincident with "cold waves," and that on this occasion there was a very marked low-pressure area receding to the east and an abnormally high barometer to the west. It is suggested that the observations of the clock stars may have been affected by lateral refraction, and that a study of the weather map might possibly help to explain the anomalous results which have occasionally been obtained in determinations of the positions of stars.

THE HECTOR OBSERVATORY, NEW ZEALAND.—The report of the Government Astronomer for the past year includes an account of the excellent system of time-signals which has been organised by Mr. Adams, and a plea for the establishment of a wireless time-service. In co-operation with Mr. H. F. Johnston, of the Magnetic Department of the Carnegie Institution, a determination of the longitude of Papeete, in Tahiti, was made by wireless signals from the observatory. Local time was determined by means of a theodolite, with a probable error of half a second of time. The longitude of Point Venus was found to be 149° 30′ 1″ west, this being about three seconds of time greater than that usually quoted. The adopted position of the transit instrument at the Hector Observatory is longitude 11h. 39m. 4·27s. east of Greenwich, latitude 41° 17′ 3·8″ south, and height 418 ft. above 1909 mean sea-level. Improved equipment for an observatory so far south is greatly to be desired.

ORBITS OF THREE SPECTROSCOPIC BINARIES.—Three spectroscopic binaries of considerable interest have been further investigated at Ottawa by Dr. W. E. Harper (Journ. R.A.S., Canada, vol. xi., p. 341). The star 20 π Cassiopeiæ, of type A5 and photographic magnitude 5·2, has two luminous components, and the orbits of both have been determined. The period is 1·96408 days, and the range of velocity of each component 235 km. per sec. The orbit is nearly circular. The star 29 Majoris is the typical star of the Harvard class Oe, showing the dark lines of hydrogen, helium, and the ζ Puppis series, in addition to faint emission bands at 4633 and 4688; its visual magnitude is 4·77. The range of velocity is 437 km., and is the largest for any spectroscopic binary yet discovered. The period is 4·3934 days. The emission band 4688 shares in the periodic shiftings due to the orbital motion. The eccentricity of the orbit is 0·156.

In the case of the star Boss 3511, of type F and photographic magnitude 5·3, the range of velocity is 20·5 km., and the period 1·61275 days. The eccentricity of the orbit is 0·067.

PALÆONTOLOGICAL PAPERS.

FOSSIL floras figure largely in the recent publications of the United States Geological Survey. In Professional Paper 98-H, F. H. Knowlton describes thirteen species of plants from the Fox Hills Sandstone of S. Dakota, only four of which were previously known. Remains are scanty, since the beds are marine; but their interest lies in their position between series, the Montana and Laramie formations, that contain abundant plants. The affinities are distinctly with the Upper Cretaceous, and the flora seems to have been well supplied with moisture along a shore-line. E. Wilber Berry (Prof. Paper 91) furnishes a detailed report, accompanied by 117 plates, cn "The Lower Eocene floras of South-Eastern North America." The material is derived from the widely spread Wilcox series, which is typically developed in Wilcox County, Alabama, and is known through Mississippi, Arkansas, Texas, Tennessee, and Kentucky. Except for a small fauna (a "faunule") recently discovered in Mississippi, the almost entire absence of animal remains in this vast area is remarkable. Insects, which must have been abundant, are represented merely by the traces of their activities among the plant-remains. The flora is of Ypresian age (p. 152), and contains thirty-nine genera in common with that of Alum Bay in the Isle of Wight. Identical climatic conditions on both sides of the Atlantic are implied.

In Publication No. 254 of the Geological Survey of Queensland, J. H. Reid clears up an important point in connection with the upward range of Glossopteris. Newell Arber had previously, and with good reason, doubted the occurrence of this genus in the Lower Cretaceous Desert Sandstone of Bett's Creek, and it is now shown that there is an unconformity at this locality, and that the remains of Glossopteris belong to the underlying Permo-Carboniferous system.

The problematic *Parka decipiens* of the British Old Red Sandstone has been reinvestigated by the late Lieut. A. W. R. Don and George Hickling (Quart. Journ. Geol. Soc. London, vol. lxxi., p. 648, 1917 for 1915). The vegetable nature urged in 1890 by Reid and Graham is confirmed; but considerable doubt is thrown on the alleged microspores and prothalli, and the general form and vegetative structure are found to be "closely reproduced by some specimens of the recent alga, *Melobesia lichenoides*" (p. 659). A tentative suggestion is made that Parka was a thallophyte with algal affinities.

C. D. Walcott deals with "The Albertella Fauna in British Columbia and Montana" (Smithsonian Miscell. Coll., vol. lxvii., No. 2, 1917), and shows, after field-investigations in a picturesque and mountainous district (plates 1 and 2), that the Mount Whyte Beds containing Olenellus are truly Lower Cambrian and not in the Middle Series, and that the fauna characterised by the trilobite Albertella is found above them, and is of Middle Cambrian age. The author is thus able to accept L. D. Burling's conclusion with regard to the latter fauna, while correcting him in reference to an alleged survival of Olenellus. Numerous species of trilobites are figured.

L. W. Stephenson adds to our knowledge of the exclusively Cretaceous genus of corals, Micrabacia (U.S. Geol. Survey, Prof. Paper 98-J, 1916), and adds six new species and two varieties from Upper Cretaceous horizons in the United States. Bruce Wade (*Amer. Journ. Sci.*, vol. xliii., p. 293, 1917) describes *Busycon cretaceum* as the oldest known of the Fulgurid gastropods. He points out that the family should strictly be called Busyconidæ. It has special interest in being restricted to the eastern region of the United States, from this Upper Cretaceous example to the present day, a fact that is explained by the absence of a free-swimming larval stage.

Several new species of trilobites are described by A. Ware Slocum from the Upper Ordovician Maquoketa Beds of Fayette County, Iowa (Ann. Rep. Iowa Geol. Survey for 1914, published 1916). The new genus Cybeloides is established (p. 212) as distinct from Cybele in the characters of its cephalon. The remarkable genus Sphærocoryphe, with its globular apex to the glabella, is abundant in the upper beds.

The genus Eurypterus is so rare in Upper Carboniferous strata that we welcome the description of a new species from the Coal Measures of Belgium by Xavier Stainier of Ghent (Quart. Journ. Geol. Soc. London, vol. lxxi., p. 639, 1917). A review is given of the eleven Carboniferous species previously recorded.

The largest amphibian known from the Trias of North America is represented by part of the left half of a labyrinthodont jaw from the Newark Beds of Pennsylvania (*Amer. Journ. Sci.*, vol. xliii., p. 319, 1917). The describer, W. J. Sinclair, names the genus Calamops, since impressions of "horse-tail rushes" occur upon the layer encrusting the bone. Surely this is making too much of an accident to an individual. The name "Reed Face" among American Indians would not be extended to others of the tribe.

Joseph Barrell (*Scientific Monthly*, vol. iv., p. 16, 1917) suggests that a climatic change, involving desiccation, reduced the forests that were the habitat of arboreal anthropoids, and thus led to the development of primitive man. "The apes which were trapped in this way in Central Asia were forced to win most of their living on the ground" (p. 23). Pithecanthropus of forest-clad Java must have arisen farther north, and the ancestors of true man must be looked for in Miocene strata in regions which were then passing into steppes. Incidentally, Prof. Barrell seems to accept too readily (p. 21) G. S. Miller's view that the jaw found at Piltdown is that of an ape and not of *Homo dawsoni*.

G. A. J. C.

INDIAN IRRIGATION.[1]

ONE of the earliest and most difficult problems, towards the solution of which man has addressed his ingenuity and resource, is that of artificial irrigation. The rain, we are told, descends alike upon the just and the unjust, but, as regards its geographical distribution, its incidence is irregular, and at times capricious. Of two localities within a few miles of each other, one will receive copious and embarrassing supplies, while the other will be given a scanty and pitiful dole, which, apart from the satisfaction of immediate human needs, is utterly inadequate for agricultural purposes of any kind. In arid regions, recourse is had to wells, storage reservoirs, and river dams, all of them capable in some degree of alleviating the evil, provided means are at hand to raise and distribute the supplies obtained.

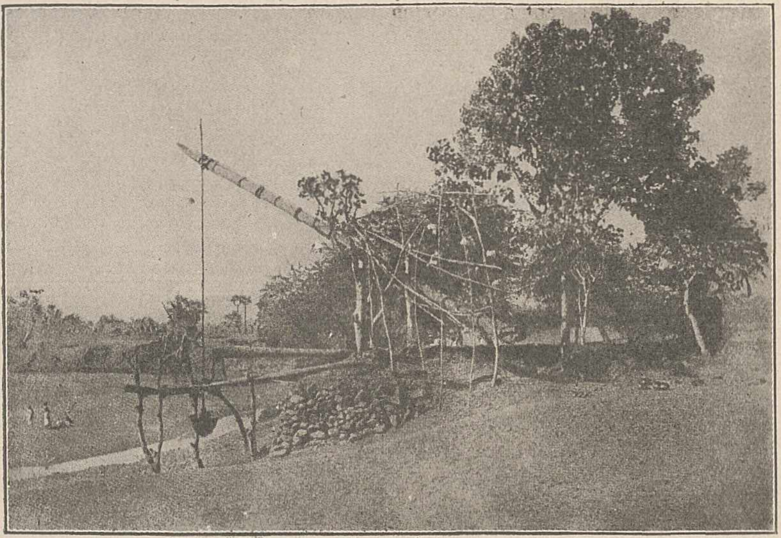

FIG. 1.—Picottah worked by four men (Tuni, Vizagapatam district).

It is particularly interesting, therefore, to read the account given by Mr. R. Cecil Wood of the expedients adopted in the less developed parts of a country like India, where the rudimentary appliances of bygone ages are still in vogue. In such districts labour is cheap and plentiful, and the installation of machinery a costly and troublesome process. It is, therefore, little wonder that the *mhote*, the *picottah*, and the *karim* still maintain an unimpaired popularity. Yet, even in conservative India, centuries old in tradition and routine, modern innovations are making headway, and machinery is ousting the native and the bullock alike from their accustomed tasks. Centrifugal pumps, driven by oil engines of the most recent type, are now to be found at a number of stations, and one of the largest, erected on the Divi island, in the Kistna district, consists of a battery of eight Diesel oil engines, each of 160-b.h.p. capacity, and driving a 39-in. centrifugal pump, giving a total output of more than 570 cub. ft. per sec., or nearly thirteen million gallons per hour.

The introduction of machine-driven pumps is, of course, governed by the available flow of water, and it is manifestly not economical to install a power plant unless it can be effectively utilised. Experience has shown that an engine must be kept at work continuously for four hours in the twenty-four, in order to render its installation remunerative. The Department of Industries in Madras provides portable plant on hire, so that actual tests may be undertaken before any commitment is made.

It is, of course, not practicable in a short notice to deal with all the matters of interest touched upon in Mr. Wood's brochure. Sources of supply and their relative merits, problems of distribution, cost of working and upkeep, systematic cultivation, minimum and maximum requirements, are topics discussed at varying length, and much valuable advice is given for the benefit of the ryot, or peasant land-holder. We may, perhaps, allude to the special difficulty which attaches to agriculture in certain tracts in tropical countries. The rapid and extensive evaporation which takes place causes an upward movement of the subsoil water, with the resultant deposition of salts at or near the surface; certain of these salts, sodium carbonate in particular, and the chlorides and sulphates of magnesium and sodium, are deleterious and produce alkalinity of the soil, under the influence of which crops become thin and sparse, plants acquire an air of sickliness and decline, and foliage is pale and falls early. The remedies adopted are principally directed towards a diffusion of the salts and the reduction of the degree of concentration within limits, at any rate, which admit of the maintenance of a state of productivity. The simplest method is that of flooding the areas affected, allowing the water to sink downwards, carrying the salts with it. But, as Mr. Wood

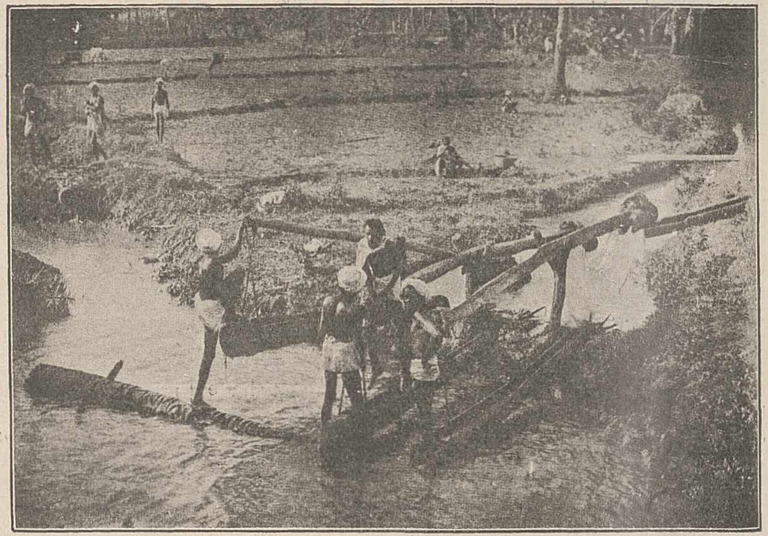

FIG. 2.—Karim (Gōdāvari district).

[1] "Irrigation." By R. Cecil Wood, Principal of the Agricultural College, Coimbatore. Pp. 62+33 figures and photographs. (Madras: Department of Agriculture, 1917.) Price 1s. 6d.

points out, this is merely an alleviation, and the only satisfactory method is that which goes to the root of the trouble and removes the salt accumulation entirely by efficient drainage. BRYSSON CUNNINGHAM.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Friday last, November 30, when the council and officers whose names were given in NATURE of November 8 (p. 190) were elected. The annual report of the council was adopted, and the president, Sir J. J. Thomson, delivered his address. Subjoined are a summary of some of the main points in the report of the council, and an abridgment of the president's address.

Report of the Council.

The report of the council records that shortly after the entry of the United States into the war the Royal Society received the following cable message from the National Academy of Sciences at Washington:—

"The entrance of the United States into the war unites our men of science with yours in a common cause. The National Academy of Sciences, acting through the National Research Council, which has been designated by President Wilson and the Council of National Defence to mobilise the research facilities of the country, would gladly co-operate in any scientific researches still underlying the solution of military or industrial problems."

The following reply was dispatched:—

"The Royal Society heartily welcomes the offer of the National Academy to co-operate in scientific researches connected with the war, and will communicate by letter proposals for carrying this into effect."

Steps have been taken by the society to carry the proposed co-operation into effect in connection with the Admiralty, the Ministry of Munitions, and the Department of Scientific and Industrial Research. Experiments on a large scale have been undertaken by the U.S. National Research Council to determine the effect of variations in the milling standard, and in the nature of the cereals employed, upon the digestibility of bread; and parallel investigations are in progress in this country.

Reference is made to the transfer of the National Physical Laboratory to the Department of Scientific and Industrial Research. The scientific control of the laboratory will continue to be exercised by the president and council of the Royal Society, as in the original scheme, but the financial responsibility will be assumed by the Committee of the Privy Council for Scientific and Industrial Research. A working arrangement has been arrived at between the Advisory Council of this body and the Government Grant Committee of the Royal Society by which the society is to inform the council of applications received for sums of money out of the Government grant, and the council is to refer to the society any applications received by it which may be more suitably dealt with by the society than by the council. It is not clear whether this arrangement accounts for the fact that though applications for grants amounting to 5381*l.* were received by the Government Grant Committee, the ordinary grants made amounted to only 1295*l.* The grants made in 1915 amounted to 3344*l.*, and in 1916 to 2482*l.*

The reduction of the magnetic survey of the British Isles was completed in the early part of this year. The important and simple result has been obtained that "formulæ for the geographical components of magnetic force, which are linear in the differences of latitude and longitude all over the British Isles, and satisfy the condition for a potential, give as close a representation of the main features as the more elaborate and empirical expressions obtained by Rücker and Thorpe." Accordingly "disturbances" are defined as the differences between the observed values and those calculated from this potential. Direct comparison of the primary observations in the two surveys has been made, and shows that, with few exceptions, the secular change is remarkably uniform in the various districts. The mean annual change for these islands generally has been in $H+13{\cdot}2\gamma$, in $D-6{\cdot}1'$, and in $I-1{\cdot}2'$. The annual change in H and I has been distinctly less in the north, but the change in D is practically constant all over. The disturbing forces in the two surveys are also in good general agreement, although the differences, which are chiefly in the vertical component, suggest a modified view of "ridge" lines. The two surveys, however, prove that these disturbances are not mere errors of observation, but are due to regional and local causes. That they arise from magnetic material (presumably iron) seems undoubted, and the only questions are whether this material is concentrated locally or disseminated widely, and whether it is near the surface or deeply seated. The possible economic importance of this led to the appointment of an Iron Ore Committee, to consider whether magnetic observations might be of assistance in locating iron ore. A more detailed survey of the Melton district was made by Mr. G. W. Walker this autumn, by aid of a grant from the society, and this is being followed up by a petrological survey under the director of the Geological Survey.

The possibility of introducing a more convenient system of timekeeping at sea has lately been under consideration, both in this country and in France. The conclusions reached at a conference under the chairmanship of the Hydrographer to the Admiralty, in which representatives of scientific societies took part, are included in the report of the council. The most practical method of obtaining uniformity is considered to be the establishment, outside territorial waters, of zones corresponding with the hourly zones on land. It is proposed that the zone extending from $7\frac{1}{2}°$ east to $7\frac{1}{2}°$ west of Greenwich should be the zero zone, and that the other zones west and east should be respectively described as *plus* or *minus*, with an indication of the actual correction required for reduction to Greenwich time and date. On this system +12 would be the half-zone east of the "date line," and −12 the half-zone west. Any alteration of the time of clocks in ships should always be one hour, but the instant of making the change need not necessarily be that of passing to a new zone. In the case of self-recording meteorological instruments, which it would be difficult to adjust for changing zone time, Greenwich time is considered most convenient, but ship's time should be used for the regular observations. If the proposed zone times be generally adopted, it is recommended that the receipt and dispatch of telegraphic and other messages should for the immediate future be recorded in zone time; but, eventually, it would be most convenient for such purposes to adopt Greenwich time throughout the world.

Presidential Address.

The extent to which men of science in this country are engaged on investigations connected with the war is scarcely realised, except by those who have to try to find the men for any new piece of work of this kind which may have to be put in hand. It is a matter of the greatest difficulty to find any competent person who is not already engaged on such work. Professors from our Colonies have come back to help at home, and in some cases have brought their demonstrators and senior students with them. The importance of having an ample supply of trained scientific workers, and the necessity for this country to increase its supply in the future, could scarcely be proved more incisively than by our experience in this connection.

The need for a greater appreciation of the value of science has been brought into such prominence by the war that most of those who have advocated the claims of science in education have not unnaturally laid the greatest stress on the importance of science to the welfare, the power, and even the safety of the nation. The supporters of literary studies have, on the other hand, dwelt mainly on the fact that literature broadens a man's horizon, and gives him new interests and pleasures, that it teaches him how to live, if not how to make a living. The result of this divergence of appeal has made the discussion appear, to those who watch it from outside, almost like a discussion between spirituality and materialism, or between a saint and a man of business.

Echoes of this sentiment are to be found in the opinions expressed by some members of the Labour Party; there is a tendency to regard science teaching with suspicion, as being intended to make the working man more valuable to his employer rather than to increase the brightness and interest of his own life.

I recognise—and I know no man of science who does not—the necessity of literary studies as a part of the education of every boy and girl, but I must protest against the idea that literature has a monopoly in the mental development of the individual. The study of science widens the horizon of his intellectual activities, and helps him to appreciate the beauty and mystery which surround him. It opens up avenues of constant appeal to his intellect, to his imagination, to his spirit of inquiry, to his love for truth. So far from being entirely utilitarian, it often lends romance and interest to things which to those ignorant of science make no appeal to the intellect or imagination, but are regarded by them from an exclusively utilitarian point of view. A knowledge of science brightens and widens the intellectual life, and is a constant stimulus to the intellect and imagination.

The question of the position of science in schools is of vital importance; I think that we ought also to pay attention to the need for sustaining and stimulating in after-life the interest in science which we hope will have been aroused at school. We should encourage and develop efforts to bring to the notice of the public those results of science which are of general interest. I am not sure that we do all that is possible in this direction, and yet it seems our duty to the community to give it everything which can add interest to life and stimulate the intelligence; to do everything in our power to increase appreciation and interest in science among our citizens; without such appreciation, a full utilisation of the resources of science and adequate encouragement for its development are impossible in a democratic country.

There are many results of general interest embodied in papers which could not be read by anyone who was not a specialist in the subject. I will give one instance, taken from what might seem a somewhat unpromising branch of science—arithmetic. If we take the numbers in order 1, 2, 3, ... we see that there are some, such as 3, 5, 7, 11, which cannot be divided by any number smaller than themselves; these are called prime numbers; the number of such primes which are less than a given number is a matter of very considerable importance, and Gauss, many years ago, gave, without any rigorous proof, a rule about it. The rule was tested by actual trial for numbers up to a thousand millions, and, as it was found to be true over that immense range, it was accepted as universally correct in spite of the absence of a satisfactory proof. Quite recently, however, Mr. Littlewood, one of our fellows, has shown that, in spite of this apparently overwhelming evidence in its favour, the result is not general, but the numbers, for which it breaks down, are so enormous that it would be quite beyond the powers of human endurance to detect its failure by actual trial. I may say, in passing, that, enormous as these numbers are, they are mere nothings compared with what we have to deal with in many branches of physics. Here, then, we have a result which has satisfied, and apparently always will satisfy, any direct test that can be applied to it, and yet is not generally true; there seems to me to be something of a tragedy, perhaps the suspicion of a sermon, in this investigation, which is in a paper of a highly technical character, quite unintelligible to anyone who was not an expert mathematician.

There are many results of this kind, known only to specialists, but which would interest a very much wider circle of readers if they could be brought to their notice. Unfortunately, there does not seem to be at present any recognised method of doing this. There are excellent periodicals with special circles of readers which might find a place for some of them, but these only reach a minute fraction of the educated public. There is room, I think, for a periodical which would appeal to a much wider circle, which should contain interesting and trustworthy accounts of results of interest, not only in science, but also in the other subjects included in a general education.

The desirability of a journal of this kind was recently brought before the notice of the Executive Committee of the Conjoint Board of Scientific Societies. If it could be established, it would, I believe, do good work by stimulating the intellectual life of the nation and increasing the appreciation of science throughout the country.

The Medallists.

COPLEY MEDAL.—M. Emile Roux, Pasteur's chief collaborator, succeeded him as the director of the Institut Pasteur, which he has successfully developed and maintained as the foremost school of bacteriology, both for teaching and for research. From the early 'eighties, when he was associated with Pasteur and Chamberland in the study of anthrax and the production of vaccines against this disease, he has played a leading part in the development of our knowledge of the processes of immunity. His work with the distinguished veterinarian Nocard upon the contagious pleuro-pneumonia of cattle was the first demonstration of the existence of "ultra-microscopic," or, as they are now termed, filterable viruses as disease-producing agencies; his work with Yersin, the first full study of the bacillus of diphtheria and of its toxins. He shares with the late Prof. Behring, of Marburg, in the introduction of diphtheria antitoxin as a practical means of prophylaxis and cure, and with him as co-founder of serum therapeutics was awarded the Nobel prize. All the leading French bacteriologists of our generation have been his pupils.

ROYAL MEDALS.—Dr. Aitken is distinguished for his lifelong researches on the nuclei of cloudy condensation, embodied in a series of memoirs communicated to the Royal Society of Edinburgh. The latest of these appeared in the present year. Dr. Aitken's discoveries opened up a new field of investigation in physics, and constitute a chapter of knowledge of great importance intrinsically and in their relation to the physics of meteorology. Dr. Aitken, who has pursued his work as an amateur, has displayed great experimental ingenuity, and his remarkable construction of the "dust-counter" has provided a permanent scientific appurtenance of precision to the physicist and climatologist. Among other contributions to science, Dr. Aitken has made important advances in our knowledge of the formation of dew.

Dr. Smith Woodward has been for many years keeper of the Department of Geology in the British Museum, and has published a very large number of valuable memoirs on fossil vertebrates, especially fishes. He has also published an important "Catalogue of Fossil Fishes in the British Museum," and his "Outlines of Vertebrate Palæontology," published in 1898, is a standard text-book on the subject. Dr. Smith Woodward's original memoirs are too numerous to mention, but they have secured for him a world-wide reputation, and he is universally regarded as one of the highest authorities on vertebrate palæontology.

DAVY MEDAL.—M. Albin Haller, professor of organic chemistry at the Sorbonne, Paris, founder and first president of the International Association of Chemical Societies, and at the present time the most representative chemist of France, is distinguished for his many and important contributions to chemical science during the past forty years. His investigations have covered a very wide field in the domain of organic chemistry, the most important being those dealing with compounds belonging to the camphor group. He has maintained over a long period of years the reputation of the Sorbonne School of Chemical Research, created by Dumas and Wurtz, his predecessors in the chair.

BUCHANAN MEDAL.—Sir Almroth Edward Wright was the first (1896) to apply laboratory knowledge on typhoid immunity to the protection of human beings against enteric fever. Against formidable opposition he carried out a long series of observations with the highest scientific acumen and unsurpassed technique, and laid the foundations for the effective elimination of enteric fever from the armies of the world. Nothing of importance has been added to his work down to the present time.

HUGHES MEDAL.—Prof. C. G. Barkla's investigations have mainly dealt with X-rays, and their absorption and secondary emission by solid substances. He showed that secondary emission of X-rays was of two varieties. In one of these the X-rays are scattered, without change of quality. The scattered rays were shown by examining tertiary emission to be polarised, and this was a fundamental result for the classification of X-rays with ordinary radiation, at that time doubtful. Prof. Barkla's other kind of secondary emission is characteristic of the secondary radiator, and is accompanied by selective absorption of the primary rays. He showed that each chemical element emitted more than one definite kind of secondary fluorescent radiation. Concentrating attention on, say, the less penetrating kind, it was found to vary in quality by definite steps with the atomic weight of the secondary radiator.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Romanes lectures, which has been in abeyance for the present year, will, it is hoped, be delivered in the course of 1918. The lecturer appointed by the Vice-Chancellor is the Rt. Hon. H. H. Asquith, D.C.L., honorary fellow of Balliol College. The subject and date are not yet announced.

A BEQUEST of 10,000*l.* has been made to the University of Liverpool by Mrs. A. C. Chaddock for the endowment of a chair of commerce in memory of her husband, unless such a chair has been endowed already, in which case the bequest is to be used for such purposes as the authorities shall determine.

THE provision of excellent laboratories at the Bristol Grammar School was followed in 1915 by the formation of a Scientific Society, which now issues its first report. The society is made up of the science masters and science students, members of the classical side and the upper school being admitted under special rules. The society gives the members special opportunities for developing their school studies along lines of their own choosing, subject to the approval of the master in charge, and work of this character is expected from the members during meeting hours. A strong library has been formed, and the nucleus of a local herbarium, to which the members have contributed 350 species. War difficulties and lighting regulations have somewhat hindered the holding of working meetings, their place being taken by lectures, to which the upper and middle schools were admitted.

AT the Massachusetts Institute of Technology the faculty changes have introduced some new problems, since there has been so much demand by the U.S. Government and by industrial corporations related to the war for men of technical skill. So great has been this draft, says *Science*, that in the department of electrical engineering one-third of the staff has been called away, in mechanical engineering a dozen men have gone into war work, while civil engineering, chemistry, naval architecture, and the other departments have sustained serious losses. On the other hand, the demands for instruction have not only not decreased, for the registration is but slightly less than normal with much the same distribution through courses, but are to a considerable extent greater, for the institute is furnishing instruction on academic and engineering lines to the schools of aeronautics for the Army and Navy, and is carrying on no fewer than three schools for deck officers and the school for marine engineers. Changes already announced include the retirement of Prof. C. R. Cross, with the title of professor emeritus, and the appointment of Prof. E. B. Wilson, of the department of mathematics, to the chair of mathematical physics and head of the department of physics. Prof. C. L. Norton has been appointed professor of industrial physics. In the department of chemical engineering of the University of Michigan all but one member of the faculty have left for active service. Every effort made by the University to replace them temporarily proved unavailing, owing to the unprecedented demand for men in this branch. The situation became so acute that several manufacturing concerns of the State, which employ expert chemical engineers, and the Michigan Agricultural College, came to the aid of the University, and it opened with a complete staff in this department. Dr. C. D. Holley, of the White Lead and Colour Works, of Detroit, will act as head of the department during the absence of Prof. A. H. White.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, November 20.—Mr. E. G. B. Meade-Waldo, vice-president, in the chair.—J. J. **Joicey** and G. **Talbot**: New South American Rhopalocera, New South American Arctiidæ, new butterflies from Africa and the East, Gynandromorph of *Papilio lycophron*, Hbn., and three aberrations of Lepidoptera.—S. **Alphéraky**: Deformity of *os penis* in a *Phoca caspica*, Nilsson.—Lt.-Col. J. M. **Fawcett**: Notes on a collection of Heterocera made by Mr. W. Feather in British East Africa, 1911–13.—Prof. F. W. **Jones**: The structure of the orbito-temporal region of the skull of Lemur.

Geological Society, November 21.—Dr. Alfred Harker, president, in the chair.—J. **Morrison**: The Shap minor intrusions. The paper deals with the minor igneous intrusions occurring in the triangular area between

Shap, Windermere, and Sedbergh. From their field relations and petrographic characters the intrusions are found to belong to one or the other of two well-marked groups, a division which is regarded as connoting also an age-classification. The rocks of the earlier set, characterised by the presence of large orthoclase-felspars of the granitic type, are intimately associated with the granite, to the immediate neighbourhood of which they are practically confined. The rocks range from quartz-felsites to lamprophyres. Of considerable interest in this group is a series of hybrid intrusions, consisting essentially of rocks of a more or less basic magma enclosing xenocrysts of a more acid (but allied) magma obtained by settlement under intratelluric conditions.

Royal Microscopical Society, November 21.—Mr. E. Heron-Allen, president, in the chair.—E. **Heron-Allen** and A. **Earland**: Variation in the arenaceous rhizopod, *Thurammina papillata,* Brady. The paper was based on a study of many thousands of specimens dredged by the Scottish Fisheries cruiser *Goldseeker* in the North Sea and North Atlantic. The authors regard all hitherto recorded species of Thurammina and Thuraminopsis as varieties of the original type, *T. papillata,* Brady, and as having no biological significance. For taxonomic reasons most of the specific names are retained with varietal values, and certain new varietal names are proposed for forms not previously separated or recorded. The life-history of the genus is for the first time worked out. The paper was illustrated by a number of lantern-slides prepared from direct photographs.

PARIS.

Academy of Sciences, November 12.—M. Camille Jordan in the chair.—E. L. **Bouvier**: The classification of the Parapotamonea, fresh-water crabs of the family of Potamonidæ.—Y. **Delage**: The utilisation of the bathyrheometer for anemometry in cold regions. The instrument, figured and described, has the advantages of giving continuous records of the direction and intensity of the wind, and of working in any climate at any altitude.—M. **Fréchet**: Prolongable functions.—V. **Crémieu**: New experimental researches on gravitation. In an earlier note the question as to whether the Newtonian attraction between two bodies is modified by the relative motion of these bodies was examined experimentally, with negative results. A second series of experiments is now described, in which the results are also negative. The arrangement was such that an alteration of 1 per cent. in the gravitational attraction between the two bodies could have been detected.—M. **Guilleminot**: Quantitative determinations in X-radiotherapy. Choice of the best radiation.—P. **de Sousa**: The eruption of the Algarve coast (Portugal).—M. **Fauchère**: Sericiculture at Madagascar. Races of *Sericaria mori* introduced into Madagascar from Europe, after a period of about two years, give six generations a year instead of one. Contrary to the views usually held, the cocoons produced are not found to be inferior, either in quantity or quality, to the cocoons produced by the original strain. Some precautions found useful in preventing the spread of disease among the silkworms are described.—N. A. **Barbieri**: The laminar optic nerve and ganglionic optic nerve.—E. **Rabaud**: The paralysing instinct of stinging Hymenoptera.—A. **Lécaillon**: The special characters presented by accidental bivoltins (silkworms) at different stages of their development. Races of silkworms producing one generation per annum (univoltin) give occasionally accidental bivoltins. In 1917 377 of the latter type were produced by the author, and the results of the comparison of these with the normal type are given.

November 19.—M. Paul Painlevé in the chair.—G. **Humbert**: The development of irrational quadratics in continued fractions of Stephen Smith.—P. **Appell**: The experiments of M. Carrière on the movement in air of light spherical balls turning round an axis perpendicular to the plane of trajectory.—M. Farlow was elected a correspondant for the section of botany, in succession to the late Julius Wiesner.—W. H. **Young**: The series of polynomials of Legendre.—P. **Humbert**: The reduction of the equation of the critical Jacobians.—H. **Guilleminot**: A new fluorometric apparatus for the estimation of the X-rays. The method proposed is photometric; one-half of a screen is illuminated by a small barium platinocyanide screen receiving the X-rays, the other half of the screen is lit by a standard electric lamp, suitably screened with coloured glasses.—Mlle. E. **Peytral**: The pyrogenous decomposition of methyl alcohol at high temperatures. The quantitative study of the products of decomposition of methyl alcohol at 1150° C. in contact with platinum shows that formaldehyde and hydrogen are the primary products, the aldehyde then giving carbon monoxide and hydrogen.—P. **Russo**: The Djebel Tekzim (Djebilet, western Morocco).—(The late) Mlle. S. **Coëmme**: A new method of reproducing the valves of Ammonites.—C. **Nicolesco**: The application of collodion prints to the reproduction of the valves of Ammonites.—E. **Patte**: Rocks with cup-shaped and pediform cavities in Greek Macedonia.—H. **Arctowski**: Magnetic storms, faculæ, and sunspots.—R. **Souèges**: Embryogeny of the Alismaceæ. Development of the proembryon in *Sagittaria sagittaefolia.*—M. **Mirande**: A new cyanogenetic plant, *Isopyrum fumarioides.*—C. **Matignon** and Mlle. G. **Marchal**: The utilisation of the grape marc as fuel. The dried marc has a calorific value of 4700 calories per gram. The phosphorus and potash can be recovered from the ash, and the fresh marc is more readily air-dried than peat.—L. **Roule**: The relations between the parentage of the salmon (*Salmo salar*) and the European trout (*Salmo trutta, Salmo fario*).—J. **Amar**: The absolute resistance of the muscles after atrophy or lesion of the nerves.—W. **Kopaczewski**: Researches on the serum of *Muraena helena.* Molecular equilibrium and toxic power of the serum.—Em. **Bourquelot** and M. **Bridel**: An attempt at the biochemical synthesis of the glucosides of the polyvalent alcohols.—The β-diglucoside of glycol.—N. **Fiessinger** and R. **Clogne**: A new ferment of the leucocytes of blood and pus: lipoidase.—Em. **Thiercelin** and C. **Cépède**: Vaccinotherapy and pathological states produced by enterococci.

SYDNEY.

Royal Society of New South Wales, October 3.—Dr. C. **Anderson**: Azurite crystals from the Iodide Mine, Mineral Hill, near Condobolin, N.S. Wales. Fine crystals of azurite (basic oxide of copper) are found in the Iodide Mine, near Condobolin, accompanied by cerussite, cerargyrite, malachite, and cuprite. A total of twenty-one forms, of which one is new, were identified on the crystals, and new elements have been calculated for the mineral.—A. A. **Hamilton**: Notes on topographical, ecological, and taxonomic ocean shoreline vegetation of the Port Jackson District. It is shown that the factor most injurious to plant-life in this region is the on-shore wind, which compresses the shrubs into a stunted horizontal growth and sets up an unstable condition for the beach and dune plants by eroding and transporting the loose sand. The latter adopt various devices to secure a foothold in the mobile soil, trailing, deep tap-rooting, forming a carpet, or framing a network of underground stems. Two indigenous grasses, *Spinifex hirsutus* and *Festuca littoralis,* play an important part in the building and upkeep of the exposed dune embankment, the Fescue performing the office of pioneer builder and the Spinifex retaining the sand collected by its hardier associate, which ventures out on the beach beyond the limit of other vegetation. The fruits of the beach plants are specially equipped for sea voyaging.—Edna D. **Sayce**: Some determinations of the heat conductivity of selenium. The heat conductivity of selenium has been measured under different conditions, and shows variations similar to, but less marked than, those occurring in the electrical conductivity. In the crystalline (conducting) form the conductivity depends on the temperature of preparation, the age, and the temperature at the time of testing; the conductivity of vitreous selenium varies with the temperature of testing, being independent of the age of the specimen.—Dr. J. B. **Cleland** and E. **Cheel**: Early stage of development of "Dead Man's Finger" (*Lysurus gardneri*). These interesting fungi are developed under the surface of the soil, and only emerge when they are fully matured. The specimens brought under notice were dug out of the ground, and the peculiar structure of certain parts was noted when the egg-like volva burst open to liberate the column or receptacle.

MELBOURNE.

Royal Society of Victoria, August 9.—Mr. F. Wisewould in the chair.—Ellinor **Archer**: An abnormal venous circulation in the frog. The anterior abdominal vein, instead of entering the liver, opened directly into the inferior vena cava. In spite of the absence of any hepatic portal system, the liver was well developed, and the frog healthy and well nourished. Apparently the hepatic portal system is not of primary importance, as in this case all the blood reaching the liver was arterial.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings, vol. iii., No. 7, July).—Teresa **Cohen**: The Cayleyan curve of the quartic.—C. E. **St. John**: A search for an Einstein relativity-gravitational effect in the sun. A series of observations stretching over several years indicates that the Einstein effect does not exist.—L. P. **Eisenhart**: Triads of transformations of conjugate systems of curves.—M. **Gomberg** and C. S. **Schoepfle**: The molecular weights of the triarylmethyls. After discussing factors influencing dissociation and the relation between dissociation and the nature of the aryl groups, seven triphenylmethyls are investigated in detail and various inferences are drawn from the graphs of their dissociations against their concentrations.—F. R. **Lillie**: Sex-determination and sex-differentiation in mammals. Discussion of the results of studies of the anatomy of twenty-two fœtal free-martins, ranging in size from 7·5 to 28 cm. Sex-determination in mammals is not irreversible predestination; with known methods and principles of physiology we can investigate the possible range of reversibility.—A. W. **Hull**: The crystal structure of magnesium. The structure is analysed by means of X-rays.—W. M. **Davis**: The structure of high-standing atolls. Attention is directed to the relation of atoll limestones to their supposed foundation of volcanic rocks. The relative merits of the Glacial-control theory and of Darwin's theory are discussed.—H. **Shapley**: Studies of magnitude in star clusters. VII.—A method for the determination of the relative distances of globular clusters. The median magnitude of short-period variables is constant in each cluster and may be used to determine the distance of the cluster which, with one or two exceptions, is found to be greater than 30,000 light-years.—H. **Raymond**: The principal axes of stellar motion. Three principal axes are determined along which the various groups of stars show markedly unequal motion.—C. D. **Perrine**: Relation of preferential motion and of the spectral-class and magnitude velocity progressions to proper motion.—D. H. **Campbell**: Growth of isolated sporophytes of Anthoceros. The young sporophyte of *Anthoceros pearsoni*, separated from its association with the gametophyte, is capable of limited growth in length, and is able to mature normal spores and elaters from the young sporogenous tissue.—J. W. **Fewkes**: The Mesa Verde types of Pueblos. A morphological study of Far View House and other types of prehistoric buildings.—Margaret C. **Shields**: A determination of the ratio of the specific heats of hydrogen at 18° and $-190°$ C. The value 1·4012, closely in accord with kinetic theory and different from previous determinations at 18° C., is obtained; the value 1·592 is found at $-190°$ C.—W. W. **Coblentz**: Note on the coefficient of total radiation of a uniformly heated enclosure. The value $5{\cdot}722 \times 10^{-12}$ is found by direct measurement, and agrees with that calculated by Millikan on the basis of his values for h and e.—C. E. **St. John** and H. D. **Babcock**: The development of a source for standard wave-lengths and the importance of their fundamental values. It is necessary to examine for pole effect; the problem of wave-length determination is not one of routine, but one for real investigation.—J. J. **Abel** and M. C. **Pincoffs**: The presence of albumoses in extracts of the posterior lobe of the hypophysis cerebri. Secondary albumoses, and possibly peptones, were found to be present in all the therapeutically used extracts of the posterior lobe of the hypophysis cerebri that were examined. The "hypophysin" of the Farbwerke-Höchst is not, as claimed for it, a solution of the isolated active substances of the pituitary gland, but a mixture of albumoses with varying and unknown amounts of active and inactive constituents of the gland.—E. **Uhlenhuth**: The *rôle* of the thymus in the production of tetany. It would seem that thymus contains the substances which cause tetany and secretes them into the body, from which they are removed by the parathyroids. Extirpation of the latter would thus cause tetany.—W. J. **Crozier**: Evidence of assortive mating in a nudibranch. Mating pairs of the nudibranch Chromodoris zebra are found to exhibit a rather high degree of correlation between the sizes of the two members. This is due to assortive mating, which may constitute an important influence tending to increase the numbers of larvæ.—A. G. **Mayer**: Coral reefs of Tutuila, with reference to the Murray-Agassiz solution theory.

PETROGRAD.

Academy of Sciences, May 10.—Ja. S. **Bezikovič**: Magnetic observations at fifty-four points of the Government of Bessarabia in 1914.—V. N. **Liubimenko**: Medicinal plants of the Government of Taurida.—V. I. **Iskiul**: Investigation of the fire-resisting clays of the Tichvinskij district of the Government of Novgorod.—P. **Eskol**: Mineralogical observations in the Government of Olonetz in the summer of 1916.—N. M. **Abramov** and P. N. **Čirvinskij**: The puzzolanes of the south of Russia.—P. A. **Borisov**: Crystals of silicates from the dolomites of the Povênc district.—K. A. **Nenadkevič** and V. I. **Vernadskij**: The hydrogen sulphide in limestones and dolomites.—V. M. **Rylov**: *Heterocope soldatovi*, a new species of fresh-water Crustacea (Eucopepoda, fam. Centropagidæ).—V. I. **Palladin** and Miss E. R. **Hubbenet**: The absorption of the ultraviolet rays by plants.—O. A. **Walther**: The diastatic splitting of arginine in the yellow lupin.

May 24.—A. S. **Famincyn**: A new method for the culture of micro-organisms.—A. S. **Vasiljev**: Proof of the ellipsoidal form and of the tides of the terrestrial atmosphere. Influence of these factors on the zenithal distances of the stars.—N. A. **Kulik**: The Upper Cretaceous of the Pečora region.—P. **Zemiatčenskij**: The absorbent properties of Russian clays.—K. K. **Matvěev**: Radio-active minerals of the Borščovok range.—Ja. V. **Samojlov** and A. G. **Titov**: Ferro-magnesian concretions from the beds of the Black Sea, the Baltic, and the Barents Sea.

BOOKS RECEIVED.

The Life of Sir Clements R. Markham, K.C.B., F.R.S. By Admiral Sir A. H. Markham. Pp. xi+384. (London: J. Murray.) 15*s*. net.

The Life of Sir Colin C. Scott-Moncrieff. Edited by Mary A. Hollings. Pp. xii+374. (London: J. Murray.) 12*s*. net.

Adolescence. By S. Paget. Pp. 59. (London: Constable and Co., Ltd.) 7*d*. net.

The Human Body. By Prof. H. N. Martin. Tenth edition, revised by Prof. E. G. Martin. Pp. xviii+649. (New York: H. Holt and Co.)

The Wheat Problem. By Sir W. Crookes. Third edition, with Preface, and Additional Chapter, bringing the Statistical Information up to date, and a Chapter on Future Wheat Supplies, by Sir R. H. Rew. Pp. xvi+100. (London: Longmans and Co.) 3*s*. 6*d*. net.

The American Indian. By C. Wissler. Pp. xiii+435. (New York: D. C. McMurtrie.)

The Self and Nature. By Prof. De Witt H. Parker. Pp. ix+316. (Cambridge, Mass.: Harvard University Press; London: H. Milford.) 8*s*. 6*d*. net.

Notions Fondamentales de Chimie Organique. By Prof. C. Mouren. Fifth edition. Pp. 548. (Paris: Gauthier-Villars et Cie.) 20 francs.

The Chemical Constitution of the Proteins. By Dr. R. H. A. Plimmer. In three parts. Part i., Analysis. Third edition. Pp. xii+174. (London: Longmans and Co.) 6*s*. net.

Treatise on Applied Analytical Chemistry. By Prof. V. Villavecchia and others. Translated by T. H. Pope. Vol. i. Pp. xvi+475. (London: J. and A. Churchill.) 21*s*. net.

Quantitative Chemical Analysis. By Prof. F. Clowes and J. B. Coleman. Eleventh edition. Pp. xxiv+580. (London: J. and A. Churchill.) 12*s*. 6*d*. net.

Therapeutic Immunisation. By Dr. W. M. Crofton. Pp. 224. (London: J. and A. Churchill.) 7*s*. 6*d*. net.

Reagents and Reactions. By Prof. E. Tognoli. Translated by C. A. Mitchell. Pp. viii+228. (London: J. and A. Churchill.) 6*s*. net.

Locke's Theory of Knowledge and its Historical Relations. By Prof. J. Gibson. Pp. xiv+338. (Cambridge: At the University Press.) 10*s*. 6*d*. net.

The Problem of Creation. By the Rt. Rev. J. E. Mercer. Pp. xiii+325. (London: S.P.C.K.) 7*s*. 6*d*. net.

The Vegetable Garden. By E. J. S. Lay. Pp. 144. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*.

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 6.

ROYAL SOCIETY, at 4.30.—The Series of Legendre: Prof. W. H. Young.—The Discharge of Gases under High Pressures: L. Hartshorn.—Internal Ballistics: Lieut.-Col. A. G. Hadcock.—The Electrostatic Problem of a Conducting Sphere in a Spherical Cavity: Dr. Alex. Russell.—The Zeroes of Bessel Functions: Prof. G. N. Watson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Electrical Cooking as applied to Large Kitchens: W. A. Gillott.

CHEMICAL SOCIETY, at 8.—The Relation between Chemical Constitution and Physiological Action: Dr. F. L. Pyman.

MATHEMATICAL SOCIETY at 5.—A New Method of describing a Three-bar Curve: Col. R. L. Hippisley.—Proof of the Primality of $N=\frac{1}{9}(10^{19}-1)$: Oscar Hoppe.—New Tauberian Theorems: Messrs. Hardy and Littlewood.—The Curves which lie on the Quartic Surface in Space of Four Dimensions and the corresponding Curves on the Cubic Surface and the Quartic with a Double Conic: C. V. Hanumanta Rao.—(1) The connection between Legendre Series and Fourier Series; (2) Series of Bessel Functions: Prof. W. H. Young.

MONDAY, DECEMBER 10.

ROYAL SOCIETY OF ARTS, at 4.30.—Progress in the Metallurgy of Copper: Prof. H. C. H. Carpenter.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Future of Siberia and her Neighbours: Col. Harold Swayne.

WEDNESDAY, DECEMBER 12.

ROYAL SOCIETY OF ARTS, at 4.30.—Technical Training for Disabled Soldiers and Sailors: Lord Charnwood.

FARADAY SOCIETY, at 7.50.—Annual General Meeting.—At 8.—A Study of the Refractivities of Saturated and Unsaturated Compounds, I. and II.: Gervaise Le Bas.—The Thermal Properties of Sulphuric Acid and Oleum: Dr. Alfred W. Porter.—Iso-piestic Solutions: W. R. Bousfield, K.C.

THURSDAY, DECEMBER 13.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Formation of Nitrites from Nitrates in Aqueous Solution by the Action of Sunlight and the Assimilation of the Nitrites by Green Leaves in Sunlight: B. Moore.—The Transition from Rostro-carinate Flint Implements to the Tongue-shaped Implements of River-terrace Gravels: J. R. Moir.

LINNEAN SOCIETY, at 5.—Seeds with a Stony Endocarp and their Germination: A. W. Hill.—*Inter se* Experiments in Pheasant Crossing in evidence of Mendel's Law: Mrs. R. Haig Thomas.

ROYAL SOCIETY OF ARTS, at 4.30.—The Trade of India with Russia, France, and Italy: D. T. Chadwick.

OPTICAL SOCIETY, at 8.—Proposed Standard Optical Notation and Sign Convention: J. W. French.—Optical Nomenclature and Symbolism: T. Smith.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Discussion on the Metric System. Introductory Papers by L. B. Atkinson and A. J. Stubbs.

FRIDAY, DECEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—The Use of Soap Films in Solving Torsion Problems: A. A. Griffith and G. I. Taylor.

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ST. MARTIN'S STREET, LONDON, W.C.2.

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Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.