THURSDAY, JULY 25, 1918.

SCHOOL AND COLLEGE MATHEMATICS.

(1) *Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, for the Years* 1908–17. Edited by R. M. Milne. (London: Macmillan and Co., Ltd., 1918.) Price 7*s*.

(2) *A Short Course in Elementary Mathematics and their Application to Wireless Telegraphy*. By S. J. Willis. Pp. 173. (London: The Wireless Press, Ltd., 1917.) Price 3*s*. 6*d*. net.

(3) *Infinitesimal Calculus*. By Prof. F. S. Carey. Section i. Pp. xiii + 144 + Answers v. Price 6*s*. net. Section ii. Pp. x + 145–352 + Answers iv. Price 10*s*. 6*d*. net. (London: Longmans, Green, and Co., 1918.)

(1) THIS collection of examination papers will be found useful by many teachers and students, even if their work is not immediately associated with the requirements of the military authorities. The papers for the Army Qualifying Certificate include questions on more advanced arithmetic, elementary algebra and geometry, mechanics, and a little trigonometry; special attention is paid to practical methods and applications. The papers for admission are wider in scope and more difficult in character. The mathematics is divided into three parts. The elementary papers are of a practical nature, involving principally drawing and mensuration. The intermediate papers are also practical, and include mechanics, besides some algebra, geometry, and trigonometry. The higher papers introduce in addition easy differentiation and integration. The questions are very skilfully devised, and many teachers and examiners would benefit by a perusal of this volume.

(2) Mr. Willis has written an eminently useful exposition of the mathematics required by the student of wireless telegraphy. To use the language of the accompanying advertisement, the book does not presume that the student is unable to add two and two together, nor does it plunge into advanced work for which the student is quite inadequately prepared. There are chapters on logarithms and the slide rule, practical geometry and mensuration, including a little on conic sections, equations and progressions, the fundamental ideas and formulæ of trigonometry, vectors with examples from statics and dynamics, and an excellent chapter on the "use of squared paper" with the beginnings of differentiation. Many examples are worked in full, others are set as exercises. The volume concludes with some useful tables.

The author's style is very pleasant and persuasive, and the book is one that can be safely recommended for the purpose for which it was written. A few typographical criticisms must, however, be offered. The base of Napierian logarithms is written differently in different places, and dashed letters are sometimes written a^1, b^1; this is quite inexcusable when dashes are used in the figure, and "ones" in the accompanying text. Some of the conics are badly drawn. The notation used is sometimes confusing; surely no student should be encouraged to write: "Thus the series is a G.P. in which $a=a/2x$. . . ."

With regard to the mode of treatment, we would like to suggest that the elaborate investigations on the factors of quite simple quadratic expressions are unnecessary, and that the order of treatment is a little unsound pedagogically.

(3) Prof. Carey's book can be heartily approved as a compact and clear statement of practically all that the ordinary student of the infinitesimal calculus "as an instrument in the attainment of further knowledge" is likely to require. Section i. deals with the more elementary parts of the subject, including the theory of limits, easy differentiation and integration, and applications to curves, areas, volumes, etc. Section ii. proceeds to the advanced parts of the subject, and discusses, *inter alia*, definite integrals, polar and other properties of curves, and the important types of differential equations. The author has evidently kept in mind all through the practical application of the methods and results, as is indicated by the references to problems in mechanics and physics. A short chapter on graphical methods includes a brief account of nomography, a graphical process which is gaining currency in this country owing partly to the intimate relations now existing between our engineers and their French and American brethren.

Whilst we welcome the commendable brevity of the book, we cannot but express the fear that the author has attempted to cater for too wide a range of students. The first section is far too difficult to be accepted as corresponding with "the syllabus of some examinations for higher school certificates." Much of the contents of the chapters dealing with the notion of a function, limits, and continuity should come at the end of a first course on the subject, rather than at the beginning.

The main ideas of the calculus must be based at first on geometrical intuition, and this is recognised by the author, who has given many illustrations of the processes by means of curve plottings. We should have welcomed a similar treatment of differential equations. Instead of this we have the traditional series of tricks for the solution of selected types. It is to be hoped that before long the student of mathematics will be taught this branch of the subject by methods more in accord with recent developments. Perhaps it was also lack of space that caused excessive compression of the treatment of this and other branches. The references to nomography, for example, would have been far more valuable if space had been spared for a fuller discussion of the underlying principles.

The book is well printed and neatly produced. An exception to the general excellence is to be found in the diagrams, many of which are not well drawn. We hope that in a future edition care will be taken to remedy this and some other minor defects.

There is one statement that we feel cannot be accepted without some consideration: "If a man ever scales 9 stone there must have been a time at which he weighed $4\sqrt{5}$ stone." Is this necessarily so? S. B.

LECITHIN AND ALLIED SUBSTANCES.

Lecithin and Allied Substances: The Lipins. By Dr. H. MacLean. ("Monographs on Biochemistry.") Pp. vii+206. (London: Longmans, Green, and Co., 1918.) Price 7*s.* 6*d.* net.

THE time had come when an account of the chemistry of lecithin and allied substances should be written and must be read by everyone interested in bio-chemistry. Ten years ago it had not. At that time the subject could only have been presented as an unprofitable series of disputes on insecure premises. Now there must be many for whom this monograph will be a revelation, many who, though they may have read, have not collated the important contributions to the elucidation of this most difficult subject that have appeared in the last few years, and who, when they see this done admirably, as it is done here, will realise that a new epoch in the history of bio-chemistry is being marked out.

It is just ten years since Dr. MacLean published the first of a series of papers in which, starting from the fact that the amount of choline obtained in the hydrolysis of lecithin was always less than the supposed structure of this substance required, he established good ground for his belief that this is due to the fact that lecithin, as ordinarily obtained, is mixed with kephaline, in which, as we know now from the work of Parnas and his associates, the basic group is aminoethanol. Dr. MacLean has described a method of purifying lecithin, so that it gives the theoretical yield of choline, and, therefore, is free from kephaline. Other impurities that are associated with lecithin which he can by his method remove may, indeed, so disguise it as to make it appear as some one or other of those vague phosphatides of which too many have been described, and of which we are told little but that they are soluble in this and insoluble in that solvent, and contain nitrogen and phosphorus in a certain proportion. Lecithin and kephaline now mean something more than this.

Then from the limbo of protagone there have emerged sphingomyelin and the cerebrosides, with their common basic component sphingosine, substances that forty years ago Thudicham had seen before their day had come. In the last few years the work of Thierfelder, of Rosenheim, of Lapworth, and, above all, of Levene, who, to the advantages of a richly endowed institution, has added the enthusiasm and the patience of a great investigator—work that has finality—has given to these somewhat ghostly shapes reality and precision of outline. This work on the constitution of sphingosine and on the strange fatty acids of sphingomyelin and the cerebrosides confers on these substances a living interest, now that their chemical structure is acquiring definition, as great as that which has been focussed, for instance, on the nucleic acids or on hæmatine. In all there are the same elements of novelty, mystery, and wealth of biological significance. Dr. MacLean is to be congratulated on his opportunity no less than on the use he has made of it.

It was no doubt unavoidable that this book, coming just when it has, should still contain, in addition to the chapters describing the advances of recent years, whole sections devoted to the unwelcome task of pronouncing judgment on so many substances, named and unnamed, the discovery of which has not been established. Dr. MacLean would probably, too, have preferred not to have had to commit himself in the matter of nomenclature. The things that count have good enough names. Lecithin, sphingosine, and sphingomyelin are appropriately and successfully named, though it is true as much cannot be said for kephaline, phrenosine, or kerasine. Schematic nomenclature matters less, and it is in this that agreement has not been attained. When the subject reaches the schools this will be added to it.

A FAUNISTIC SURVEY.

The Invertebrate Fauna of Nottinghamshire. By Prof. J. W. Carr. Pp. viii+618. (Nottingham: J. and H. Bell, Ltd., 1916.)

THE Nottingham Naturalists' Society is to be congratulated on having produced a finely executed survey of the invertebrate fauna of the county. It is part of a survey which was resolved upon when the society completed its fiftieth year, the task being placed in the competent hands of Prof. J. W. Carr. He has been efficiently helped by collectors and by specialists, and it is satisfactory to read that "practically every species recorded has been submitted to and named by a leading authority in the group to which it belongs." The whole work shows a high standard of carefulness, and it will be of great service to active local naturalists, who have now an authoritative list to which they may add. That there are many additions to be made is plain when we look at the sparseness of the records as regards Nematodes, Rotifers, Leeches, and some other classes.

Among the excellent features of this "Fauna" we may mention (1) the precision which so often marks the record of the particular kind of environment frequented by a particular species, and (2) the insertion of introductory descriptions of phyla, classes, orders, and sometimes even families. They are tersely and clearly phrased, and greatly increase the value of the lists. The consistent use of different type-founts for the various grades of classification from phylum to species is another instance of carefulness, and the whole typography is excellent. As data accumulate, the indefatigable editor proposes to append supplements, and already there are nearly 300 additional species of Diptera waiting for admission. The Vertebrate

Fauna and the Flora will be dealt with in separate volumes. We are glad to know that along with the published records there is growing up a local collection of actual specimens—in short, a regional survey museum. For these "Faunas" and "Floras" are not appreciated at their highest value when considered by themselves; their larger importance is as components of an integrated survey; and those who may think that we are saying too much about a book consisting mainly of careful records of the finding of hundreds of spiders, insects, molluscs, and worms have yet to understand that one of the factors in secure progress must be—more than heretofore—an intimate and scrupulously accurate survey of all the facts of every region.

OUR BOOKSHELF.

A Handbook of Briquetting. By Prof. G. Franke. Translated by F. C. A. H. Lantsberry. Vol. ii., *Briquetting of Ores, Metallurgical Products, Metal Swarf, and Similar Materials, including Agglomeration.* With Appendices. Pp. xi+214. (London: C. Griffin and Co. Ltd., 1918.) Price 15*s.* net.

THE promised second volume of the translation of Prof. G. Franke's work on briquetting has now appeared, dealing with the briquetting of materials other than fuels. These materials are, first and foremost, iron-ore, to which the greater part of the work is necessarily devoted; next flue-dust and certain other metallurgical by-products; and, finally, metallic borings and turnings, which the translator is pleased to designate "swarf." The work is distinguished by the same amount of careful detail, particularly in the description of the mechanical appliances, that characterised the first part, but it is evident that the author has not the same practical familiarity with this portion of his subject as he displayed in dealing with fuel in his former volume. Much of his information is derived from current literature, and is neither so complete nor so accurate as it was in the case of coal. His handling of the important subject of the briquetting of iron-ores is far inferior, for example, to the paper on the same subject read before the Iron and Steel Institute last autumn by Messrs. Barrett and Rogerson. For instance, the list of Swedish briquetting works given by the author refers only to the year 1906, and is now hopelessly out of date. Still worse is the total omission of the entire group of modern sintering processes, such as the Dwight-Lloyd, Huntington-Heberlein, Greenawalt, etc., which are generally looked upon as the most promising of any of the methods hitherto devised for treating iron-ores. It cannot be denied that these defects rob the work of much of its value, though anyone desiring detailed accounts of the older methods will find them given very fully.

As regards the translation, it is possibly an improvement on that of the first volume, but still leaves very much to be desired.

State Geological and Natural History Survey. (State of Connecticut. Public Document No. 47.) Vol. v., Bulletin 22. *Guide to the Insects of Connecticut.* Part iii. *The Hymenoptera or Wasp-like Insects of Connecticut.* By H. L. Viereck, with the collaboration of A. D. MacGillivray, C. T. Brues, W. M. Wheeler, and S. A. Rohmer. Pp. 824+plates x. (Hartford: Printed for the State Geological and Natural History Survey, 1916.)

COLLECTORS and observers of insects in New England are fortunate in having at their disposal such a "guide" as this to lead them in the discrimination of genera and species in that most fascinating, but systematically most difficult, order, the Hymenoptera. Some of the most eminent of American entomologists have collaborated in the production of this volume, and their careful diagnoses and analytical tables are rendered the more comprehensible to the beginner by clear structural text-figures. As very many genera are common to both the western and eastern continents, this book will be of value to European workers, who will be interested to find that not a few of the Connecticut species of ants, wasps, and bees are identical with familiar British insects. Although the treatment is predominantly systematic, information on the habits of many of the families is furnished, and the plates illustrating gall-forming and nesting activities are instructive. Good line-drawings would have been preferable to the photographic reproductions of museum specimens of insects, many of which are badly set and some mutilated. The great merit of the book consists in its presentation of the modern classification of all the families and the more important genera of Hymenoptera in a single, if somewhat bulky, volume. G. H. C.

The Baby. ("Manuals of Health," ii.) By Dr. S. Seekings. Pp. 63. (London: Society for Promoting Christian Knowledge, 1918.) Price 9*d.* net.

WE do not find anything particularly novel in this little book on baby management, nor does it seem to present anything that cannot be found in several other books of a similar type. It is written clearly and simply, and the directions can be easily followed. For artificial feeding it is recommended that the milk be always scalded, but no direction is given on the importance of cooling in hot weather. In the chapter on common ailments (or elsewhere) we find no mention of vaccination and the treatment of the arm, while, though comparatively infrequent in the infant, measles and whooping-cough are discussed. It is stated that measles causes more deaths among children under a year old than at any other age. This is incorrect: almost twice as many children die in their second year from this cause as in the first year, and the measles death-rate in the second year is nearly eight times that in the first year. Some useful directions are given in an appendix for the preparation of barley and albumin water, etc., and for knitting infants' garments. R. T. H.

LETTERS TO THE EDITOR.

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

Discovery of Neanderthal Man in Malta.

Of the various problems relating to extinct forms of man, none is of greater interest than that which concerns *Homo neanderthalensis*. This peculiar and extinct species of man appeared in Europe about the commencement of the Mousterian cultural period, and all traces of him vanish towards the close of that period. Where he came from and where he finally disappeared we do not know, hence every additional fact we can collect about him is of value. So far his remains have been found at Gibraltar (1848), the Rhine valley (1857), Belgium, the Dordogne, and Croatia. The peculiar teeth of this race were reported from the Mousterian strata of a cave in Jersey by Dr. R. R. Marett in 1911. Excavations in the cave of Ghar Dalam, in the south-eastern corner of Malta, carried out by Dr. Giuseppe Despott, curator of the Natural History Museum of the University of Malta, working for a research committee of the British Association, has brought to light the remains of Neanderthal man in that island, thus extending the distribution of this species to another continent; for, in a zoological sense, Malta is African rather than European. It is true that so far only two teeth have been found—a first upper molar and a milk molar—but those who are familiar with the characteristic form of the molar teeth of Neanderthal man will have no hesitation in assenting to the truth of Dr. Despott's discovery. I append Dr. Despott's photograph of the two Neanderthal teeth, giving for comparison photographs of the teeth of a modern type of man found in the Neolithic strata of Ghar Dalam, overlying the strata from which the Neanderthal teeth were derived (Fig. 1).

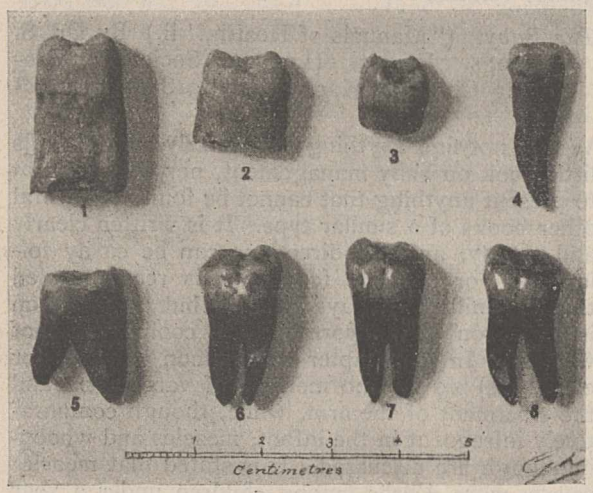

FIG. 1.—Teeth from Ghar Dalam. (1) Upper Neanderthal molar; (2) upper Neanderthal milk molar; (3) milk molar from Neolithic strata; (4, 5, 6, 7, 8) other teeth from Neolithic strata.

A brief history of the discovery is as follows:—In 1914 Section H (Anthropology) of the British Association appointed a research committee to carry out archæological investigations in Malta, Prof. J. L. Myres being chairman, and Dr. T. Ashby, of the British School of Rome, secretary. Dr. Ashby, in partnership with Dr. Zammit and Dr. Despott, commenced to investigate Ghar Dalam, a cave more than 700 ft. in length, with a width of 26 ft. to 60 ft., and strata in its floor running down to a depth of 12 ft. or more. In 1917 Dr. Despott, with the aid of a further sum of 10*l.* granted by the British Association, continued the investigations for the committee in July and August, 1917. Two trenches were dug across the floor of the cave—one 50 ft. from the mouth, the other 60 ft. further along. The strata encountered will be seen from a drawing given by Dr. Despott in his report for 1916. The upper two layers indicated

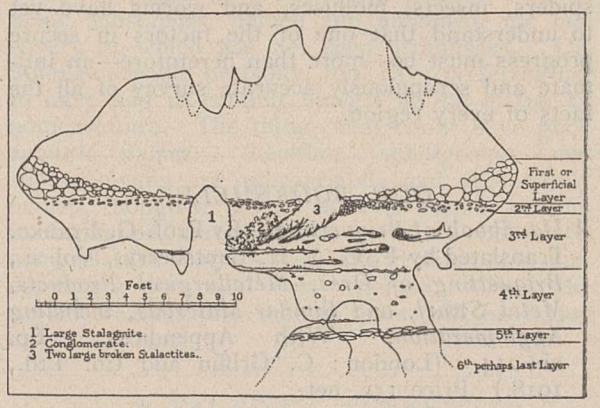

FIG. 2.—Section of the strata of the floor of Ghar Dalam.

in the plan yielded remains of animals and pottery of the Neolithic period. The third layer yielded remains of the stag, a vole, a variety of snail (*Helix vermiculata*, var. *despottii*), and human remains—the first upper molar of *Homo neanderthalensis*; the other human bones have not yet been studied. In the same stratum and at the same level as the human remains were found a flint scraper, three obsidian scrapers, a chert knife, and a piece of apparently worked chert. At another site in the same stratum was found part of a fine flint knife, which Sir Hercules Read regards as of late Cave period in workmanship.

The milk molar of Neanderthal man came from the next layer—the fourth in the appended section (Fig. 2). In this stratum were found the remains of stag (apparently two species), plentiful remains of the extinct elephant (*Elephas mnaidrensis*), the fossil tooth of a shark, worn and chipped at the point by being used as a tool, and mollusc shells which had apparently been opened and their contents extracted by ancient man. Still deeper strata yielded numerous remains of three extinct elephants (*E. mnaidrensis*, *E. melitensis*, and *E. falconeri*), two species of hippopotamus and of the stag. So far traces of man have not been observed in these deeper and older strata.

When the committee of Section H came to consider the report transmitted to it by Dr. Ashby from Malta, it at once recognised the value of Dr. Despott's discovery and the importance of Ghar Dalam as a repository of Pleistocene history. When one considers the extent of the cave, the thickness of its floor, and the fact that every trench so far made has yielded traces of man, it is not too much to hope that we have here a Pleistocene palace of Knossos—a site which is likely to throw the same light on early man in the Mediterranean as was thrown on the Bronze period of that area by the discoveries made by Sir Arthur Evans in Crete. The committee, in recommending the renewal of a grant of 10*l.* for the investigations carried on by Dr. Despott, was well aware of its total inadequacy, but it had to remember that in these times the finances of the British Association

have been crippled; the Association has now to draw on its very limited capital. The committee took the view that, as an Imperial people, it is our duty to shoulder our responsibilities and develop the resources of the Empire—resources of knowledge as well as resources of material—in time of war as well as in time of peace. We are too apt to make war an excuse for postponing our immediate duty. Sir Thomas Wrightson, Bart., has given 50*l.*, but it does not seem too much to expect that three other subscriptions of equal amount may be placed at the disposal of the Research Committee for Archæological Investigation in Malta, in addition to the grant from the British Association. The labour conditions in Malta are at present favourable for the continuance of this kind of Imperial undertaking, and the men who are in charge have the skill and experience to employ to the best advantage the modest sum here asked for.

ARTHUR KEITH,
President, Section H (Anthropology) of the British Association.

A Successful Method of Obtaining Amœbæ for Class Purposes.

ZOOLOGICAL departments in all parts of the British Isles have experienced, during the last few years, considerable difficulty in obtaining a good supply of *Amoeba proteus* for class purposes at the proper time, the usual hunting-grounds for this organism failing, for some reason or other, to yield their former abundant supply.

The difficulty was overcome in this department during the present session by making use of amœbæ obtained from soil by a suitable culture method, the outcome of the writer's work on soil protozoa. This method has proved so successful that it has been thought desirable to give a brief account of it, especially as it has come to my knowledge that other zoological departments are desirous of trying it. A somewhat similar method of obtaining amœbæ for class purposes has been in use for some years in the University of California, and has been described by Kofoid in the Trans. Amer. Micro. Soc., vol. xxxiv., October, 1915.

For the cultivation of amœbæ from soil a liquid medium is preferable to a solid one, such as nutrient-bouillon agar, frequently used for amœba cultivation, owing to the fact that one frequently finds on a solid medium amœbæ with two or more nuclei and various other abnormalities not found in amœbæ from a liquid-culture medium.

One per cent. hay-infusion is a very useful medium, and is constantly used here. It is prepared as follows:—Ten grams of chopped hay are put into a beaker or flask with one litre of distilled water, and steamed for about three-quarters of an hour; filter, and then make the filtrate just alkaline by the addition of a sufficient quantity of caustic-soda solution (N.NaOH solution is quite suitable) to make a strip of red litmus paper turn a bluish tint when immersed in the liquid. Sterilise in the autoclave, and, when cold, pour a small quantity into three or four Petri dishes until the liquid is a few millimetres in depth, and inoculate each with soil; about half a gram is sufficient soil for each plate. Almost any kind of soil will serve—garden or field soil.

Put the dishes aside for a day or two, either in an incubator at 20°–25° C., or on the laboratory-table, away from direct sunlight, and then examine under the microscope for amœbæ. The latter are, as a rule, of the *limax* type, and are generally to be found on the surface or at the bottom of the culture.

Ciliates and flagellates will also be found in considerable numbers; in fact, the ciliates frequently predominate in the early days of the culture, and only when they become less numerous do the amœbæ increase in numbers.

For the purposes of examination clean coverslips may be dropped on to the surface of the culture-liquid, and then removed to slides and examined under the microscope; or a platinum loopful or two of the surface layers may be taken and put on a slide and then covered with a clean coverslip. When most of the amœbæ are at the bottom of the culture, as sometimes happens, they are more difficult to remove to slides, but they may be sucked up by means of a capillary pipette gently moved over the bottom of the dish and then transferred to the slide. The coverslips should be sealed with vaseline or wax to prevent evaporation.

The amœbæ vary in size from very small forms, which are not of much service for class purposes, to fairly large forms, which are quite admirable, showing great amœboid activity and revealing clearly under the higher powers of a junior-class microscope the differentiation between ectoplasm and endoplasm, the nucleus, and the streaming of the protoplasm during the progression of the amœba. Such forms may measure anything from 20 μ–60 μ in length, according to the degree of extension of the body, and even larger forms may be met with. The organism which has been obtained in practically pure mixed culture here, and has proved so useful, measures between 30 μ and 50 μ when extended. The cyst has a diameter of 16 μ–17 μ.

Having obtained a good-sized form, one should allow it to multiply, and finally to encyst. The cysts may then be picked up by means of a capillary pipette and transferred to fresh culture medium, when one is almost certain to obtain a practically pure mixed culture. Further subcultures can be made by inoculating the cysts into fresh dishes of hay-infusion, and by this means the race may be kept going for months, or even years.

Even if the cultures dry up, and remain dry for a month or two, it will still be found possible to obtain a supply of organisms by scraping some of the brown deposit from the inside of the dish and placing this in fresh sterile hay infusion. After a few days amœbæ will be plentiful, having hatched out of the cysts contained in the deposit from the old culture.

Such a cyst-containing deposit or old culture containing cysts can be kept as a stock, and when active amœbæ are required all that is necessary is to seed a dish or two of hay-infusion with cysts two or three days before the organisms are wanted, and one can be certain of obtaining a good supply of active forms.

I shall be pleased to supply any zoological department with a small quantity of cyst-containing deposit or old culture liquid containing cysts of the form cultivated here in case no success is obtained with the method described above.

T. GOODEY.

Department of Zoology, The University, Birmingham, July 16.

SCIENTIFIC PLANT BREEDING.

SO much attention has been directed to the purely scientific advance that has followed the birth of Genetics as a new branch of science that little regard has been paid to the very remarkable results already reached by the application of Mendelian methods to the problems of economic plant production. It is necessary to distinguish somewhat sharply between the facts which Mendel was the first to discover, and the hypotheses which

have been put forward to explain these facts. The practical plant breeder is not primarily concerned with the theory of the subject; the Mendelian fact of grand importance to him is that unit characters do segregate, and that new combinations of these characters can be made.

It may be of interest, therefore, to consider some of the more important results obtained in regard to food-producing plants, and to indicate some of the difficulties which may impede future progress. Of food grains none is more important than wheat. The most marked achievement in wheat breeding is the production of a variety resistant, if not entirely immune, to the fungous disease known as Yellow Rust (*Puccinia glumarum*), as a result of the discovery that resistance to this disease obeys the Mendelian law of segregation. Once this was established it became a comparatively simple matter to transfer this character as an independent unit from the poor yielding Russian wheat, "Ghirka," in which it was found, to a wheat suitable to the conditions of England. The variety "Little Joss," which was "made" in this way some ten years ago, is now well established in the Eastern Counties.

The possible economic value of this achievement becomes apparent if the enormous yearly losses caused by rust—perhaps not far short of 10 per cent. of the yield annually—are considered. Another economic character that can be controlled in the same way is stiffness of straw, a matter of importance in those parts of the country, such as the Fens, where a weak-strawed wheat becomes "laid" in wet seasons. It is interesting to learn that a short, stiff-strawed variety known as "Fenman" has recently been produced which is likely to be largely adopted in the Fen country. But the possibility of greater additions to the food supply of the country is now in sight. It is well known that wheat is commonly a slow-growing plant; sown in late autumn or winter, it is harvested in August. Barley and oats, on the other hand, come to maturity more rapidly, and need not be sown until spring. There are, however, certain varieties of wheat which can be sown in spring, but, unfortunately, their yield of grain is considerably less than that given by winter wheats. The result has been that under the ordinary conditions of farming in this country the area that can be sown with wheat is limited to that not occupied by a crop during winter. Barley and oats must be grown after "roots" because the latter are not completely off the ground until early spring. If, then, it were possible to make a spring wheat combining the character of early maturity with a yield approaching that given by winter wheat, the economic gain might be enormous, for, obviously, it would be in the interest of home food production to curtail the area occupied annually by barley. If, then, we could add to the existing acreage sown annually with wheat only one-quarter of the normal acreage under barley and oats, we should add probably 20 per cent. to the home-grown cereals available for human food. The possibility of making an improved spring wheat depends upon how far early maturity and yielding capacity are found to segregate. Apparently, there are indications that the former does, but the problem in regard to the latter is complex, depending for its solution on the clearing up of the difficulties that are encountered in dealing with quantitative characters, such as yield, as distinct from qualitative characters, such as colour of grain.

The questions involved are obviously of great economic importance, for it is the quantitative characters that often determine the economic value of a plant or animal. But it is not simply a question of the universality of the Mendelian law. If, as some geneticists hold, the inheritance of quantitative characters is regulated by a complex of unit characters, the practical application of Mendelian principles becomes exceedingly difficult, for with any number of characters over three the number of possible combinations of unit characters becomes generally too large to handle. And the difficulty does not end there, for, owing to environmental fluctuation, the comparative genetic behaviour of individuals cannot be disentangled, and the plant breeder is consequently driven to resort to purely empirical methods of selection. Nevertheless, the fact that the exact nature of the laws regulating the inheritance of quantitative characters is still obscure may not seriously impede the work of the practical breeder. In fact, it has been found in practice that, provided desirable qualitative characters can be built up in the desired complex, the quantitative characters may be susceptible of improvement by selective methods of a more or less empirical nature.

But when all is said, scientific plant improvement in Great Britain has made only a small beginning, due, no doubt, in part to the general excellence of the varieties of economic plants now established in this country. The "Improvers" of agriculture and horticulture in the nineteenth century revolutionised the industry, and, as an outcome of their activities and influence, British seedsmen, largely by selective methods, effected very great improvements in economic plants. It is only comparatively recently that this country has fallen behind. Allusion may be made to the great advances achieved in Sweden as a result of the work of the Svälof plant-breeding station. Denmark also is forging ahead, but, curiously enough, progress has not been remarkable in Germany, owing, perhaps, to the extraordinary cult of Darwinism which prevails there, and the consequent belief in the effectiveness of mass selection. In America considerable progress has been made from a scientific as well as from an economic point of view—notably in producing a cotton immune to the destructive Wilt disease.

But if a striking object-lesson of the successful application of new methods to plant production is needed we must turn to India.[1] Dating from

[1] Report on the Progress of Agriculture in India for 1916–17. (Calcutta Supt. Govt. Printing, 1918.)

the foundation of the Pusa Research Institute about the beginning of the present century, great developments in the scientific exploitation of Indian agriculture have taken place. Much credit is due to Lord Curzon, who, aided, it is now curious to recall, by the munificent bequest of an American (Mr. Phipps), founded a department which it is no exaggeration to say has added thousands, and will add millions, to the wealth of the country. India undoubtedly presented a fine field for the modern plant breeder. If we consider the immense variety of her plant products, their value either as food or in the arts and industries, and then observe that, owing to the absence of any skilled seed production industry, there is an uncounted number of identifiable races within each distinctive variety of economic plant, we can form some conception of the possibilities which even selection presents: superadding hybridisation, it is difficult to assign any limits to the field that is opening out.

It would be impossible in the ordinary limits of space to give a detailed account of what has already been achieved, but some indication may be given of proved successes in relation to the more important economic plants.

Mention may first be made of Wheat, of which upwards of 30 million acres are grown, and which was naturally one of the first crops to receive attention. Both selection and hybridisation have been brought into action, and several new varieties are now firmly established. In the United Provinces in 1917 alone "Pusa No. 12" occupied 100,000 acres, and was extensively grown in the Punjab as well. This wheat gives a cultivator an *increased yield of 25 per cent.* over the varieties formerly grown by him, as well as nearly one shilling per quarter more on the market, owing to its improved quality. Another and later production of Pusa has on occasions given a yield of nearly fifty-five bushels per acre, which for India is an unheard-of figure, and may be compared with thirty-two bushels, the British average yield of wheat. In the Punjab another new variety occupied 97,000 acres, and it is estimated that the growers of this wheat were presented with an additional income of nearly 15,000*l.* In the Central Provinces improved varieties, returning to the cultivators considerably increased profits, occupied 200,000 acres.

Remarkable progress is also being made in the production of improved varieties of Rice, the most important cereal crop in India. A variety known as "Indrasail," isolated by pure lime selection, occupied 20,000 acres in Bengal. In the Central Provinces it has been necessary to establish thirty seed farms for the production of other new varieties. Turning to non-food products, we find that extraordinary advances have been made in regard to cotton (of which 20 million acres are grown in India). In Surat an improved cotton has been produced giving a premium value of 13 per cent.; in Sind new varieties are giving a premium of 23 per cent. In the Central Provinces a new introduction is estimated to occupy no less than 800,000 acres, and to have brought the cultivators increased profits of nearly 900,000*l.* After this we may pass over such relatively inconsiderable figures as 215,000 acres under a new variety in the Punjab, but, for its human interest, mention may be made of one incident in a campaign directed to the eradication from a certain district of an inferior indigenous variety. It is a good example of the methods adopted to impress the Oriental imagination. "In the Tinnevelly district the department had to resort to drastic action for the control of seed in the case of some ninety acres of *pulichai* [the inferior cotton] . . . the seed from this cotton was publicly burnt . . . before a large gathering of ryots."

In the improvement of Jute (of which India exports annually products worth 40,000,000*l.*) some notable advances have been made. It is expected that in the present year more than 30,000 acres will be sown with a new selected variety as a result of the distribution by the department of 500,000 packets of seed. In this connection a valuable scientific discovery may be mentioned. The pernicious weed, water hyacinth, which infests the waterways of Bengal, has been found to have a high potash content, and is consequently a valuable manure for jute, the use of which not only directly stimulates yield, but also protects the plant against a Rhizoctonia disease which attacks it.

It will be readily admitted that this tale of economic progress is astonishing. No mention has been made of the purely scientific results achieved, and they are very considerable. The workers no doubt feel well rewarded by the satisfaction with which they must regard the additions to knowledge which they have made, but they may also feel some pride in the remarkable economic advances which their labours have brought about, especially in regard to the food-producing plants.

THE VALUE OF INSECTIVOROUS BIRDS.

THROUGHOUT the country at the present time farmers, fruit-growers, allotment-holders, and owners of gardens are faced with a plague of insects such as has not been experienced in the United Kingdom for many years past. True it is that we have had more or less local outbreaks of the winter moth, the cabbage butterfly, apple and plum aphids, wireworms, leather jackets, and numerous other pests of great severity, but not, in the present writer's opinion, to such a general extent as at the present time.

The reason for this very serious state of affairs is not difficult to discover, and although the truth may not be palatable, it is, nevertheless, true that it is largely due to neglect and to an absence of a State Department with a thoroughly practical and scientific staff. It would be futile and unprofitable to dwell upon either of these two causes. Rather let us turn to another phase of the matter not altogether foreign to the subject, viz. the value

of our insectivorous birds in controlling insect life.

Whilst no one possessing a knowledge of the food habits of wild birds will for a moment contend that any species will ever exterminate any species of injurious insect, it is equally clear that if present in sufficient numbers our insectivorous birds do materially help to maintain the balance of Nature, and so prevent certain species of insects from becoming so numerous as to assume the dimensions of a plague. There is now ample evidence to prove this, both in our own country and elsewhere.

Unfortunately, in this country, the species of wild birds that are truly insectivorous in their habits are not plentiful. During the past few years two causes have materially tended to bring about a great reduction in their numbers, viz. the severity of the winters of 1916–17 and 1917–18, particularly the former, and the misguided enthusiasm of certain individuals who, in and out of season, claim protection for practically every species of wild bird. This latter cause, in our opinion, has been as fully disastrous as the severity of our climate. When a certain section of the educated public shuts its eyes to the enormous depredations that a comparatively few injurious species of wild birds commit, and is so prejudiced as to misrepresent facts, one result is inevitable, viz. those who are the sufferers and losers wrongly take matters into their own hands and proclaim a ruthless war on all species of wild birds. This is what has taken and is taking place in the country at the present time, much to the detriment of the agriculturist, fruit-grower, etc. Moreover, this is likely to continue so long as the biased view of uniform protection is advocated, with the result that year by year we shall see great plagues of caterpillars making their appearance and devastating the countryside. Crops will be lost, the supply of our home-grown food materially lessened, and the numbers of our insect-eating wild birds must continue to grow less.

The outlook is not a cheerful one, and it is fraught with exceedingly grave possibilities, much graver and more far-reaching than most people realise.

With the first cause we are, at present, unable to deal, although it is exercising the minds of many as to the best manner in which to counteract or checkmate this misguided and pernicious zeal. For the second, however, we believe there is a remedy, if not wholly, at least in part, viz. the enlightenment of the agricultural community as to the part these birds play in the economy of Nature; and this is the immediate object we have in view. For we believe that if, without bias or prejudice, the facts are truthfully and carefully laid before those interested, this terrible destruction will be arrested to an appreciable extent.

The thoughtful reader will no doubt inquire, "Do not the Wild Birds' Protection Acts afford complete protection to these species of birds and an effective means of preservation?" Our answer is "No." To a very large extent the Act of 1880 and its four supplementary Acts are practically dead letters. From 1880 to the present time they have all proved largely ineffective.

The actual number of species of insectivorous wild birds we have in this country is comparatively small, and many visit us for only a brief season of the year. Of the few that remain throughout the year a heavy toll has been taken. Let us consider briefly the nature of the food and the feeding habits of some of these.

The fieldfare, water ouzel, wheatear, whinchat, stonechat, redstart, and robin are all above suspicion. The warblers and wrens (excepting the whitethroat and blackcap) belong to a like category, as also the hedge accentor, dipper, tits, wagtails, pipits, flycatchers, swallow, martins, and tree creeper. Of the finches we must except the greenfinch, chaffinch, house sparrow, and bullfinch, the two latter being wholly injurious. So far as their food habits are known, none of the buntings are injurious. In some districts the corn bunting is rather plentiful and has been accused of damaging grain and ricks, but much more careful investigation is necessary before condemning it. All the larks do far more good than harm, whilst the swift, nightjar, woodpeckers, wryneck, kingfisher, cuckoo, and owls are all most beneficial. Thus, of the 280 species of British birds, excepting those aquatic or littoral in their habits and the game birds, we have somewhat fewer than a hundred insectivorous species, many of which are quite rare. Surely it is to the interest of the agriculturist and fruit-grower to do all in their power to help to protect and increase these beneficial species, which constitute a really important factor in crop production.

Some during the whole of the year, and others during the period they are in this country, are feeding almost entirely upon insects and the seeds of weeds. It is difficult to estimate the enormous bulk of food that they consume, but we can form some idea when it is stated that a bird about the size of a skylark consumes about 6 lb. of food per year, so that 10,000 birds would require about 27 tons of food in a year, of which fully half or more consists of insects and caterpillars.

Taking a miscellaneous lot of insects and caterpillars from the stomachs of ten skylarks, we find that in the different individuals, according to the particular species of insects eaten, 174, 160, 162, 162, 177, 182, 156, 138, 154, and 156 weigh exactly one ounce, or an average of 162, so that 10,000 birds would consume 78,382,080 insects in a year, whilst every 1000 birds would account for nearly 8,000,000, and each bird an average of 8000 per year. In all probability our smaller species of insect-eating birds consume a number of insects far in excess of these figures.

Bird counts, such as have been carried out in the United States of America, do not exist in this country, so we cannot state even approximately the number of insect-eating birds we have in the United Kingdom, but assuming that there are 32,000,000 acres of land under cultivation and that we have a pair of birds to every four acres,

these 16,000,000 would consume annually 135,411,328,000 insects. Such figures require some thinking about before we can realise or form any true conception of the vast quantities that are included in such measures. It is impossible fully to realise the millions of insects and caterpillars that birds destroy just at the season of the greatest agricultural activity.

Wherever insectivorous birds have been destroyed there has followed an increase or plague of injurious insects. Scores of cases are on record, such as the destruction of woodpeckers and tits in the forests of Saxony and Brandenburg prior to the year 1798, in France in 1859–60, in Nebraska between 1865–77, and in Russian Siberia in 1893–94.

An anonymous writer stated a short time ago: "Some of the very greatest friends that our nation has are being destroyed without mercy. If the British Navy were threatened with destruction, a great cry would rise from the people, but only whispers are heard now and then about the slow destruction of a defensive force upon which most of our prosperity depends."

Surely we shall not appeal in vain to the various agricultural and horticultural organisations of this country to bring the weight of their influence to bear on a matter so vital to the country's interests. If the cultivation of the land has to prove profitable, it can do so only by preserving and utilising every factor that is favourable to crop production, and so long as economic entomology and ornithology remain neglected or only of academic interest in the United Kingdom, it behoves us to awaken and to take heed where we stand, or for some years to come our land will groan with the cry of desolation, due to our apathy and the ignorance and neglect of the ways and habits of our insectivorous birds, and the wanton destruction of what has ever been Nature's means of adjusting the complications of animal life, which man in his ignorance is seeking to pervert.

WALTER E. COLLINGE.

INDIAN INDUSTRIAL PROGRESS.

TWO publications[1] have recently been received which would indicate that decided progress is now being made in industry in India, owing to the stress involved under war conditions. The Indian Munitions Board undertook its formal duties as a Department of the Government of India in April, 1917, its primary function being the utilisation to the utmost extent of Indian resources in materials of all kinds required for the prosecution of the war.

When considered from a broad aspect, the munitions for a modern army cover practically all the wants of a civil community, with the addition of the special weapons, the armies' munitions, etc., which are employed by the soldier or sailor in actual fighting operations. With the enormous armies which are now used in warfare, the scale of operations is such that the wants of these fighting men necessarily compete with the requirements of civil life; hence the necessity for departments which will be able to cover the whole aspect of the economic and other life of a country. India has hitherto been mainly an agricultural country, but with the operations of war preventing supplies reaching India from England and other countries, it has become essential that many manufactured articles, which were formerly solely imported into India, must now, or, at all events, so long as the war lasts, be largely manufactured in India itself.

It is probably not too much to say that, owing to the influence of the war, India has already made progress which would otherwise have occupied almost a generation, and the Report on the Indian Munitions Board now available shows that its activities have been manifold.

The Indian Munitions Board was fortunate in being able to secure as its President Sir Thomas Holland, who was formerly for some years Director of the Geological Survey of India, and happened to be in India as head of an Industrial Commission which was engaged in developing India's industrial resources. The Board consists of the President, Sir Thomas Holland, assisted and advised by four members; and it is attached to the headquarters of the Government of India. At headquarters the work is divided into a number of well-defined branches, each branch being under the administration of a Controller. There are also provincial organisations in the different parts of India, and nine Controllers of the principal provinces, provided with proper deputies and assistants, have been appointed.

The provincial Controllers are responsible for utilising local industries which are not within the sphere of the special branches at headquarters. The organisation, therefore, appears to be fairly complete. The subjects dealt with under the control and supervision of Government are very varied, but the main object of these changes appears to be the utilisation of all indigenous materials and their exploitation so far as possible. As indicating the diverse activities now being carried on by the Indian Munitions Board, it may be mentioned that such special subjects as the following are now being worked at:—Timber supplies and resources, hides, tanning, and leather, the chemical and metallurgical industries of India, the potash salts in India suitable for chemical manufactures, manufacture of organic chemicals, essential oils, and perfumes, glycerine manufacture, wood distillation, indigenous dyes, etc. It would hence appear that great developments may be expected in future in the industries of India.

In connection also with the Indian Munitions Board, a conference was called by it for the consideration of the reorganisation of chemical research in India, the meeting being held at Lahore on January 8 last. This was attended by the majority of qualified and skilled chemists in

[1] "Indian Munitions Board Handbook" and "Proceedings of a Conference for the Consideration of the Organisation of Chemical Research in India, held at Lahore, January 8, 1918." (Simla: Government Monotype Press.)

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India, and appears to have been a great success. At the present time, what is under consideration is the form of reorganisation which would be best; but it would appear that it is possible that economic research departments may be recognised under a director-general of chemistry with deputy directors for various special branches of economic science, and that all chemists in Government employ should be included in the service, the reorganisation being intended, of course, to increase the output of work and to prevent overlapping. Thus, if there were a director-general of chemistry in India, the deputy directors working under him would include a deputy director for agriculture and a deputy director for forest products, while the provincial agricultural and forest men of science would work in co-ordination with their brethren in other provinces under instruction from, and in general consultation with, their particular deputy director. Apparently, there would also have to be separate directors, say, for organic chemistry and also in charge of mineral chemistry, etc. If this were carried out properly India might make extremely rapid progress in industry and commerce, and in such a way that its future may be revolutionised.

NOTES.

FROM a White Paper published on July 10 we learn that among the Supplementary Estimates for the year ending March 31, 1919, is the sum of 1,000,000*l.* which is to be devoted through the Board of Trade to the purpose of assisting the dye-making industry. This is the first instalment of a total sum of 2,000,000*l.* to be provided in the shape of loans and grants to be spread over three years, and divided as follows:—1,250,000*l.* in loans at not less than 1 per cent. above the Bank rate, with a minimum of 5 per cent., repayable in twenty years or earlier if the profits of the manufacturer are more than 9 per cent.; 600,000*l.* in aid of extensions of plant and buildings; and 150,000*l.* in grants in aid of research. It will be remembered that early in 1915 a grant of 1,000,000*l.* was made to one firm at Huddersfeld, out of which was created the company known as British Dyes, Ltd. This, not unnaturally, created a feeling of dissatisfaction on the part of those dye-making firms which received nothing. The sum mentioned is to be distributed among these firms, besides the substantial amount allocated to the purposes of research. Presumably the 100,000*l.* given for this purpose in 1915 has been spent, but it would be interesting to know how and by whom the money has been used and with what results, in view of the fact that the central research laboratory originally contemplated has never been erected, nor the Technical Committee announced in July, 1915, called into existence.

WE publish this week an article dealing with recent advances in scientific plant-breeding, in which the remarkable progress made in recent years, especially in India, is described. As a pendant to this article we may invite attention to the announcement made in Parliament by the President of the Board of Agriculture on July 18 that active steps have been taken with a view to the establishment at Cambridge of an Institute of Agricultural Botany, the primary function of which will be the breeding and distributing of improved varieties of agricultural crops. The scheme in question was very fully described by Mr. Lawrence Weaver, of the Board of Agriculture, at a meeting of the Agricultural Seed Association held on July 15. It appears that the new institute will be modelled on the famous Swedish plant-breeding station at Svälof, and that its activities will be to follow two distinct lines, one of which will be purely scientific, while the other will have a commercial outlook. More precisely, the scientific wing will be concerned with the producing of pure cultures of new varieties on the field-plot scale; the economic wing will deal with the growing and distribution on a large scale of these varieties. Presumably, on the Svälof model, the scientific side will oversee the operations of the commercial to the extent of guaranteeing the purity of the stocks distributed by the latter. It has been announced that subscriptions towards the establishment of the new institute amounting in the aggregate to upwards of 30,000*l.*, have already been received, including a sum of 10,000*l.* down and 2000*l.* a year for five years from the firm of Sir Robert McAlpine and Sons. It has also been announced that the Board of Agriculture will provide the necessary buildings and equipment. It is most gratifying to have this evidence of the growing appreciation by the public of the value of scientific work in economic directions. The new institute may be confidently expected to have a profound influence on the future development of British agriculture.

THE question of the payment for the services of scientific men working in connection with the industrial research associations being formed on the lines suggested by the Department of Scientific and Industrial Research has been raised in the House of Commons by Sir William Beale. Though the associations could make remuneration to scientific men appointed to serve on advisory committees, or to specific posts constituted by them, they were not authorised to pay them for services as members of councils or boards of management. It has now been decided by the Board of Trade that this condition may be abrogated, and payment can be made after approval by the Department of Scientific and Industrial Research. Sir William Beale's question, asked on July 18, and Sir Albert Stanley's answer, are as follows:—*Sir William Beale:* To ask the President of the Board of Trade whether he is aware of the conditions under which scientific men are asked to serve on the councils or boards of management of industrial research associations formed under the direction or with the approval of the Board to carry out or promote scientific and industrial research, in consequence of the rules and practice prescribed by the Board of Trade to discourage payment for such services rendered by scientific men other than reimbursement for out-of-pocket expenses; and whether the Board has taken or will take steps to enable such further reasonable remuneration to be paid as will attract to or at least make possible for such research committees as are being formed in connection with the Department of Scientific and Industrial Research the co-operation, advice, and assistance of scientific men of undoubted capacity to render valuable services whose position and means do not enable them to do so on mere compensation for out-of-pocket expenses. *Sir Albert Stanley:* In dealing with applications for licences under the provisions of section 20 of the Companies Consolidation Act, 1908, due provision is made for the payment of reasonable remuneration to members of the council of management of such industrial research associations with the approval of the Department of Scientific and Industrial Research.

THERE is a strongly expressed opinion among those engaged in the fisheries industries that the time has

now come for the establishment of a separate Ministry or Board of Fisheries. The National Sea Fisheries' Protection Association carried a motion, at its annual meeting at Fishmongers' Hall last week, pressing for such reconstruction and appointing a deputation to wait upon the President of the Board of Agriculture and Fisheries. In other quarters the same attitude is now being generally taken up. The needs of the immediate future—that is, unification of control, better local administration, scientific research in relation to fish as food, the better training and education of boys passing into the deep-sea fishing industry, and increased facility of distribution—do not seem likely to be satisfactorily dealt with under the present system of local and imperfect central control. The question of reconstruction of the present depleted fishing marine is also regarded as one of great importance, and it is felt that postponement of this until after the war may be prejudicial to the future of the industry, and that it can be adequately considered only by a strongly organised Department of Fisheries.

THE establishment of a Ministry of Health has attracted considerable public attention, and a widely signed national memorial in support of this has been forwarded to the Prime Minister by Sir Kingsley Wood. In the House of Lords on July 17 Lord Willoughby de Broke directed attention to the desirability of establishing a Ministry of Health without undue delay, and moved a resolution to that effect, which was carried. He pointed out that we are faced with the lowest birth-rate on record, and that the Registrar-General had estimated that but for the war there probably would have been 650,000 more babies born in England and Wales since 1914 than there had been. The motion was supported by Viscount Haldane, who said that far the greatest loss of population was ante-natal rather than post-natal, and urged that the matter required careful scientific investigation. There ought to be an authority like the Board of Education working through borough and county councils, the effect of which would be that the Local Government Board would become what it primarily ought to be—a ministry of public health, and only secondarily a ministry of local government. Viscount Peel, who replied sympathetically on behalf of the Government, said that there was no suggestion that the Maternity Bill was to be substituted for a measure co-ordinating all the powers of the central authorities. There were considerable difficulties to be overcome, and the matter could not be dealt with in a Bill of a few clauses. To attempt to separate the administration of local government from health questions would be deplorable, and there would be great difficulty in separating the health functions of the administration of the Poor Law from functions connected with public assistance.

THE death is announced, on July 18, of Dr. F. Hodson, for several years science master at Bedales School, Petersfield, and the author of "Broad Lines in Science Teaching."

WE regret to note that the death of Mr. John Frederick Robinson is announced in *Engineering* for July 19. Mr. Robinson was born in May, 1853, and was a director of the North British Locomotive Co., Ltd. He was educated at Owens College, Manchester, and served an apprenticeship with Messrs. Sharp, Stewart, and Co., Ltd. He was a member of the Institution of Civil Engineers, and served on the council of the Institution of Mechanical Engineers during the period 1902–9.

DR. W. J. M. ETTLES, whose death on July 19, at fifty years of age, as the result of an operation, we record with much regret, was distinguished not only by his work as a consulting oculist and ophthalmic surgeon, but also by his knowledge of the principles of physical optics, as evidenced by the fact that he had been president of the Optical Society, as well as of the Hunterian Society. Dr. Ettles qualified as M.B., C.M., at Aberdeen in 1890, and after a few years' practice in London he returned and graduated with highest honours as M.D. in 1896. He gave the Hunterian oration in 1908 upon the subject of "The Renaissance of Ophthalmology during the Hunterian Era," and he contributed to the Transactions of the Optical Convention in 1905 a paper on "Optical Principles of the Ophthalmometer, with Descriptions of New Instruments." Dr. Ettles was particularly interested in colour-vision tests, and played an important part in the "Trattles" case of about ten years ago, which led to a revision of the methods adopted by the Board of Trade in examining in colour-vision candidates for certificates as master or mate in the mercantile marine. His death while in the prime of life will be deplored by many friends, as well as by numerous patients who have had the advantage of his professional knowledge and skill.

ATTENTION having been directed in Kentish papers to the desirability of establishing the new marine grass, *Spartina townsendii*, in the extensive mud-banks of the Medway between Chatham and Sheerness, the owner of some "saltings" has decided to act on the suggestion, and, having through Mr. W. H. Shrubsole secured the co-operation of South Coast naturalists, arrangements are now in progress for collecting and transferring plants to the Medway. On the Essex coast there are large marshy areas suitable for the growth of Spartina; and if it were planted there and in similar districts around our shores it is highly probable that before many years our supply of home-grown material for paper-making would be considerably increased.

AT the invitation of the council of the Institution of Electrical Engineers, a conference of representatives of the Associated Municipal Electrical Engineers of Greater London, the Chief Technical Assistants' Association, and the Electrical Power Engineers' Association was held at the temporary offices of the institution on July 9. The chair was taken by Mr. C. H. Wordingham, C.B.E., president of the institution. At the close of the proceedings it was resolved that one single combined protective association be formed for the whole electric supply industry. Chief engineers will be included in the membership provided they are not employers or employers' representatives on an industrial council or similar body dealing with technical staffs. The qualifications for membership of the association will be those of the Electrical Power Engineers' Association, but all new members elected after December 31, 1921, shall be required to have passed the A.M.I.E.E. examination or an equivalent examination.

DR. R. R. MARETT, who has held the office of president of the Folklore Society for the unusually long period of five years, devoted his final presidential address to a discussion of the transvaluation of culture. He protested against the description of the science of folklore as the study of survivals. It would be better, he believes, to reject the fossil metaphor altogether. Inasmuch as survivals survive, they are not quite dead after all, but in some humble and surreptitious way of their own help to constitute and condition the living present, whether it be for worse or better. It is of chief importance to inquire what survival is as a process, and how this particular process is related to the other processes that go with it to make up the general movement of history. In short,

a dynamic study of the facts relating to survival keeps in touch with reality as manifested in the life-force.

IN the *South African Journal of Science* (vol. xiv., No. 4) for November, 1917, Prof. J. W. Bews discusses the plant-succession in the thorn veld. The acacias, especially *Acacia horrida* and *A. arabica*, are the pioneers, as they are able to establish themselves with no shade, shelter, or protection against grass-fires. After they are established many other species, germinating in the seed-bed prepared for them by the activity of earthworms, termites, and ants beneath the thorn-tree, grow up in the shade. Various stages have been traced, and ultimately the subsequent species may kill the pioneer. As a rule, however, the thorn-trees remain dominant in what is, at present, over the largest areas, the final stage. Seed-dispersal is little due to wind, the chief agents being birds, but for species with capsular fruits and small seeds, ants, which are very abundant, play an important part. Termites also exert important influence on the plant-succession.

THE various forms of "scab" found on potato-tubers have for long been more or less puzzling to plant pathologists. The investigations of recent years have considerably enlarged our knowledge of parasitic organisms such as *Synchytrium endobioticum*, *Spongospora subterranea*, *Actinomyces chromogenus*, etc., and of their effects upon the tuber. Workers in this domain of research will be interested, therefore, in a paper published in the *Journal of Agricultural Research* for May 27 by Mr. J. J. Taubenhaus, who describes a form of scab of the sweet potato which he calls "Pox," and which also occurs on the ordinary potato (*Solanum tuberosum*). According to this author, the causative parasite in this case is a myxomycete named *Cystospora batata*, Ell., which probably hibernates as cysts in the soil. It would be interesting to know whether this organism occurs in the Old World as well as in the New, and doubtless the publication of the paper referred to will stimulate search for it.

THE damage to tomatoes and other valuable glass-house crops due to the root-nematode or eelworm (*Heterodera radicicola*) is widespread and considerable, and, so far, no economical and effective measures of control have been devised. Some experimental work on this subject is described in an article by Mr. Willis P. Durz in *Soil Science* (vol. iv., No. 6), in which the application of sodium cyanide to infested greenhouse soil was tested, and under certain conditions gave satisfactory results. The cyanide dissolved in water was applied in the proportion of 200 lb. per acre, one-third gallon per square foot of soil, as weaker solutions were found to be ineffectual; one week after the first treatment a second similar treatment was given. In order to bring out the larvæ from their cysts the soil was kept moist and warm for about five days before each application. All plants should be removed from the soil before applications of sodium cyanide at this rate, and the soil should be aerated and leached to remove any traces of cyanide gas before replanting. Other methods of control recommended are the application to the soil of formaldehyde and of sphagnum-moss extract and the raising of the temperature of greenhouses to 101° F.

THE latest addition to Messrs. E. Stanford's series of war-maps is a map of Denmark, Schleswig-Holstein, etc., published at the price of half a crown. The scale is approximately 1 : 1,140,000. No relief is shown, but water under ten fathoms is coloured lighter blue than water of greater depth. International boundaries on land are shown in red. It would have been useful to mark the boundary of the Danish Archipelago towards Sweden and Germany by a dotted line. The map has plenty of names, and railways are clearly marked. The courses of the British and German fleets at the Battle of Jutland are shown in red.

WE have received from the Commonwealth Meteorologist a copy of the rain-map of Australia for 1917. Besides the chief map showing the details of the annual rainfall, the sheet has smaller maps giving the rainfall for each month during the year. The small maps are clear, but the principal one is very obscure in places. Previous editions had not this defect, and it is to be hoped that it represents merely a passing phase of difficulty in printing. The abnormal conditions of rainfall were even more pronounced in 1917 than in 1916, and 75 per cent. of the area of the country had a rainfall above the average. Some parts of Western Australia had the wettest year on record. Throughout the wheat belt rains in general were much above the normal, especially during August, September, and October. In parts of Victoria, New South Wales, and Western Australia too much rain injured the wheat harvest, the returns of which were considerably below the average. The unusual conditions are attributed by Mr. H. A. Hunt partly to the strong monsoonal influences in summer and partly to the exceptional development of southern low pressure in winter. Very similar conditions prevailed in 1916.

IN the Journal of the Royal Society of Arts (No. 3417, May 17) Mr. Alfred Dickinson discusses "Water-power in India." As an example he quotes the dam across a valley in the Western Ghats constructed by Messrs. Tata, Sons, and Co., which provides 300,000 h.p. continuously. Mr. Dickinson is now investigating the possibility of utilising the irrigation lake at Perigar, in the Madras Presidency, for power purposes, and numerous other schemes of the same kind are possible. With its enormous supply of minerals for metallurgical development, materials like cotton, flax, and jute, and abundant and cheap labour, a great commercial and industrial development may be expected. "Although much has been done, her industrial possibilities, to use a vulgarism, have scarcely been 'scratched.'"

THE Engineering Experiment Station of the University of Illinois has published Circular No. 6, March, 1918, by Prof. H. H. Stock, upon the storage of bituminous coal. This subject has attracted considerable attention within the last few months on both sides of the Atlantic, papers having appeared on the subject in the publications of the Canadian Department of Mines and in the Transactions of two English engineering societies, whilst the theory of the spontaneous combustion of coal, which forms, or should form, the basis upon which all methods of coal storage are based, has been worked out at the Doncaster Coalowners' Laboratory. The present circular practically disregards the theoretical side of the subject, but concerns itself more particularly with the engineering features of coal storage. The various methods of storing coal are described in much detail, and, amongst others, the method of storing under water is fully considered. The various precautions in the way of thorough ventilation of the pile, restricting its height and subdividing it suitably, as well as the proper grading of coal intended to be stored, are all discussed, and stress is laid upon the importance of regular inspection and determination of the temperature of the pile; the author holds that when the temperature reaches 150° F. the pile needs to be carefully watched, and if it rises to 175° or 180° F. the coal should be removed as promptly as possible.

To which country is the advance of seismology chiefly indebted? M. de Montessus de Ballore endeavours to answer this question in an interesting paper published in the last *Bollettino* of the Italian Seismological Society (vol. xx., 1916, pp. 263–72). His estimate is based on a bibliography of seismological memoirs now being published by the Sociedad chilena de historia y geografia. This bibliography contains the titles of about 9000 articles, of which 2002 are written in Italian, 1768 in French, and 1185 in German. Great Britain is credited with 911 articles, the United States with 636, and Japan with 352. The number of papers per million inhabitants since the year 1840 is 40 in Italy, 30½ in France, 12½ in Germany and Austria, and 10½ in Great Britain. These figures take no account of the value of the individual works. Omitting purely descriptive papers, the author estimates that of papers of a general nature 12·9 per cent. are contributed by French writers, 10·6 per cent. by German, 10·2 per cent. by English, and 7·7 per cent. by Italian writers. A more satisfactory conception of the relative value of national contributions would perhaps be furnished by the number of references in some standard treatise on seismology. Taking, for instance, M. de Montessus de Ballore's "La Science Séismologique," and including only those authors quoted more than five times, we find that there are 103 references to English writers, 65 to Italian, 61 to German and Austrian, 49 to Japanese, 35 to French, and 21 to American (United States).

A NOTICE in *Metall und Erz* for May 8 states that the important Bavarian establishments for the production of nitric acid from the air are to undergo considerable extension, in which some 200,000 h.p. of water-power will be used. A strong syndicate of bankers and others has been formed to carry out the scheme, which will involve a capital of 150 million marks.

FOLLOWING upon the establishment of the Kaiser Wilhelm Institute for Research on Iron and Iron-ores comes the news from the German daily Press of some preliminary steps that have been taken to found a similar institution for researches on all other generally useful metals. A committee composed of eminent engineers and university professors has been formed to consider the establishment of a metal research institute for the benefit of the German metallurgical industry.

NEW sources of mineral wealth are to be found in European Turkey. According to *Metall und Erz* for May 8 last, copper-ore exists in great quantities in Turkish Rhodope, in the neighbourhood of Yardimli. In the Turkish Balkans ores of nearly all the metals occur, while gold occurs in Markova Reka, south of Uskub. In the neighbourhood of Kratova gold and galena containing a fairly high percentage of gold have been discovered. Chromium-ore in abundance has been found near Niausta, on the Salonika-Monastir railway. The mountain range of southern Macedonia is especially rich in chromium-ore, and there are iron, antimony, and lead ores.

IN the *Schweizerische Elektrotechnische Zeitschrift* for January 5 last is given a summary of the results obtained from tests of various lamps with orthochromatic plates and silver-eosin plates prepared by two German firms. The tables show wattage and candle-power of various lamps and their actinic values, absolute and per watt and per Hefner candle-power for both kinds of plates with and without yellow filters. The lamps tested in this way were the Hefner lamp, vacuum and gas-filled tungsten-wire lamps, arc lamps with solid carbons and yellow and white flame-carbons, enclosed arcs, and quartz-enclosed mercury arcs.

WE note in the *Chemical News* of June 21 an account of the preparation and properties of fibres made from fused steatite or soapstone (a magnesium silicate), which resemble fused quartz in their elastic properties. It was desired to obtain threads of 0·1 to 0·2 mm. in diameter and a metre long; such threads are somewhat difficult to prepare from fused quartz on account of the presence of air-bubbles. The material in question was found by Prof. Guthe (Bureau of Standards, Washington, Bulletin i., No. 1) to answer admirably; it had all the characteristic properties of fused quartz with the additional advantage that thick fibres do not break so readily. In the oxyhydrogen flame the substance fuses to a clear glass, and can be formed into threads of the requisite dimensions. The elastic fatigue of such fibres is very small—about one-third that of steel or phosphor-bronze. The linear coefficient of expansion was found to be −0·0000045.

AN article on coal-saving by the scientific control of steam-boiler plants appears in *Engineering* for July 12. The author, Mr. D. Brownlie, gives average figures for 250 typical steam-boiler plants, covering the period from 1910 to the present time. It is estimated that 58,500,000 tons of coal per annum are used in this country for steam-raising purposes (in normal times), exclusive of 15,000,000 tons used in railways. The 250 plants had a total of 1000 boilers, principally of the Lancashire type. With hand-firing the average net working efficiency is 57·8 per cent., as against mechanical firing with an average net working efficiency of 61·4 per cent. Both varieties receive very little scientific attention and supervision; efficiencies from 75 to 82½ per cent. can be maintained with both types. The author's experience is that in normal times the average firm could save 7 to 10 per cent. in the fuel bill alone by buying on scientific lines. The author estimates that there are 45,000 to 60,000 steam boilers at work in Great Britain, calculated in terms of average-sized Lancashire boilers, and considers that all the steam produced in the country to-day could be obtained much more economically with 25 per cent. fewer boilers.

MESSRS. *Crosby Lockwood and Son* announce "Plane Surveying," by Prof. J. K. Finch, and "How to Become a Wireless Operator: A Practical Presentation of the Theory of Electrical Waves, their Propagation, and their Adaptation to Wireless Communication," by C. B. Hayward. Messrs. *Longmans and Co.* have in preparation a new edition—the second—of Sir R. A. S. Redmayne's "The Ventilation of Mines," containing additional notes relating to the Coal Mines Act of 1911. The fifth volume of the same author's "Modern Practice in Mining" is also in preparation. *Sir Isaac Pitman and Sons, Ltd.*, will issue shortly "A Small Book on Electric Motors for Continuous and Alternating Currents," by the late W. Perren Maycock.

MESSRS. J. WHELDON AND CO., 38 Great Queen Street, W.C.2, have just issued, at the price of 2*d.*, a very full and well-arranged Botanical Catalogue (new series, No. 83), which should be of interest and value to many of our readers. It is conveniently divided into eight sections, dealing respectively with general botany, geographical botany, and the floras of Britain, Europe, Asia, Africa, America, and Australasia. Many first and rare editions are included;

also sets of botanical serials. Among the latter we notice Curtis's *Botanical Magazine* from 1787 to 1906; Edwards's *Botanical Register*, a complete set; Maund's "Botanic Garden," large-paper edition; the Transactions of the Linnean Society of London, complete to 1916; the *Orchid Album*; the *Orchid Review*; the *Phytologist*, by Luxford, Newman, and Irvine, all published. Messrs. Wheldon also have for disposal a large-paper copy of Loddige's "Botanical Cabinet," complete in 20 vols.

OUR ASTRONOMICAL COLUMN.

PERIODIC COMETS.—Wolf's comet was detected by Prof. Barnard at Yerkes Observatory on July 12, three days later than M. Jonckheere's first observation. M. Kamensky's predicted date of perihelion, 1918 December 13·3899, appears to be too early by 0·0531d., which is not a large error, and the ephemeris given in NATURE for July 11 will suffice for finding the comet.

Borrelly's periodic comet will pass perihelion a month earlier than Wolf's, and the conditions will be favourable for observation. Mr. L. v. Tolnay gives the following ephemeris in *Ast. Nach.*, No. 4948; it is for Greenwich midnight:—

	R.A. h. m. s.	S. Decl. ° ′	Log r	Log Δ
July 29	3 19 0	17 1	0·2653	0·2107
Aug. 2	3 28 5	16 41	0·2591	0·1972
6	3 37 10	16 21	0·2529	0·1835
10	3 46 15	16 1	0·2467	0·1696
14	3 55 18	15 41	0·2405	0·1554
18	4 4 19	15 20	0·2343	0·1411
22	4 13 17	14 59	0·2282	0·1265
26	4 22 12	14 37	0·2222	0·1116
30	4 31 4	14 13	0·2162	0·0964

The perihelion passage is about November 16·65, log a=0·5598, e=0·6153, log q=0·1450.

THE PERIOD OF SIRIUS.—The companion to Sirius has lately been more easily observable than during the previous forty years, and has completed rather more than a revolution since its discovery in 1862. Mr. R. Jonckheere has obtained measures with the 28-in. refractor at Greenwich in the course of the last four winters, and has taken the opportunity of making a revised estimate of the period (Monthly Notices, R.A.S., vol. lxxviii., p. 480). The mean result is 50·02 years, which is 1·78 years shorter than that given by Burnham. The shortest period ever given was that of 48·84 years, arrived at by Zwiers, and the longest that of 58·47 years given by Gore. Mr. Jonckheere recalls that nearly eleven years before the visual discovery Peters made an investigation of the orbit from transit observations, and although the maximum displacement was only 0·152s., he obtained the closely accurate period of 50·01 years. Adopting the parallax 0·38″ and a semi-major axis of 7·5″, the corrected mass of the system is 3·07 times the mass of the sun.

TWO SPECTROSCOPIC BINARIES OF LONG PERIOD.—The spectroscopic binary 32 θ_2 Cygni has been under observation at the Dominion Observatory, Ottawa, by Mr. J. B. Cannon since 1914, and a preliminary orbit has now been determined (*Astrophys. Journ.*, vol. xlvii., p. 193). The period of this star is more than three years, and the eccentricity of the orbit 0·182, but there are irregularities which suggest the presence of a third body. The velocity-curve may be explained by considering the system as consisting of a luminous star revolving about another body in a circular orbit in 390 days, and the pair revolving in an elliptic orbit about a third body in 1170 days. The star is of spectral type G5 and magnitude 5·15.

A spectroscopic binary of still longer period has been under investigation at the Cape Observatory by Dr. J. Lunt since 1903. The star in question is α Phœnicis, and the period has been found to be 10·62 years, or 3880 days. The eccentricity of the orbit is 0·32, and the system is receding with a velocity of 75·76 km. As regards length of period, the star is second only to Polaris, which has a period of 11·9 years. The star is of magnitude 2·44 and of type K.

STONYHURST COLLEGE OBSERVATORY.—The annual report of this observatory for 1917 includes a valuable record of the state of the sun's surface on 210 days of observation. In units of one five-thousandth of the visible surface the mean disc-area of the spots was 12·1, which is about three times greater than that of the previous year, and twice as great as at the previous maximum. The increased activity commenced early in February and reached its greatest intensity in August, the greatest area on any one day being 50 units on August 11. The February and August groups were of exceptional size, and second to none that have appeared during the last thirty-eight years. As regards the ranges of magnetic declination and horizontal force, the year was relatively quiet and out of accord with the solar activity. A comparison of the Stonyhurst drawings with spectroheliograms taken at the Yerkes Observatory has shown an almost perfect agreement between the faculæ and the calcium flocculi, but no similarity with the hydrogen flocculi. The report also includes particulars of meteorological and magnetical observations.

THE FUTURE OF THE ELECTRICAL TRADES.

THE Departmental Committee appointed by the Board of Trade to consider the position of the electrical trades after the war, with special reference to international competition, has now issued a Report (Cd. 9072, price 2*d*.). Like other similar Committees, this urges that "remedial and unifying legislation governing the supply and distribution of electrical energy should be introduced forthwith." A historical *résumé* of electrical enterprise in this country is given, and it is pointed out that, like the automobile industry, it has been hampered all through by the lack of a scientific outlook on the part of the officials of our Government Departments. Acting according to their lights, they encouraged competing companies using different types of plant and different systems to set up in the same area, the reason given being that the healthy competition would cheapen the supply to the consumer. The mischievous effect of this policy is well illustrated by the circular issued by the Board of Trade in 1916 calling on the supply companies to link up with one another in the national interests so as to reduce the consumption of coal and economise labour. That is, after making it practically impossible for the companies to link up, the Board calls on them to do so.

Looking to the future, the Committee points out that as the supply of electrical energy is a "key industry," it is imperative that questions concerning it should be prevented from becoming party questions. They should be considered solely on their merits from the point of view of national requirements. We quite agree, but we are afraid that this is a counsel of perfection. Few questions are of greater urgency than that of standardising some system for electrifying

Electric industries

all our railways. The power stations need to be placed in the best positions for civil and military needs, and all main and local lines should be properly co-ordinated. At present our railways are being electrified in a piecemeal and desultory way. A comparison is made between manufacturing conditions in this country and in Germany. The conclusions, with some of which we do not agree, are altogether in favour of the German methods. The Committee was impressed by the fact that the balance-sheets of the Allgemeine Elektricitäts Gesellschaft showed a cash balance of more than six million pounds in 1915. Another flourishing firm, the Siemens-Schückert Co., has stated that its large cash balance will shortly be depleted by the manufacture of "peace products" for stock for disposal at the end of the war.

At least, up to the present time, German manufacturing firms have had little to pay in the way of extra taxation or excess profits duty, and so English firms are naturally getting anxious. The Committee recommends that the import of enemy goods should be prohibited for three years after the conclusion of peace. Other recommendations are the imposition of import duties (in other words, Protection), combination between manufacturers, the provision of extended banking facilities, and, most important of all, the promotion of a better understanding between employers and employed and the provision of better housing and working conditions. A supplementary report is promised which will deal, *inter alia*, with education, research, the decimal system, and the consular service. As Sir Charles Parsons and Sir John Snell are on the Committee, their educational proposals will be looked forward to with keen interest.

ITALIAN METEOROLOGY.

A NUMBER of interesting papers dealing with various aspects of meteorology in Italy, including results from a new station in the colony of Gebel Bengasi, have recently been issued by Prof. Eredia, director of the service. The first (1) contains the results of observations made at Nalut during the two years ending May, 1915. The co-ordinates of the station are lat. 31° 53′ N., long. 8° 45′ E., and the height 600 m. The mean temperature is 65·7° F.; that of the warmest month, July, 84·6°, and of January, the coldest month, 44·4°, showing the large variation of more than 40°. The mean daily maxima vary from 98° in July to 52·5° in January. The corresponding mean minima are 70·6° and 36°, so that the amplitude in the day values is 10° in excess of the night values. The mean daily range is 21·5°, and the absolute extremes of temperature are 111° and 23°. Compared with Tripoli, on the coast, the mean temperature is 1·6° lower. In summer (May to August) Nalut is 5° warmer than Tripoli, in winter 10° colder, the extreme differences being +6° in June and −11° in January. The annual rainfall is 194 mm. (7·63 in.), which almost all falls between December and April. The average number of days with rain in the year is nineteen. The rain falls in heavy showers of short duration, which, as a rule, do not exceed thirty minutes. Only on three occasions did the duration of a shower exceed five hours, although one rainstorm lasted two days. The heaviest fall was 1½ in. in two and a half hours, on April 4, 1915. December, 1914, was the wettest month, with 5·16 in., falling on four days during an aggregate of twelve hours, although in the same month of the previous year only 0·03 in. fell. There are 237 cloudless and 36 overcast days annually. The predominant wind is N. at all seasons, accounting for about half of all the observed winds, while winds from the E. and S.E. rarely occur.

The second paper (2) is a discussion of thunderstorm frequency over the north plains of Italy, with special reference to the barometric pressure at the time of the occurrence. Data from ten observatories are examined for the months April to October for the ten years ending 1916, with the general result that thunderstorms are most frequent with pressure under 755 mm. (29·73 in.), while a secondary maximum occurs between 759 mm. and 762 mm. Only in 5 per cent. of the cases was pressure more than 765 mm. The frequency is also discussed with reference to the relative humidity at the time of the thunderstorm. In summer the air was dry (under 60 per cent.) in one-third of the cases, but in early autumn only one thunderstorm in ten occurs with so dry an atmosphere.

The pressure conditions associated with two floods on the River Uadi, at Derna, on the coast of Bengasi, are discussed in (3), from which it is shown that in the flood of November 30, 1913, there was an anticyclone over Western, and a low-pressure area over Central, Europe. The wind at Derna, and, indeed, throughout Bengasi, changed from S. to N., indicating the passage of a depression to the north. In the flood of April 12, 1916, pressure was low to the north of Scotland and high in Portugal, with a subsidiary area of low pressure over Algeria. Details of some other rains associated with flooding in various parts of Tripoli and Bengasi are also given.

The last paper (4) summarises the work of the Italian Meteorological Office since its initiation in 1879. The geophysical branch dates from 1887, and upper-air research from 1902. In October, 1917, there were 181 stations provided with direct-reading and automatic registers, and other 341 stations observing rainfall, temperature, wind, and cloud. Of extra rainfall stations there were 161. Full particulars are given of the special researches carried out by the various sections.

A new edition of useful tables, such as are available in our own "Computers' Handbook," is given in (5), which include tables for the conversion of millimetres into the new pressure units. R. C. M.

[1] (1) Prof. F. Eredia, "Contributo alla Climatologia del Gebel," *Biblioteca Agraria Coloniale*. (2) Prof. F. Eredia, "La Frequenza dei Temporali in Val Padana," *Rend. della R. Acad. dei Lincei*. (3) Prof. F. Eredia, "Le Piene dell' Uadi di Derna" (Ministero delle Colonie). (4) "L'Officio Centrale Italiano di Meteorologia e Geodinamica," Estratto da *La Scienza per Tutti*, No. 1, 1° Gennaio, 1918. (5) Prof. F. Eredia, "Tavole ad Uso degli Osservatorii Meteorologici Italiani."

GEOLOGY OF THE BARBERTON GOLD-MINING DISTRICT.

THE Geological Survey of the Union of South Africa has issued an important memoir on the geology of the Barberton gold-mining district. This district is made up essentially of the Older Granite and the Swaziland System, probably of pre-Cambrian age, and underlying the Transvaal System, the latter being of importance mainly as determining the great escarpment of the Drakensberg; it may be noted that the latter contains auriferous deposits, both reef and alluvial, that have been worked for some thirty-five years. The tectonics of the Barberton district are very complex, intense folding in various regions, such as the Sheba Hills, having been brought about by the intrusion of the great masses of granite. One of the most interesting features of this report lies in the conclusions reached respecting the genesis of the auriferous deposits of the Barberton district. Apart from the alluvials, auriferous deposits of two types are recognised, namely, pyritic quartz reefs and zones of impregnation. The former occur mainly in the granite of the De Kaap valley, and in some of the older rocks, and in many cases the results obtained from their exploitation have been, upon the whole,

disappointing. The latter include some of the best-known deposits, such as the famous Sheba Mine; the deposits do not show definite walls, and the auriferous rock does not differ from the surrounding country except by its impregnation with iron pyrites and with gold, often very finely disseminated, so that the workable limits of the deposits can be established only by continual assays. It is pointed out that the zone of contact between the granite and the adjoining stratified rocks is the area within which most of the important gold-bearing deposits are situated, and it is suggested that "gold occurrences are far more likely to be expected within the sphere of influence of the intrusive granite," this forming a belt of country averaging about three miles in width. Furthermore, in prospecting, it should not be forgotten that many of the payable deposits of the Barberton district take the form, not of the well-defined quartz reef, with which most prospectors are familiar, but of "mineralised zones of impregnation, sometimes almost indistinguishable from country rock."

THE SPINNING-TOP IN HARNESS.[1]

THE gyroscopic theory of the lecture and its applications was illustrated by experiments with apparatus designed to show the chief principles of gyroscopic motion on a large scale, so as to be visible to an audience; some bicycle-wheels and a Maxwell dynamical top were used.

The lecture began with a quotation of the initial sentence of Maxwell's own description of his top, as given to the Royal Society of Edinburgh, April, 1857, and the phrase "the perplexities of men who had successfully threaded the mazes of the planetary motions" was interpreted as a sly, malicious dig at Newton and his struggle in the "Principia" with the gyroscopic theory of precession.

Twirled by the left hand, the dynamical top gives the appropriate precession in direction; called precession because the seasons come up in consequence of it twenty minutes earlier each year than otherwise, and twenty minutes a year gives the twenty-six thousand years required for a complete revolution among the stars.

Two large 52-in. bicycle-wheels were employed as spinning-tops on the floor, made originally by Prof. C. V. Boys for his Otto bicycle. A hub was fitted with ball-bearings, carrying a spike and a long stalk. Spun by hand, with the spike resting in a small cup raised about 3 ft. from the floor, the evolutions of the wheel could be watched as they became more violent, and finally extinguished when the rim reached the floor.

When the stalk was grasped and raised horizontal and the wheel spun, the gyroscopic effect was very marked if the wheel was allowed to drop or the stalk was brandished. Letting the spike rest in the hand, the wheel moved round in precession, and Kelvin's rule could be shown off in the alteration of the inclination of the axle.

According to this rule, "Hurry the precession, and the axle rises against gravity." This is observed instinctively in riding a bicycle on the road. To avoid an object the bicycle must be steered towards it in a smaller circle, so as to rise and swerve away. A bicycle cannot run straight.

The stability of the axle was shown by hammering the wheel-rim with a stick, causing it to flinch only slightly, but hurrying the precession.

The mathematical theory was too complicated to be undertaken in the course of an hour's lecture, even when stated in Poinsot's concise manner, "which has brought the subject under the power of a more searching analysis than the calculus, in which ideas take the place of symbols and intelligible propositions supersede equations."

The elliptic function theory arises in all its complexity, and appears as if created to speak the language of gyroscopic theory.

Two special cases of motion were suggested to interest the mathematicians in the audience, where the equations are quasi-algebraical, and may be employed as typical illustrations in the wilderness of general theory:—

(1) Project the axle of the gyroscope horizontally with no spin of the wheel; this gives a spherical pendulum motion, as of the bob of a simple pendulum projected so as to move in a spherical curve, and not in plane oscillation.

(2) Spin the wheel and hold the axle up at an angle above the level, such that when let drop the axle reaches the horizontal and rises again, and so on to a series of cusps.

This motion was illustrated on the gyroscopic apparatus exhibited, an ordinary 28-in. bicycle-wheel and hub screwed to a stalk, a short length of steel rifle-barrel, suspended in altazimuth freedom from a vertical spindle, another bicycle hub, fastened to an iron bracket, bolted to the underside of a wooden sleeper supported on brackets—not a thin lath, as I found them trying in Rome with the specimen I had sent to the Mathematical Congress in 1908. All details to be bought cheap or easily constructed.

The three angles, θ, ψ, ϕ, introduced into the treatment by Euler (1750), were shown in the altazimuth suspension: θ is the angle of the axle with the nadir downward vertical; ψ is the azimuth; while ϕ measures the rubbing angular displacement of the wheel over the axle.

The exact dynamical interpretation of ϕ is rather delicate in its relation to the rotation of the wheel about a moving axle. Thus, starting with the wheel at rest on the axle, we cannot turn it by twirling the axle. But move the axle round in a conical way back to rest at its original start, and we find the wheel has turned round on the axle through an angle ϕ proportional to the conical angle described by the axle. So here is an answer to the challenge of Aristotle: to turn a sphere round that is perfectly smooth, or spitted along a perfectly smooth diametrical axle.

In showing the θ and ψ displacement in altitude and azimuth, the wheel must be held to the axle by the thumb; as, if free, the angle ϕ will come into existence.

Anyone can show this off with a pencil or penholder held between finger and thumb.

The small bicycle-wheel is dismounted by removing the supporting pin, and can then be spun by hand as another top alongside the large wheel, or else superposed, as in Maxwell's experiment of the "top on the top of a top," thus forming two links of a gyrostatic chain, standing up like a *will o' the wisp*, which may be supposed in imagination to reach up to the ceiling, as a mechanical model of the electromagnetic rotary polarisation of light.

Sir William Thomson gave an elaborate mathematical investigation of the vibration and wave propagation, but this can be simplified and brought under elementary treatment by considering the gyrostatic chain as a uniform helical polygon rotating uniformly about the vertical, as I have explained in my Report on Gyroscopic Theory (1914).

Any similar discussion of a double pendulum, as of a bell and clapper, or a chain of links, is simplified in this manner by comparing the oscillation with a

[1] Abstract of a discourse delivered at the Royal Institution on May 3 by Sir George Greenhill, F.R.S.

steady revolving motion, throwing a shadow moving to and fro in plane vibration on the wall.

The bicycle-wheel forms a compound pendulum, with the axle held fixed, and put out of balance with an iron rod between the spokes; and then the wheel can show off oscillation of any finite extent, beating the elliptic function, or it can make complete revolutions, say from I to XI, or all round the clock.

For this experiment an ordinary bicycle complete will serve, laid on its back, using the front wheel, and then the hind wheel, to show off the effect of the inertia of the chain and crank-axle. The writhing of the frame on a smooth floor will illustrate the stress of reaction of the frame to the motion.

Prof. Perry has written a popular book on the "Spinning Top" in his most stimulating kindergarten style, but it is doubtful if he has ever seen a top of the size of these bicycle-wheels; and I wonder if he has ever seen this gyroscope apparatus, although I made him a present of one many years ago.

As in skating over thin ice the novice can progress swiftly, never stopping to look down at the black water underneath, whereas if he paused to consider the depth below he would break through and go down; so in the theory of the top the analytical difficulties would drown the beginner if not kept out of sight as long as possible.

The kindergarten explanation of the spinning-top is eloquent in answer to the beginner's question of the how and why. But in mathematical treatment it is the "how much?" That is the question.

Crabtree's "Gyroscopic Motion" goes more deeply into the mathematics of the subject in elegant treatment; and here is a Report on Gyroscopic Theory (1914) intended to serve for reference on the complete theory, where no analytical difficulty is avoided when any practical problem arises for solution. And the simple apparatus shown here is intended to be applied at once to a practical test of any new suggestion of harnessing a top or gyroscope.

Attention was directed to the deformable Henrici hyperboloid passing through the shape of a confocal system. This was employed by Darboux for the material representation of a state of top-motion by geometrical constants. Calculation was thereby replaced by measurement on a drawing.

Then there is Kirchhoff's kinetic analogue of the bent and twisted wire, to associate in making a mental picture of the top-motion in all its complexity.

This analogue states that if an elastic round wire, rod, or shaft is bent and twisted into its most general tortuous curve under the action of an equal opposing wrench at each end, the shape of the curve is such that if a point moves along the curve with constant velocity, the hodograph of its motion is a spherical curve, which can be identified as the curve described by a point fixed in the axle of a symmetrical top spinning about a fixed point, as in this small cup, and in the same period by a proper choice of the constant velocity.

In most practical applications the nutation is small and imperceptible, though never absent entirely, and the motion is apparently steady, with the axle at a constant inclination and moving round with uniform precession; in the Kirchhoff analogue the shaft is sprung slightly.

The curious property of a spinning body in rising erect in opposition to gravity, or of running along like a hoop or bicycle without falling over, has directed attention to the distinction between balance and stability according as it is statical or dynamical.

It was mentioned that Lord Kelvin, just twenty-five years ago, lectured at the Royal Institution on "Isoperimetrical Problems—Dido, or Making Things Spin," on a sheet of plate-glass fenced with a frame.

Since Newton compared himself with a child gathering pebbles on the shore, he set the fashion for his rivals of making them spin. But Newton took it for granted his audience knew he was quoting against himself the lines from "Paradise Regained":—

> Many books
> Wise men have said are wearisome.
> Who reads incessantly and to his reading brings not
> A spirit and a judgment equal or superior
> (And what he brings, what needs he elsewhere seek?)
> Uncertain and unsettled still remains,
> Deep versed in books, and shallow in himself;
> Crude or intoxicate, collecting toys
> And trifles for choice matters, worth a sponge,
> As children gathering pebbles on the shore.

In the contrast of balance, statical and dynamical, the C.G. in statical equilibrium seeks the lowest position it can find, but it rises as high as it is able in dynamical stability of balance, as of a sleeping top or bicycle. A top is said to sleep when spinning steadily upright; man or an animal sleeps lying down, with the C.G. low. But for ease of progression a man assumes the noble upright attitude of a biped, not on all fours, or rides upright on the back of a horse or high up on a bicycle. Any burden, rifle or knapsack, he carries as high as possible. Mounted still higher on stilts, his progress is not more difficult with the confidence of experience.

Confusion between statical and dynamical stability of balance has led to serious mistakes and misapprehension of theory, as of lowering the soldier's knapsack, or ballasting a ship too low and so making it uneasy among waves, as recommended by Euler; or spreading the railway gauge to lower the boiler and carriage-body between the rails, in Brunel's idea.

The modern locomotive is seen to-day high up over the wheels, as high as it can go under the old cramping limitation of the loading gauge of our bridges and tunnels.

A literary friend has directed attention to De Quincey's account of a wonderful brother, who claimed the power of rising against gravity to walk like a fly on the ceiling, provided with spin enough, but that he would require the flagellation of a whip-top in harness, emblem of fortitude in adversity.

> Tu ne cede malis, sed contra audentior ito.

Without attaining so far as the positive levity of De Quincey's brother, we have seen how a top can be made to climb a pole in the model described to the Royal Society by Mr. Tournay Hinde in their Proceedings. And Brennan can make it run along the tight-rope or on a single rail, concealed in harness inside a carriage, to which it gives the upright stability, acting automatically as the brain in riding a bicycle.

In the description of the American poet—

> Are you the Mr. Brennan makes gyroscopic tops
> To keep a car in balance when it runs, or if it stops,
> On single rail or wire rope that's stretched across a chasm?
> Pray write and tell me, Mr. Brennan, if you're the man that has 'em.

Axial stability of motion of an elongated body through the air, an arrow, bullet, or shell, is maintained by the gyroscopic action of the spin imparted by the rifling, and the calculation of the least amount required is a delicate question of dynamics. No more spin should be given than absolutely necessary, or the shell or bullet will be uneasy in flight, as a ship is uneasy among waves if bottom-heavy, as recommended by Euler, the weights stowed too low.

Passing from small to large applications, the Parsons turbine in the steamship requires to be treated on gyroscopic theory for motion among waves. Rolling does not affect them, but the internal stress due to pitching becomes important, and must receive investigation.

So, too, if electric dynamos are mounted with axle across the ship, they are very sensitive to the rolling,

and are heard squealing and complaining as the ship rolls.

When a vessel proved a heavy roller, a cure could be made by fitting bilge-keels, but at a permanent loss of speed in all weather, rough or smooth, of a knot or two. Schlick's sea gyroscope will cure the rolling with no sacrifice of speed; it need not be put in action until wanted, and requires little power to keep it going.

The gyroscope consists of a heavy horizontal fly-wheel harnessed in gimbals, and controlled by a hydraulic buffer in the line of the keel. The damping action of the buffer can be regulated by a valve to suit the period of the waves, and it makes the flywheel react against the rolling and kill it out.

The inventor is said to have been offended when his apparatus was found more useful still in increasing the rolling and maintaining it, in the case of an ice-breaker, to worry a way easier through the pack or even in working off a sandbank. A different setting of the buffer valve was all required.

A spinning-top stands up vertical in a smooth cup even when the cup is moved about, as on a rolling ship, as we can show here with the Maxwell top; so that if the top carries a polished mirror across the axle, it can serve as the mercurial horizon does on *terra firma*, and so give an altitude when the sea horizon is obscured.

The idea was suggested by Serson in 1744, and the enterprising Admiralty of the day did not crab the idea straight off with the usual "won't work," but sent him to sea in the *Victory* to make a practical test; unfortunately the ship was lost with all hands on the Casquets, near Alderney.

A specimen from the King's collection is preserved in King's College, Strand. The idea has been revived of late years by French navigators as the Fleuriais gyroscopic horizon; it is claimed to give good results in skilful hands where an ordinary observation would be impracticable through fog.

But the most important service to navigation in recent times of the top in harness is the gyroscopic compass. The idea was suggested by Sir William Thomson, but the high spin requisite could not be realised in his day until the great improvement arrived in modern mechanical skill of an Anschutz or Sperry, as a steel flywheel was required, some 4 in. in diameter, spun at 20,000 revolutions a minute. The axle, mounted freely, is always striving after the position as close as it can get to the direction of the polar axis, and so carries the compass-card with it pointing due north, with no magnetic variation requiring constant correction.

Because in modern swift steamship navigation across the Atlantic, where the great circle course must be maintained, practically the only nautical observation required is for azimuth, in its correction of magnetic variation; and there is no variation in the gyro-compass. A specimen would be too complicated and delicate to show off in this room. And if any young researcher should take it into his head to test the action by pushing the card away from its course, it would take an hour or more to swing back into place again.

But the greatest spinning-top we know is this Earth itself, spinning round once a day, with the axis pointing near to the Pole Star. Ancient observation reveals a precession (as in the Maxwell top here, twirled with the left hand), so that the pole is making a circuit among the stars, which will be completed in 26,000 years. Since Homer's day the pole has made more than one-tenth of the way round, and the constellations have changed from one sign of the zodiac well back through the next, and beyond.

We are able thence to assign a date to Homer and Hesiod from their astronomical allusions. Thus the nymph Calypso gives Ulysses his final instructions how to keep off Africa before he sets sail on his raft from Gibraltar: "Never to let the Bear take a bath. He alone should be unsharing of the baths of Ocean," not setting below the horizon any star of the constellation. To-day these instructions would land Ulysses well ashore, some six hundred miles on Africa.

Ulysses could take his latitude with a piece of string, one end held up to the pole, and sliding the other finger to cover some well-known star, then sweeping the hand round to see if the star would graze the horizon, in which case the polar distance of the star is equal to the latitude.

Two such observations on different stars would fix his position, on Sumner's method, provided he had a chart; and Lord Kelvin amused himself on his yacht in testing the primitive methods of Ulysses and the old Greek navigators against the most modern instruments of observation, sextant and chronometer, with Nautical Almanac.

In the ancient tradition there was formerly no obliquity of the ecliptic, and the year was one perpetual spring. But after the Fall of Man, in the Greek legendary astronomical theory Milton has thrown into verse in "Paradise Lost"—

> Some say he bid his angels turn askance
> The poles of Earth, twice ten degrees and more,
> From the Sun's axle. They with labour pushed
> Oblique the centric globe.

No particular labour would be required, as we see with the Maxwell top, if only the polar axis projected, as the angel could move the poles by holding his finger against the axle and letting it run up. A reverse action at the Millennium will restore eternal spring.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—A generous offer made by Sir Basil Zaharoff, G.B.E., through the Air Ministry, to provide a sum of 25,000*l.* for the establishment of a chair of aviation has been accepted by the Senate with cordial thanks, and steps have been taken to secure a speedy appointment to the post.

New regulations have been adopted by the Senate under which extended facilities are offered to graduates of other universities, especially to students from overseas with suitable qualifications, to register as internal students and as candidates for higher degrees (except in medicine and surgery).

The following doctorates have been conferred:—*D.Sc. in Biochemistry:* Mrs. M. T. Ellis, an internal student, of the Physiological Laboratory and the South-Western Polytechnic Institute, for a thesis entitled "A Contribution to our Knowledge of the Plant Sterols." *D.Sc. in Chemistry:* Mr. L. H. Parker, an internal student, of the Imperial College, Royal College of Science, for a thesis entitled "(i) Reactions between Solid Substances, and (ii) The Interaction of Sodium Amalgam and Water." Mr. O. C. M. Davis, an external student, for a group of papers dealing with steric influence and other subjects. *D.Sc. in Statistics:* Mr. Alexander Ritchie-Scott, an internal student, of University College, for a thesis entitled "(i) The Correlation Coefficient of a Polychoric Table, and (ii) A First Study of Polychoric Functions and the Incomplete Moments of a Normal Correlation Surface." *D.Sc. (Engineering):* Mr. James Montgomerie, an internal student, of the West Ham Municipal Technical Insti-

tute, for a thesis entitled "Stress and Strain Conditions in Rectangular Flat Plates Fixed at the Edges and Exposed to Uniform Pressure over Surface."

THE New York correspondent of the *Times* announces that a legacy of 3,000,000*l.* has been bequeathed to Yale University by the will of Mr. J. W. Sterling, who died suddenly on July 5. Mr. Sterling graduated from Yale in 1864.

MR. R. DOUGLAS LAURIE, who has been chief demonstrator and assistant lecturer in zoology and lecturer in embryology in the University of Liverpool for some years, has been appointed head of the department of zoology in the University College of Wales, Aberystwyth.

A FEW days ago a meeting was held at the Cardiff Exchange to consider the means of development of technological institutions, and the suggestion was then made that a sum of 50,000*l.* a year should be raised by the industrialists of the district. A beginning has been made in this direction by a contribution of 25,000*l.* from Lord Glanely towards the cost of a chemical laboratory, to be known as the Tatem Laboratory, in the University College of South Wales and Monmouthshire, Cardiff. In making this princely gift Lord Glanely remarks that the laboratory is the first step in a scheme essential both to the welfare of the college and the industrial community of South Wales. He adds:—"I understand that for the completion of the scheme in a manner worthy of a great industrial area a sum approaching 125,000*l.* is required, and I trust my contribution may be regarded as but the first step towards the accomplishment of this great undertaking. Slowly, but, I believe, surely, the industrial community is awakening to the importance of science and its application, and also to the necessity for its encouragement if we are to hold our own in the difficult times which are ahead of us. I am aware of the efforts made by Principal Griffiths to further the closer union of science and industry and to promote the cause of research, especially in those branches which most affect our local industries. It is, therefore, my earnest hope that his successor may be one who will realise the vital importance of this matter, and has the training and knowledge which will enable him to appreciate the problems which must be faced, and complete the work of which the foundations have now been laid."

THE University of London proposes to establish a degree in commerce. The scheme, to be really effective, must be worked out as a whole with an independent organisation, not as a mosaic of fragments built up from various faculties. The needs of the teaching depend on the aim of the degree course and the type of student for which it is intended. Finance and commerce in the broadest sense are the main interests of London, and likely to provide the mass of the students. The training should be correlated to the main interests of the individual, though in no sense a substitute for actual experience of business. Elementary economics, geography, and accounting, together with a thorough knowledge of a modern commercial language, with the addition of certain optional subjects, such as a science, or mathematics, or history, would provide a broad basis for more specialised work. The broad facts of commercial and financial organisation, recent historical development of the great commercial Powers, and the main principles of commercial law are of importance to all. Beyond these are two groups of subjects: on one hand, business organisation, the banking and financing of production and trade, and the movements of capital; on the other, the industrial and commercial conditions of the great markets of the world. Mr. A. J. Balfour, on July 18, spoke at a meeting at the Mansion House called to support the scheme of the University. He pointed out the two main criticisms that would be brought against degrees in commerce, one by those who argue that academic training is of little value in the actual practice of life, and the other by those who argue that vocational education is narrowing, and, indeed, may be so narrow as not to be education at all. He remarked that few subjects have so many aspects and so much human interest as the many-sided life of commerce.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 27.—Sir J. J. Thomson, president, in the chair.—Prof. T. H. **Havelock**: Periodic irrotational waves of finite height. It is shown that an extension of Michell's analysis for the highest wave gives a method which includes waves of any permissible height.—Dr. G. N. **Watson**: The diffraction of electric waves by the earth. Approximate formulæ have been obtained by Poincaré, Macdonald, Nicholson, and others, which express the disturbance due to a Hertzian oscillator at a distant point of the earth's surface. This paper contains a transformation of the series for the magnetic force into a series which converges very rapidly except in the immediate neighbourhood of the oscillator.—Dr. A. D. **Waller**: Concerning emotive phenomena. Part ii. Periodic variations of conductance of the palm of the human hand. This paper gives an account of further observations of changes of electrical resistance associated with emotive phenomena. Their physiological lost time is between two and three seconds, and occurs principally in the skin (palm of hand). With higher and lower conductivity the effects are greater and smaller. The electrical conductivity (palm of hand) exhibits a diurnal periodicity concurrent with the waxing and waning of physiological activity during the twenty-four hours.—Prof. J. A. **MacWilliam**: The mechanism and control of fibrillation in the mammalian heart. An essential condition in fibrillation is an altered (fascicular) mode of conduction. This may characterise even single beats as "fibrillar." The production of a rapid, continuous series of contractions in typical fibrillation depends on a disturbance in the normal relations of conduction time and refractory period, leading to the establishment of a mechanism of circulating excitations. Gradations are traced between fibrillar beats and rapid fibrillation. The chief protective and remedial agents described are urethane, adrenaline, strontium chloride, hirudine, and pilocarpine. The action of the last may reproduce the different actions of the vagus in auricles and ventricles respectively, promoting fibrillation in the former and restraining it in the latter.—Dr. J. F. **Gemmill**: The development of the sea anemones, *Actinoloba dianthus* and *Adamsia palliata*. An account is given of the development of these anemones from fertilisation to the eight-mesenteried stage. In both species the eggs are relatively small, those of Actinoloba containing so little food-yolk that the free-swimming planula feeds by the action of cilia on two precociously formed mesenteries (the future sulco-laterals), and afterwards crawls mouth-downwards with stomodæum everted, presumably obtaining food from the substratum. This is the only known instance of a feeding Actinian planula, and, indeed, the only previous detailed account of anemone development is that of Appellöf for Urticina, which has large yolky eggs.—

R. **Beer** and Agnes **Arber**: The occurrence of multinucleate cells in vegetative tissues. Binucleate or multinucleate cells have been observed by the authors in 174 plant species belonging to fifty-nine families. They have been found in each of the five classes of living Pteridophyta, in Gymnosperms, and in Angiosperms. They occur in a wide range of tissues belonging to stem, root, and leaf. The multinucleate condition has, in all cases, been found to arise by mitotic division of the nucleus, and in no instance have amitotic divisions been seen to play a part.—Dr. J. H. **Mummery**: The epithelial sheath of Hertwig in the teeth of man, with notes on the follicle and Nasmyth's membrane. The author shows that the "epithelial sheath of Hertwig" is present as a complete organ in human teeth, and, as shown by von Brunn in many mammalia, is the moulding or limiting organ of the dentine of the root, being constantly present where dentine is being deposited.—H. H. **Jeffcott**: The periods of lateral vibration of loaded shafts. The rational derivation of Dunkerley's empirical rule for determining whirling speeds. This paper deals with the periods of lateral vibration of loaded shafts, and gives the rational basis of Dunkerley's empirical method for determining the first whirling speed of a shaft carrying a number of loads. Results obtained by the Dunkerley formula are compared with the exact solutions in a few simple cases. The method employed is of general application, and leads to a theorem connecting the several speeds of vibration of a system of masses elastically connected with the speeds of vibration of the partial systems obtained by reducing to zero a given number of the masses in turn in all possible combinations.—Prof. Norman **Collie** and Dr. H. E. **Watson**: The spectrum of cadmium in the inactive gases.—C. F. **Brush**, Sir Robert **Hadfield**, and S. A. **Main**: Further experiments on spontaneous generation of heat in recently hardened steel.—T. **Matsushita**: The slow contraction of hardened carbon steels.

DUBLIN.

Royal Dublin Society, June 25.—Dr. G. H. Pethybridge in the chair.—Dr. F. E. **Hackett**: The twist and magnetisation of a steel tube in a spiral magnetic field. This paper deals with the verification of a formula given by Knott in 1888 relating the Wiedemann effect to the Joule effect, viz. twist=length (radius)$^{-1}$ $\sin 2\alpha (e_1+e_2)$, where e_1 and e_2 are the longitudinal elongation and transverse contraction in a given magnetic field. The theory was tested by keeping the spiral field constant and varying the pitch-angle α. Examination of the longitudinal magnetisation under the same conditions shows that the slight deviations observed from the expected linear relation of the twist to $\sin 2\alpha$ are due mainly to the demagnetising effects at the ends.—R. G. **Allen**: The absorption of water by vulcanised fibre and erinoid on exposure to moist air, and the consequent change of electrical resistance. Results were given for thoroughly dried samples of vulcanised fibre and erinoid which were immersed in nearly saturated air for measured intervals of time. The quantity of water absorbed was found to be approximately related to the time of immersion by a simple equation, and fibre was demonstrated to be much more hygroscopic than erinoid. Other results were given for these materials, showing the change of electrical resistance with quantity of water absorbed from moist air and the rapidity of decrease in resistance, especially in the case of fibre, with increase of this quantity. It was also shown that, whatever the quantity of absorbed water in fibre and erinoid, the same simple relation between temperature and resistance, common to many materials, including water, was followed in every case. The latter result was pointed out as giving strong support to the theory that electricity is conducted through the material of an insulator by the vehicle of water-films.

BOOKS RECEIVED.

Colour in Relation to Chemical Constitution. By Dr. E. R. Watson. (Monographs on Industrial Chemistry.) Pp. xii+197. (London: Longmans, Green, and Co.) 12*s*. 6*d*. net.

Wireless Telegraphy and Telephony: A Handbook of Formulæ, Data, and Information. By Prof. W. H. Eccles. Second edition, revised and enlarged. Pp. xxiv+514. (London: Benn Bros., Ltd.)

War Nursing: What Every Woman Should Know. Red Cross lectures by Prof. C. Richet. Translated by H. de Vere Beauclerk. Pp. xi+119. (London: W. Heinemann.) 3*s*. 6*d*. net.

Natural Science and the Classical System in Education. Essays New and Old. Edited for the Committee on the Neglect of Science by Sir Ray Lankester. Pp. ix+268. (London: W. Heinemann.) 2*s*. 6*d*. net.

The Practice of Soft Cheesemaking: A Guide to the Manufacture of Soft Cheese and the Preparation of Cream for Market. Fourth revision by C. W. Walker-Tisdale and T. R. Robinson. Pp. 106. (London: J. North.) 3*s*. net.

The War and the Coming Peace: The Moral Issue. By Prof. M. Jastrow, jun. Pp. 144. (Philadelphia and London: J. P. Lippincott Co.) 5*s*. net.

A Short Handbook of Oil Analysis. By Dr. A. H. Gill. Revised, eighth edition. Pp. 209. (Philadelphia and London: J. P. Lippincott Co.) 10*s*. 6*d*. net.

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