THURSDAY, MARCH 15, 1917.

HUNGER AND APPETITE.

(1) *The Control of Hunger in Health and Disease.* By Anton Julius Carlson. Pp. vii+319. (Chicago: University of Chicago Press; Cambridge: At the University Press, 1916.) Price 9*s.* net.

(2) *Food and Health: An Elementary Text-book of Home Making.* By Prof. Helen Kinne and Anna M. Cooley. Pp. vi+312. (The Home-Making Series.) (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1916.) Price 3*s.* net.

(1) PROF. CARLSON gives, in this volume, a general account of the work done, chiefly in his laboratory, on the physiology of hunger and some related questions. He was fortunate to have as subject of experiment a man who possessed a gastric fistula, made in consequence of an œsophageal stricture when he was a boy. Experiments were also made on Prof. Carlson himself and other normal subjects, as well as on dogs and lower animals.

The net result of the investigation is to show that the sensation of hunger is due to a periodic series of rhythmic contractions, which take place in the stomach when empty. Haller had suggested this cause, but thought that the sensation was produced by the rubbing together of folds of the mucous membrane. Prof. Carlson shows that the sensation has its origin in receptors in the muscle substance itself. The contractions are started in the stomach, although their rhythm is slightly altered after the stomach is separated from the central nervous system. When food is taken the hunger contractions cease for a few minutes, and then the movements of digestion begin. These differ from the hunger contractions, being primarily concerned with the pyloric end, whereas the latter are initiated at the cardiac end and pass as peristaltic waves over the whole stomach. It would seem that the only satisfactory explanation of the digestion contractions is that they are brought about by the central nervous system, the hunger contractions being inhibited for the purpose. This inhibition can be produced by sensations of taste, or by the presence in the stomach of water, gastric juice, acid, alkali, oil, and other things, or in the intestine of gastric juice, acid, or alkali. It is interesting to note that alcohol inhibits hunger, while it may increase appetite. Appetite, in fact, is quite different from hunger, being rather a mental anticipation of pleasant sensations to come. It is, however, more complex than this, as the discussion in Prof. Carlson's book shows. We know that appetite may be present without hunger, and the experience of fasting men is that hunger may be present without appetite.

The nerves that convey the afferent impulses produced by the hunger contractions are the vagi. As already stated, these contractions are not set into action by any stimuli from the outside, although they can be thus inhibited. The channels of inhibition appear to be chiefly through the splanchnic nerves, but central inhibition of the tone of the vagus centre also plays a part. We find, therefore, a further case of reciprocal innervation of the kind described by the reviewer in vaso-motor reflexes.

Various other questions are elucidated incidentally. The sensibility of the gastric mucous membrane to heat and cold is shown to be a true one, and Head's statement as to its protopathic nature is confirmed.

The want of food, even in protozoa and plants, is manifested by increased excitability and restlessness. In animals this state induces them to take food, because they have learned that food abolishes the feeling.

The book concludes with observations on the secretion and the chemical properties of human gastric juice, and with the discussion of hunger and appetite in disease. As a practical general conclusion we may note that the physiological way of increasing hunger and appetite is moderation in the amount of food taken, or increasing the utilisation of food by outdoor living, fresh air, cold baths, and muscular exercise.

The book is a very valuable and interesting account of a somewhat neglected branch of physiology.

(2) This manual is of a different nature. Although intended primarily for use in schools, it contains a mass of useful information for all concerned with occupations in the home. It is chiefly concerned with the preparation of food, but includes instructions for its preservation, and also for the raising and selling of poultry and so on. The making and properties of bread are described in considerable detail.

The physiological facts are correctly given, and the explanation of the energy value of food and the unit in which it is expressed, the Calorie, is particularly well done. There are, however, one or two surprising omissions. No reference is made to the "accessory factors" of food, or to the misuse of alcohol, although we have a warning against the far less serious misuse of tea and coffee. Perhaps the alcohol question is not so pressing in the United States as with us.

Both books are well provided with illustrations, and contain indexes and references to literature for those who wish to follow up the subject in more detail. Many otherwise excellent works lose much of their value owing to the absence of one or other of these indispensable components.

W. M. BAYLISS.

THEORETICAL AND PRACTICAL PHYSICS.

(1) *A Text-book of Physics.* Edited by A. Wilmer Duff. Fourth edition, revised. Pp. xiv+692. (London: J. and A. Churchill, 1916.) Price 10*s.* 6*d.* net.

(2) *Practical Experiments in Heat.* Pp. viii+123.

(3) *Practical Experiments in Light.* Pp. viii+112. By W. St. B. Griffith and P. T. Petrie. (London: Rivingtons, 1916.) Price 3*s*. 6*d*. net.

(1) THE fourth edition of the "Text-book of Physics" edited by Prof. A. Wilmer Duff shows numerous changes, especially in the paragraphs dealing with the dynamics of rotation. A new part on sound has been prepared, in which recent important work is described, including the researches of Prof. Miller by means of his "phonodeik" and the experiments of Prof. Sabine on architectural acoustics. A careful study of the results obtained by the latter investigator has shown that attempts to reduce reverberation by stretching fine wires across a hall or by similar devices are entirely useless. Other sections of this excellent treatise have also been brought up to date; we notice an interesting account of Dr. Langmuir's mercury-vapour pump, which is given high praise: "Because of its remarkable simplicity and rapidity of action, it marks a great advance in methods of obtaining high vacua." The only criticism of the volume we have to make is that some of the illustrations (*e.g.* the tangent galvanometer, p. 384) are scarcely worthy of the text.

(2) and (3) The authors of these text-books on practical physics are masters at Uppingham School, and they have found, as have other teachers, that a laboratory guide, either written or printed, is requisite for the efficient teaching of large classes. There are drawbacks to every method of instruction; some students are met with who, from mental inertia or defective elementary education, seem incapable of following the description of an experiment given in print, whilst they can understand an oral account. Others, again, slavishly follow the printed page, and will even copy the diagram in their text-book instead of sketching the actual apparatus used. In such cases it is, perhaps, unfortunate that all the quantitative experiments should be illustrated by worked-out numerical examples. The books under discussion are intended "for the use of boys between the ages of thirteen and twenty." Their chief recommendation is the large number of simple experiments which can be carried out without the use of elaborate apparatus. Graphical methods are rightly emphasised, and a word of praise must be given to the clearly drawn graphs reproduced in the text. Some of the other diagrams in "Heat" are not quite so satisfactory.

The directions given are, as a rule, lucid and exact, but occasionally we find a misleading or careless sentence—*e.g.* "Do not touch the calorimeter and use the thermometer as a stirrer" (p. 50); "The temperature of different Bunsen flames vary considerably" (p. 71). The authors do not appear to realise that convection plays a more important part than radiation in the cooling of a hot body. In the chapter on calorimetry (one of the best in "Heat") the calorimeter, "bright on the outside," should not be exposed on the bench, but be supported in an outer metal vessel or be wrapped with cotton-wool and put in a beaker. The account of Newton's law of cooling is defective for the same reason. It is to be regretted that in the experiment on Boyle's law the results are tabulated with six significant figures, though the observations contain only three figures. The authors have not even the excuse of Biot, who, when his attention was drawn to a similar case, replied sarcastically that if the first figures were wrong, perhaps the last would be right. In Regnault's hygrometer the end of the boiling tube must be cut off before the metal thimble is cemented to it. There are in all fifty-nine experiments in "Heat" and sixty-eight in "Light." The experiments in "Light" are of the type now familiar, pin methods being employed frequently. In the first experiment, which purports to show that light travels in straight lines, it is necessary to prove that the hat-pin (used to test the alignment of the holes in the three cardboard screens) is straight. As an optical method is inadmissible, this might be done by fixing two of the screens, rotating the hat-pin, and noticing whether there is any lateral displacement of the third screen. The questions addressed to the student form a valuable feature in connection with the earlier part of the Light course. H. S. A.

THE TECHNOLOGY OF TYPOGRAPHICAL PRINTING SURFACES.

Typographical Printing-surfaces: the Technology and Mechanism of their Production. By L. A. Legros and J. C. Grant. Pp. xxiv+732. (London: Longmans, Green and Co., 1916.) Price 2*l*. 2*s*. net.

THIS work is the outcome of a paper read by one of the authors before the Institution of Mechanical Engineers a few years ago: the paper created at the time some amount of interest in the printing world owing to the thoroughness with which it had been prepared. That matter has now been considerably enlarged—perhaps too much so in some instances—but we must readily admit the usefulness of the bulk of the information collected together, because of its previously being scattered abroad in many directions, and due credit must be given to the compilers for the great labour involved in bringing together so much valuable material; certainly as a work of reference on its subject the book will be found most useful.

The volume is jointly dedicated to our first authority on printing, Joseph Moxon, 1627–1700, and to the French writer, Simon Fourrier, another great authority, 1712–68, and is a stupendous work of its kind. As it professes, it covers a good deal of the ground which hitherto has been but scantily treated, so far as type-founding is concerned, in any English text-book on printing ever published. In fact, Moxon, in his "Mechanick Exercises," 1683, is the only writer who has attempted to deal with this subject to any extent. Naturally, at that period Moxon treated of typefounding by the hand method of casting, but in the large work now under notice the founding of even single letters is shown to be produced by many machines of various kinds. Hand-casting is rarely used nowadays, except for the occasional casting of small orders or for special purposes. Further, in adopting mechanical means many of the preliminary and finishing stages needful in the old hand method are now dispensed with.

Even as hand-press work is not to be compared with the output of the power-press, so it is with typefounding—thousands of letters are now turned out in the place of a single hundred, and the comparison is even greater when the rotary system of casting is employed.

As its title implies, the work is confined to the production of typographical surfaces of all kinds, and this covers a very wide range indeed. It includes not only hand-set types and those composed by different machines, but engraved blocks, reproductions by the stereotype and electrotype methods, process blocks, and all other surfaces in relief. The details of designing type faces—a most important matter if a good fount is desired—punch cutting, and the making of the matrices and moulds for the final stage of casting, are all admirably described, particularly so from both the draughtsman's and the engineer's point of view. Besides very full and concise descriptions of the various casting machines in use at the present time, the different systems of type-composing machines from their first conception up to recent date have several chapters devoted to long and technical descriptions.

In addition to several useful appendices, much other information of a general character is given—most interesting to those practising, or who are students of, the art of printing—which stamps the volume as a valuable work of reference.

The numerous diagrams have been very carefully drawn, and the reproductions of other illustrations are equally well rendered. These, with a number of useful tables, a technical vocabulary in three languages, and a very full index, complete a work which must create a demand for its possession.

The authors are deserving of praise for the careful labour they have bestowed on the compilation of this bulky and useful volume. It certainly must be a great revelation to non-technical readers, who can have but a faint idea of the vast amount of detail underlying the fundamental stage of preparing typographical surfaces for the printing press, the greater portion of which only developed during the closing years of the nineteenth century. It all helps to prove how necessary a scientific training is for the technical education of our future craftsmen.

The typographical production of the book itself must have been a great tax on the resources of the printers responsible, and they are to be congratulated on the result.

IS VARIATION A REALITY?

Evolution by Means of Hybridization. By J. P. Lotsy. Pp. viii+166. (The Hague: Martinus Nijhoff, 1916.) Price 6*s*. net.

DR. LOTSY'S book is one of many signs that biologists are growing uneasy about the adequacy of evolutionary theory. By whatever doubts the doctrine of Selection was assailed, it has hitherto been common ground that in their generations the forms of life varied abundantly, and that somehow through these variations the diversity of species had come to pass. Modern genetic research has led to the paradoxical discovery that much of the best evidence of variability is capable of other interpretations. Consider the "variation" of any polymorphic moth. No one doubted that from any of the varieties any other might be bred. Now we see that was a mistake. Such variation is not promiscuous, and the varieties are really an orderly series consisting of distinct types which will breed as true as any species, and of mongrel forms which can throw certain fixed types, and those only. The Mendelian conception of the homozygote has raised a new problem. The question arises: Can the offspring of homozygotes vary? Dr. Lotsy is sure they cannot. New forms can only come by crossing. That is the thesis of this book. "*Crossing, therefore, is the cause of the origin of new types; heredity perpetuates them; selection is the cause,* not of their origin, as was formerly supposed, *but of their extinction.*"

This is a bold pronouncement, and it contains much of truth. We think not merely of the many species suspected of hybrid origin, but comprehensively of the innumerable species, now perfectly distinct, which can quite reasonably be thought of as segregates derived from some cross ages ago. Few also now believe that the domesticated forms comprising many breeds really had single origins. Apart from difficulties introduced by exact genetic knowledge, modern writers have felt driven to suggest "polyphyletic" origins for pigeons, fowls, dogs, cereals, the common fruits, etc. Almost whenever the history of a modern breed is known it can be traced to a cross. Dr. Lotsy took over a wonderful F_2 from a cross in Antirrhinum made by Prof. Baur, and, as he rightly says, it contained many types capable of perpetuation as incontrovertible species. Most geneticists have seen such series and been tempted to similar conjectures. But Dr. Lotsy is for taking still wider flights. Geology shows, he says, that new classes appear suddenly with many highly differentiated forms—the Cycads, for instance, of Mesozoic times. May not they be the direct consequence of some cross? Perhaps; but whence came the original diversity? Why were there distinct forms ready to be crossed? We find no answer to that fundamental question. In the view of the present writer, too, the doctrine of invariability of the homozygote cannot be maintained. Variability is rarer than we supposed, but it is a genuine phenomenon witnessed in unimpeachable examples.

The book will do good if it rouses any reader from the torpor of an easy orthodoxy. It may excite doubts, if it cannot allay them. The language and printing of the book make it something of a curiosity. Cosmopolitanism is a virtue we are glad to meet in these days. Still, English *à la Hollandaise* is a sore distraction in a serious book.

W. BATESON.

OUR BOOKSHELF.

The Biology of Tumours. By C. Mansell Moullin. Pp. 55. (London: H. K. Lewis and Co., Ltd., 1916.) Price 2*s*. 6*d*. net.

THIS book comprises the Bradshaw Lecture, somewhat extended, delivered by Mr. Mansell Moullin before the Royal College of Surgeons in 1912. The author admits that the conclusions he has arrived at differ in many particulars from the views that are generally current; nevertheless, his suggestions are stimulating, and in the present state of our knowledge of the causation of tumours it cannot be said that they are erroneous. Mr. Moullin divides tumours by their mode of origin into two classes: one due to the sudden awakening of the innate reproductive power of the tissues, in virtue of which they give birth to "buds" that grow into tumours; the other due to details of structure not being carried out so completely as they ought to be. The distinguishing feature of the former class of tumours is their independence: they grow quite irrespective of the tissue in which they develop. This group includes the vast majority of tumours, innocent and malignant. Development is the influence which restrains the potentiality possessed by the cells of the tissues to multiply indefinitely, and is due to chemical influences. All that is needed, then, for tumour formation is some exciting cause, mechanical or chemical, to give the growth a start. Thus, multiple tumours of the skin may develop from the prolonged administration of arsenic, tumours of the bladder are relatively common in workers in fuchsin, and cancer of the skin often follows the continued application of soot, tar, and paraffin.

We believe we have stated the author's views correctly, though they are somewhat difficult to follow, and it would have been useful had he given a brief summary at the end of the book. In some respects the hypothesis is similar to that of Ross, who regards certain chemical substances—"auxetics," as he terms them—as capable of inducing cellular proliferation.

Atoms. By Prof. Jean Perrin. Authorised translation by D. Ll. Hammick. Pp. xv+211. (London: Constable and Co., Ltd., 1916.) Price 6*s*. net.

THE appearance of the authorised translation of Prof. Perrin's book, "Les Atomes," is very welcome. It is true that the demand for translations into English of ordinary French scientific works is not great, but books of the semi-popular kind such as the one under review are in a rather different category. A student with only a moderate knowledge of French may read with advantage a standard French treatise, but he would be apt to miss the point of many of the illuminating illustrations and analogies with which Prof. Perrin's work abounds.

Mr. Hammick is to be congratulated upon the excellence of his translation. Without previous knowledge, one would scarcely suspect that the book is a translation at all—it reads as though it had been written in English in the first instance. And yet, upon comparison with the original, it is found that the translator has adhered remarkably closely to the text. A few small errors have survived revision—for example, the use of *definitely* for *definite* on p. x, line 26, and *which* for *who* on p. 207, line 37.

The original French edition has been already reviewed. In the present translation there is an additional paragraph dealing with Mr. C. T. R. Wilson's beautiful photographs of the paths of α and β particles. The book is well bound and printed, and is unhesitatingly recommended both to those who will appreciate a popular exposition of the subject, and to those to whom it is of interest to survey the modern methods and results in widely differing fields of research converging towards the same end.

LETTERS TO THE EDITOR.

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Thermodynamics and Gravitation.

THE Carnot cycle in Dr. G. W. Todd's interesting letter (NATURE, March 1, p. 5) leads by a ready extension to the result that if the force of gravitation on a body depended on its temperature, and thermodynamics were applicable, there must be interaction between the gravitational field sustained by a body and its thermal molecular energy; so that part of the exhaustion of energy of position when the field does work on the body would go to increase its store of heat, only the remainder appearing as work done. Thus when, owing to displacement of a body of mass m in the field of force, work δW is done *against* the field, so that energy δW is gained, then also heat must be gained by the body of amount $-\frac{T}{m}\frac{d}{dT}\delta W$, if its temperature is not to change. There would be dissipation of energy involved in the diffusion of such heat, just as in the case of heat of compression in sound-waves of very slow period. Only in two ideal limiting cases will there be conservation, and then δW will be the increment, arising from the displacement alone, of a function of position and also temperature, which thus constitutes a gravitational potential W: in these cases the heat of the body will depend definitely on its temperature T and its position in the field of force, the latter contributing an amount constant $\frac{T}{m}\frac{dW}{dT}$. These two cases, of some curious theoretical interest, are: (i) that of a universe isolated in an enclosure maintained isothermal by internal radiation; (ii) that of an adiabatic universe in which there is no exchange of heat by radiation or contact.

Reverting to the formula: if the gravitation exerted on m increased by the fraction $1/k$ of itself for a rise of $1°$ C. in temperature, then at temperature $0°$ C. a change of gravitational energy into work would be accompanied, on Carnot's principle, by a gain of thermal energy equal to $273/k$ of its amount, which could scarcely escape notice unless k were large.

The sign in Dr. Todd's relation (1) seems to require change. An objection applies to his hypothesis (2) that it leads him to a temperature term in the law of force which has the same value at all distances.

Cambridge, March 4. J. L.

THE interesting letter from Dr. G. W. Todd in NATURE of March 1 opens new ground on the subject of gravitation and temperature. But does not the expression found need some modifications? Thus, in the general case with m at temperature θ and M at temperature Θ, we might write for the force the expression

$$F = G\frac{Mm}{r^2} + A\,(M \log \Theta + m \log \theta).$$

But even when thus generalised, the formula still seems unsatisfactory. Has Dr. Todd considered how to deal with the following curious facts?—(1) The temperature corrections vanish at *unit* temperature; (2) at the temperature of absolute zero the attractive force becomes *minus infinity, i.e.* an *infinite repulsion*! (3) the temperature correction is given as independent of r, the distance apart of the masses. Hence

$$\frac{\text{temperature correction to force}}{\text{force itself}} \propto r^2.$$

Thus, for large values of r, the temperature correction to the force might exceed the Newtonian value of the force itself. E. H. BARTON.

University College, Nottingham, March 8.

Floating Earths.

WILL any of your readers kindly help in elucidating a passage of Strabo? It occurs in his Book XIII., i., 67. The Greek is fairly plain, so a translation will suffice:—

"It is said that at Pitane the bricks float on water, which has occurred also in the case of an islet in Tyrrhenia; for the earth is lighter than an equivalent bulk of water, so that it rides on the surface. Posidonius also says that he saw in Iberia a certain argillaceous earth, used for taking moulds of silver work, from which bricks were made which floated."

The site of Pitane is the modern Chandarli, or Sandarli, a small harbour on the west coast of Asia Minor, about 30 miles north of Smyrna and 15 miles south-west of Bergama (Pergamon). Tyrrhenia is, of course, Tuscany. Iberia is, no doubt, in this case Spain. The name is also used for a district in the Caucasus practically identical with the modern Georgia; but without qualification it should mean Spain; and Strabo elsewhere quotes Posidonius as an authority on natural phenomena in that country.

The two "earths" which occur to me as floating on water are pumice and meerschaum. Meerschaum is, of course, found in Asia Minor; Eski Shehr is the principal source. But that is a long way from the west coast, and I can find no record of its occurrence anywhere near Pitane. In any case, it does not seem likely that it should have been used for building purposes; and the use of the definite article, "the" bricks (τὰς πλίνθους), seems to imply that the substance in question was the ordinary building material of the district.

Pitane lay on the south side of the Kara-dagh, a large mass of eruptive rocks, andesite overlying tuffs, as I learn from Philippson, who has described the formation (*Reisen u. Forsch. im westl. Kleinasien*, Petermann's Mitth., suppl. 167 (1910), p. 95). It would seem, then, that in the case of Pitane the material must have been tuff. Is it possible that a tuff porous enough to float on water could be used as a building material, or that passably durable "bricks" could be made of it?

The floating "islet" in Tuscany may, I suppose, have been a mass of pumice from the Lipari Islands drifting northwards. Such islets are recorded to have floated about the Ægean Sea after the great eruption of Santorin in 1650, and even to have blocked some of the ports. But though the Lipari Islands contain enormous masses of pumice light enough to float, I can find no record of any having been actually ejected into the sea in historical times. Can anyone tell me if there is such a record?

The "argillaceous earth" in Spain clearly cannot have been tuff or pumice. Can it have been meerschaum? This material is, of course, capable of delicate carving; would it be suitable for making moulds for copying silver work? It is said that there are limited deposits of it in Spain. It may be noticed that the quotation from Posidonius does not imply that it was actually used for building, but says only that bricks "formed" (πηγνυμένας) from it will float. This may mean no more than that blocks of the shape and size of a brick will float. I am not clear as to the exact meaning of πηγνυμένας—whether it implies any process more than mere cutting. One would naturally expect it to mean "congealed" or "solidified." Meerschaum is, I understand, soft when dug, but hardens on exposure to the air. Perhaps, therefore, the word may mean "hardened." On the other hand, I feel confident that in the phrase ᾗ τὰ ἀργυρώματα ἐκμάττεται the verb is used in the technical sense of taking a mould or impression, not, as some have thought, with the trivial meaning, "with which silver work is cleaned."

Anyone who can enlighten an ignorant Hellenist on these points would be assured of his gratitude.

WALTER LEAF.

6 Sussex Place, Regent's Park, N.W., February 24.

SCIENTIFIC ASPECTS OF FUEL ECONOMY.[1]

THE appointment of a Board of Fuel Research by the Committee of the Privy Council for Scientific and Industrial Research on the recommendation of the Advisory Council was noted in NATURE of February 22, and something may perhaps be said with advantage on the real and pressing need for securing, so far as it may be done by official efforts, the fullest investigation of the potentialities of fuel.

To those occupied with the study of the scientific utilisation of coal, the crude and wasteful way in which we, as a nation, have been maltreating our supplies of that irreplaceable raw material has been for some time past a depressing spectacle. Recognition of the value of purely thermal economies has been fairly general, although the quantities of fuel used in feeding

[1] Report of the British Association Committee on Fuel Economy, September, 1916.
Memorandum by Chief Engineer, the Manchester Steam Users' Association, for the year 1915.

small steam-engines permit no unqualified statement to that effect; but the less instinctive appreciation of the chemical value latent in coal has been a slow, and is still a stunted, growth. Our recent needs for benzene, toluene, and phenol for the making of high explosives, and the publicity given to the coal-tar dye question, have opened many eyes to the value of carbonisation, apart from its production of coke for our blast furnaces and gas for our towns; but even now the iniquity of the prevalent nitrogen waste passes almost unnoticed. To regard coal always as a source of available heat, tar, and nitrogen is a habit of mind to cultivate; consistent condemnation and eventual elimination of methods of use which offer violent offence to that regard will follow.

The particular directions which reform will take, or ought to take, in the many uses to which coal is put are less obvious than the urgent necessity for reform. Carbonisation, with all its possible variation of methods and results, demands a closer systematic study on the small and large scale, in laboratories suitably equipped and staffed and in the works. Comparison of the results obtained by Wheeler at home and by Pictet abroad with those of ordinary coke-oven or gasworks practice shows the extent to which the nature and quantity of products are dominated by variation in conditions of operation, and emphasises the necessity for a thorough knowledge of the processes involved in the transition from primary to secondary products of carbonisation, with a view to their intelligent control.

The work of Bergius, although of uncertain value on the industrial scale, touches upon another possibility, that of carbonising under very high pressure; if successful, it would demand a new type of plant, somewhat analogous to that employed for the Haber synthetic-ammonia process, and presenting new problems of construction and working. At the other end of the scale stands carbonisation with reduced pressure, already under trial on a scale above that of the laboratory. Less removed from current practice in carbonisation are the low-temperature processes, such as the Del Monte, and the presumably improved form or development of the ill-fated Coalite process, which, it is hoped, will receive an adequate trial at Barugh. Several questions await an answer from such processes. It is conceded that they can produce tar rich in low-boiling-point constituents, but are these constituents to be mainly paraffinoid, as certainly seems probable, or aromatic, with benzene and toluene? The ammonia yield is in question; laboratory experiments indicate that a real beginning is not made in forming ammonia from coal by heating until a temperature of 500° C. is exceeded, and that 700° to 800° C. is necessary for a yield which the standard carbonising practice would call good. Soft coke has undoubted advantages for the open grate, but can it be made for carrying in bulk without crushing? These are some of the simpler issues.

As regards nitrogen, the Mond process, with its 60 to 70 per cent. recovery as ammonia, is satisfactory, but the gasification of coal in an air-steam blast gives of necessity a gas too highly diluted with nitrogen to be of any service for high-temperature operations, excepting in large furnaces where regeneration can be employed. The tar, too, has its peculiarities. Otherwise the process is successful in practice, as it is sound in principle, and all concerned with its initiation are to be doubly congratulated, in the first place on an extremely valuable contribution to the science and practice of fuel utilisation, and in the second on the comparatively advanced stage to which the working-out of the process had been carried before it was declared ready for use.

None of our methods of using fuel can be regarded as attaining the ideal, but the most disturbing factor in the situation is that such advances as we have made are not properly utilised; even to-day the great bulk of our domestic heating is done with raw coal in the open fire, and our great modern power-houses are mainly run with raw coal in their boiler furnaces. The pall of smoke over our cities signalises the daily sacrifice. Then, again, our metallurgical industries, although using gaseous fuel largely in regenerative open-hearth furnaces which do secure thermal economy, still neglect and destroy the chemical value of coal by gasifying without recovery of either tar or ammonia.

The country was never so ready as now to accept the application of a remedy for these evils, but must first feel that before it lies a rational treatment, based on a sane and sober diagnosis, and not on the facile verbalism of ill-considered propaganda. Some few simple prohibitions, automatically progressive in their application, may be found advisable, and, if so reasonable as to be practicable, would probably be effective in checking criminal waste, and at the same time encourage those developments in the technique of fuel utilisation on which we must depend ultimately for success.

There has been wanting sufficient systematic attention to fuel problems from investigators, administrators, and legislators alike. It is true that, owing largely to the initiative and foresight of Prof. Smithells, the University of Leeds (followed more recently by the Imperial College in London) has established a department of fuel technology, and that the gas industry has generously endowed there the Livesey chair in memory of a great leader; but how long has the paramount necessity for what were pioneering ventures a few years ago been recognised, and how very much more remains to be done before it can be claimed that the subject of the scientific utilisation of fuel is receiving anything like adequate study or the same degree of public support as is accorded in America and Germany. Committees are to the fore just now, and the British Association has appointed one, with Prof. Bone as chairman, for the investigation of fuel economy, the utilisation of coal, and smoke prevention; this may be one sign of an awakening. The terms of reference are wide, which consideration presumably justifies a list of members somewhat disconcerting in its length.

The committee has issued a first report, and if it relates intention rather than achievement, that is only natural at a time when so many of the committee must be very fully occupied with urgent national duties. The field has been mapped out, however, and a number of sub-committees appointed to give special attention to sectional work.

Having regard (says the report) to the magnitude of its work, and the fact that the coal question is one upon which almost every branch of manufacturing and transport industry is dependent, the original committee of thirteen members appointed by the Association in October, 1915, decided to exercise somewhat freely its power of co-option so as to make a general committee sufficiently large and representative of all the important interests involved.

The chemical and statistical sub-committee, with Dr. J. T. Dunn as chairman, is proposing to occupy itself with the chemical investigation of coal, the survey of the chemical character of the principal British coal seams, and an inquiry into the amount of wastage due to coal which for one reason or another is at present left behind in the pits. Another sub-committee, with Mr. T. Y. Greener as chairman, is to deal entirely with carbonisation. A return is to be prepared which, when completed,

will enable the committee to arrive at an approximate estimate of the margins of possible economies in the shape of improved utilisation of the coal carbonised, which can now be effected in the coking industry, and the directions in which further progress is likely to be made. A memorandum is also in course of preparation describing the more important developments of the by-product coking industry, from its inception until the present day.

"The committee would welcome the offer of proper facilities to enable them to investigate the question of low-temperature carbonisation."

Dr. J. E. Stead is chairman of the sub-committee for metallurgical, ceramic, and refractory materials, which is concerning itself mainly with ascertaining actual fuel consumptions in these industries, and

will endeavour to draw up a statement as to the best lay-out and arrangement of a combined by-product coking, iron-smelting, and steel-making plant, from the point of view of utilising as completely as possible surplus gases and waste heat, and thus realising the maximum fuel economy in the heavy steel industry.

A sub-committee on power and steam-raising, with Mr. C. H. Merz as chairman, is to investigate the economies in fuel which would result from the use of improved methods. Regarding the practice of to-day,

in view of the impossibility of obtaining accurate returns of fuel consumption per horse-power-hour from the whole of the power users in this country, it has been decided to investigate the matter by asking for detailed returns from typical factories in various trades and in different districts throughout the country, selected by members of the sub-committee who have special knowledge of particular trades. Special memoranda are in course of preparation on questions of organisation of power production for industrial and transport purposes, the use of large turbine- and gas-engines, and other important aspects of the power question.

Mr. E. D. Simon, secretary of the committee, is also acting as chairman of the domestic fuel sub-committee, which feels

that it will be wise to recognise at the outset that there is probably no single solution of the domestic heating problem which is likely to be universally adopted within any measurable period of time; and that, therefore, it should preferably concentrate its efforts upon questions of more immediate practical importance.

It proposes, therefore, to examine the possibilities of existing systems and methods, and also the relative efficiencies of coal-fired, gas-fired, and electrical heaters.

Arising out of the present extensive use of solid fuel in domestic fires, the sub-committee will also consider the important question of the prospects of substituting for raw coal some form of carbonised fuel (semi-coke or coke). There can be no doubt but that if such a substitution could be effected, without either increasing the domestic coal bill or involving some other disadvantage, not only would there be a great addition to the amount of valuable by-products annually obtained from coal consumed in the Kingdom, but also the smoke nuisance in our large centres of population would be materially reduced.

The scheme of work which the committee and its five sub-committees set out is frankly ambitious and highly comprehensive, and although this first report would be more accurately described as a prospectus, that peculiarity will presumably not attach to future issues.

A memorandum on a special aspect of the fuel question has been issued to the executive committee of the Manchester Steam Users' Association by Mr. C. E. Stromeyer, their chief engineer; it is concerned primarily with steam-raising. The author thinks that "our manufacturers have been spoiled by the ease with which they could obtain the very best coal in the world," and deplores "our almost universal practice of over-working boilers." On the Continent, he points out, first-class coal cannot be obtained, "but there the works provide themselves with ample boiler power, and, on the whole, they obtain a higher efficiency than we can hope for with our superior coal but hard-worked boilers." To use coke and conserve by-products would necessitate the same reform. "Steam users naturally do not like coke, partly on account of its relatively high price, and partly because it would require larger boilers than the present ones in which to burn it with as good effect as the best coal." But Mr. Stromeyer does not expect too much from this source; he considers a number of working results with steam-engines of various types, and concludes:—

The fuel economy question may therefore be briefly summarised by saying that hardly any improvement is likely to be effected in the economic working of boilers, for, as is well known, there is only a margin of about 20 to 25 per cent. to play with. Considerable pecuniary saving might often be effected by increasing the number of boilers, so as to be able to burn a poor and relatively cheap fuel if this can be got. Our chief hopes will therefore have to be centred on engine improvements, for here large savings might be possible, because at present about eight units are thrown away for every one doing useful work.

The steam turbine is regarded as combining the greatest number of advantages among the prime movers of to-day, and as an interesting novelty the Lundholm turbine is mentioned, consisting of two discs and blades revolving in opposite directions.

As there is no difference of expansion of the two discs there is every prospect that the clearances of the blades can now be reduced to a minimum, and that this very serious source of loss will be materially reduced.

The possibilities of the gas-engine, and particularly of the internal-combustion turbine, perhaps in the near future, appeal to Mr. Stromeyer and lead to the following :—

From a national economic point of view the combination of the internal-combustion engine with electric distribution of power would seem an ideal one. Our collieries would then be encouraged to mine even our dirtiest coal. This coal would produce by-products for farmers and for the coal-tar industries and supply the engines with suitable gas, and our factories would receive their power at a lower cost than they could produce it.

The general attitude of the author seems to be that of an experienced engineer, convinced that economy in power production is going to be so vital to us after the war that strenuous effort and a bold and encouraging policy as regards both invention and research are primary conditions of our continued commercial progress.

Although in all probability no such effective blight could be laid upon the work of scientific investigation in any field as that of undue centralisation and impossible regimenting, enough has perhaps been said to indicate that the scale of research necessary for adequacy in the domain of fuel necessitates, among other things, liberal financial support, and if the Government is going to provide that support it will naturally seek for guidance. Presumably the new Board of Fuel Research is to guide. Its director is Sir George Beilby, whose varied industrial and scientific experience should prove of the greatest value. Sir Charles Parsons, Mr. Richard Threlfall, and Sir Richard Redmayne will assist him as members of the board, and Prof. W. A. Bone will act as consultant. This form of organisation for research is new to the country and its working will be watched with great interest. There are pitfalls in the way, which it may be difficult to avoid, and would certainly be folly to ignore, but an administration directed with liberality of spirit to really national ends will go a long way to command success. JOHN W. COBB.

THE SEPTIC PROBLEM IN WAR.

OF all the many varieties of wounds with which surgery has to deal, incised, contused, lacerated, etc., the most dreaded one is the punctured variety. This is because the inflicting weapon is almost necessarily infected with pathogenic organisms, and because these organisms are therefore implanted in the depths of a long and narrow track, into which antiseptics can be made to penetrate only with considerable difficulty.

Of all punctured wounds those produced by gunshots are the most difficult to deal with. The reasons for this become obvious upon consideration. The mere force of impact, in the first place, is an unusual and important feature. The energy in foot-tons of a projectile of known weight and velocity can easily be calculated, and it is to be remembered that this energy is concentrated upon a small area, with the result that the actual track of such a missile in human tissues is a tunnel the walls of which are *dead tissues*.

The importance of this fact in favouring bacterial growth is immense. Moreover, the tunnel is surrounded by a cylinder of tissue of which the constituent elements are bruised and under the influence of local shock, so that their vitality and resisting power to bacterial invasion are reduced. If such a missile strikes hard bone, a high degree of shattering and splintering takes place, while portions of broken bone are driven into the surrounding muscles, sometimes lacerating important vessels and nerves, and even bursting through the skin, and forming a large opening known as an "explosive exit." Owing to the ballistic properties of the pointed bullet, which is now used by all countries, and which tends to turn over on its short axis on impact, the proportion of these severe wounds is somewhat greater than in previous campaigns.

Another difficulty in the case of gunshot injuries is their special liability to severe forms of septic infection in the circumstances of the present campaign. In South Africa military surgeons found that a large number of wounds, even when bone was involved, showed small wounds of entrance and exit, and, so far as infection was concerned, merely required cleaning and sealing to heal without trouble. This was in part due to the shape of the bullet and its tendency to traverse the tissues by a straight course without turning on its short axis. This meant small external openings, and therefore less liability to infection from them. But the chief cause of the immunity from infection was the comparative dryness of the country, and a soil for the most part uncontaminated by human occupation or cultivation.

The conditions in the European area of the present conflict are very different. The humidity of the climate is greatly in excess of that of South Africa, and intensive cultivation means copious manuring of the soil, so that most of the ground occupied by our troops is thoroughly sown with bacteria of fæcal origin, which include, besides those ordinarily called pyogenic or pus-producing, the special germs of tetanus, malignant œdema, and gas gangrene. It is in ground thus infected that our soldiers sleep, take their food, and are occasionally buried alive. Their skin and clothes are plentifully smeared with bacterial mud, and it is no matter for surprise that when a bullet passes into their bodies it carries with it, and implants in all the interstices of a deep and complicated wound, the potentialities of a surgical catastrophe.

That the bullet is infected by passing through muddy skin or clothing, often carrying with it portions of the latter, seems fairly certain. Some wounds in South Africa became infected when the bullet passed through the mouth or any part of the alimentary tract, both highly infective regions of the body. The bullet itself, when fired, is probably a fairly clean body from a surgical point of view. The sides are cleaned by the friction of the rifle barrel, and the base is seared by the flame of the explosion. Nevertheless Col. La Garde's experiments have shown that if deliberately infected before firing, it can be shown to be still carrying infection after firing.

The problem, then, which was presented by gunshot injuries was how best to combat sepsis in punctured wounds of all varieties, complicated often by bone injury and severe lacerations of soft parts, the bacterial infection coming usually not from the wound openings, but being deeply implanted by the actual stroke of the bullet as it passed through the tissues. Obviously, the mere application of even the most efficient antiseptics to the parts about the external wounds will not meet such a case. The infection must be attacked in the depths of the tissues, preferably at a very early date after the receipt of the wound, before the bacteria have time to multiply in the tissues. Moreover, practically all wounds of any depth must be dealt with thus. It would be bad surgery to wait until the infection was established, even though few signs of mischief appear at first. Accordingly it was soon recognised that the wound must be opened up, cleaned as far as possible, foreign bodies removed, and free exit provided for discharges by means of drainage tubes.

Some surgeons hoped that in a wound thus opened up, and thereby converted from a punctured to an incised type, it might be possible to remove the infection altogether, and here the advocates of the application of strong antiseptic solutions had their view. A mass infection can be completely destroyed by the application of, say, pure carbolic acid. At a very early stage of infection this may perhaps be possible, but not when the bacteria are in the depths of the tissues. Moreover, it is difficult to reach all the recesses of a large wound, and if one pocket is left unattacked, the surgeon's pains are thrown away. Strong antiseptic solutions, too, are very damaging to the tissues, which, it must be remembered, are in a condition of impaired vitality already. Another drawback to the use of antiseptic solutions, whether weak or strong, is the fact that many of them tend to become inoperative when in contact with the albuminous solutions like blood or pus. They form inert compounds with albumin, and will no longer destroy bacteria. It is claimed for an entirely new antiseptic, called from its colour flavine, that it actually proves more formidable to germs when in solution in blood-serum than in aqueous solution. But further trial is required before its value can be exactly classified.

Another device for the early removal of septic matter is to cut away the infected tissues bodily. The extremely localised nature of gunshot injury is a help in this case. It is possible to excise the entire internal surface of the wound *en masse,* with all its sinuosities and pockets, and to sew up the clean cavity remaining. This method enjoys the advocacy of Col. H. M. W. Gray, who has had success with it, but to be satisfactory it obviously must be done early, and requires in many cases considerable surgical skill. Cranial injuries and wounds of joints have been treated by this method with an encouraging measure of success.

But both the above methods can be effectively applied only when the wound is seen early, and in warfare this is not always possible. Many hours or even days may elapse before wounded men can be collected and carried to the casualty clearing stations. What, then, can be done when bacteria, deeply implanted in the tissues, are multiplying freely and in circumstances very favourable to their growth? Here the physiologist steps in and reminds the surgeon that the living body has its own guards against bacterial invasion; that healthy blood fluids are inimical to the growth of many, though not of all, bacteria; that the white corpuscles, the so-called phagocytes or germ-eaters, form an immense army for home defence; and that the effect upon the body of the absorption of the special toxins produced by bacterial action is to cause it to elaborate a neutralising substance or antitoxin. Here, then, is the physiological basis both of the salt method and of the vaccine method of treatment. It is found that if a strong or saturated solution of common salt be applied to an infected wound, the salt by its osmotic action sets up a greatly increased flow of lymph from the tissues into the wound, thus relieving the inflamed tissues of congestion, and setting up a flow of fluid from within outwards which tends to wash away bacteria. Both the lymph and the strong salt solution are unfavourable to the growth of bacteria. So far as the white corpuscles are concerned, strong saline solutions are unfavourable to their vitality; but when the wound has become healthier it is usual to decrease the strength of the salt solution until its saturation has reached that of a fluid of the same specific gravity as the blood. In a fluid of this degree of concentration the phagocytes can live and act freely.

The practical application of these principles consists either in packing the wound with gauze, between the folds of which tablets of salt are placed, or arranging for the continuous irrigation of the wound with a solution of salt of a known concentration. The latter method is suitable in a fixed hospital. And it is one of the great advantages of the former method that a case so dressed often requires no redressing for a few days, so that the anxieties connected with the provision of fresh dressings during transport from the casualty clearing station to the base hospital are set aside. The question of treatment by vaccines can scarcely be efficiently dealt with within the limits of a short article. In any case the *rôle* of vaccines is to neutralise tissue poisons elaborated by bacteria, rather than to contribute directly to the closing and healing of the wound itself. The ideal vaccine would naturally be one which, injected into the body immediately after the wound is inflicted, has the power of getting in ahead of the toxins and neutralising them. This prophylactic action is possessed by one of the serums used, and fortunately in the case of one of the deadliest of the bacteria, the tetanus germ. It has been found that the use of this serum in a moderate dose immediately after the infliction of the wound protects the wounded man from tetanus, and consequently an important part of the treatment at the casualty clearing stations is the administration of this preventive dose. As regards the other bacteria, serums and vaccines are used, but their value is not so well established as in the case of tetanus, though important results have been obtained and valuable lessons learnt from their trial.

It will be seen from the above remarks that surgeons had not only to appreciate and elucidate a problem which at first presented many new and puzzling features, but also to devise means for its solution. How far they have been successful cannot be quite known until after the war. But enough experience has been gained to justify the hope that we are on the right track, and that the treatment our brave soldiers have a right to expect can now be given to them.

NOTES.

AN article of immediate interest and importance appeared in our contemporary *La Nature* (February 17, p. 100) on the utility of supplying soldiers with body armour—a proposal which has been already urged in this country. The writer, "A. G.," states: (1) That in trench warfare nearly 75 per cent. of wounds seen in hospitals are caused by missiles of low velocity—such as could have been warded off by a comparatively thin armour-plate. (2) That missiles of low velocity which lodge in the body are more dangerous to life than missiles of high velocity which penetrate and leave the body, because every missile which lodges is presumably an infected body. (3) That the total mortality from head wounds has been enormously decreased since the introduction of protective helmets. The form of body armour proposed by the writer in *La Nature* is fully illustrated and compared with suits worn by soldiers in the Middle Ages. A cuirass of armour-plating is proposed for the protection of the thorax and upper abdomen, covering the most vital organs; a gorget of chain mail protects the neck, and a girdle or short "kilt" of the same material the loins and groins; there are a mask for the face, and sheaths for the shoulders, elbows, and knees. How far such an armour would interfere with mobility is a matter on which only military men can decide, but from a surgical point of view such a protection has every recommendation. We may here point out that a soldier of average stature presents, as he faces the enemy in open field, a target with an area of 2740 square cm. Of that target the head and neck make up 9 per cent.; the thorax and abdomen 28 per cent.; while the less vital parts—the limbs—make up the largest part, viz. 63 per cent. Even if only the more vital parts could be protected, there would be a great saving of life.

THE Committee on Commercial and Industrial Policy, of which Lord Balfour of Burleigh is chairman, has recently forwarded to the Prime Minister a copy of resolutions passed on the subject of Imperial preference, and its report (Cd. 8482, price 1*d*. net), which includes a copy of the covering letter addressed to the Prime Minister, has been presented to Parliament. In the light of experience gained during the war, the committee contends that special steps should be taken to stimulate the production of foodstuffs, raw materials, and manufactured articles within the Empire, wherever this is possible, and it therefore recommends that preferential treatment should be accorded to the products and manufactures of the Colonies, either by exemption from, or reduction of, duties. Such recommendations from the committee, composed as it is of well-known representatives of politics, economics, engineering, metallurgy, trade, and industry, will no doubt carry considerable weight. There is, however, one direction in which this committee ought to be strengthened. Since the beginning of the war the importance of applied chemistry has become obvious to everyone, but it is not yet sufficiently realised by Government Departments and public officials that there are many industrial and economic questions in the consideration of which some knowledge of the science of chemistry and its applications, actual or potential, is indispensable. These questions cannot be handled with success by ordinary men of business, however able, without such knowledge, and it appears therefore eminently desirable that a duly qualified representative of chemical industry should be added to the committee.

COUNT ZEPPELIN is dead, and has left a name that brings to our minds the murder of innocent women and children in air-raids over open towns. Yet it must be admitted that his work in developing the rigid airship, in spite of many failures, is worthy of all praise. Count Zeppelin showed us how far the rigid airship can be developed, and the war has shown us the use and abuse of such aircraft. As scouts for the navy they are invaluable, being able to hover over one spot for lengthy periods without wasting their fuel reserves, a manœuvre impossible to an aeroplane. It is, however, clearly recognised that the use of airships for raiding open towns is quite indefensible, and that as a means of invasion they are very unlikely to prove a serious menace. In peace time they might be used to convey mails and passengers, but their speed is not higher than that of an express train, and their liability to destruction in bad weather is a serious objection to these uses. In spite of Count Zeppelin's painstaking labours, in face of great difficulties, it does not seem that his rigid airships are ever likely to be serious rivals of the aeroplane, either for military or commercial purposes.

IT is interesting to learn that the Imperial Institute proposes to constitute a comprehensive bureau of mineral intelligence, with the object of supplying information as to all mineral deposits within the British Empire. For some years past the Imperial Institute has been doing a certain amount of such work, and it will be a decided advantage to have a mineral intelligence bureau available to the public. This subject has occupied the attention of several similar institutions. A paper dealing with the occurrence and distribution of certain of these minerals, read by Prof. Cullis before the Society of Engineers on December 11, 1916, was summarised in NATURE of January 4 (p. 361); and it is understood that the Department of Scientific and Industrial Research is also moving in the same direction. None of these attempts, however praiseworthy and valuable, can take the place of a properly established Government Department of Minerals and Metals, which should co-ordinate all these scattered efforts, and should deal with the whole subject from the point of view of a great Imperial industry, which is of vital importance to the future of the British Empire. This is surely a subject for the Government, and should not be left to the enterprise of individuals or associations, and there is probably no way in which public money could be expended with a better assurance of prompt and manifold reimbursement.

THE resignation of Dr. E. A. Letts from the chair of chemistry in the Queen's University, Belfast, is announced.

SIR W. E. GARSTIN and Sir G. K. Scott-Moncrieff have been elected honorary members of the Institution of Civil Engineers.

THE third Guthrie lecture of the Physical Society will be delivered in English at the Imperial College of Science and Technology on Friday, March 23, by Prof. P. Langevin. Its subject will be "Molecular Orientation."

THE twenty-second annual congress of the South-Eastern Union of Scientific Societies will be held at Reading on June 6–9, under the presidency of Prof. E. B. Poulton.

WE learn from *Science* that Dr. V. M. Slipher, for many years chief assistant at the Lowell Observatory, and known for his spectroscopic researches, has been appointed director of the observatory in succession to the late Percival Lowell.

THE *Times* announces that Dr. Douglas W. Freshfield, president of the Royal Geographical Society, has been elected an honorary member of the Russian Geographical Society, and Sir Ernest Shackleton a corresponding member.

WE regret to announce the death, on March 9, at eighty-eight years of age, of the Rev. O. Pickard-Cambridge, F.R.S., author of "Specific Descriptions of Trapdoor Spiders" (1873), "The Spiders of Dorset" (1879–81), and other works on arachnology, entomology, and general natural history.

WE are glad to be able to state that the announcement made at the meeting of the Linnean Society on February 15 as to the death of Prof. G. O. Sars, the distinguished zoologist of Christiania, is incorrect. The mistake arose from a confusion of his name with that of his brother, J. E. Sars, professor of history in the same university, who died recently.

THE Right Hon. Sir William MacGregor, late Acting High Commissioner for the Western Pacific; Sir William Peterson, principal of McGill University, Montreal; and Sir Ernest Rutherford, professor of physics, University of Manchester, have been elected members of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public service."

LETTERS on the optical deterioration of the atmosphere during July and August last appeared in NATURE of October 5, November 9, and December 28, 1916. Father J. G. Hagen, director of the Vatican Observatory, writes to say that the defects referred to were severely felt at that observatory, and were attributed, as was done by Prof. Riccò in NATURE of November 9, to the eruption of Stromboli, which reached its maximum on July 4. Father Hagen has recorded these facts in the *Astronomische Nachrichten*, No. 4871.

THE following is the list of officers of the Physical Society elected for the ensuing year: *President:* Prof. C. Vernon Boys. *Vice-Presidents* (in addition to those who have filled the office of president): Mr. W. R. Cooper, Sir Napier Shaw, Dr. S. W. J. Smith, Dr. W. E. Sumpner. *Secretaries:* Prof. W. Eccles, Finsbury Technical College, Leonard Street, E.C.; Dr. R. S. Willows, The Sir John Cass Technical Institute, Jewry Street, Aldgate, E.C. *Foreign Secretary:* Dr. R. T. Glazebrook. *Treasurer:* Mr. W. Duddell. *Librarian:* Dr. S. W. J. Smith. *Other Members of Council:* Dr. H. S. Allen, Prof. E. H. Barton, Prof. G. W. O. Howe, Prof. J. W. Nicholson, Mr. C. C. Paterson, Mr. C. E. S. Phillips, Prof. O. W. Richardson, Dr. S. Russ, Mr. T. Smith, Mr. F. J. W. Whipple.

MR. JAMES GILLINGHAM, of Chard, recently presented to the County Museum at Taunton a large number of photographs and papers collected by him for the purpose of perpetuating the memory of John Stringfellow, of Chard, "the pioneer of flight and father of aviation." Nine of the photographs, mostly enlargements, are mounted on cards as follows: (1) Portrait of John Stringfellow; and (2) another as an old man; (3) Stringfellow's aeroplane, 1848; (4) his triplane, 1868; (5) another view of his triplane; (6) flower show and sports on Bewley Down, near Chard, the place where Stringfellow experimented with his flying-machine in 1847; (7) aeroplane designed by W. S. Henson and patented as "The Ariel Steam Carriage, 1842"; (8, 9) two photographs of the memorial to Stringfellow in Chard cemetery, designed by James Gillingham; in addition, the original drawing of the last-named subject, in large frame. At the present time these photographs are exhibited in a case in the Great Hall of Taunton Castle. The collection contains a good deal of miscellaneous manuscript and printed matter having reference to aviation, and includes the memorandum of agreement made by John Stringfellow and W. S. Henson with regard to a partnership for constructing "a model of an aerial machine," dated December 29, 1843.

BY the death of General J. A. L. Bassot, on January 17, international geodesy has sustained a severe loss, and France mourns a distinguished geodesist. Born in 1841, General Bassot took part in the war of 1870, and immediately after it was appointed to the Service Géographique de l'Armée, where, under General Perrier, he was employed on the remeasurement of the arc of meridian in France. Later, in 1879, he took part in the geodetic operations for connecting the triangulation of Spain with that of Algeria, where Bassot occupied the mountain station of Filhaoussen for nearly eight weeks before he could effect his purpose. In 1884 he laid out and observed the chain of triangulation from Algiers to Laghouat, and a few years later, in 1888, he succeeded his former chief, General Perrier, as director of the Military Geographical Service. Administrative duties now put an end to his geodetic work in the field, but he continued to direct and promote geodetic operations of importance, in spite of the arduous work and heavy responsibilities which the provision of maps for the French Army entailed. In these, too, he made numerous improvements. The remeasurement of the arc of meridian in France naturally suggested a revision of the arc of Peru, which had been measured in the eighteenth century in connection with the geodetic operations in France. A proposal to this effect was warmly supported by the International Geodetic Commission at its meeting at Stuttgart in 1898, and in June, 1899, work was commenced under the direction of General Bassot, and has since been carried to a successful termination. At several meetings of the International Geodetic Commission General Bassot presented reports on various geodetic operations, and at its meeting of 1903 he was elected president, which post he held until the commission automatically ceased to exist at the end of 1916, a few days before his death. On his retirement from the Army he became director of the Observatory of Nice in 1904, and devoted his energies to scientific work there and to his geodetic studies, besides taking part in an expedition to Spain in 1905 to observe the eclipse of the sun of that year. He was elected a member of the Académie des Sciences in 1893.

THE *Journal of Mental Science* for October, 1916, contains an interesting article by Prof. E. W. Scripture on "Reaction Time in Nervous and Mental Diseases." The fact that we judge whether a person is normal or not by our observations or how he reacts to his environment suggests that the study of nervous and mental diseases would be furthered by having some method by which we could study in detail the reactions of a patient to various stimuli. The usual reaction time apparatus is complicated, and involves much laborious calculation before the records can be utilised; it is therefore unsuitable for clinical work. The author of the article has devised, in order to obviate this, a self-recording method that shows directly to the eye, without measurement, how quick the reaction time is and how it varies. He gives details of records obtained with this apparatus from normal people and from patients suffering from alcoholism, hysteria, epilepsy, and general paralysis. The few diseases studied show marked reaction types, even for the simple form of reaction, and the author thinks that the test can be made so complete and trustworthy as to give an accurate diagnosis of many nervous diseases.

PROFS. M. BOULE and R. Anthony, in the *Journal of Anatomy* for January, make a spirited reply to Prof. Symington's strictures on deductions drawn from endocranial casts taken from human skulls. In their paper, "Neopallial Morphology of Fossil Men as Studied from Endocranial Casts," they contend that Prof. Symington's mistake lies in assuming, implicitly and without question, that what is true of modern men must also, necessarily, be true of Neanderthalians. As a matter of fact, they show that, while in modern man furrows are to be seen only at the base of such brain casts, in Neanderthalians these furrows are traceable on the frontal and occipital regions. They also show that in the case of the lemurs, and in carnivores and ungulates, endocranial casts show the neopallial foldings over the whole brain, which can be read on a cast nearly as easily, and with as much exactitude and precision, as on the surface of the brain itself.

ACCORDING to *Commerce Reports* (Washington) of June 12, 1915, nearly 400 square miles of seaweed-beds exist along the United States Pacific coast. From this area it is officially estimated that 59,000,000 tons of seaweed might be cut annually, from which 2,300,000 tons of potassium chloride could be produced. Arrangements have been made by the United States Department of Agriculture for experimental work on the production of potash from this seaweed to be carried out on a commercial scale. In the New York *Journal of Commerce* of November 24 (quoted in the *Journal of the Board of Agriculture*, February, p. 1158) it is stated that an appropriation of 175,000 dollars has been made for the purpose, and that the plant will probably be established in southern California, either at Santa Barbara or Long Beach. A plant capable of dealing with about 200 tons of wet seaweed per day will be erected, and a daily yield of about five tons of potassium chloride is expected. Numerous methods will be employed experimentally, but for the most part distillation processes will be used.

IN a recent communication from the National Health Insurance Commission (England) to the Board of Agriculture and Fisheries the opinion is expressed that of the many home-grown plants used in the treatment of disease only four can be regarded, from a medical point of view, as really essential—namely, belladonna, henbane, digitalis, and colchicum. The communication, which is published in the February issue of the *Journal of the Board of Agriculture*, proceeds further to give approximate estimates of the amounts of these essential plants required annually for home consumption, ranging from about 50 tons each of dried leaves and roots in the case of belladonna to about 20–25 tons each of dried leaves of henbane and digitalis, and a much smaller quantity of colchicum. It appears that there is sufficient digitalis and colchicum growing wild in this country to meet home requirements, and that a considerable proportion of the home demand for belladonna and henbane could also be met by the collection of wild plants with well-organised schemes for collection and drying. Moreover, the cultivated area under belladonna and henbane has considerably increased since the outbreak of war, and probably now suffices, together with the supplies obtainable from wild plants, for home requirements.

THE relation of the geographical conditions to the present situation in Mexico, as it may affect the United States, is the subject of some notes in the *Geographical Review* for January (vol. iii., No. 1). It is pointed out that the scene of action, if the United States intervenes in the affairs of Mexico, must be in the thinly peopled and arid northern frontier regions, where conditions are greatly in favour of the Mexicans. Water is scarce, and transportation of men, food, and materials will be difficult, which will handicap the Americans, but, on the other hand, will be correspondingly an advantage to the Mexicans, habituated to life in these desert conditions. A campaign in northern Mexico would therefore involve transport arrangements costly out of all proportion to the number of troops employed, and it would be far removed from the high plateau on which are situated nearly all the great cities of Mexico and most of its population. The article has a short but useful bibliography of geographical works on Mexico, and is accompanied by a map of the northern frontier regions.

IN a paper in the *Geographical Journal* for February (vol. xlix., No. 2) Mr. C. B. Fawcett has tried to devise administrative divisions for England and Wales more rational and more in harmony with local and regional consciousness than the divisions into counties. The aim of his divisions is to facilitate good local government. This entails certain considerations.

The boundaries must be drawn so far as possible along the more thinly peopled tracts of land. Each province must have a regional capital. This is essential to the development of a provincial patriotism necessary for good government. The minimum of population in each province should be about one million, and no province should be so populous as to dominate the others. It is a sound geographical principle that a valley forms a unity, and so boundaries should be drawn near watersheds. Lastly, as the new boundaries to some extent supersede the ancient counties, county patriotism must be allowed for in determining the new provinces. The result, as illustrated by a map, is to divide England and Wales into thirteen provinces centred respectively round London, Cambridge, Oxford, Southampton, Bristol, Plymouth, Cardiff, Birmingham, Nottingham, Leeds, Manchester, Newcastle, and an unchosen capital for the south-east province. While the various provinces are not intended to be equal in importance any more than they are in area, it is difficult to admit of any adequate division of Metropolitan England, to use Mackinder's term, which is, and must be, dominated by London. In the north the problem is easier.

WE have received a copy of the Egyptian Almanac for the year 1917 (Government Press: Cairo). The almanac is descriptive rather than statistical, and so forms a complementary volume to the Annuaire Statistique. There are chapters on the geographical features, agriculture and industries, and on the work of the various public departments. The section on the antiquities department has been considerably extended, and contains a list of the principal antiquities and monuments of art. A transliteration system of Arabic is added to the almanac. It would have enhanced the usefulness of the volume if a list of maps published by the survey department had been added.

A RENEWAL of wintry weather occurred in all parts of Great Britain on the three days March 7–9, and the cold snap was greatly intensified by a keen and searching easterly wind. Slight snow was experienced generally. On March 7 the highest day temperatures failed to rise above the freezing-point at most of the health resorts reporting to the Meteorological Office in the northern and eastern English districts. On March 8 the minima, or lowest temperatures, in the early morning were below 20° over Scotland, as well as at places in the north of England. At Aberystwyth the sheltered thermometer fell to 19° and at Bournemouth to 22°. In the London suburbs the lowest temperatures in the screen were generally about 22°, and at Hampstead the thermometer fell below 20°. The day temperatures were almost as low as on March 7. On the morning of March 9 the thermometer reading was again very low, registering 15° in parts of Scotland, and 20° at several stations in the east and south-east of England, as well as in the London suburbs. Much milder weather, with rain, set in over the south-west of England, and the change spread rapidly to other parts of Great Britain.

COMMUNICATION 149 from the Physical Laboratory of the University of Leyden contains the results of the measurements of the specific heat at constant pressure of solid and liquid nitrogen carried out by Prof. Kamerlingh Onnes and Dr. W. H. Keesom. The pure nitrogen used was condensed and entered the calorimeter at a low temperature. It was there heated electrically through a range of temperature of about a degree, and the work done and the rise of temperature observed. The calorimeter was enclosed in a vacuum jacket kept at a low temperature to diminish the flow of heat from its surroundings. The atomic heat of the solid nitrogen at 15° Absolute is 1·6, at 20° 2·4, at 40° 4·5, at 50° 4·9, and at 60° 5·3. The atomic heat of the liquid nitrogen above the triple point 63° is 6·6 up to 76° Absolute.

A NEW list of small electric furnaces, for temperatures up to 1000° C., has just been issued by Messrs. A. Gallenkamp and Co., Ltd. These furnaces are characterised by a simplicity of construction and ease of manipulation which should render them of considerable value in chemical and other laboratories. The general advantages of electric furnaces are well known, but by many it may not yet be realised how much more convenient their use has become since the introduction of high-resistance, high-melting-point alloys, such as are employed in the apparatus referred to here. These materials enable small furnaces to be wound for use on voltages up to 250 (direct or alternating), while the low-temperature coefficient of the winding obviates the continued attention during heating-up that is demanded by a platinum or nickel wound furnace. In addition, the renewal of the heating tube, should breakdown occur through accidental over-running, is quickly carried out and at small cost. The types listed comprise a good selection of single and multiple tubular furnaces for combustion and explosion tube work. Muffle furnaces suitable for general chemical analysis and for small metallurgical operations are constructed on similar lines, while a vertical crucible furnace has recently been included in the list. This latter piece of apparatus is provided with a device for lifting the crucible from the heating tube from below—an arrangement which should greatly conduce to ease of working. The list gives useful information as to the power consumption for each size of furnace, while prices of renewal tubes and of suitable regulating resistances are quoted in each instance.

A PAMPHLET entitled "Slav Achievement in Advanced Science," by Prof. B. Petronievics, of Belgrade (American Book Supply Co., Ltd., 1s.), contains brief accounts of the following worthies: (1) Copernicus, (2) Boscovich, (3) Lobachevski, (4) Mendeléeff. They are all interesting, and (2) and (4) are particularly good. Even to an English reader (1) goes over familiar ground, and (3) contains blemishes in detail which make it rather untrustworthy. Thus from p. 19 the reader would infer that CD in the figure is a "straight" line; on p. 21 it appears as the locus of points "equidistant" from AB, and is, therefore, not a straight line. Riemann's "plane" (p. 22) cannot be *constructed* in Euclidean space, but we have an exact image of it in ordinary spherical geometry; *i.e.* we can translate any formula of the latter into a formula for the Riemann plane. Similarly, formulæ for the so-called pseudosphere in ordinary space can be applied to the geometry of a plane in Lobachevski's space. As illustrations of recent advance in scientific thought, we may remark that no one now would claim for Copernicus's theory any absolute superiority over Ptolemy's; it is only a matter of choosing axes of reference assumed to be fixed, and since the sun undoubtedly moves with reference to the fixed stars, the simplest explanation of celestial motions compels us to discard the Copernican axes, at any rate as a fixed system. Again, the theory of electrons has brought in a mathematical analysis which in some respects is analogous to Boscovich's. We are glad to learn that Prof. Petronievics is about to publish a work "On Simultaneous Discoverers"; this ought to be very interesting.

FROM the early days of the industries based on coal-tar products it has been fashionable to illustrate the derivation of synthetic dyes and other commercially important substances from coal-tar by diagrams somewhat on the lines of a genealogical table. This method of demonstrating the importance of coal-tar and the direct products of its distillation becomes increasingly difficult each decade, because of new developments which are constantly being made. Messrs. G. Allen and Unwin, Ltd., are responsible for the publication of one of the latest of these "coal-tar charts," which was adapted by Dr. T. H. Norton from a diagram originally drawn up by Dr. von Brunck, the veteran director of the Badische Aniline and Soda Company. In this chart the genesis of many important modern dyes is traced from six direct or immediate coal-tar derivatives, namely, benzene, toluene, the xylenes, naphthalene, phenol, and anthracene. Among the recent additions are the substantive wool dyes of the anthraquinone series, of which alizarine saphirol may be taken as type. The direct cotton-blues are valuable colours, the derivation of which from tolidine and dianisidine is indicated, and reference is made to some of the more important chromed colours. It is, however, significant of the rapidity with which these charts become obsolete, that in the present instance no place is found for the direct coal-tar product, carbazole, and its important derived colour, hydrone-blue.

THE North-East Coast Institution of Engineers and Shipbuilders has just issued a standard specification for cargo-steamer engines. This specification is for reciprocating triple-expansion engines intended for moderate-speed cargo-boats engaged in general trade, and is based on the best practice of the day; the object in view is the ultimate standardisation of parts. It is hoped that the specification will be extended to include not only the main engine proportions and scantlings, but also the boilers, auxiliaries, and other details. The council proposes that an annual revision should be made in order that the specification may be kept thoroughly up to date. In view of the tasks which will have to be faced directly the war is over, the specification and proposals are of importance, and will tend to improve the organisation of our shipbuilding industry in this class of vessel.

OUR ASTRONOMICAL COLUMN.

ECLIPSE TEST OF EINSTEIN'S THEORY OF GRAVITATION.—At the meeting of the Royal Astronomical Society on March 9, the Astronomer Royal directed attention to the favourable opportunity which would be afforded by the total eclipse of the sun on May 28, 1919, for testing Einstein's predicted deflection of a ray of light in passing close to the sun. The theoretical displacement of a star near the sun is $1{\cdot}75'' \, r_0/r$, where r_0 is the sun's radius, and r the perpendicular distance of the ray from the sun's centre. At the eclipse of June, 1918, visible in the United States, the sun will be situated in a region poor in stars, but on May 28, 1919, it will be in the Hyades group. There will then be thirteen stars in the vicinity of the sun, of magnitudes 4·5 to 7·0, for which the theoretical displacements range from 1·20″ to 0·26″. The greater part of the track of this eclipse will unfortunately be over the Atlantic, not far from the equator, but, in view of the importance of the suggested observations, it is hoped that suitable observing stations may be found in Brazil or Liberia. A re-examination of the photographs taken by the Greenwich observers at Sfax in 1905 revealed three star images, and a possible fourth image involved in the corona, but no trustworthy deduction as to the reality of the Einstein effect could be made. These photographs, however, show that the standard astrographic telescope employed is quite a suitable instrument for the purpose in view.

THE VARIABLE NEBULA N.G.C. 2261.—Dr. V. M. Slipher, director of the Lowell Observatory, has obtained a spectrogram of Hubble's variable nebula N.G.C. 2261, to which reference has previously been made in this column (NATURE, vol. xc., p. 298). The nebula is of cometic form, and has the irregular variable star R. Monocerotis as its nucleus. The nebula and star have been found to show the same peculiar spectrum, consisting of a continuous spectrum with bright lines or bands which are not identical with those of gaseous nebulæ. The observation suggests that the nebula shines by reflected light of the pulsating nucleus. Mr. Lampland has obtained two direct photographs with the 40-in. reflector, one on March 2, 1916, and the other on January 25, 1917, showing striking differences in parts of the nebulous detail. The magnitude of the apparent changes suggests that no actual transference of matter takes place, but rather that we witness the progressive motion of pulses of light resulting from fluctuations in the brightness of the variable star. The displacement is estimated at 15 seconds of arc, and, assuming this to be perpendicular to the line of sight, which would generally overstate the distance, the parallax of the nebula would be about 0·00027″. The corresponding distance would be 12,000 light-years.

THE CHEMICAL ENGINEER.

THE president and council of the Faraday Society are to be congratulated on their enterprise in organising a very successful debate on the training and work of the chemical engineer held on March 6, which supplements the discussion in November last on the same subject before the London section of the Society of Chemical Industry. The importance of a knowledge of engineering to the chemist engaged in industry was accepted by all present, but the speakers showed a great difference of opinion in their definition of the chemical engineer. Sir George Beilby, who initiated the discussion, considered that chemical engineering has for its function the design and construction of apparatus required for the carrying out of chemical processes on a manufacturing scale. The chemical engineer is a specialist who not only has at his command a sound knowledge of chemical phenomena and laws, but, more important still, he must be able to see chemical problems from the chemist's point of view.

Prof. Donnan drew a distinction between research chemists, engineer-chemists, and chemical engineers, using the last term in the same sense as Sir George Beilby. The engineer-chemist is the ordinary chemical student to whom a good deal of engineering knowledge has been imparted. or, as Prof. Donnan termed it, applied physical chemistry. He corresponds to what is usually known as the plant chemist in chemical industry—that is, the trained chemist who has naturally mechanical aptitude and has gained engineering knowledge by experience. Prof. Donnan's desire was to include a comprehensive training in engineering in the four years' course for chemists. It was suggested that some attempt should be made by the teacher at the end of three years to state as to what branch of chemistry a particular student showed the greatest aptitude. Prof. Donnan very properly laid considerable stress on the rarity of the really gifted research worker, who was born rather than made by training.

Even more important in this connection was Sir

George Beilby's statement that the point of view of the engineer is not so far removed from that of the ordinary intelligent person that the latter cannot grasp, in a general way, his aims and objects; but the thoughts and aims of the chemist are for the most part quite inscrutable to the vast majority of his fellow-men. Since the chemist's views are so much further removed from everyday notions and conceptions than are those of the engineer, it is wiser first to imbue the mind of the student thoroughly with the more difficult, because less ordinary, point of view.

On the other hand, many of the speakers seemed to advocate that chemists should be trained as chemical engineers—that is, primarily to design and control chemical plant; and that the factor of cost in relation to chemical processes should not be overlooked. From the point of view of the chemical manufacturer, it was urged that the main requirement of the industry was men fully equipped with a real knowledge of chemistry: the individual with mechanical aptitude would without difficulty be able to learn enough to think as an engineer, and appreciate engineering problems.

In addition to the scheme outlined by Prof. Donnan for the training of the would-be works chemist in engineering, papers were contributed by Mr. C. H. Darling on the training in physics given at the Finsbury College, and by Mr. J. W. Hinchley on the course at the Imperial College. The former course is designed to make the student acquainted with the type of instrument he will later meet with in works, but it was recognised by Mr. Darling that the young chemist who is to be of the maximum use to his employer must, in addition to the possession of specific knowledge, have his ideas running in the right grooves.

HIGH-SPEED TELEGRAPHY.

THE report of the committee appointed by the Postmaster-General in December, 1913, to consider the question of high-speed telegraphy has now been issued in the form of a White Paper (Cd. 8413, price 3*d*.). Unfortunately the work of the committee was interfered with by the outbreak of war in August, 1914, which cut short a series of tests designed to show the best results which various competing systems could produce under identical conditions. In the absence of comparative statistics the complete examination of all the claims of rival inventions is impossible, but as such minute statistical comparisons would be mainly valuable in connection with further investigation, the considerations on which the committee's recommendations have been framed should suffice for the present.

The question before the committee resolved itself into a rivalry between automatic high-speed systems on one hand, and the multiplex on the other, though the inventions of Mr. Creed and the advent of various keyboard perforators affected the situation of the former. Automatic high-speed systems were fully reviewed, but the conclusion arrived at by the committee is that for ordinary commercial telegraph work between the main centres of the British Post Office service the inventions based on the multiplex method are superior, as they conduce to economy in staff, are subject to fewer serious stoppages and delays than automatic systems, and necessitate less spare plant and less costly maintenance. The fundamental principles of nearly all multiplex instruments are based on the Baudot system, invented more than thirty years ago. Ten years later it assumed, in the hands of the original inventor, practically its present form. Although some of its main principles had been anticipated by earlier inventors, Baudot was the first who combined them into a system of practical utility, and the production of the system may be regarded as marking an epoch in the history of telegraphy. The leading features of the Baudot system are: (1) its method of obtaining synchronism; (2) its direct transmission from keyboard to line; (3) its cadence and speed; (4) its direct printing on slip.

Of the multiplex systems at present available, the Western Electric is said to have given the best results, and the committee recommends that a number of quadruple duplex installations of this apparatus be ordered. Seven or eight sets should suffice, as although present conditions favour the rapid application of systems with the greatest output, it is desirable to avoid too great a dislocation of working, and to allow time, so far as possible, for other makers to demonstrate their capabilities. Page- or column-printing is preferable to tape-printing on the busiest routes, and the Western Electric Company's page-printing on a continuous roll of paper, cut off after each message, is quite satisfactory. The committee does not consider it desirable that either page- or column-printing should be adopted throughout the service to the exclusion of tape-printing, while the Creed receiving apparatus is recommended for use in the Post Office news service. The application of printing methods to the less important circuits should be kept steadily in view, and early trials of the one-way and two-way installations of the Western Electric, and of the light line printer of the Automatic Telephone Manufacturing Company, are recommended. The committee was impressed with the possibility of two-way working with one operator at each end, both to signal their messages simultaneously to the other end, and then both to gum the tape. An hourly load can be carried in this way equivalent to the average Morse load with two operators at each end, and having the additional advantage of printing the telegrams. The committee predicts that the introduction of multiplex methods for news work will call for serious consideration in the near future, and it urges that the application of these systems, to give simultaneous communication on one wire between each one of three or possibly more offices, should be kept in view as multiplex methods are extended.

HEREDITY AND DISEASE.

IN the lately issued Bulletins Nos. 16 and 17 of the Eugenics Record Office (Cold Spring Harbour, New York) Prof. C. B. Davenport and Dr. Elizabeth B. Muncey discuss "Huntington's Chorea in relation to Heredity and Eugenics" and "The Hereditary Factor in Pellagra." Nearly a thousand cases of the chorea "can be traced back to some half-dozen individuals who migrated to America during the seventeenth century." The disease manifests itself in various sets of symptoms—nervous tremors, dementia, etc., —most of which act as dominants. Though the hereditary nature of the disease has been recognised for generations, "there is no clear evidence that persons belonging to the choreic lines voluntarily abstain to any marked degree from, or are selected against, in marriage." With regard to pellagra, there appears to be a distinct hereditary predisposition to infection; nearly half the children of a pair of susceptible parents are themselves susceptible.

The long-disputed question of the influence of poison on germ-cells has received another contribution in Dr. Raymond Pearl's paper on the effect of continued administration of certain poisons to the domestic fowl, with special reference to the progeny (Proc. Amer. Phil. Soc., lv., 1916, pp. 243–58). This is an abstract of three papers from the Maine Agricultural Experiment Station, and a fuller memoir is promised later. A new feature in this research is that "the foundation stock used came from pedigreed strains of two breeds, Black Hamburgs and Barred Plymouth Rocks . . . whose genetic behaviour under ordinary circumstances may be predicted with a degree of probability amounting practically to complete certainty." The birds were treated by inhalation with ethyl alcohol, methyl alcohol, or ether, and examination of the offspring gave the surprising result that "out of twelve different characters for which we have exact quantitative data, the offspring of treated parents taken as a group are superior to the offspring of non-treated parents in eight characters." Dr. Pearl does not consider that his results contradict those of the experiments by which several recent workers—such, for example, as Laitinen and Stockard—have established the degenerate nature of the offspring of many alcoholised mammals. He points out that the strength of treatment may be such as to exercise a selection among the germ-cells, so that, through the elimination of feeble sperms and ova, a larger proportion than usual of vigorous gametes in the narcotised animals take part in the production of zygotes, whereas with a stronger treatment all the gametes are injuriously affected. It is likely that the germ-cells of birds may be less affected than those of mammals by such influence, and Dr. Pearl is certainly justified in asking for caution in transferring these results to problems of human inheritance, though he is apparently willing to accept at their face-value the much-disputed statistics of Elderton and Pearson, so loudly acclaimed as an excuse for alcoholic indulgence among mankind.

G. H. C.

THE U.S. NATIONAL RESEARCH COUNCIL.

UNDER the pressure of conditions of war, national advantage is being taken of the services which science can render, through committees or by the appointment of men of science to posts in Government departments. Definite problems have to be solved, and attention has to be concentrated upon them, though this means that the freedom which is the prime characteristic of exploration in scientific fields is necessarily restricted. In the United States at present there is no necessity of this kind; and the National Research Council is, therefore, free to develop a plan in which purely scientific investigation takes its essential place, without consideration of immediate problems of national defence and industrial demands. The council has recently sent a circular to the chief educational institutions in the United States recommending the formation of research committees such as have been established already at the Massachusetts Institute of Technology and certain other institutions at its suggestion. The obligations of men of science towards national defence and industry are not overlooked, but it is equally important to provide for the free scientific research upon which great developments will depend in the future as in the past. "We must not forget," says the council, "that pure science, not directly stimulated by patriotic impulse for national service or the promise of financial reward from industrial profits, should be accorded the encouragement which enlightened leaders of industry are so willing to concede as its due." We subjoin an abstract of the main points dealt with in the circular from which this quotation is taken.

Research Committees in Educational Institutions.

A very large proportion of the scientific research of the United States is conducted in the laboratories of educational institutions. It is now widely appreciated that contact with knowledge *in the making* is the most effective means of seizing and holding the student's attention. And it is also recognised that no greater injury can be done to the cause of science than to compel a promising investigator, fresh from the researches of his graduate years, to relinquish all hopes of further studies because of the complete absorption of his time and energy by other duties.

It is with the fullest appreciation of the difficulties which financial limitations involve, and with a sincere desire not to interfere with the just demands of the teacher's profession, that the National Research Council invites the co-operation of educational institutions in the promotion of research at this critical period in our national progress. We believe it to be feasible, without decreasing the efficiency of the university, the college, or the professional school as teaching institutions, to increase greatly their contribution to knowledge through research. Indeed, we do not hesitate to say that if a portion of the time now given to teaching were devoted to investigation, and if the courses of instruction were so altered as to take full advantage of this change, the educational efficiency of the institutions in question would be materially enhanced. In extending a request for the formation of research committees in educational institutions of high standards, which accord serious support to scientific research undertaken by the faculty and advanced students, we beg to direct attention to some of the possibilities which lie open to committees of this character.

Before sending out a general invitation, a preliminary test of the plan has been made in certain institutions. The Massachusetts Institute of Technology, Yale University, the University of Chicago, North-western University, and Throop College of Technology have already established research committees to co-operate with the council. In each case these committees are composed of the president of the institution, two or three leading members of the board of trustees who are interested in research, six or more faculty members engaged in research, and two or more members of the alumni occupied with research or interested in its promotion. Following the example, at least for the present, of similar organisations abroad, the council has directed its activities to the promotion of research in chemistry, physics, engineering, mathematics, astronomy, geology and palæontology, geography, botany, agriculture, zoology and animal morphology, physiology, medicine, hygiene, psychology, and anthropology. There is no reason, however, why other departments of research should not be represented on the research committees of educational institutions wherever this appears desirable.

In view of the importance of encouraging research on the part of members of the faculties of colleges which do not undertake graduate instruction, the invitation of the council is not limited to universities and other institutions now giving specific recognition to research. It is highly important to encourage competent men to continue the work of research begun in their university career, and a sympathetic research committee could help greatly in this respect. Even the existence of such a committee should serve as a valuable stimulus to men who properly look for some measure of encouragement. In small institutions powerful support can be given to research by a body of men who genuinely appreciate its significance.

As the invitation of the council is being rather widely extended, a word of caution may not be out of place at this point. In the case of institutions not in a position to give serious support to research, it would evidently be inadvisable to appoint research committees. It is quite possible, however, that the strong moral support which could be given by a committee, even if it were unable to command large financial aid, would justify its formation. Indeed, it is scarcely conceivable that a research committee really in sympathy with the objects we have in view could fail to secure valuable material assistance to competent investigators.

Each research committee will doubtless discover its own best method of procedure, adapted to the circumstances of the case. The following suggestions as to possible lines of work may nevertheless be of service in organising the committees:—

(1) Prepare a survey of the research already in progress in the institution in question.

(2) Assist in the preparation of a national census of research indicating the equipment for research, the men engaged in it, and the lines of investigation pursued in Government bureaux, educational institutions, research foundations, and industrial research laboratories.

(3) Increase the supply of suitably trained men to carry on research work. The tendency towards narrow specialisation, so common at present, should be counteracted by developing more interest in science as a whole. Lectures on the history of science, and broad courses on evolution, covering its various aspects from the constitution of matter and the evolution of stars and the earth to the rise of man and the development of civilisation, should be widely encouraged. From the purely educational point of view such courses may be expected to produce a more favourable influence and leave a more lasting impression than routine discussions of the minutiæ of the various branches of science, though the latter are obviously essential in the training of the investigator.

(4) Develop a wider appreciation of the part which men of science may play in researches bearing both on industrial progress and national defence, including those of ship design, aeronautics, the fixation of nitrogen, and many other subjects.

(5) More general co-operation and co-ordination in research, within each educational institution and in alliance with other workers outside, is another important subject for consideration.

(6) Interchange of research workers, especially to secure for the smaller institutions the stimulus given by leaders of research, should be strongly encouraged.

(7) Establishment of a large number of research fellowships, each yielding one thousand dollars or more annually.

(8) Establishment of research professorships and research endowments.

(9) Encouragement of the *spirit* of research, and the development of a sympathetic atmosphere in which the investigator can work to the best possible advantage.

Central Committees on Research.

The National Research Council, with the co-operation of the American Association for the Advancement of Science, the American Chemical Society, the American Physical Society, the American Mathematical Society, and other national scientific societies, has established a series of central committees to organise research in the various branches of science.

The purpose of these committees may be outlined as follows:—

(1) To join in the preparation of the national census of research. This will be taken by the census committee of the Research Council, of which the chairmen of the various central committees are members.

(2) To prepare reports embodying comprehensive surveys of the larger possibilities of research in the various departments of pure science, suggesting important problems and favourable opportunities for investigation.

(3) To survey the economic and industrial problems of the United States, and report on possible means of aiding in their solution by the promotion of research in the fields represented by the various committees. (In co-operation with the council's committee on the promotion of industrial research.)

(4) To indicate how investigators in each committee's field can aid in the solution of research problems involved in strengthening the national defence. (In co-operation with the military committee of the National Research Council.)

(5) To point out opportunities, national and international, for co-operation in research, and to assist in the co-ordination of the various agencies already established for this purpose.

(6) To keep in touch with the research committees of educational institutions, and to supply research problems, suggestions, or thesis subjects when requested to do so.

(7) To serve as a national clearing-house of information regarding research problems in each committee's field which arise from scientific, industrial, and other sources, and are communicated to the council by local research committees or other agencies.

(8) To promote research by such other methods as may prove advisable, including the encouragement of such courses of instruction in educational institutions as are best adapted to develop greater breadth of view, a wider understanding of the methods of research, and a more general perception of the national importance of all forms of research, both in pure and applied science; the more effective use of existing research funds; the establishment of research fellowships, research professorships, and research endowments.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Prof. R. Saundby having resigned his post as professor of medicine in consequence of ill-health, the following resolution has been passed by the University Council: "That in accepting the resignation of Prof. Robert Saundby the council records its great regret that circumstances of health have rendered this step necessary. It desires to thank him for his long and distinguished services to the medical school in Mason College and the University, and takes this opportunity of expressing its appreciation of the invaluable assistance which he has rendered to medical education during the twelve years in which he has represented this University on the General Medical Council."

The work of Mr. John Humphreys, M.D.S., in connection with the Odontological Museum of the University of Birmingham has been acknowledged by the council in the following resolution: "That the council desires to express its keen appreciation of the ability, zeal, and generosity with which Mr. John Humphreys, M.D.S., has prosecuted for so many years the formation, in the University, of the Odontological Museum; and now that the catalogue of the specimens in the museum prepared by him has been published by the council, it takes the opportunity of congratulating him on the completion of the task. As a further mark of its gratitude to Mr. Humphreys for his life-long devotion to the scientific side of dental education, so well illustrated by this unique collection, the council decides that the museum shall in future be named 'The John Humphreys Odontological Museum.'"

The family of the late Frederic Milward of Redditch has placed the sum of 1200*l.* in trust for the foundation of a scholarship to be known as the Frederic Milward Scholarship, which will be open to pupils on the registers of the county secondary schools of Redditch, and will be tenable at the University of Birmingham by students attending day courses in science, commerce, or engineering.

The Rev. P. S. Belton (a voluntary war-worker) has been appointed honorary assistant and demonstrator in the metallurgical department.

Miss B. M. Bristol has been appointed honorary assistant demonstrator in botany for the present term.

OXFORD.—All Souls College has come to the assistance of the University finances by devoting fifteen hundred pounds in aid of the general fund and the like sum to the purposes of the Bodleian Library. In the present depleted state of the University chest, owing to the war, these gifts are especially welcome.

On March 13 the form of statute establishing the degree of doctor of philosophy was passed by Congregation, and the statute was amended in certain particulars.

IN view of the value of the rabbit as food, the vice-chancellor of the University of London has given instructions that it shall not be used in practical examinations in zoology for science students or in general biology for medical students during the period of the war.

A READING from the poems of Sir Ronald Ross, K.C.B., F.R.S. (including the suite now appearing in the *Poetry Review*), will be given on Friday, March 23, at 3 p.m., at the house of Sir William Lever on Hampstead Heath. Sir Herbert Warren, K.C.V.O., will preside.

THE United States Department of the Interior has, says *Science*, designated Minnesota as one of the three States where mining experiment stations are to be established within a year. The Government will appropriate 5000*l.* annually for the support of such a station, and the State must supply the building. The regents have asked for 35,000*l.* for this purpose. There are to be ten such stations established eventually. Minnesota's importance as a mining centre has caused her to be selected as one of the first group.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 1.—Sir J. J. Thomson, president, in the chair.—Prof. W. E. **Dalby**: A graphical method of drawing trajectories for high-angle fire. A previous paper by the author, printed in Series A, vol. xcii., p. 239, explained a graphical method of finding the range, time of flight, angle of elevation, and other elements of a trajectory, from the data given by a curve showing the resistance of a standard shell in terms of the velocity. The graphical method followed the analytical method laid down in the military text-books. The paper dealt with direct fire, which is officially defined as "fire *under* angle of elevation 150°." The present paper is a continuation of the paper referred to above, adapting the graphical method to high-angle fire. For this the density of the atmosphere has to be brought into the calculation as one of the variables of the problem. Briefly, the method consists in applying the graphical method explained in the first paper in a series of steps, dealing in each step first with the vertical element of the trajectory and then with the corresponding horizontal element of the trajectory. The magnitude of a step is so selected that the influence of the change of tenuity on the resistance is negligibly small during the part of the trajectory corresponding to the step. The value of a quantity corresponding to, but not the same as, the ballistic coefficient in direct fire is changed from step to step to allow for the changing value of the tenuity as the shot moves in its trajectory. The method is applied to determine the trajectory of a shell weighing 380 lb., fired from a 9·2-in. gun elevated to 40°, taking the conditions of the shots fired during the Jubilee Trials in 1898.—Earl of **Berkeley**, E. G. J. **Hartley**, and C. V. **Burton**: Osmotic pressures derived from vapour pressure measurements.—Aqueous solutions of cane sugar and methyl glucoside. The paper forms a continuation of researches on the same subject already communicated to the society. If the ratio of the vapour pressure of a pure solvent to the vapour pressure of a solution is known, the osmotic pressure between the solution and the solvent can be theoretically calculated. Since the osmotic pressure is proportional to the logarithm of the ratio of the vapour pressures, a specially accurate determination of the value of the ratio is required in order to obtain good values for the osmotic pressure. The paper deals with the experimental arrangements for determining the vapour densities and the special precautions that have been taken to secure a high degree of accuracy. A number of corrections applicable to the simple theoretical formula have been examined, both experimentally and theoretically. The experimental results given refer to solutions of different degrees of concentration. The dissolved substances dealt with are cane-sugar and methyl glucoside and sulphuric acid, while the solvent in each case is water. The experiments were made at standard temperatures of 0° C. and 30° C.—W. **Wilson**: The complete photo-electric emission from the alloy of sodium and potassium. The subject of this investigation is the law governing the variation of the complete photo-electric emission with the temperature of the source of full radiation causing it. Theoretical considerations indicate that this law should be the same as that governing the temperature variation of the thermionic emission from hot bodies, namely, that expressed by the formula

$$C=AT^{\lambda}e^{-\frac{\phi}{2T}}$$

where T is now the temperature of the source of radiation, C is the photo-electric current per unit area of the emitting substance, A and ϕ are characteristic of the substance and independent of T, and λ is a small number, probably not differing much from 2. Experiments are described in which the alloy of sodium and potassium was exposed to approximately full radiation. A wide range of photo-electric currents and the corresponding temperatures of the radiator were measured, and the relation between them was found to be well expressed by the above formula.

Aristotelian Society, February 5.—Dr. H. Wildon Carr, president, in the chair.—F. C. **Bartlett**: Valuation and existence. Three important stages mark the development of the act of valuing. (i) The attitude of satisfaction, or of contentment, which is conditioned by readiness of apprehension and the presence of a feeling of ease. In this there is psychologically no element of direction upon an object, although, as a matter of fact, what is apprehended, the act of apprehending, and the feeling are all different. (ii) The stage of "liking," where what is apprehended begins to be distinguished from the apprehension and the feeling. In neither of these cases is there assertion or assumption of existence. (iii) We have finally the definite judgment forms: "This is beautiful, good, etc." With regard to the objects valued in these instances no consideration of existence or of reality is required in the æsthetic judgment; in judgments of economic value existence is probably indirectly assumed; the moral judgment assumes existence only if acts are to be considered as existing, for it is solely upon acts as performed that the moral judgment is passed. In every instance of its attribution it is required that there should be something possessing qualities and entering into relation with a subject. Thus, neither in the rudimentary attribution of value, nor in the developed value judgment, is anything of necessity assumed or asserted with respect to existence.

Geological Society, February 7.—Dr. Alfred Harker, president, in the chair.—C. T. **Trechmann**: The Trias of New Zealand. The fossiliferous Triassic rocks of New Zealand have been at different times attributed by New Zealand geologists to a Devonian, Permian, Permo-Carboniferous, Lower, Middle, or Upper Triassic, or Trias-Jura age. They are distinct from the Matai rocks, which contain a Permo-Carboniferous fauna. Triassic beds appear at intervals from Kawhia to Nugget Point—a distance of 620 miles. They are steeply inclined, and where they approach the Alpine chain of the South Island pass into semi-metamorphic greywackes or completely metamorphic phyllites and schists. In the North Island only the Noric and Rhætic horizons have been recognised. The Trias passes conformably up into Jurassic deposits. The lowest fossiliferous horizon of the Trias occurs near the top of a great thickness of greywackes, called the Kaihiku Series. The Kaihiku fossils are scanty in species, and no cephalopods occur. The Kaihiku fossil horizon is either late Middle or early Upper Trias, and the great unfossiliferous series below it represents the Middle and possibly Lower Trias. The most highly fossiliferous division is the Carnic—the Oreti and Wairoa Series of New Zealand geologists. Several of the Carnic fossils show affinities with European Alpine forms. The Noric horizon, the Otapiri Series in part, is represented by felspathic sandstones. The Rhætic, the upper part of the Otapiri Series of local geologists, comprises a great thickness of sandy and pebbly beds. Forty-seven genera and species of molluscs and brachiopods are recorded, of which three genera and forty-one species are regarded as new. The affinities of the New Zealand Trias with that of the Malay Archipelago, and especially of New Caledonia, are discussed.—Dr. F. A. **Bather**: The Triassic crinoids from New Zealand collected by Mr. C. T. Trechmann. The specimens are all from the Kaihiku Series. Comparison of the three new species based on all these remains with the Triassic crinoids described from Europe, and especially with those from North America, leads to the conclusion that they are of Upper Triassic age. They bear, however, no resemblance to the Upper Triassic crinoids from Timor.—H. C. **Sargent**: A spilitic facies of Lower Carboniferous lava-flows in Derbyshire. The igneous rocks of Derbyshire form a basic series, consisting mainly of lavas and sills, hitherto classed as olivine-dolerites and basalts. All occur in Lower Carboniferous strata. The lavas were submarine and contemporaneous. Specimens of the lavas from certain localities exhibit a trachytic structure, and possess affinities with both spilites and mugearites. Field evidence shows that these spilitic rocks, as a rule, underlie the basalts. The whole series may have been derived from a common magma of normal basaltic type, and by the upward passage of gases through the magma a relative concentration of the alkalies took place in its upper part. It is suggested that the intense decomposition of the spilites is a case of autometamorphism, due to retention of volatile constituents resulting from the physical environment of a submarine flow. Since the spilites appear to be differentiates from a normal basaltic magma, it is concluded that they do not form a separate suite of igneous rocks distinct from other alkaline rocks.

Royal Anthropological Institute, February 27.—Major A. **O'Brien**: The criminal in the western Punjab. Crime is so excessive in the Punjab that if it were on the same scale here, there would be 1500 murders a year in the United Kingdom. The object of the paper was to determine how far the Punjab criminal is the outcome of his country's past history of internecine wars and how far of the present methods of administering law and order. A number of instances were quoted to show that at present the law, however majestic, is not very widely respected. The reasons for this state of affairs may be summarised as follows: The criminal code has not been adjusted with sufficient regard to the popular notion of what is criminal and what is not; the judicial system, supposed to have been modified to suit the country, is neither Oriental nor British, and falls between two stools; the official staff of judges, magistrates, police, and Crown counsel is quite inadequate to the work to be done. The Punjabi has adjusted himself to these conditions by taking infinite pains to fake his cases, which leads in return to his cases being viewed with the gravest suspicion. The innocent get convicted in a sufficient number of cases to encourage the policy of faking against enemies. The guilty get off too often scot-free. Thus there is a vicious circle of real crime, false accusations, acquittals, and more crimes in revenge for those unavenged judicially.

PARIS.

Academy of Sciences, January 22.—M. A. d'Arsonval in the chair.—The president announced the death of General Bassot, and gave a summary of his work.—G. **Bigourdan**: The first learned societies of Paris in the seventeenth century. The Academy of Montmor.—B. **Gambier**: The identity of Bézout.—M. **Petrovitch**: Value of the action along various trajectories.—M. **Mesnager**: A formula in simple series of the uniformly charged plate, fixed on a plane rectangular contour.—M. **Sauger**: The energy possessed by the earth from the fact of its rotation on itself, when for the density at its interior the law of variation $d=10\left(1-0{\cdot}76\,\frac{r^2}{R^2}\right)$ is assumed.—M. **Mazérès**: The location of foreign bodies by the X-rays without normal incidence and known height of bulb.—C. K. **Reiman**: Contribution to the revision of the atomic weight of bromine. The density of gaseous hydrogen bromide under reduced pressure. The known action of pure dry hydrogen bromide upon mercury excludes the direct measurement of the compressibility of the gas. It can, however, be determined indirectly by density measurements under different pressures. In the experiments described the gas was prepared by two methods: by direct synthesis from its elements, and by the interaction of potassium bromide and phosphoric acid. The final density leads to 79·924 as the atomic weight of bromine.—W. J. **Murray**: Remarks on the normal density of hydrobromic acid. Work carried out at Geneva on similar lines to that described in the preceding paper. The gas was prepared by the action of a limited quantity of water on anhydrous aluminium bromide, followed by fractional distillation. The mean density found was 3·6440 grams per litre.—H. **Hubert**: Preliminary sketch of the geology of Senegal.—P. **Fallot**: The tectonic of Ibiza.—E. **Belot**: The satellite hypothesis and the orogenic problem.—H. **Devaux**: Cultural methods producing an increase in the production of wheat.—L. **Roule**: The larval and post-larval development of the fishes of the genus Mugil.—A. **Berthelot**: Researches on the production of phenol by micro-organisms. An organism, named *B. phenologenes,* has been isolated from the intestinal flora of man which is capable of producing about ten times as much phenol as the most active phenol-producing species hitherto known. With tyrosine as nutrient, a concentration of 800 mg. of phenol per litre is produced.—M. **Tonzes-Diacon**: The formation of turbidity in wine.—V. **Raymond** and J. **Parisot**: Trench feet. The authors give evidence that this condition is due to an infection by one or more moulds.

BOOKS RECEIVED.

Natural Health *versus* Artificial Health. By Satis Chandra Lahiri. Pp. vi+120 (Calcutta: J. Chandra Adhikari.) 8 annas

Science and the Nation: Essays by Cambridge Graduates, with an Introduction by the Rt. Hon. Lord Moulton Edited by A. C. Seward. Pp. xxii+328. (Cambridge: At the University Press.) 5*s.* net.

Kodak Bromide Pictures. By Some Who Make Them. Introduction by W. L. F. Wastell. Pp. 64. (London: Kodak, Ltd.)

The Principles of Plant-Teratology. By W. C. Worsdell. Vol. ii. Pp. xvi+296+26 plates. (London: Ray Society.)

Germany's Lost Colonial Empire and the Essentials of Reconstruction. By J. H. Harris. Pp. vii+88. (London: Simpkin and Co., Ltd.) 1*s.* net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 15.

ROYAL SOCIETY, at 4.30.—The Initial Wave Resistance of a Moving Surface Pressure: Prof. T. H. Havelock.—Experiments with Mercury Jets. (1) The Relation between the Jet-length and the Velocity of Efflux; (2) A Comparison with Jets of Other Liquids: Prof. S. W. J. Smith and H. Moss.—The Mode of Approach to Zero of the Coefficients of a Fourier Series: Prof. W. H. Young.—The Dissipation of Energy in the Tides in Connection with the Acceleration of the Moon's Mean Motion: R. O. Street.

ROYAL INSTITUTION, at 3.—Sponges: a Study in Evolutionary Biology: Prof. A. Dendy.

ROYAL SOCIETY OF ARTS, at 4.30.—The Industrial and Economic Development of Indian Forest Products: R. S. Pearson.

LINNEAN SOCIETY, at 5.—The Preparation of Plants for Exhibition: C. E. Jones.—A Systematic Study of the North American Melanthaceæ from the Genetic Standpoint: Dr. R. R. Gates.

FRIDAY, MARCH 16.

ROYAL INSTITUTION, at 5.30.—Scientific Forestry for the United Kingdom: Sir J. Stirling Maxwell.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Heat Treatment of Large Forgings: Sir W. Beardmore, Bart.—Heat Treatment of Steel Forgings: H. H. Ashdown.

SATURDAY, MARCH 17.

ROYAL INSTITUTION, at 3.—Imperial Eugenics: Saving the Future: Dr. C. W. Saleeby.

MONDAY, MARCH 19.

ROYAL SOCIETY OF ARTS, at 4.30.—Memorials and Monuments: L. Weaver.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Palestine; its Resources and Suitability for Colonisation: Dr. E. W. G. Masterman.

VICTORIA INSTITUTE, at 4.30.—The Significance of the Geography of Palestine: Sir Charles Warren.

TUESDAY, MARCH 20.

ROYAL INSTITUTION, at 3.—Geological War Problems: Prof. J. W. Gregory.

ROYAL STATISTICAL SOCIETY, at 5.15.—How to Improve our Fishing Industries: The Right Hon. The Earl of Dunraven.

MINERALOGICAL SOCIETY, at 5.30.—The Basaltic Rocks of Spitsbergen and Franz Joseph Land in Relation to the Brito-Arctic Province: A. Holmes, with Analyses by Dr. H. F. Harwood.—A General Proof of the Limitation of the Symmetry-numbers of Crystals: Dr. J. W. Evans.—The Numerical Relation between Zones and Faces of a Polyhedron: Prof. E. S. Fedorov.—The Crystallisation of Parahopeite: A. Ledoux, T. L. Walker, and A. C. Wheatley.

ZOOLOGICAL SOCIETY, at 5.30.—The Prechordal Portion of the Chondrocranium of *Chimaera colliei*: E. Phelps Allis, jun.—A Sketch Classification of the Pre-Jurassic Tetrapod Vertebrates: D. M. S. Watson.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—The New Electric Power-house at Birchills, Walsall: E. M. Lacey.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—Sulphur in Petroleum Oils: Dr. F. Mollwo Perkin.

WEDNESDAY, MARCH 21.

ROYAL SOCIETY OF ARTS, at 4.30.—Colour Printing, and Some Recent Developments: G. W. Jones.

ROYAL METEOROLOGICAL SOCIETY, at 5.—The Formation of Mist and Fog: Major G. I. Taylor.

ENTOMOLOGICAL SOCIETY, at 8.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Bateriology of War Wounds: Kenneth Goadby.

THURSDAY, MARCH 22.

ROYAL SOCIETY, at 4.30.—*Probable Paper:* Observations and Experiments on the Susceptibility and Immunity of Rats towards Jensen's Rat Sarcoma: J. C. Mottram and Dr. S. Russ.

ROYAL INSTITUTION, at 3.—Modern Improvements in Telegraphy and Telephony: Prof. J. A. Fleming.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Modern Methods of Finding the Latitude with a Theodolite: Dr. J. Bell.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Machine Switching Telephone Gear: F. R. McBerty.

FRIDAY, MARCH 23.

ROYAL INSTITUTION, at 5.30.—Magic in Names: E. Clodd.

SATURDAY, MARCH 24.

ROYAL INSTITUTION, at 3.—Russian Idealism: S. Graham.

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