Mendelism
Karyokinesis
Caryokinesis
× chromosomes
× cytokinesis

THURSDAY, APRIL 6, 1916.

HEREDITY AND CHROMOSOMES.

The Mechanism of Mendelian Heredity. By Prof. T. H. Morgan, A. H. Sturtevant, H. J. Muller, and C. B. Bridges. Pp. xiii + 262. (London: Constable and Co., Ltd., 1915.) Price 12*s.* net.

THIS latest book of Prof. Morgan and his collaborators should be sure of a welcome from a wide circle of readers. In his preface Prof. Morgan deplores a tendency to regard heredity as a subject for specialists only, and states expressly that the present volume has been written for the biologist at large as well as for those who are more actively engaged in these studies. He has produced a book which should present no difficulties to anyone with the elements of a biological training, while at the same time it sets forth clearly and within reasonable compass the latest deductions and speculations of genetic research.

Prof. Morgan's book is avowedly an argument in favour of what is known as the chromosome theory of heredity. He points out that the mechanism revealed in the process of the maturation of the germ cells is also a mechanism which fulfils the requirements of the mode of distribution of Mendelian factors. A further argument is provided by the fact that in certain insects two kinds of sperms, differing in the number of the chromosomes which they contain, are associated respectively with the formation of a male and a female individual, and this argument was greatly strengthened when the discovery of the heredity of sex-linked characters provided independent evidence that the difference of sex could be expressed in terms of Mendelian factors.

As the result of a remarkable series of experiments with the pomace fly (*Drosophila ampelophila*) Morgan and his collaborators are able to add a striking piece of evidence in favour of the chromosome theory. In the course of these experiments more than one hundred characters of various kinds were shown to exhibit Mendelian inheritance, but the chief point of interest lies in the fact that they fall into four groups. The members of any given group exhibit linked inheritance with regard to one another, but are transmitted quite independently of the members of the other three groups. The importance of this point becomes evident when it is stated that the number of chromosomes in the pomace fly is four. If the chromosome theory is true and if the number of chromosomes is less than the number of factors exhibiting Mendelian heredity, it is clear that the factors must exist in groups corresponding to the number of the chromosomes. The large number of workable factors in Drosophila, coupled with the small number of chromosomes, has rendered possible an exhaustive test of this point such as is at present out of the question for any other species of animal or plant. The result clearly bears out the chromosome theory, and it is further strengthened by the fact that the members of only one of the four groups of characters show sex-linked inheritance, these being presumably those borne by the chromosome that also bears the sex-determinant.

There is, however, a complication which Prof. Morgan deals with in a most ingenious manner. When a cross is made between an individual containing two factors, A and B, lying in the same chromosome pair and another individual whose corresponding chromosomes contain the allelomorphs *a* and *b*, then in all subsequent generations proceeding from the AB × *ab* the two factors A and B should always hang together; in other words, there should be complete linkage between them. This, however, is not so, but in F_2 there appear a small proportion of individuals which may be represented as A*b*, together with a corresponding proportion of the form *a*B; that is to say, the linkage is generally incomplete. To get over this difficulty Prof. Morgan suggests an explanation based on the observations of Jannsens that at certain stages of meiosis the homologous chromosomes belonging to a given pair twist round one another, and supposes that in a certain proportion of cases the chromosomes break on separation, so that both members of the resulting pair contain a portion of each of the two original chromosomes. This conception of "crossing-over," which is clearly explained and illustrated, involves the supposition that every factor has a definite locus in the chromosome in which it occurs, and Morgan claims that if the values of the crossing-over for A and B and also for B and C have been experimentally determined it is possible to predict the value of the crossing-over for A and C. Indeed, he has been able to construct a map of the four chromosomes of Drosophila showing the positions thus deduced of many of the factors.

The development of the chromosome theory in its present form is clearly incompatible with the presence and absence theory of factors as usually accepted; for unless each member of a pair of homologous chromosomes contains the same number of corresponding factors arranged in the same sequence the "crossing-over" could not occur in an orderly manner. Morgan points out that several cases now known are open to the simple interpretation that three factors are involved, any two of which are allelomorphic to one another. In Drosophila, for example, red and eosin eye form a simple pair, as also do eosin and white. Nevertheless, red and white also give a simple Mendelian result, no eosins making their appearance in F_2. These systems of multiple allelomorphs, which are not necessarily confined to three members, open up problems of great interest, to which the reader will find a chapter of the book devoted.

Though Prof. Morgan has succeeded in stating a strong case for the chromosome theory, there are nevertheless some gaps in the argument. We do not, for instance, know at present whether Drosophila shows the peculiar twisting of the homologous chromosomes round one another, such as was described by Jannsens in Batracoseps. The existence of such twisting is, of course, essential to the "crossing-over" explanation of the linkage of characters in heredity, and it is to be hoped that the cytologist will be able to decide the point one way or the other. Another phenomenon which requires clearing up is the absence of any "crossing-over" in the male for any character whatever, though the number and arrangement of the chromosomes in the two sexes are apparently identical. It is, of course, not impossible that what now appears to be a weak point might turn out to be a strong one if the cytologist could show that the behaviour of the chromosomes during the maturation divisions differed in the two sexes.

There are other objections to the chromosome theory which would require too much space to set out in detail, but whether the theory advocated by Prof. Morgan prove to be well founded or not, there can be no doubt that he has given us a most interesting and stimulating book. Not only does it give a clear and well-illustrated account of one of the most important groups of facts relating to heredity yet elucidated by the experimental method, but at the same time it offers the most successful attempt so far made to relate these facts to our knowledge of cellular anatomy. Together with the author we hope sincerely that it may be widely read outside the circle of professed students of heredity, and especially that it may be digested by those whose particular province is the minute structure of the cell.

THE TECHNOLOGY OF SULPHUR AND SULPHUR COMPOUNDS.

Manuals of Chemical Technology. V. Sulphuric Acid and Sulphur Products. By Dr. G. Martin and Major J. L. Foucar. Pp. viii+77. (London: Crosby Lockwood and Son, 1916.) Price 7*s.* 6*d.* net.

A MELANCHOLY circumstance attaches to this book, which to a large extent disarms criticism. Before the section on sulphuric acid, for which Major Foucar, a former assistant manager of the Beckton Gas Works, was responsible, was ready for the press, war broke out, and Major Foucar was killed when leading his men into action. It devolved, therefore, on Dr. Geoffrey Martin, the editor of the series, to put together the material which had been collected, and at the same time to extend the scope of the volume.

The result is a book of some seventy pages—a space wholly inadequate to deal properly with the important subject with which it professes to deal. It is divided into four chapters, treating, respectively, of the sulphur industry, sulphuric acid, the manufacture of sulphur dioxide, and of certain other sulphur compounds, viz., carbon disulphide, sodium thiosulphate, and hyposulphite and sulphuretted hydrogen. The total amount of space given to these subjects is about sixty-five pages, the rest of the book, exclusive of the short preface and indexes, being made up of tables of weights and measures and comparisons of thermometer and hydrometer scales of the conventional type. Each chapter consists of short, disconnected notes on features of interest rather than of systematic accounts of the several industries. It is not very obvious what class of readers it is intended to serve. The student may gain from it a superficial knowledge of the technology of sulphur and of such of its compounds as are mentioned, but the actual manufacturer will find its information far too slight and "scrappy" to be of practical service. The language of the preface would seem to imply that the person aimed at is that ubiquitous individual known as the general reader. But if this is so we fear that person will gain a somewhat confused idea of its purport, for, small as is the amount of information conveyed, a glance through the pages of the book shows that it obviously presupposes some previous knowledge of the subject.

The account of the sulphur industry, constituting chapter i., will serve to illustrate what we mean. The whole chapter occupies five pages, of which half is given to a meagre description of the sources and mode of extraction of natural sulphur; about a page is given to a still more meagre account of the Chance-Claus method of sulphur recovery, the so-called thiogen process of treating smelter-smoke, and the Burkheiser and Feld methods of obtaining sulphur from sulphuretted hydrogen in coal-gas purification, whilst the remainder is concerned with the properties and uses of sulphur. The reference to the Sicilian industry and the allusion to the "calcarone" method convey no meaning to the uninitiated or any information to those who are initiated. The account of the Gill kiln and of the method of its working is so slight as to be practically valueless. The Frasch process of winning Louisiana sulphur is one of the most striking achievements of modern technology. It constitutes indeed one of the romances of applied science. Although Dr. Martin's method of treatment seems to disallow anything in the nature of descriptive writing, we think it would have added greatly to the interest and value of his book if he had given a fuller account of it. It is still not so generally known in this country as it ought to be, in spite of the fact that, as he truly states, it dominates the world's sulphur market.

Our general impression of this book is one of disappointment as a wholly inadequate treatment of a vastly important subject.

HOMER AND HISTORY.

Homer and History. By Dr. Walter Leaf. Pp. xvi+375. (London: Macmillan and Co., Ltd., 1915.) Price 12*s.* net.

THE researches of Dr. Leaf have opened a new phase in the discussion of the Homeric problem. His first task is to discard the interpretations which have hitherto held the field. Until the publication of Wolf's "Prolegomena" the unity of the Epic was, as a matter of course, accepted. We were then invited to believe that the Iliad at least was a collection of lays welded into a single whole by some skilful editor. With the study of comparative philology came the theory that the gods of Homer were manifestations of nature powers adapted to the local geography and the traditional history. This was followed in more recent times by the suggestion that the Iliad represents a reflex of combats fought, not in the Troad, but of tribal battles in Asia Minor between Eubœan-Bœotian colonists and Locrians or South Thessalians, or between Locrians and Bœotians on the Greek mainland.

Such speculations Dr. Leaf has little difficulty in confuting. He has now carried out an exhaustive survey of the text mainly on the basis of geography, and from this inquiry startling results emerge. In his last book on the subject he confined himself mainly to the Trojan side of the question. He proved that the Catalogue of the Trojan forces was a historical document of the highest value. Following Thucydides in his pregnant remark that wars in ancient as well as in modern times were based on trade rivalry, he made it at least highly probable that the war of Troy represented an attempt by the Achæan Greeks to gain possession of a great commercial *entrepôt* controlling the trade routes to the Black Sea and the hinterland of Asia Minor. The war was therefore a historical event, fought, not by faded survivals of nature deities, but by living soldiers and their generals.

The second important document in the Iliad is the Catalogue of the Greek ships, which is now found to stand in a very different position from that of Troy. It is full of discrepancies, such, for instance, as the fact that the Bœotians who figure largely in it were still in Thessaly in the time of the Great War. Besides this, the unsuitability of Aulis as a rendezvous for a fleet acting against Troy, and the impossibility of reconciling the domains of the Achæan princes with geographical facts, are now clearly demonstrated. The document, in short, was an attempt by a later hand to make its contents correspond with an altered condition of Greece.

This fruitful survey of Homeric geography and Greek tradition makes it possible to link the world of Homer with Gnossos and Mycenæ as they have been revealed to us by the excavations of Sir A. Evans and Schliemann, and the review of the historical and geographical situation which forms the introduction to this fascinating work is perhaps its most interesting feature.

We have no space to deal with the new light which Dr. Leaf has thrown on the problem of the Odyssey. He shows clearly that while the eastern Ægean was familiar to the Achæans, the west was a land of mystery, the home of a series of folk-tales, and he follows Dr. Dörpfield in his remarkable demonstration that the modern Thiaki is not the Ithaca of Odysseus, whose home was Leucas.

We have said enough to show the importance of Dr. Leaf's work. The book is a course of lectures intended to be delivered at the North-western University, Evanston, Illinois, a project which fell through on the outbreak of the war. They are now published by the courtesy of the Norman Wait Harris Lecture Committee. To use Dr. Leaf's words: "It may at least serve as a protest, faint and feeble enough, against the extinction of intellectual interest in the flood of barbarous materialism which has been let loose upon Europe." It is much more than this, a statement of the problem defined with logical precision and grace of style, which commend it not only to the trained scholar, but to all who are interested in one of the most vital questions of literature.

OUR BOOKSHELF.

A Manual of Soil Physics. By Prof. P. B. Barker and Prof. H. J. Young. Pp. vi+101. (London: Ginn and Co., 1915.) Price 3*s.*

PROFS. BARKER AND YOUNG have done well to collect the laboratory exercises which for the past ten years have been in use in the College of Agriculture of the University of Nebraska. In this region, where soil physics is so important, one may feel reasonably certain that survival for ten years is a sound test of value, and therefore teachers who are trying to introduce the subject into their courses will welcome the book.

All agricultural courses are modified by their surroundings. Nebraska is fortunate in possessing considerable areas of loess soil well provided with all the elements of fertility, but apt to suffer from drought at critical times. There is, however, sufficient rainfall to supply the needs of the plant if it is properly husbanded, and this is done by maintaining a fine layer of earth on the surface of the soil to act as a non-conductor and protect the bulk of the soil from the sun's rays. The study of the water relationships of soil forms a great part of soil physics, and in one form or another comes into a large proportion of the exercises here.

The authors have modestly had the book turned out in the form of a biflex binder note-book, so that loose pages can be taken out. This makes it difficult to handle, and it deserves something better. We hope that in later editions it will appear in proper book form so that it can be kept for permanent use. E. J. R.

The Journal of the Institute of Metals. Vol. xiv. Edited by G. S. Scott. Pp. ix+289. (London: Institute of Metals, 1915.) Price 21*s.* net.

THIS volume contains the papers which were read at the autumn meeting of the Institute of Metals in 1915, an account of which has already appeared in the columns of NATURE, together with the discussion and written communications. So far as these papers are concerned, the chief place in technical importance must certainly be given to that by Mr. Parker on specifications for alloys for high-speed superheated steam turbine blading, which drew an important contribution from the president, Sir Henry Oram, the engineer-in-chief of the Navy. One of the special merits of this paper is that it makes a point of stating what are the chief requirements in modern specifications of such alloys, and thus gives scientific workers definite problems of first-rate technical importance to work out. Prof. Edwards's paper on metallic crystal twinning by direct mechanical strain is illustrated by some very fine photomicrographs, which will repay detailed study, and prove that, in the case of tin, at any rate, twins are formed by mechanical strain.

The outstanding feature of the volume, however, is the text of the May lecture delivered before the Institute by Sir Joseph Thomson on the conduction of electricity through metals, in which he enunciated a new theory and directed attention to the remarkable results on super-conductivity obtained by Kamerlingh Onnes, of which there is no sign at the temperature of liquid hydrogen, but which are fully displayed at that of liquid helium. H. C. H. C.

Memoirs of the Wistar Institute of Anatomy and Biology, No. 6. The Rat: Reference Tables and Data for the Albino Rat (Mus norvegicus albinus) *and the Norway Rat* (Mus norvegicus). Compiled and edited by H. H. Donaldson. Pp. v+278. (Philadelphia: Wistar Institute, 1915.) Price 3.00 dollars.

THE white rat, like the frog, is one of that select little group known as laboratory animals. For the study of problems connected with mammalian physiology it offers conveniences which in most cases place it beyond competition. After a brief introduction on the classification and early records of the common rats, the greater part of the book is devoted to the white rat, by which is understood the albino variety of the Norway rat (*Mus norvegicus*).

Following some short chapters on the biology, anatomy, and physiology of this animal, the bulk of the work is taken up by statistical tables dealing with the growth of the body and of its various organs in relation to it and to one another, a subject in which the author has conducted research for some years past. The general results of the growth records are also illustrated by a series of graphs by means of which the reader can at once obtain the general drift of the figures. A few pages are devoted to the wild Norway rat, for which far fewer data have been collected than for its pink-eyed relative, and the work concludes with a bibliography of more than fifty pages. A most useful feature of the book is the list of references arranged under headings at the end of each chapter. By means of these and of the bibliography at the end the student can at once ascertain what has been written on, for example, the anatomy of the urogenital system or the physiology of respiration in the white rat. Indeed, we think that this part of the work would bear some amplification. Under "Reproduction," for instance, no mention is made of Marshall's "Physiology of Reproduction," in which work occur other references not given here. Some omissions there are doubtless bound to be, but in this guide to the white rat the author has produced a valuable work of reference which should find a place in every physiological laboratory.

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.]*

Science versus Classics.

IN "Musings without Method"—which might with equal alliteration be termed "Ravings without Reason"—the editor of *Blackwood* gives in the March number his views on the claim of science to occupy a more prominent position in general education than has hitherto been allotted to her. He calls this claim "a ferocious attack on the humanities," an evidence of "unbalanced minds" devoid of "the sense of humour and proportion." He gratuitously assumes that men of science desire "to kill all other learning than their own," and asserts that for all men there is a need of verbal expression "which is most easily satisfied by the study of Greek and Latin." He endeavours to pour scorn on the usefulness of scientific knowledge by the story —probably apocryphal—of a "commercial house in the East" which sent to Cambridge for a chemist, and when a chemist was forwarded to them, promptly returned him on the ground that although there was nothing wrong with him as a chemist, he had no knowledge of the world! One wonders what has become of "Maga's" "sense of humour"? Clearly the "commercial house in the East" did not want a chemist! Had they asked for what they really wanted they would have been sent a classical don; who doubtless would have proved more than a match for the heathen Chinee, which was probably the problem to be tackled!

It is essentially the cause of Oxford and Cambridge which our knight of the pen comes forward to champion—at least, it is what he conceives to be the cause of Oxford and Cambridge. But why should Oxford and Cambridge furnish an exception? They might, it is true, from their more ancient standing, claim to give a lead to the others, but it should surely be the aim of all the universities to provide the best system of education which the needs of the country require.

The question is: What is the best system? We others believe that it is to be found in the introduction of the study of natural science into the upbringing of everyone, whatever his ultimate aim in life may be. The prime object of education is, or should be, the attainment of a knowledge of ourselves and our surroundings: this knowledge can only be obtained through the study of natural science. That other branches of learning—mathematics, philosophy, history, language, and literature—may help, is not contested, but the basis of education in an age in which all our prosperity, present and prospective, depends upon proficiency in science must be scientific. If he who runs cannot read as much as this, he is either purblind or hopelessly slow of understanding!

We need not go outside the pages of "Maga" to prove the inadequacy of the classics. Of what is this Cabinet composed which the editor has denounced in unmeasured terms from month to month as patterns of imbecility, hesitation, and vacillation, unable to see beyond the ends of their noses, incompetent to manage any department of State? Are not the ranks of the "gallant twenty-two" (now twenty-three) recruited almost exclusively from the institutions on the system of education of which "Maga" sets so high a value? Is not the Prime Minister, against whom particularly the editorial fulminations of "Maga" have so often been directed, himself a notable example of classical attainments? Far be it from scientific men to belittle these or any other accomplishments—philosophical, literary, or artistic. Our contention is that—along with the more advanced study of the natural sciences—these other branches of learning should be treated as subjects of special education: that they ought not to dominate the general education of the country. So far from having any wish to kill all other learning, we desire to promote *all* learning, but that desire does not prevent us from thinking that training in science will have to take the place in schools which is now occupied by Greek and Latin.

I am aware that our opponents may retort we have no right to assume that persons who have had training in science as an integral part of their education are more competent to manage the affairs of the nation or to carry on business or industrial operations than those who do not possess this advantage. We possess, however, an example of the influence of scientific training on efficiency in one of the largest of our public departments—the Navy. This is admitted, even, I believe, by "Maga," to be the best organised of those departments; it is certainly the one in which the public places the most confidence. But the men upon whom this efficiency depends are distinguished from those of all other public Services in the fact that their education is, from the beginning, purely scientific. They have had no opportunity for the acquisition of that knowledge of the classics which "Maga" appears to consider necessary for the making of men; yet even the boys of the Navy have again and again demonstrated by their actions that the scientific training which they have received has not prevented them from showing of what stuff they are made.

Nor has "Maga" the right to assume that it is only the classical members of our ancient universities who have come forward so splendidly in this crisis of our national life. For, side by side with those of their classical fellows, "stand imperishable upon the roll of honour" the names of hundreds of science students who have—whether "from their despised studies" or not I cannot say—also "learned and taught the habit of command," and many of whom have, alas! also made the supreme sacrifice. But to anyone with a "sense of proportion," it must be obvious that this can have nothing to do with the question at issue. For in showing their readiness to give their lives for their country the members of the universities are doing no more than is being done by millions of their fellow-subjects at home and abroad.

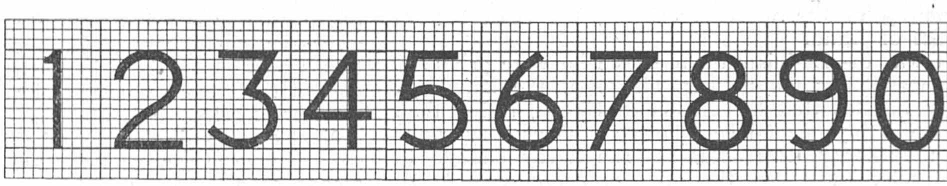
E. A. SCHÄFER.

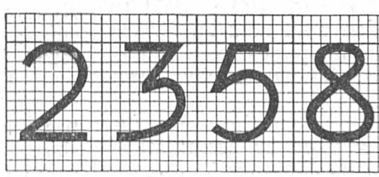
Numerals for Scales and Punches.

SEEING that excellently designed numerals are common on the scales of instruments, and bad styles are rare, I have been surprised at the interest which has been taken by engineers and others in the proposed numerals which were illustrated in NATURE of February 24. I have adopted some of the suggestions which I have received in the revised set here illustrated. My intention eight years ago was to produce designs suitable for the scales of measuring instruments and for the dials of engine counters and electric supply meters, where the numerals appear through holes. Most of the suggestions which I have received since my paper appeared in the Journal of the Institution of Electrical Engineers relate to numerals punched on metal.

There are four classes of numeral characters: (1) For writing, including ordinary script, formal writing, inscriptions moulded in metal or cut in stone; (2) for typography; (3) for scales; and (4) for punches. Script demands legibility first, but gives considerable scope for caligraphy. In formal writing these requirements are reversed, and for inscriptions they carry equal weight. Typography makes certain intricate and subtle exactions for the purpose of producing balance and apparent uniformity of the characters. Such refinements do not seem to be required in the case of scales and punches. Scales often have to be read in a bad light, and, as I have said in my paper, elegance of shape is not to be disregarded altogether, but wherever necessary it must be sacrificed to legibility and to special restrictions in uniformity of size and thickness of line.

Punches for stamping numerals on metal make two additional demands on the designer. The first is that a character when inverted shall not be mistaken for another; the second is that if the impression is imperfect it shall do its best to be legible. The first case





consists essentially of the relation of the 6 to the 9, and it is so difficult to make a difference, that other numerals must lend their help. The 1 therefore should have a small serif, and there should be a marked difference between the upper and the lower part of the 8. I propose to retain my original 6, and I offer a 9 with a tail curling up a little to the left, but not enough to cause confusion with 8 or 0. In these numerals the thickness of the line is $7\frac{1}{2}$ per cent. of the height.

The 2 in the present set is a compromise between the swan-breasted one of the first set, and the acute angled type. I have tried to improve the 3 by adding one unit to the length of the top bar, but this has the drawback that if the lower 6/10ths is lost there may be a confusion with 7. The tail of the 3 is turned up higher than that of the 5 or 9. The 4, 6, 7, and 0 remain as before. For the sake of appearance the down stroke of the 5 slopes 1 in 10, instead of 1 in 20. Good impressions of the upper 4/10ths of these numerals should be legible. If the lower halves only appear, the difference between 3 and 5 is but slight, and there is no difference between the lower half of the 6 and of the 8. But if the lower 6/10ths are visible, I think that each numeral is legible. If 4/7ths of the breadth are lost on either side the remaining 3/7ths are legible.

I have shown these numerals to a friend, who said, "They are quite clear but quite beastly," and he pointed out that the limitations do not altogether preclude beauty of form. He directed my attention to certain good models, and I have based on these a 2, 3, 5, and 8. The 8 has the advantage that the lower half differs from that of 6.

I shall be glad to receive any further suggestions.

I have a few copies of my paper, and will send one to anybody who has not access to the Journal of the Institution of Electrical Engineers, and who is specially interested in the subject. A. P. Trotter.

Athenæum Club, Pall Mall, London.

International Latin.

I have always shared the regret of your correspondents that Latin has now ceased to be employed as the international language of science, although for more than a thousand years after it had ceased to be a vernacular it had, among men of education, maintained its position as a living language, adapting itself to the varying needs of the times. I have devoted some attention to the development during the Middle Ages and succeeding centuries of the branches of science in which I am more especially interested, and have been struck by the clear, fluent Latin in which the majority of the scientific treatises were written. That of Agricola, Encelius (Entzelt), Gesner, Camden, and Cæsalpinus in the sixteenth century; Francisco Imperato and Aldrovandi in the seventeenth; and Isaac Lawson, Cramer, and Linnæus in the eighteenth, and most of their fellow-workers is, as a rule, as easy to follow as French, in spite of the handicap of the want of articles, the most serious defect of Latin.

It was the Latinists themselves who were primarily responsible for the modern disuse of the language. They insisted that the diction of Cicero, rather than that of Pliny, should be followed, and as they spoke with authority, there was no one hardy enough to contradict them, so that the unfortunate man of science had to face a hail of ridicule if he failed to reproduce the mannerisms which were held up for his imitation, while if he succeeded his pages were almost unreadable for most of those who would have been interested in their contents.

If Latin were ever again to come into use for scientific purposes, it would only be by assimilating its style and idioms to those of its daughter languages at the present time, by accommodating itself to the changes of meaning which have overtaken so many of its words, and by borrowing freely from their vocabulary, especially in the case of terms which are practically international. At the same time the inflexions and syntax of classical Latin would be generally, but not slavishly, followed.

I am afraid, however, that it is too late to undo the work of those who have slain the object of their affections by strenuous efforts to renew the golden age of its early youth when by far the more important portion of its long career of usefulness still lay before it; and now that it is, as it would seem, really dead, had we not better regretfully but resolutely bury it out of sight and turn our thoughts to the flexible idiom handed down to us by our forefathers, which is already understood throughout the whole civilised world? John W. Evans.

Imperial College of Science and Technology, South Kensington, March 28.

Osmotic Pressure or Osmotic Suction—Which?

The interesting controversy between Profs. van Laar and Ehrenfest, referred to in Nature of March 16, again raises the question of the cause for the approximate equality between osmotic pressure and gas pressure. In this connection the following simple proof, based on the kinetic theory, of van't Hoff's well-known relationship, may be of interest.

The tendency of a liquid to diffuse is measured by its diffusion pressure, which may be defined as the bombardment pressure exerted by the liquid molecules on either side of a plane of unit area placed anywhere within the liquid. If we regard a perfect liquid as formed by the compression of a perfect gas until the molecules almost touch one another, it will be seen that the diffusion pressure is proportional to the number of molecules in unit volume, or the absolute concentration, and also to the absolute temperature. The diffusion pressure for ordinary liquids has a very large value. For instance, if water were a perfect liquid, its diffusion pressure would be about 1200 atmospheres.

Since the absolute concentration of a solvent is reduced by the introduction of a solute, it is evident that diffusion pressure is reduced in the same way; so that the diffusion pressure of the solvent in a solution is always less than that in the pure solvent itself. Hence solvent travels across a membrane from the pure solvent side to the solution side, unless a hydrostatic pressure equal to the difference between the two diffusion pressures is placed on the solution. The osmotic pressure, which is defined as the aforesaid hydrostatic pressure, is therefore proportional to the difference between the absolute concentrations of the *solvent* on the two sides of the membrane. Further, it is also approximately proportional to the concentration of the solute because the latter is itself approximately equal to the difference in solvent concentration on the two sides, since the process of solution consists essentially in the spatial replacement of part of the solvent molecules by a more or less equal number of solute molecules.

Next as regards the gas relationship. Consider the case of a pure solvent separated from its solution by means of a semipermeable membrane (diagram I.). Remove from the solution side *all* the solvent molecules; and also an equal number from the pure solvent side. The system then assumes the appearance shown in diagram II. Now this process merely reduces the absolute concentrations and diffusion pressures on the two sides of the membrane to an equal extent; but leaves unaltered the *differences*. The residue of solvent molecules [⊙] will diffuse across the membrane just as before; whilst the solute molecules will bombard the membrane. Moreover, the pressure of the solvent residue on the one side will be equal to the pressure of the solute on the other; and both will be equal to the corresponding gas pressure, since the molecules are at distances from one another comparable to gas distances. Hence to prevent the residue of solvent from flowing across the membrane, a hydrostatic pressure equal to the gas pressure will have to be applied. The usual way of doing this is to make the solution into a kind of piston.

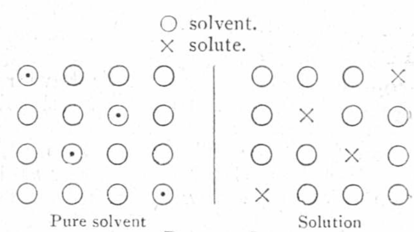


Diagram I.

Diagram II.

On the other hand, the solute bombards the membrane with a pressure equal to the corresponding gas pressure, whether a hydrostatic pressure is placed on the solution or not. The solvent itself can exert no pressure on the membrane, since it is supposed to be able to travel across the membrane just as if the latter were non-existent.

The phenomenon of osmotic flow is therefore due to the residue or excess of *solvent* molecules on the pure solvent side; the solute molecules play an indirect part only. But the solute molecules do cause a strain to be placed on the membrane, which tends to rupture the latter.

The fundamental difference between osmotic phenomena in the gaseous and solution states is that whereas the active molecules (see diagram II.) have a vacuum for a medium in the gaseous case, they have a liquid solvent for a medium in the solution case. The other differences between compressed gases and concentrated solutions nearly all proceed from this fundamental one.

FRANK TINKER.

University of Birmingham, March 21.

The Expansion of a Homogeneous Function in Spherical Harmonics.

IN a recent paper, entitled "Notes on Spherical Harmonics" (Proceedings of the Edinburgh Mathematical Society, vol. xxxii., 1914), Dr. John Dougall wrongly claims as new the expansion which he has given there for a homogeneous function of the coordinates of a point on a sphere. This expansion was first given in 1900 by Dr. G. Prasad, in the *Messenger of Mathematics*, vol. xxx., p. 13, and again, by a different method, in 1912 in the *Mathematische Annalen*, vol. lxxii., p. 436. The method of Dr. Prasad in the second paper is the same as that of Dr. Dougall.

S. K. BANERJI.

Calcutta Mathematical Society,
University College of Science, Calcutta, March 8.

PREVENTIVE EUGENICS.[1]

LORD SYDENHAM and his colleagues deserve the thanks of the nation for their prompt and faithful discharge of the difficult task allotted to them, in November, 1913, of inquiring into the prevalence of venereal diseases in the United Kingdom, their effects upon the health of the community, and the means by which those effects can be alleviated or prevented. No one can read the commissioners' report without an increased conviction of the seriousness of the evil that is dealt with, of its grave and far-reaching effects (even on the biological plane alone) upon the individual and the race. In careful terms and with scientific precision the commissioners give the evidence for the statement that the effects of the diseases in question "cannot be too seriously regarded," for "they result in a heavy loss, not only of actual, but of potential population, of productive power and of expenditure actually entailed." The misery account cannot be estimated.

Except in the case of the Navy and Army, there are at present no means of arriving at an accurate estimate of the prevalence of venereal diseases in Britain, and many deaths due to them appear to escape official recognition. Sir William Osler considers that, "of the killing diseases, syphilis comes third or fourth," and the commissioners, while rightly cautious, conclude that the number of persons who have been infected with this disease, acquired or congenital, cannot fall below 10 per cent. of the whole population in the large cities, and that the percentage affected with gonorrhœa must be much larger. As regards geographical distribution, syphilis is shown to be essentially a town disease. As regards the social distribution of venereal diseases as a whole, there is high incidence (in descending order) among unskilled labourers, in those intermediate between them and skilled labourers, and in the upper and middle classes. There is relatively low incidence among (in descending order) textile workers, miners, and agricultural labourers. It is regrettable that the statistics, both of total prevalence and of distribution, remain somewhat uncertain. It is also to be regretted that the commissioners have allowed themselves to speak repeatedly of "hereditary syphilis"—a quite inaccurate phrase.

One of the most tragic aspects of this widespread human scourge is the suffering inflicted on the innocent. Children infected before birth may be blinded or deafened, or terribly diseased in skin and bone, in body and mind. More than half of all cases of blindness among children are the result of venereal diseases in their parents. Of registered still-births, probably at least half are due to syphilis, and it is estimated that from 30 to 50 per cent. of sterility among women is due to gonorrhœa. The "suffering incalculable" that may be inflicted on an innocent mother, taken along with wrong done to the offspring and other possible consequences, have led the commissioners to the recommendation that the presence of communicable venereal disease should be regarded as a disqualification for marriage and as a ground for a declaration of nullity—without, of course, affecting the legitimacy of the children. Those who still think that nothing should be done to make the cure of the diseases easier, because this lessens the punishment of the guilty and makes indulgence safer, should consider carefully the section of the report which deals with the consequences to mothers and children. We confess that it overwhelms us in its awfulness. There is also to be borne in mind the terribleness of the nemesis involved in the occurrence in the offender himself of general paralysis or locomotor ataxy, it may be ten or fifteen years after the infection. An even wider consideration, especially in these days of wastage, is the "enormous" economic loss traceable to reduced working capacity, and the heavy public cost of maintaining the various kinds of patients. The commissioners are convinced that the cost of curative and preventive measures would soon be counterbalanced by what would be saved.

We are not here concerned with the medical measures by which, according to the commissioners, the diseases can be controlled and reduced within narrow limits, but we wish to direct attention to two accessory points:—(1) There is a wholesome eugenic breeze in the suggestion that a warning given by a physician in regard to the undesirability of a marriage shall be regarded as

[1] Royal Commission on Venereal Diseases. Final Report of the Commissioners. Presented to both Houses of Parliament by Command of His Majesty. Pp. 191. (London: Wyman and Sons, Ltd., 1916.) Price 1s. 11d.

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a privileged communication. We do not sympathise with those who regard it as an infringement of liberty to require, as a matter of course, a medical certificate on both sides before marriage, for this is surely a social as well as a personal matter, and we have a well-grounded confidence in the general wisdom of the medical profession—a wisdom which would be more generously displayed if it were more frankly and courteously appealed to. (2) The commissioners are strongly convinced that it is time to let in more daylight. Medical students should have more adequate instruction in regard to these scourges of the race; the public should be authoritatively informed (*e.g.*, by literature which has received the imprimatur of the National Council for Combating Venereal Diseases) as to the biological gist of the matter (of which most know nothing), and as to parasitological commonplaces, *e.g.* regarding exchange of pipes or tooth-brushes; students in training colleges should be carefully prepared so that they may be able to guide and advise senior pupils; the practice, followed by some head-teachers, of warning and encouraging pupils before they leave school should be general; instruction should also be given in evening continuation schools (we doubt the wisdom of including factories and workshops); use should be made of those voluntary associations that show a sufficiently high standard of efficiency and tact; and, last but not least, "the guidance of medical practitioners should be secured."

All this is, in its general trend at least, wise counsel, which should be made the basis of earnest experiment towards lessening one of the disgraces of our civilisation. We would add, however, a plea that the instruction, for lack of which many perish miserably, should not be restricted to the pathological and prudential aspects, but should be broadened out into positive eugenic education, with a frank recognition, for instance, that wholesome, full-blooded, high-minded love, in spite of the awfulness of its *corruptio optimi pessima,* is the finest thing in human life.

In connection with this terrible subject there is a brilliant record of scientific achievement. Thus we may remember Neisser's discovery of the micro-organism (*Gonococcus*) that causes gonorrhœa; the pioneer experiments of Metchnikoff and Roux; Schaudinn's discovery of the micro-organism (*Spirochaeta pallida*) that causes syphilis; Noguchi's observation of the occurrence of the spirochæte in the brains of persons dying of general paralysis and locomotor ataxy; Wassermann's suggestion of a valuable diagnostic bio-chemical test; Ehrlich's working out of the salvarsan cure, for which there are now various substitutes available. Such records make us proud of mankind, but the reason for it all fills us with shame. The commissioners are wise enough to discern that men become victims of vicious circles. Overcrowded and insanitary dwellings indirectly contribute to the spread of the diseases in question; occupational depression leads to alcoholism, and the "communication of disease is frequently due to indulgence in intoxicants"; and so the dismal circles run.

Biologically regarded, the measures proposed by the commissioners must be approved of without hesitation. Two invisible parasites cause widespread human misery; science has mastered these parasites; and, if men will, the misery may in greater part, or altogether, cease. But to consider man from the biological point of view alone is a fallacious and, indeed, impossible abstraction. For he is a rational, social person, a member of a realm of ends as well as of the class of mammals. Thus the question arises—and who is wise enough to answer it?—whether our scientific saving of the sinner from the punishment of his sins—always a dangerous thing to do—will be justified in the long run by a finer race. In actual fact, however, there is no alternative, for social instinct, with the obsolescence of patriarchal ways of looking at things, is now strong enough to secure that women and children be shielded, so far as available science makes it possible, from the effects of masculine selfishness.

The terms of the commissioners' reference precluded consideration of the moral aspects of the questions with which they had to deal, but there is no dubiety as to the firm ethical undertone of the report. "We are deeply sensible of the need and importance of the appeals to conscience and honour which are made by the religious bodies and by associations formed for this purpose. We believe that these appeals will gain force if the terrible effects of venereal disease upon innocent children and other persons who have no vicious tendencies are more fully realised."

We have exceeded the space editorially allotted to us, but we plead that this is one of the most important bio-sociological documents of recent years, and we wish to quote its well-considered final appeal:—

> The diminution of the best manhood of the nation, due to the losses of the war, must tell heavily upon the birth-rate—already declining—and upon the numbers of efficient workers. The reasons for combating, by every possible means, diseases which in normal times operate with disastrous effects alike upon the birth-rate and upon working efficiency are, therefore, far more urgent than ever before. Now and in years to come the question of public health must be a matter of paramount national importance, and no short-sighted parsimony should be permitted to stand in the way of all means that science can suggest and organisation can supply for guarding the present and future generations upon which the restoration of national prosperity must depend.

THE MANUFACTURE OF PORCELAIN.

IN early days almost nothing was accurately known of the manufacture of porcelain. European potters had never made ware with such admirable qualities as that which was brought by the traders from China, and their attempts to imitate Chinese porcelain were not very successful. The first synthetical experiments were based on the hypothesis that Chinese porcelain was a

Porcelain
× Stoneware
Pottery
Earthenware
Ceramics
× China (porcelain)
× Chinaware

devitrified glass, or a glass opacified by the addition of clay; afterwards Böttger, a pupil of Walther von Tschirnhaus, who had had a great deal of experience in the manufacture of crucibles for his alchemical work, made a vitreous body which had some of the qualities of porcelain, but an objectionable colour. The ware was very vitreous and no glaze was used; Böttger seems to have tried to get the bright glossy surface by polishing the body. Böttger then found a deposit of white clay at Aue, near Schneeburg, and, by using that in place of the crucible clay, he was able to produce fair imitations of the body of Chinese porcelain, and a works was started near Meissen in which extreme precautions were taken to preserve the secret. This porcelain was the type now known as hard or felspathic porcelain. A generalised hard porcelain body has the composition:—

Clay	50
Felspar	25
Quartz	25

The discovery of china clay at St. Yrieix, in France, enabled the French potters to take up the manufacture of this same type of porcelain, but in France a totally different type of porcelain was in use. It was called soft porcelain. The composition of soft porcelain can be generalised into the recipe:—

Calcareous clay	30
Glassy frit	30
Quartz	40

Soft porcelain lent itself peculiarly well to the production of beautiful pottery, but the cost of manufacture was too great to enable it to compete successfully with the bone china and hard porcelain; as a result, the soft porcelain industry is virtually dead. Artificial teeth, however, are made from a variety of soft porcelain.

Cookworthy, of Plymouth, discovered that the Cornish stone and china clay of Cornwall could be employed for making a porcelain body, and works were started at Plymouth. The English hard porcelain, while preserving a special character of its own, belonged to the same general type as the German and Chinese. The manufacture of this hard porcelain in England does not appear to have been very successful, and was soon abandoned. A third type of porcelain developed in England, the English porcelain, or bone china. The body of this can be generalised in the recipe:—

Bone ash	50
Clay	25
Cornish stone	25

We have considered only the body of the various porcelains. The composition and character of the various glazes are of equal importance. Shortly, hard porcelain, which matures at the glaze temperature—which is very high—has a hard glaze of the nature of felspar; soft porcelain had a lead glaze which matured at a comparatively low temperature.

The manufacture of pottery is very largely dependent upon a multitude of conditions, each one of which might appear to be of little intrinsic importance. Successful potting involves close attention to detail, and this probably more than in any other industry.

There is a marked difference in the behaviour of these three types of ware in the firing. In all types of pottery there is a range of temperature or margin of safety outside which the fireman must not go. If the temperature be *above* these limits the ware is liable to be spoiled; and if *below*, the ware is insufficiently fired. With hard porcelain there is a particularly wide margin of safety; with soft porcelain the margin of safety is so narrow and the resulting losses so great that the manufacture had to be abandoned as commercially impracticable. With English bone china, too, there is a comparatively narrow margin of safety, which is necessarily attended by proportionate difficulties.

Hard porcelain, unlike soft porcelain and bone china, is first baked at a comparatively low temperature, and the glaze and body are subsequently fired together at the higher temperature. The preliminary baking is not a critical operation, and it can virtually be done by the waste heat of ovens firing at the higher temperature. With soft porcelain and bone china two critical firings are needed; with hard porcelain there is one. The first or biscuit fire with soft porcelain and bone china is much the hotter; the second or glost fire is not so hot.

Hard or felspathic porcelain and bone china virtually command the world's porcelain market. Both forms are *porcelain*, and both are colloquially called *china*, although the latter term is more commonly applied to the English porcelain as distinct from the Continental. It appears that in quality—presumably æsthetic—British porcelain reigns supreme; but in certain special lines—chemical, electrical, and possibly hotel ware—the Continental porcelain has important advantages which render it advisable to start seriously making it in England. Just as the manufacture of the British type of porcelain has not been particularly successful outside this country, so the manufacture of Continental porcelain has not been successful here. The two types have developed on different lines, and certain radical differences obtain, so that certain conditions necessary for success in the one lead to failure in the other. The cessation of German supplies of chemical ware has led manufacturers to make fairly good imitations of hard porcelain by modifying parian, insulator, and mortar bodies, but these temporary imitations are not so satisfactory as the true hard porcelain. The problem must be solved by our taking up the manufacture of true hard porcelain, and not frittering away valuable time on imitations which past experience has proved to be less suitable for the work. The manufacture should offer no insuperable difficulties to our men once their skill is deflected and adapted to suit the special conditions required for the new type of ware. The subject wants tackling boldly and confidently on a large scale with British raw materials. If much raw material has to be purchased abroad the cost of production will rise accordingly.

This seems a very good opportunity for State assistance, since at present it is to the interest of no individual manufacturer to assist in the development of the new type of ware. It is therefore pleasing to learn that the Committee of the Privy Council for Scientific and Industrial Research has made a substantial grant towards the capital outlay for an experimental factory where the conditions necessary for the successful manufacture of hard porcelain can be studied on a large enough scale to reproduce manufacturing conditions. Once the necessary conditions have been established, the manufacture of hard porcelain will probably interest a great many potters, and this idea has probably led the Pottery Manufacturers' Association to bear a proportionate part of the estimated cost of maintenance. Instead of working slavishly on Continental lines it will probably be far more rational to introduce as few radical changes as possible, so that the supreme skill and traditional experience of our craftsmen may be utilised to its maximum. In this way it is quite likely that a new kind of hard porcelain will be evolved, which will unite the good qualities of the Continental with those of the British porcelain.

B. M.
J. W. M.

THE COMMONWEALTH INSTITUTE OF SCIENCE AND INDUSTRY.

THE scheme for the establishment of a Commonwealth Institute of Science and Industry, of which we gave an account in our issue of March 9, is described by Prof. Orme Masson in an interesting article in the Melbourne *Argus* of January 22. Prof. Masson points out that, just as Lord Roberts pleaded in vain the military necessities of the nation, so the warnings of men like Sir Henry Roscoe, Sir William Ramsay, and Sir Norman Lockyer, as to the consequences of the neglect of science, were disregarded before the war. After the scheme for the development of scientific and industrial research, under a committee of the Privy Council, had been put forward about a year ago, Mr. Hughes, the Prime Minister of Australia, determined to do as much—and more—for the Commonwealth, with the view of making the country independent of German trade and manufacture when the war is over. Following the example of the British Science Guild ten years ago, he appointed a committee representing State scientific departments, universities, and industrial interests to prepare a scheme; and within a few days the committee had produced the draft already published in our columns.

The proposed Institute is to be governed by three directors, one of whom will be selected for proved ability in business, finance, and organisation; while the two others will be scientific men of similar high standing and reputation. This combination, devoted wholly to the work, should be able efficiently to conduct affairs and operations having for their object the union of science with industry. The directors are to be assisted by an advisory council composed of nine representatives of primary and secondary industries and of science; and these representatives are to seek information, advice, and assistance from specialists throughout Australia.

The first function of the Institute will be to ascertain what industrial problems are most pressing and most likely to yield to scientific experimental investigation; to seek out the most competent men to whom each such research may be entrusted; and to arrange for their having all necessary appliances and assistance. The Institute is also to build up a bureau of industrial scientific information, which shall be at the service of all concerned in the industries and manufactures of the Commonwealth. Its third main function will be to erect, staff, and control special research laboratories, the first of which will probably be a physical laboratory somewhat on the lines of our National Physical Laboratory.

The scheme cannot be brought into operation until it receives the sanction of the Commonwealth Parliament, after the return of Mr. Hughes from his visit to England. In the meantime, the Federal Government has appointed a temporary advisory council and provided the money necessary to enable it to make a beginning with the organisation of industrial scientific research and the collection and dissemination of scientific information bearing on Australian industries. According to Press reports, Mr. Hughes said, before leaving Australia, that the Government is prepared to spend up to 500,000*l.* upon the establishment of the scheme; and if the matter is taken up in this large-minded spirit the Commonwealth will have made the best possible provision for the industrial and commercial struggle which must come after the declaration of peace.

NOTES.

PROMOTERS of the proposal to put the hands of timepieces forward by an hour during certain months of the year are now advocating the adoption of this principle of "Daylight Saving" by deception on the grounds of national economy in fuel and light. The scheme has been before the public for many years, and has been rejected by Parliament on more than one occasion. It has not received the approval of a single scientific society of any importance, and only one or two scientific men have given it any support. Yet Lord Salvesen made the astounding assertion, in the *Times* of March 31, that the Daylight Saving Bill "is supported by substantially the whole intelligent opinion of the country." He evidently believes that "intelligent opinion" upon time-standards is not to be found in the views of experts, but in the resolutions of town councils, district councils, chambers of commerce, and like bodies, who want to pretend that during a prescribed period every year the hour of seven o'clock is really eight, and so for other hours. It is usually understood that people cannot be made sober by Act of Parliament, yet it is seriously suggested that they should be made to rise earlier by a legalised plan of national deception. We have condemned this ridiculous measure whenever it has been brought forward, and dealt with it in detail in an article in NATURE of May 11, 1911 (vol. lxxxvi., p. 349). A correspondent suggests that we should reprint this article, but we doubt whether the corporations who want Parliament to do for them what they could do for themselves by changing their habits would be convinced by any appeal to authoritative opinion. They might not be in favour of altering temperature standards during certain months of the year, so that in the summer 80° shall be called 70° by Act of Parliament, in order to pretend that the weather is not really so hot as the thermometer indicates, yet the principle which they adopt so cheerfully is precisely the same. If they understood the meaning of time-standards so well as they know those of length, weight, and temperature, the "Daylight Saving" scheme would long since have passed into the limbo of forgotten things.

THE enterprise of the *Times* in the issuing of an "Imperial and Foreign Trade Supplement," to be continued monthly, is both commendable and timely. The purpose is to bring enlightenment to the British producer and merchant, and to induce them to support measures sound in policy and method with a view to enable them to compete on advantageous terms, both at home and abroad, with their foreign rivals, especially those of Germany. A frank, well-informed, and unprejudiced discussion of the intricate problems involved, having always the welfare of the home consumer in mind, can result in nothing but good. An instructive article is contributed by Sir Philip Magnus on the value of science in its application to commerce and industry, in which the economic success of Germany and the results of her peaceful, penetrating efforts throughout several decades are ascribed to the effective school training, which has not only enabled the citizens to develop in their own country new and profitable industrial undertakings, but also to establish themselves in a dominating commercial position in other countries. Drastic changes are urged in respect of the organisation of our education, not necessarily on German lines, throughout all its grades, but especially in the training given in our universities and technological schools, which is compared very unfavourably with that available in similar German institutions, and with the number of students engaged therein in operations involving specialised scientific research. There is also an important article by Sir Algernon Firth on British trade policy, in which reference is made to the recent great commercial conference held in the Guildhall, and to the approval given to the demand that the Empire should produce within its own borders all that it requires from its own soil and factories, and that the Government should be urged to provide larger funds for the promotion of scientific research and training. Only the barest allusion is made, however, to this necessity in communications received from numerous correspondents throughout the country, the chief stress being laid upon fiscal restrictions.

THERE is still no news of Sir Ernest Shackleton's ship *Endurance,* but that need not increase the anxiety as to her safety, as, owing to the unfavourable ice season, her return may be delayed until the middle of April. The *Aurora* was towed into Port Chalmers, New Zealand, on Monday, April 3. It appears that on May 6, 1915, a violent gale tore the vessel from her moorings, and that she was then carried with the ice to the north. The rudder was crushed on July 21, and the vessel was not able to emerge from the ice until March 1 4last last, when it was in a badly damaged condition. Whether the *Aurora* will be fit to return to the Ross Sea in the next Antarctic summer appears doubtful. The fact that she had to be towed during the last part of her voyage to New Zealand was due to the loss of her rudder, though a jury rudder was rigged up. The cautious remarks attributed by the cable to Mr. Stenhouse, the chief officer of the *Aurora,* suggest, however, doubt as to whether, in his opinion, the *Aurora* will be available. He is reported to have expressed the hope that the staff of the *Aurora* will return as a relief party, but he says nothing as to the return of the ship herself. We must hope, however, by next week to have news of the *Endurance,* and of the seaworthiness of the *Aurora.*

DR. M. O. FORSTER, F.R.S., the chairman of the Technical Committee of British Dyes, Ltd., and Mr. J. Turner, the manager of the works, have been offered, and have accepted, seats on the board of the company, and Dr. J. C. Cain has been appointed chief chemist of the new works at present under construction at Dalton, Huddersfield.

WE regret to announce the death, on April 4, in his eighty-first year, of Sir John Gorst, F.R.S., vice-president of the Committee of Council on Education from 1895 to 1902, and the first president of the Educational Science Section of the British Association.

MR. W. B. HARDY, Sec.R.S., Admiral Sir H. B. Jackson, K.C.B., F.R.S., and Sir G. A. Smith, Principal and Vice-Chancellor of Aberdeen University, have been elected members of the Athenæum Club under the rule which empowers the annual election of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

THE day lectures at the Royal Institution after Easter include:—Prof. C. S. Sherrington, Harvey and Pavloff; Dr. T. M. Lowry, optical research and chemical progress; Sir Ray Lankester, flints and flint implements; Prof. W. H. Bragg, X-rays and crystals (the Tyndall lectures); Prof. H. S. Foxwell, the finance of the great war; Sir James G. Frazer, folk-lore in the Old Testament. The Friday evening discourses include:—Sir J. M. Davidson, electrical methods in surgical advance; Colonel E. H. Hills, the movements of the earth's pole; Prof. C. G. Barkla, X-rays; Mr. E. Clarke, eyesight and the war.

DR. H. R. MILL reports in the *Times* of April 3 that while the average rainfall for March at Camden Square for fifty years is 1·75 in., this year the total rainfall, including melted snow, up to a few hours before the end of the month, was 4·67 in. The record of rainfall at Greenwich Observatory for the past 100 years includes only one instance of a 4-in. fall in March, 4·05 in. having been measured in 1851. A search through the numerous rainfall records kept in and near London back to the beginning of the eighteenth century has failed to show any March with as much as 4 in. of rain.

THE annual general meeting of the Ray Society was held on March 23, Prof. W. C. McIntosh, president, in the chair. The report of the council showed a considerable loss of membership owing to the war, and stated that two volumes for 1915, the "Principles of Plant-Teratology," vol. i., by Mr. W. C. Worsdell, and the "British Fresh-water Rhizopoda and Heliozoa," vol. iii., by Mr. G. H. Wailes, had been issued to the members, and also the "British Marine Annelids," vol. iii., part 2, by the president, being one of the issues for the present year, for which the second and concluding volume of "Plant-Teratology" is also in preparation. A work on the "Trematode Parasites of British Marine Fishes," by Dr. William Nicoll, and one on the "British Diatomaceæ," by Mr. George

West, had been accepted for publication. Prof. McIntosh was re-elected president, Dr. F. DuCane Godman treasurer, and Mr. John Hopkinson secretary.

THE annual general meeting of the Chemical Society was held at Burlington House on March 30, Dr. Alexander Scott, president, in the chair. A discussion took place with regard to the removal from the list of those honorary and foreign members who are alien enemies, and it was decided to refer the matter to the council for further consideration. It was with great pleasure the president announced that the following donations had been made to the research fund:—(a) 1000*l.* from Dr. G. B. Longstaff, whose father, by his gift of a similar amount, was largely instrumental in founding the research fund forty years ago; (b) 1000*l.* from Mrs. and Miss Müller, in commemoration of the late Dr. Hugo Müller's long connection with the society; (c) 500*l.* from Dr. Alexander Scott, to mark his appreciation of the valuable work done by the research fund, and in commemoration of the seventy-fifth anniversary of the society. Prof. G. G. Henderson and Prof. A. Lapworth were elected new vice-presidents, and Mr. A. Chaston Chapman, Mr. C. A. Hill, Dr. R. H. Pickard, and Dr. F. L. Pyman were elected as new ordinary members of council. The delivery of the president's address, entitled "Our Seventy-fifth Anniversary," was postponed until to-day, April 6, at 8 p.m.

SIR RICHARD REDMAYNE, in his presidential address delivered recently before the institution of Mining and Metallury, took as his main theme a consideration of the mineral resources of the United Kingdom. Coal, as the most important mineral asset, came in for the principal treatment, which consisted in a survey of possible extensions of coal-fields and the prevention of waste in the acquisition and utilisation of coal. Iron ore and limestone were next reviewed, and, finally, the resources of non-ferrous metals, with the last of which the institution is by its constitution principally concerned. This gave the president the opportunity of explaining to members in some detail the scheme of research which is about to be undertaken by the institution in co-operation with the Royal Cornwall Polytechnic Society, and with the aid of a financial grant from the Advisory Council to the Committee of Scientific and Industrial Research of the Privy Council. The research will deal with the economic extraction of tin and tungsten from Cornish ores, and its objects are:—(a) To review the evidence upon which estimates of the total contents and recovery of tin and tungsten are based; (b) to co-ordinate and complete the researches already begun, and if necessary to institute other researches on new lines; and (c) to suggest new or improved methods of treatment indicated by the results of the researches. It is remarkable that in spite of the antiquity of this industry the precise percentage of recovery now being obtained of cassiterite from the tinstone is not known, though there is a consensus of opinion that it certainly does not exceed 75 per cent.

THE name of Auguste Rosenstiehl, whose death is announced, is indissolubly linked to that period of chemistry which inaugurated the great colour industry. Born at Strasburg in 1839, he completed his studies in the university of his native town, where he remained as lecture assistant from 1857 to 1865. Having chosen the study of tinctorial chemistry as a career, he was appointed to the chair of chemistry at the technical school at Mulhouse, of which he was afterwards director. Subsequently he acted as colour chemist to a firm of dyers. In 1877 he accepted a post in the celebrated colour works of Poirrier and Dalsace, of Saint Denis, with which the names of Lauth, Gerard, Roussin, Bardy, and many other distinguished chemists are connected. It is to Rosenstiehl that the elucidation of the formation of fuchsine, discovered by Verguin, is due. He also studied the chemistry of alizarine and the other colouring principles associated with the madder root, among the derivatives of which nitroalizarin soon received practical application in the dyeing industry. In collaboration with Noelting, director of the School of Chemistry of Mulhouse, Rosenstiehl prepared Saint Denis red, an azo-colour which led the way to the manufacture of numerous derivatives of the same group. The chemistry of dyestuffs and dyeing were not the only subjects which absorbed Rosenstiehl's attention, for he was also interested in the study of physics and the physiology of colour. Later, Rosenstiehl was appointed to the chair of colour chemistry at the Conservatoire des Arts et Métiers. His views on osmosis, which he attributed to osmotic pressure, were confirmed some years later by Van't Hoff, who pointed out the analogy with gas pressure. Among the honours conferred upon him, the Academy of Sciences awarded him a few years ago the Jecker prize for his services to colour chemistry.

THE prevalent belief that immature veal is far less nutritious food than beef is examined by W. N. Berg in a recent paper in the Washington Journal of Agricultural Research (vol. v., No. 15). He finds that no chemical difference of physiological importance can be detected between the two kinds of meat, nor does artificial digestion work more rapidly on beef than on veal, while kittens in the diet of which immature veal was the only source of nitrogen grew normally into healthy cats, the offspring of which, in their turn, throve also on the same food.

IN a recent issue (February 3, p. 630) we alluded to the important part played by the Benedict calorimeter in the investigation of metabolism. A striking illustration of this is afforded in a recent publication by Prof. Benedict ("The Physiology of the New-born Infant," by F. G. Benedict and F. B. Talbot; Carnegie Institution of Washington, No. 233, 1915). Normal infants only have been studied so far as a preliminary to a more extended pathological investigation; the Boston Lying-in Hospital provided the material (100 babies), and a constant routine was adhered to in all cases. The data obtained show that on the first day of life there are important disturbances of the regulation of temperature which result either in a decreased metabolism, or, when the infant makes efforts to compensate for the loss of heat, there is increase in the metabolism. After the second day there is a fair uniformity in the heat production per square metre of body surface, and a remarkable uniformity per square metre of body surface per unit of length. This constancy is such as to permit the establishment of a factor which indicates that when the square metre as computed from the body weight is divided by the length, the metabolism per unit is 12·65 calories. The practical outcome of this is the following:—From a study of the effect of temperature changes on the basal metabolism and the amount of available breast secretion in the first week of life, it is possible to indicate what procedure should be adopted for the conservation of energy and supplemental feeding.

In the March number of the *Zoologist* Miss Frances Pitt discusses the habits of the yellow-necked mouse, both in a wild state and in captivity. One of its most striking characteristics seems to be its pugnacity. As she remarks, we have yet much to learn in regard to the range of this handsome mouse in England, but it occurs so far north as Northumberland, and is met with also in the Midlands. Miss Pitt seems to be under the impression that it is found only in the south and west of England.

In an account of his observations on the feeding habits of the purple-tipped sea-urchin (*Echinus miliaris*), which he contributes to the *Zoologist* for March, Mr. H. N. Milligan adds a number of new facts which are well worth recording. The diet of these animals ranges from bits of chalk to living fish and mollusca; nothing seems to come amiss to them. The cast shells of crustacea are eaten with the same avidity as the dead animal. When legs of crustacea are placed near them they are partly eaten, and the remaining portions are carried up by the tube feet and placed upon the back, to serve apparently as a disguise. How they discover and locate the position of edible morsels is yet unknown, but Mr. Milligan, by means of an ingenious experiment, has shown that they soon detect the introduction of food into the tank in which they are confined, and, furthermore, make strenuous efforts to seize it when it is placed out of reach.

A REPORT on the chlorosis of the tobacco plant, generally known as "calico," is published by Mr. G. P. Clinton in the Connecticut Experimental Station Report for 1914. "Calico" is an infectious and, to a certain extent, a contagious disease which can be communicated by mere contact of calicoed plants or their juice with healthy plants. Infected plants in the seed-bed are probably primarily responsible for most of the calico in the fields. The disease is remarkable in appearing to be due, not to bacterial or fungoid agencies, but to an enzymic "virus." The virus can be filtered through a Berkefeld filter, and can be extracted from calicoed leaves by antiseptic solvents such as ether, chloroform, and alcohol, and the infected juice has its activity preserved by adding toluene. A number of precautionary measures are given for dealing with the disease and a useful bibliography of the subject.

AMONG the foreign guests of the British Association in Australia in 1914 was Dr. C. H. Ostenfeld, of Copenhagen, who has now published his observations on the vegetation of Western Australia (*Geografisk Tidskrift*, xxiii., 1915, pp. 35–46 and 132–48). He divides Western Australia into three climatic regions, each with a characteristic vegetation, tropical, central and north-west and south-west. The last region has the greatest rainfall, and is most important. It falls into three belts, depending on rainfall, which are named respectively the cattle, wheat, and timber belts, but since one or other species of eucalyptus characterises each belt of increasing rainfall from the interior to the sea, Dr. Ostenfeld proposes another and stricter classification into five belts. The Wandoo belt (*E. redunca*), with 450 to 700 mm. annual rainfall; the Jarrah belt (*E. marginata*), 700–1000 mm.; the Tuart belt (*E. gomphocephala*), about 900 mm.; the Karri belt (*E. diversicolor*), 1000–1200 mm.; and the coast scrub, with *Agonis flexuosa* and Acacia, on the sea cliffs. The Jarrah belt is the most important, not merely on account of its timber, but also for its cattle-farming and fruit-growing. The paper is well illustrated.

In the *Journal of the Royal Society of Arts* for January 28, a review of the work of the British Cotton-growing Association since its formation in 1902 is given by Mr. J. A. Hutton, chairman of the council of the association. To the activities of the association the successful cultivation of cotton in many parts of the Empire is due, and in particular Uganda, Egypt, and the West Indies may be cited. In Uganda the first export of cotton took place in 1904, when 54 bales were shipped, and in 1914 the shipment had risen to 40,000 bales. The transport facilities afforded by the Uganda Railway have made possible this successful cultivation, and in Nyasaland the extension of the Shire railway to Chindio, an enterprise largely helped by the association, will no doubt bring beneficial results to the cotton industry in the Protectorate. The association has made experiments in British colonies, both suitable and unsuitable, and has many failures to record, particularly in West Africa, where either conditions of climate were unsuitable or other crops were preferred by the native growers. In many colonies the association has been instrumental in hastening the formation of agricultural departments, with which it is now working in close harmony. Owing to the existence of the efficient Imperial Department of Agriculture in the West Indies, the Cotton-growing Association has been able to render very great help to the West Indian islands, and the cotton from that region is highly appreciated by the spinners in Liverpool.

A BLIZZARD of unusual severity swept over the British Isles on March 27 and 28, causing a large amount of damage, both on land and sea, with some loss of life. In London the weather changes indicated the passage of a double-centred disturbance, or a parent storm and its subsidiary. The first disturbance reached its maximum force late on Monday evening, March 27, when the barometer in London fell below 29 in. The gale was from the south-west and was accompanied by heavy rain and snow. The wind had abated on Tuesday morning, but the barometer remained low. In the afternoon the mercury rose briskly and the wind shifted to the northward, blowing a severe gale in the early evening of March 28, with heavy, driving snow. On the morning of March 29 the barometer had risen an inch in the twenty-four hours. The velocity of the wind is given as 70 to 80 miles an hour in parts of England, and in London early on the evening of March 28 the rate was about 60 miles an hour.

Symons's Meteorological Magazine for March gives a rainfall table for February, 1916, which shows that the month was wet over nearly the whole of the British Isles, Aberdeen being the only station among those chosen for the tentative results with a deficiency of rain. The total rainfall during the month is said to have been most excessive in the south-east of England generally, the fall being more than double the average to the south of a line drawn from Hull to Cardiff. The greatest excess of rain at the given stations occurred in Derbyshire, the measurement at Mickleover being 289 per cent. of the average. At Bury St. Edmunds the fall was 273 per cent., at Launceston 271 per cent., and at Tenterden 258 per cent. of the average. The London rainfall at Camden Square was 208 per cent. of the average. Generally over England and Wales the fall was 193 per cent. of the average, in Scotland 150 per cent., in Ireland 160 per cent., and for the British Isles as a whole 170 per cent. The duration of rainfall in London was 90·9 hours, which is 51·9 hours above the average of the previous thirty-five years, and the greatest duration in February since records commenced in 1881. A map is given showing the Thames Valley rainfall, and from this it is seen how excessive the rains were. In Hampshire there is a considerable area with more than 6 in., and a large portion of the map shows the rainfall to have exceeded 5 in.

PART 5 of vol. iv. of the Science Reports of the University of Sendai, Japan, contains a paper on the daily variation of underground temperature by Mr. S. Satô, which shows the untrustworthiness of placing the recording thermometer in an iron pipe.

Mr. Satô used both mercury and platinum resistance thermometers in his pipes, and compared their records with those of similar thermometers placed directly in the ground at the same heights. He finds that the records of the thermometers in the pipes differ both in amplitude and in phase from those of the thermometers in the ground, and that the difference is due to the heat conductivity of the material of the pipe and to the convection currents in the air in the pipe. It persists when a poor heat conductor is substituted for iron and when the depth of the pipe is increased. As a result, almost all the values of the thermometric conductivity of soils deduced from observations of temperatures in pipes are too high.

Since the outbreak of the war it has been impossible to obtain the magnetite anodes which have played so important a part in electro-chemical industry, as all these were made in Germany. A note is contained in the *Chemical Trade Journal* of March 4 on the introduction of a substitute for these in the form of "duriron" anodes, made of an iron silicon alloy. Whilst this material is not entirely unacted on when used as an anode in copper sulphate solution, from fifteen to twenty times its weight of copper can be deposited before it is entirely corroded away. Duriron anodes have a higher mechanical strength than magnetite, but require about 13 per cent. more electrical energy to deposit the same quantity of copper. The extra power goes into heat, and special precautions have to be taken to avoid too high a rise in temperature.

A bold article by Mr. C. A. Jacobson on the need for a large Government institution for chemical research, which appeared in the *Journal of Industrial and Engineering Chemistry*, is reprinted in the *Chemical News* (vol. xliii, p. 101). The scheme outlined involves the creation of an institute of chemical research on a colossal scale, consisting of fifty major departments and one hundred minor departments, comprising about fifty buildings, a staff of 1350 trained workers, and an expenditure of more than a million pounds sterling per annum. A few years back such an idea would have sounded utterly utopian and impossible, but, in face of a war expenditure in this country alone every day of five times the amount called for each year by such a scheme, the outlay seems small if thereby supremacy were ensured "in a branch of science which is not only vital to constructive agencies, but even more so to destructive ones. The present European war teaches us that men and military training are of far less importance to success than a high development of the science of chemistry."

A recent issue of *The Engineer* (March 24) contains an account of the Medlow Dam, situated in a sandstone gorge on Adams Creek in the Blue Mountains of New South Wales. The dam is remarkable for its slender profile, having a base width of only 8·96 ft., tapering to 3·5 feet at a height of 29 ft., from which level the thickness remains unaltered to the coping at a height of 65 ft. The wall is of plain concrete, without reinforcement. Our contemporary compares it with the old Bear Valley Dam in California, which, with practically the same height, had a base width of 20 ft., and was generally much more substantial in design. The Medlow Dam is built to a curve of 60 ft. radius, and cost 2762*l*. The catchment area is 1150 acres, with an average rainfall of 39 in. The dam holds up a lake having a surface of 12 acres and containing 67 million gallons of water. By means of an inclined and adjustable off-let pipe the water is drawn off from the clearest stratum at the top.

The National Physical Laboratory has issued some notes on the production and testing of screw gauges, written by members of the staff of the laboratory, and based on their experience. The Whitworth thread has seven elements, error on any one of which may be sufficient to cause a gauge to reject work which ought to pass, or *vice versâ*. These elements are: Full diameter, core diameter, effective diameter, pitch, angle, form at crest, form at root. Of these, the most important, and the most difficult to control, are the pitch and effective diameter. The laboratory is issuing specially selected needles for use with the micrometer in testing the effective diameters of screws of 12, 14, 24, and 36 threads per inch. The methods of using these, together with special arrangements for holding the micrometer in the lathe, are described in the pamphlet. Triangular needles are used for testing the core diameter. There is also described an ingenious and cheap apparatus for testing the angle of the thread; this apparatus can be put together very easily in any workshop. The best way of obtaining correct pitches is to cut a screw in the lathe, using that part of the leading screw which is to be used in cutting the gauges, and to have its pitch measured from thread to thread at the laboratory. The pamphlet contains a great deal of useful information, and should be read by everyone interested in accurate screw cutting.

Prof. Karl Pearson, Galton Laboratory, University College, London, W.C., informs us that he has lately completed the corrigenda for his "Tables for Statisticians and Biometricians," published by the Cambridge University Press, and that the list is now bound with all exemplars of the tables. He wishes it to be known that previous purchasers of the work can obtain a copy of the corrigenda by sending a request for the same with a stamped envelope to Mr. C. F. Clay, Cambridge Press Warhouse, Fetter Lane, or to the secretary, Galton Laboratory, University College, London, W.C.

The following additional volumes have been arranged for, for inclusion in the "Fauna of British India" series (Taylor and Francis):—*Lycaenidae* and *Hesperiidae*, H. H. Druce; the *Curculionidae*, G. A. K. Marshall; the *Longicorn Beetles*, C. J. Gahan; the *Ixodidae* and *Argasidae*, C. Warburton; *Leeches*, W. A. Harding; the *Brachyurous Crustacea*, Lieut.-Col. A. Alcock; the *Apterygota, Termitidae*, and *Embiidae*, A. D. Imms; the *Diptera Brachycera*, E. Brunetti; the *Rutelidae*, G. J. Arrow; and the *Operculata*, by G. K. Gude.

Mr. Francis Edwards, 83 High Street, Marylebone, London, W., has issued a catalogue of Oriental books he is offering for sale. The works deal with the following among other countries of the Far East:—China, Japan, India, Burma, Tibet, and Persia.

OUR ASTRONOMICAL COLUMN.

Comet 1916*a* (Neujmin).—Copenhagen Postcard No. 12 gives an elliptic orbit for this comet, calculated by M. J. Braae, from observations covering nine days:—

Epoch, 1916, *January* 0·5, *G.M.T.* M_0 348° 50′ 21·2″.

$$\left.\begin{aligned}\omega &= 193^\circ\ 16'\ 2{\cdot}0''\\ \Omega &= 327\ \ 20\ \ 4{\cdot}0\\ i &= 11\ \ \ 5\ \ 34{\cdot}3\end{aligned}\right\}1916{\cdot}0 \qquad \begin{aligned}\phi &= 36^\circ\ 44'\ 33{\cdot}2''\\ \mu &= 571{\cdot}493\\ \text{Log } a &= 0{\cdot}528664\end{aligned}$$

Period, 2267·74 days (6·21 years).

Perihelion passage, 1916, March 10·805 G.M.T.

The ephemeris calculated by Messrs. J. Braae and J. Fischer-Petersen from these elements is given in the following summary:—

From April 6, Greenwich midnight.

R.A., 9h. 36m. 7s., add for April 8, +3m. 31s.

For the successive intervals of two days the second differences are: +7, 4, 7, 4, 6, and 3 seconds.

Declination, −3 12·3, add for April 8, −41·1′. Successive second differences: +1·2′, 1·2′, 1·4′, 1·3′, 0·9′, and 1·5′.

The comet will pass near the "bright" nebula, N.G.C. 2974, on April 7, and N.G.C. 3115 on April 20. At the Hill Observatory on April 3 the comet was seen near the calculated position. With the 10-in. refractor, it showed a faint, diffuse, somewhat oval, coma, with a condensation north—preceding.

Solar Variation.—The annual report of the Smithsonian Astrophysical Observatory for the year 1915 contains some interesting statements regarding the variation of solar radiation. The Smithsonian measures of the solar constant have brought to light a long-period variation synchronising with sun-spot activity, and also rapid irregular fluctuations. Both types of variability are correlated with a variation of the contrast between the centre and limb of the sun's disc, but in opposite directions. In the first type of variation high solar constant values and increased contrast are associated with increased spot activity; in the second case the higher solar constant values are associated with diminished contrast. Correspondingly, two distinct causes are suggested: the long-period variation may result from changes of the sun's effective temperature, whilst changes in the transparency of the outer solar envelopes may account for the rapid fluctuations.

The Translational Motion of Binary Stars.—M. C. Luplau-Janssen has investigated the distribution of the proper-motion vectors, freed from the effect of the solar movement, of a number of double stars, with reference to their orbital planes (*Astronomische Nachrichten*, No. 4828). After rejecting five pairs of small inclination ($i<30°$), data for twenty-nine well-established orbits remain. The proper motions were taken from Boss, and reduced uniformly to their equivalents at a distance of 1 parsec. At this distance the adopted solar motion is represented by an angular displacement of 4·11″ per year. The resultant proper motions and the node-lines lie in a common plane. It is found that the included angle shows no tendency to take a value about 90°, as it would if the proper motion showed any general parallelism to the normals to the orbits. Further, on resolving the proper motions along rectangular axes, one coincident with the line of nodes, the sums of the components are found to be equal; thus there is no tendency apparent for the proper motions to be parallel to the plane of the orbits. A chance distribution is indicated.

The investigation depends on the assumption that the real parallaxes are on the average equal to twice the hypothetical minima; measured parallaxes have not been used. M. Luplau-Janssen is convinced of the substantial accuracy of the fundamental assumption by the result obtained in a determination of the solar motion from the proper motions of 180 double stars by the method of Bravais. The deduced solar velocity is given as 17·1 km./sec. This value is in good accord with that generally accepted, and also with the value (14·9 km./sec.) obtained by Weersma by the same method but from quite different data.

EDUCATION AND INDUSTRY IN FRANCE.

An extremely interesting account of the rise and growth of industrial education in France appears in the *Revue Générale des Sciences*, March 15, contributed by Prof. M. E. Bertrand, of the Ecole d'Arts-et-Métiers d'Angers. Whilst full of confidence in a military triumph, he is deeply concerned with the position of French industry, especially from the point of view of the adequate scientific and technical training of all who are engaged in it, whether apprentices and workmen or foremen and directors, and urges that it is the imperative duty of the nation to ensure also a victory in the economic sphere. Much space is given to the measures taken from the earliest times for the satisfactory training of those engaged in industry, and the rise and progress of the craft guilds down to their decay on the birth of the factory system is interestingly portrayed. The advent of the Third Republic resulted in active measures for the establishment and support of different types of schools designed to secure the effective training of those destined for industry and commerce, and many excellent mono-technic schools were established, the fine work of which made a magnificent display at the Centennial Exhibition of 1900. Yet with all the variety of effort made for the due training of French youth, it would appear that out of 600,000 young people employed in industry and commerce from thirteen to eighteen years of age, only 30,000 frequent technical schools; whilst 65,000 beyond that age give a more or less assiduous attendance at evening adult courses, as compared with 500,000 under the same conditions in Germany; and where France spends seven million francs on this form of technical education, Germany spends thirty millions from Imperial sources alone. The grave moral danger attending this neglect of training is emphasised by the fact that there are 1,600,000 unemployed young people in France wandering about the public places exposed to serious temptations. Even though Germany is engaged in a devastating war, she is still thinking of the future, and is even now taking energetic measures to conserve her industries so as to secure and advance her economic interests on its conclusion. The article calls upon France to be up and doing, since delay is dangerous, and the economic industrial position of the nation is put in grave peril. A highly appreciative account is given of the educational provision made throughout Germany for the due training of all ranks engaged in productive industry, and much emphasis is laid upon the great value of the continuation schools, which ensure compulsorily the attendance, within the usual hours of employment, until eighteen years of age of all those who have left the day schools. The article contains much of the highest interest to English readers in the present crisis, since the conditions and the aims to be accomplished are much the same in the two allied nations.

THE CORROSION OF CONDENSER TUBES.

The annual meeting of the Institute of Metals was held on March 29, when the society took leave of its retiring president, Sir Henry Oram, and listened to the address of his successor, Dr. G. T. Beilby. The latter reviewed briefly the unsatisfactory position of certain non-ferrous metal industries in this country, and then indulged in some interesting speculations as to the possibility of preparing lighter alloys, especially for aircraft, than have hitherto been produced. This address has not as yet been printed. When it has been published it will be found to repay very careful study.

The Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research has made a substantial grant to the institute for the purpose of aiding its Corrosion Committee in their investigation of the corrosion of condenser tubes. The publication of the third report to this committee by three investigators, Messrs. Gibbs, Smith, and Bengough, was therefore very timely, and the discussion of this paper occupied the greater part of the proceedings of the meeting. It was followed by a paper by Mr. Elliott Cumberland, who gave a demonstration of his method of minimising the corrosion of condenser tubes, which created considerable interest.

The ground covered in the report to the Corrosion Committee is very extensive, and it is only possible within the limits of this article to give a brief summary of its most salient features. Five alloys have been subjected to corrosion tests under a great variety of conditions. Of these one was ordinary condenser tube metal (70 : 30 brass), another was Admiralty brass, containing 1 per cent. of tin, and another a special lead brass (2 per cent. of lead). The fourth was a bronze, containing 3·5 per cent. of tin and a trace of phosphorus, and the fifth a copper-aluminium alloy containing 8 per cent. of aluminium. These have been tested in (*a*) stagnant sea-water over the temperature range 15°–60° C.; (*b*) in diluted sea-water of various degrees of dilution and with both gentle and violent aeration. The influence of their surface condition has been carefully examined, the effect of air bubbles adhering to the metal, and that of the E.M.F. due to unequal temperature distribution. Two main types of corrosion have to be considered:—(*a*) *Complete,* in which all the constituents of the alloy dissolve simultaneously at approximately the same rate and uniformly over its surface; (*b*) *selective,* in which one constituent dissolves preferentially. In brass alloys it is usually zinc, and the process is called dezincification. This type of corrosion, however, may conveniently be subdivided into "*general,*" which occurs over the whole surface uniformly, and "*localised,*" which occurs in spots. Selective localised corrosion is the type which is responsible for the chief failures in practice, giving rise as it does to "pitting," which is the most frequent cause of failure.

The authors have come to the conclusion that it is the formation of oxy-salts and their adherence to the surface of the alloy which is the prime cause of pitting, and in spite of the fact that the bronze came worst out of the majority of the tests, when the results were expressed in the form of loss of weight per unit of area, they have concluded that it would be the most likely to give the best results in practice, because its corrosion is of the "complete" type, and no oxy-salt is formed until a temperature of 60° C. is exceeded. No one alloy was found to be satisfactory under all conditions, but much the most resistant alloy under the majority of conditions was that composed of copper and aluminium.

The authors' recommendations as to the minimising of corrosion in condenser tubes are:—(1) The temperature of the water should be kept as low as possible; (2) its flow should be made smooth, foaming and churning being avoided; (3) oxy-salts should be removed as soon as possible after formation.

H. C. H. CARPENTER.

short title Gt. Britain

CIVIL SERVICE ESTIMATES FOR SCIENCE AND EDUCATION.

Viz England!

THE Estimates for Civil Services for the year ending March 31, 1917, are being issued as Parliamentary Papers. Under Class IV. are included the estimates of expenditure on Education, Science, and Art; and we record below the main points of these estimates, with details of those relating to scientific investigation and higher education.

It will be noticed that the grant in aid of scientific and industrial research has been increased from 25,000*l.* to 40,000*l.*

United Kingdom and England.

	1916–17	1915–16
BOARD OF EDUCATION.		
Administration	203,667	209,551
Inspection and examination	222,578	252,458
Public elementary schools etc.	12,640,528	12,696,815
Training of teachers ...	408,282	577,000
Secondary schools and pupil teachers and bursars, etc.	919,800	863,050
Technical schools, etc. ...	576,000	638,000
Scholarships, exhibitions, and other allowances to students, prizes, etc. ...	19,110	30,160
University institutions in respect of technological work...	60,000	59,000
Assistance in choice of employment	4,000	4,500
Imperial College of Science and Technology	30,000	30,000
Chelsea Physic Garden ...	150	150
Royal College of Art ...	8,494	10,300
Victoria and Albert Museum	63,375	70,459
Science Museum	13,943	18,892
Geological Museum	3,212	3,805
Geological Survey of Great Britain	14,718	16,820
Bethnal Green Museum ...	2,735	5,433
Deduct— Appropriations in aid ...	3,860	5,015
Net total	£15,186,732	£15,481,378
BRITISH MUSEUM.		
British Museum[1]	93,263	110,102
Natural History Museum ...	43,631	51,943
Gross total	136,894	162,045
Deduct— Appropriations in aid ...	8,295	13,400
Net total	£128,599	£148,645
SCIENTIFIC INVESTIGATION, ETC.		
Royal Society:		
(i) (*a*) Scientific investigations undertaken with the sanction of a committee appointed for the purpose (4,000*l.*), and (*b*) scientific publications (1,000*l.*)	5,000	5,000
(ii) Magnetic Observatory at Eskdalemuir	1,000	1,000
(iii) National Physical Laboratory	7,000	7,000
(iv) Aeronautical Section of the National Physical Laboratory	10,400	9,425
Total for Royal Society	£23,400	£22,425
Meteorological Office ...	22,500	22,500
Royal Geographical Society[2]	1,250	1,250
Royal Academy of Music ...	——	500
Royal College of Music ...	——	500
Marine Biological Association of the United Kingdom	500	500

[1] The British Museum (Bloomsbury) (except the Reading Room, etc.) and part of the Natural History Museum, South Kensington, are closed during the war.

[2] A condition of the Grant is that the Society exhibits to the public, free of charge, its collection of maps.

Science and state / Education and state / State and education

	1916–17	1915–16
Royal Society of Edinburgh	600	600
Scottish Meteorological Society	100	100
Royal Irish Academy ...	1,600	1,600
Royal Irish Academy of Music	300	300
Royal Zoological Society of Ireland	500	500
Royal Hibernian Academy...	300	300
British School at Athens ...	500	500
British School at Rome ...	500	500
Royal Scottish Geographical Society	200	200
National Library of Wales ...	3,200	3,200
Special Building Grant ...	——	5,000
	3,200	8,200
National Museum of Wales...	2,500	2,500
Special Building Grant ...	14,800	14,800
	17,300	17,300
Solar Physics Observatory ...	3,000	3,000
British Academy	——	400
School of Oriental Studies ...	3,000	1,500
North Sea Fisheries investigation	1,250	1,250
Imperial Transantarctic Expedition, 1914–15	——	5,000
Edinburgh Observatory ...	1,671	1,657
Scientific and Industrial Research: Grants to be distributed to institutions or persons in the United Kingdom by a Committee of the Privy Council, with the assistance of an Advisory Council, to promote the development of scientific research, especially in its application to trade and industry, and administrative expenditure in connection therewith	40,000	25,000
Total	£121,671	£115,582

UNIVERSITIES AND COLLEGES.

Universities and Colleges, Great Britain.

	1916–17	1915–16
University of London ...	8,000	8,000
Victoria University of Manchester	2,000	2,000
University of Birmingham	2,000	2,000
University of Wales ...	4,000	4,000
University of Liverpool ...	2,000	2,000
Leeds University	2,000	2,000
Sheffield University	2,000	2,000
Bristol University	2,000	2,000
Durham University	2,000	2,000
Scottish universities, grant in aid under section 25 of the Universities (Scotland), Act, 1889,[3] £42,000; Additional grant in aid £42,000	84,000	84,000
Grants in aid of certain colleges in Great Britain giving education of a university standard in arts and sciences	150,000	150,000
University colleges of North Wales, South Wales and Monmouthshire, and Aberystwyth (£4,000 to each)	12,000	12,000
Additional grant in aid of the expenses of the University of Wales and of the University colleges of North Wales, South Wales and Monmouthshire, and Aberyswyth (2,500*l*., 5,125*l*., 7,750*l*., and 5,125*l*. respectively) ...	20,500	15,000
Total for universities and colleges ...	£292,500	£287,000

[3] In addition to an annual sum of £30,000 payable to these Universities from the Local Taxation (Scotland) Account under section 2 (2) of the Education and Local Taxation Account (Scotland) Act, 1892.

Intermediate Education, Wales.

	1916–17	1915–16
Examination and inspection	1,200	1,200
Schools	27,500	28,000
Total (Wales)... ...	£28,700	£29,200
Grand total	£321,200	£316,200

Scotland.

PUBLIC EDUCATION.

	1916–17	1915–16
Administration	28,969	28,935
Inspection	43,123	44,290
Elementary schools	2,073,489	2,081,435
Continuation classes and secondary schools	241,000	247,500
Royal Scottish Museum, Edinburgh	10,610	12,832
Training of Teachers ...	145,986	193,389
Examination of accounts ...	1,565	1,524
Total	£2,544,742	£2,609,905

Ireland.

PUBLIC EDUCATION.

	1916–17	1915–16
Administration	30,004	29,526
Inspection	48,901	49,932
Training colleges	64,866	65,120
Model schools	3,861	3,861
National Schools	1,587,250	1,582,000
Manual and practical instruction	12,238	12,580
Teachers' residences ...	6,800	6,800
Superannuation, etc., of teachers (grants in aid) ...	59,484	56,800
Gross total	£1,813,404	£1,806,619
Deduct— Appropriations in aid ...	700	700
Net total	£1,812,704	£1,805,919

INTERMEDIATE EDUCATION.

	1916–17	1915–16
Towards salaries of teachers, including cost of administration	40,000	40,000
Endowed Schools Commissioners	905	900

	1916–17	1915–16
SCIENCE AND ART.		
Institutions of science and art	49,224	50,136
Schools of science and art, etc.	99,350	94,950
Geological Survey	1,749	2,171
Examinations in courses of instruction conducted in technical schools	750	850
Gross total	£151,073	£148,107
Deduct—		
Appropriations in aid ...	1,620	1,820
Net total	£149,453	£146,287

UNIVERSITIES AND COLLEGES.

Grants—		
Queen's University of Belfast	18,000	18,000
University College, Dublin...	32,000	32,000
University College, Cork ...	20,000	20,000
University College, Galway	12,000	12,000
Grants—		
National University of Ireland and University College, Dublin	30,000	40,000
Additional grant to University College, Galway ...	2,000	2,000
Total	£114,000	£124,000

SUMMARY.

EDUCATION, SCIENCE, AND ART.

United Kingdom and England.		
Board of Education	15,186,732	15,481,378
British Museum	128,599	148,645
National Gallery	11,489	15,670
National Portrait Gallery ...	3,485	4,993
Wallace Collection	4,591	7,962
London Museum	2,570	5,465
Scientific investigation, etc.	121,671	115,582
Universities and colleges, Great Britain, and intermediate education, Wales	321,200	316,200
Universities, etc., special grants	——	145,000
Scotland.		
Public education	2,544,742	2,609,905
National galleries	4,522	4,878
Ireland.		
Public education	1,812,704	1,805,919
Intermediate education (Ireland)	40,000	40,000
Endowed Schools Commissioners	905	900
National Gallery	1,845	2,165
Science and art	149,453	146,287
Universities and colleges ...	114,000	124,000
Total	£20,448,508	£20,974,949

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A PRIZE fellowship of about 100*l.* is offered by the Federation of University Women for research of direct national value in the present crisis. Candidates must have published original work. Applications will be received during the present month. Full particulars will be furnished, on request, by the honorary secretary of the federation, 28 College Court, Hammersmith.

THE President of the Board of Education will address a meeting to be held at Caxton Hall, Westminster, at 6.30 on Friday, April 14, on the future development of education in relation to science and commerce. Applications for tickets should be addressed to the secretary, Teachers' Registration Council, 47 Bedford Square, W.C.

AT the invitation of the Hon. Rupert Guinness there was an inspection of the new chemical laboratories of University College, London, on Friday last. The building is complete except in a few minor details, but much remains to be done before it can be fully used for the purposes for which it has been designed. To fit up the "William Ramsay Library," provide electric current throughout the building, and equip the important department of physical chemistry, the sum of 14,000*l.* is needed at once; and a further amount of at least 6000*l.* will be required for the development of research work, making 20,000*l.* in all. Of this amount, Sir Ralph C. Foster, Bart., the generous benefactor who had previously given 34,500*l.* towards the cost of the laboratories, has already contributed 5000*l.*, and Dr. R. Messel has given 500*l.* for the installation and equipment of the joint workshop for the departments of chemistry and physics. The provision of such a workshop as common ground for two branches of science, each of which formerly kept within its own compartment, is a sign of the times. Many of the most important advances made in chemical science of late years belong to physical chemistry, and the future rests largely with workers in this joint domain. When the laboratories at University College are properly equipped, the best possible provision will have been made for satisfactory instruction in all branches of chemistry. There will be a technical laboratory in which chemical processes can be tested on a large scale, with a view to their utilisation for manufacturing purposes, and several separate rooms are provided for general chemical research. The sum required to equip all the new laboratories as they ought to be equipped is small in comparison with the national gain which it will ensure. We trust that a few generous benefactors will see that it is speedily forthcoming. Donations should be sent to the Hon. Rupert Guinness, treasurer of the equipment and endowment fund, University College, W.C.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 30.—Sir J. J. Thomson, president, in the chair.—Prof. W. J. **Sollas**: Skull of Ichthyosaurus, studied in serial sections. The anatomy of the palate, including the form and disposition of the vomer, is described; there is no transverse bone. The parietal is split into two wings, an inner, which contributes to the roof of the cranial cavity, and an outer, which unites with the post-frontal and prefrontal to form a part of the orbital arch. This feature and the separate opisthotic recall the Chelonia. The columella cranii is an important bone which rises from the surface of the pterygoid to meet the descending limb of the parietal. A rather large pre-articular or goniale is present in the lower jaw. The hyobranchial apparatus proves more complicated than had been supposed, and is more akin to the Amphibia than the Reptiles. The relations of the bones in general are also more complicated. The prevalent squamous sutures are remarkable for their excessive overlap, an adaptive character met with also in the Cetacea. Ichthyosaurus, though a true reptile, possesses many characters in common with the stegocephalous Amphibia, so that a close comparison of the roof of the skull and the palate may be made with Loxomma, so well described by Dr. Watson. But it shares these characters with the Cotylosaurian reptiles also, and from this group it is probably descended. The nature of the material which enters into the composition of the Ichthyosaur bones, when these are of a black or deep brown colour, has been investigated, and is found to consist largely of coal. This had already been proved in the case of Coccosteus. As the bones of the Palæozoic Coccosteus have become converted into "stone" coal of the same nature as that furnished by Palæozoic plants, so the bones of the Mesozoic Ichthyosaurus have been converted into "brown" coal of the same nature as that furnished by Mesozoic plants.—Dorothy J. **Lloyd**: The relation of excised muscle to acids, salts, and bases. (1) Acids and alkalis both cause swelling in excised muscle. The degree of swelling is not directly proportional to the concentration of acid on alkali in the surrounding fluid, but has a maximum at 0·005 normal for hydrochloric acid and for caustic soda. Alkalis first coagulate and then re-dissolve the muscle substance. (2) The chlorides of the alkali and alkaline earth metals all ultimately coagulate the protoplasm of an excised muscle in isotonic solutions. The bivalent kations show this effect much more rapidly than the monovalent. (3) The iso-electric point for muscle is between $P_H = 5$ and $P_H = 7$. (4) It is suggested that the swelling and shrinking of muscles, both in the body and out, is an osmotic phenomenon, and that the state of aggregation of the colloids of the muscle substance is the chief determining factor which fixes the degree of swelling. Lillie's demonstration that acids and alkalis raise the osmotic pressure of gelatin, while the neutral salts lower it, is in harmony with this view. (5) The osmotic phenomena of muscle can be fully explained without assuming the presence of a semi-permeable membrane round the muscle fibres.—J. C. **Willis**: The endemic flora of Ceylon, with reference to geographical distribution and evolution in general.

Physical Society, March 10.—Prof. C. Vernon Boys, president, in the chair.—S. **Skinner**: Experiments illustrating the flow of heat in conducting sheets. If a sheet of tinned iron be heated locally by means of a Bunsen burner or blowpipe the tin is melted for a certain distance from the heated region. On allowing the sheet to cool the resolidified tin is separated from the unmelted tin by a very sharp line of demarcation. This line gives the equi-temperature curve corresponding to the melting point of tin. By pushing the heating to a greater or less extent a series of such equi-temperature curves can be obtained for a sheet of any particular shape heated at any given point. The cases shown illustrated the flow of heat into a rectangular plate from a heated tongue; into a circular disc from a heated tongue; round the corner of an L-shaped strip and into the vanes of an air-cooled cylinder. The results were shown to be closely analogous to the flow of electricity in similarly shaped conductors.—Dr. R. S. **Willows** and H. T. **George**: The absorption of gases by quartz bulbs. The experiments are a continuation of those of Willows (*Phil. Mag.*, April, 1901) and Hill (Phys. Soc., December, 1912) on the absorption of gas which is brought about by electrical discharges. A new quartz bulb does not absorb air, but if it be fed with repeated doses of hydrogen—which are absorbed when an electrodeless discharge is passed—it then becomes very active. If discharges in hydrogen are alternated with those in air the bulb can be made to absorb large quantities of either gas, and the activity with each gradually increases. The authors reject the theory of surface absorption and, in their own experiments at least, also Swinton's theory that the gas is shot into the walls and held there. It is supposed that chemical actions occur with air, and oxidation products are formed; these are reduced by hydrogen.

Linnean Society, March 16.—Prof. E. B. Poulton, president, in the chair.—C. C. **Lacaita**: Plants collected in Sikkim, including the Kalimpong district, April 8 to May 9, 1913. The author gave an account of his circular journey from Darjiling to his starting point, part of it with the party of H.E. the Governor of Bengal. The monotony of the forest region was mentioned, and the marvellous abundance of the Aroids.

PARIS.

Academy of Sciences, March 20.—M. Paul Appell in the chair.—Pierre **Duhem**: The hypothesis of Faraday and Mossotti, and on certain conditions verified at the contact of two dielectrics.—J. Comas **Solà**: Some remarks on the great nebula in Orion (1976 N.G.C.). The results of stereoscopic observations and photographic comparisons are given, from which it would appear that there is a proper movement of the more brilliant parts of the nebula of the order of 0·025″ per annum. Internal transversal movements of the filaments of the above nebula and also of the nebula H.V. 30, 1977 N.G.C. were also detected with certainty.—T. H. **Gronwall**: A functional equation in the kinetic theory of gases.—M. **Riquier**: Partial systems of the first order to which the Jacobi method of integration applies, and the analytical prolongation of their integrals.—L. **Reutter**: Lacustral ambers. An account of analyses of five pieces of amber of well-authenticated origin, three from the Baltic, two from Italy. Clear differences could be detected between the German and Italian ambers.—N. **Arabu**: The existence of the Hipparion fauna in the Sarmatian of the basin of the Sea of Marmora and its consequences for the classification of the Neogene in south-eastern Europe.—Maurice **Lugeon**: The rose coloration of certain rocks of the massif of the Aiguilles Rouges. The coloration is shown to be due to iron and its peculiarities are described. A theory of the cause of its origin is proposed.—Ph. **Glangeaud**: The Pavin crater lake and the volcano of Montchalm, Puy-de-Dôme.—Mlle. Yvonne **Dehorne**: A milleporoid Stromatopore of the Portlandian.—Henri **Fouqué**: The ferments of pineapple wine. Of four yeasts isolated, two were certainly Saccharomyces, and two were doubtful yeasts between Mycoderma and Torula.—E. **Demoussy**: The influence of hydrogen peroxide on germination. Old seeds, which may have preserved their germinating power, may fail to germinate under conditions favourable to the growth of young seeds if these conditions are more favourable to the development of parasitic micro-organisms requiring oxygen for their growth. In the presence of dilute solutions of hydrogen peroxide a considerable proportion of such seeds will germinate. A result of practical importance follows from this, that tests of germinating power carried out under laboratory conditions may lead to seeds being regarded as bad, whilst the same seed, grown in the soil, may prove to be of average quality. This conclusion is confirmed by results obtained in practice with seeds of beetroot.—V. **Ferrand**: A modification of the method for the sterilisation of drinking water by sodium hypochlorite. Hydrogen peroxide is proposed for the removal of the excess of hypochlorite instead of the commonly used sodium thiosulphate. There is a saving of time in the sterilisation.—MM. **Dalimier** and **Lévy-Franckel**: The

102 of Danysz in the treatment of malignant or grave syphilis. Cases which followed the ordinary course are not dealt with in the present paper, which is concerned with twenty-two cases of abnormal, or particularly severe syphilis. The results are strongly in favour of the treatment.—E. **Bataillon**: New experiments on the fecondation membrane in the eggs of Amphibia.

BOOKS RECEIVED.

Our Cottage and a Motor. By W. Moncreiff. Pp. 163. (London: G. Allen and Unwin, Ltd.) 3*s*. 6*d*. net.

Meteorites: their Structure, Composition, and Terrestrial Relations. By Dr. O. C. Farrington. Pp. x+233. (Chicago: The author). 2 dollars.

Rambles of a Canadian Naturalist. By S. T. Wood. Pp. vii+247. (London: J. M. Dent and Sons, Ltd.) 6*s*. net.

The Germans. By Rt. Hon. J. M. Robertson. Pp. viii+291. (London: Williams and Norgate.) 7*s*. 6*d*. net.

Women and the Land. By Viscountess Wolseley. Pp. xi+230. (London: Chatto and Windus.) 5*s*. net.

Report for 1915 on the Lancashire Sea-Fisheries Laboratory at the University of Liverpool and the Sea-Fish Hatchery at Piel. Edited by Prof. W. A. Herdman. No. xxiv. Pp. 62. (Liverpool: C. Tinling and Co.)

Cambridge Tracts in Mathematics and Mathematical Physics. No. 2: The Integration of Functions of a Single Variable. By G. H. Hardy. Second edition. Pp. viii+67. (Cambridge: At the University Press.) 3*s*. net.

Hydrodynamics. By Prof. H. Lamb. Fourth edition. Pp. xvi+708. (Cambridge: At the University Press.) 24*s*. net.

Catalogue of the Ungulate Mammals in the British Museum (Natural History). Vol. v. By R. Lydekker. Pp. xlv+207. (London: Longmans and Co., and others.) 7*s*. 6*d*.

British Museum (Natural History). Report on Cetacea stranded on the British Coasts during 1915. By Dr. Harmer. Pp. 12. (London.) 1*s*. 6*d*.

The Involuntary Nervous System. By Dr. W. H. Gaskell. Pp. ix+178. (London: Longmans and Co.) 6*s*. net.

The Deposits of the Useful Minerals and Rocks: their Origin, Form, and Content. By Profs. F. Beyschlag, J. H. L. Vogt, and P. Krusch. Translated by S. J. Truscott. Vol. ii. Pp. xxi+515–1262. (London: Macmillan and Co., Ltd.) 20*s*. net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 6.

ROYAL SOCIETY, at 4.30.—The Instability of the Pear-shaped Figure of Equilibrium of a Rotating Mass of Liquid: J. H. Jeans.—A Hypothesis of Molecular Configuration in Three Dimensions of Space: Sir William Ramsay.—The Motion of Solids in a Liquid Possessing Vorticity: J. Proudman.—The Occurrence of Gelatinous Spicules and their Mode of Origin in a New Genus of Siliceous Sponges: Prof. A. Dendy.—The Ultra-Violet Absorption Spectra of Blood Sera: Dr. S. J. Lewis.

LINNEAN SOCIETY, at 5.—On Five New Species of Edwardsia, Quatr.: Prof. G. C. Bourne.—A New Species of Enteropneusta from the Abrolhos Islands: Prof. W. J. Dakin.—The Southern Elements of the British Flora: Dr. O. Stapf.

FARADAY SOCIETY, at 8.—The Making of a Big Gun: Dr. W. Rosenhain.

FRIDAY, APRIL 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—Notes on the Corallian of the Oxford District: M. Odling.—The Glacial Geology of the Hudson Bay Basin: J. B. Tyrrell.

SATURDAY, APRIL 8.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

MONDAY, APRIL 10.

ROYAL SOCIETY OF ARTS, at 4.30.—Surveying: Past and Present: E. A. Reeves.

ARISTOTELIAN SOCIETY, at 8.—Parmenides, Zeno, and Socrates: Prof. A. E. Taylor.

TUESDAY, APRIL 11.

ROYAL INSTITUTION, at 3.—Modern Horticulture—Old and New Methods of Forcing (The Breaking of Rhythm): Prof. F. Keeble.

ROYAL SOCIETY OF ARTS, at 4.30.—The Forest Resources of Newfoundland: Sir Daniel Morris.

WEDNESDAY, APRIL 12.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—President's Address.—The Work of the Load Line Committee: Sir Philip Watts.—Some Questions in Connection with the Work of the Load Line Committee: W. S. Abell. At 3.—The Laws of Skin Friction of a Fluid in Stream Line and in Turbulent Motion along a Solid of Great Length: Dr. C. H. Lees.—Skin Friction Resistance of Ships and our Useful Knowledge of the Subject: G. S. Baker.—Experiments to Determine the Resistance of Bilge-keels to Rolling: Prof. T. B. Abell.—An Experimental Tank Reproducing Wave Motion: Col. G. Russo. At 7.30.—A Brief Summary of the Present Position of the Marine Diesel Engine and its Possibilities: Eng.-Lieut. W. P. Sillince.—The Co-ordination of Propeller Results: J. D. Young.—Note on Maximum Propulsive Efficiency of Screw Propellers: T. C. Tobin.

THURSDAY, APRIL 13.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Discussion:* The Present Position of Electricity Supply in the United Kingdom; and the Steps to be taken to Improve and Strengthen it.

CHILD STUDY SOCIETY, at 6.—Experiments on Hand-writing in Schools: Dr. C. W. Kimmins, Mrs. Grainger, and Miss Golds. At 7.30.—Annual Meeting.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—Subdivision of Merchant Vessels: Reports of the Bulkhead Committee, 1912–1915: Sir Archibald Denny.—Strength of Watertight Bulkheads: J. F. King.—Some Effects of the Bulkhead Committee's Reports in Practice: A. T. Wall. At 3.—Notes from a Collision Case: J. Reid.—Shipyard Cranes of the Rotterdam Dockyard Company: M. G. de Gelder.

FRIDAY, APRIL 14.

ROYAL INSTITUTION, at 5.30.—The Genesis and Absorption of X-Rays: Sir J. J. Thomson.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Theory and Practice in the Filtration of Water: W. Clemence.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, APRIL 15.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

OPTICAL SOCIETY, at 8.—Practical Workshop and Laboratory Measurements: S. D. Chalmers.—Some Further Notes on Focometry: T. F. Connolly.

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