

and are free to follow the bent of this or that special study. In the long run, their united work is immensely profitable. Here is commercial rivalry, and more; here is a better understanding of the right conditions of "applied science."

Lord Cromer, president of the society, took as a signal instance of the necessity for experiments on animals the recent discovery of a serum treatment in cases of epidemic cerebro-spinal meningitis, that ghastly disease which goes by the foolish name of "spotted fever." It is an acute septic inflammation of the membranes of the brain and the spinal cord. By experiments on animals it was proved to be due to special germs of the order of diplococci. Flexner and Jobling, working at the Rockefeller Institute, discovered a way of preparing, from immunised horses, a serum containing a direct antidote, and this serum was first used in the spring of 1907. Before that time there was no special treatment of the disease, and the mortality ranged from 68.4 per cent. to 80.5 per cent. The children—it was mostly children—suffered terribly, and died in a few days; and of those who survived many were left, from the intensity of the inflammation, imbecile, paralysed, or blind. By the use of the serum the mortality has been reduced to 36.7 per cent. In Belfast, of 275 cases treated before the use of the serum, 72.3 per cent. died, and of ninety-eight cases treated with the serum 29.6 per cent. died.

The Research Defence Society exists to keep the public informed of such facts as these, and we hope that it will have a long record of such victories over disease.

#### IS THE ASSOCIATION OF ANTS WITH TREES A TRUE SYMBIOSIS?

THE fact has long been known that some species of ants occur in constant association with certain kinds of trees. Thus members of the dolichoderid genus *Azteca* are often found inhabiting the interior of the stems of *Cecropia peltata*, and among the Pseudomyrmini *P. bicolor* forms its nests within the spines of the "bull's-horn" acacia. The view has been held by many naturalists, amongst others by Fritz Müller and Bates, that in these cases the benefit is mutual, the tree affording both shelter and sustenance to its occupants, and receiving in return protection from the attacks of the formidable leaf-cutting ants of the genus *Atta* and of other enemies. Doubts on this point have been expressed by several authorities, among them by Dr. David Sharp, in whose opinion "there is reason to suppose that a critical view of the subject will not support the idea of the association being of supreme importance to the trees."

A careful investigation of the relations subsisting between the arboreal species of *Azteca* and *Pseudomyrma* and the trees which they inhabit has lately been conducted in Paraguay by Karl Fiebrig, who has published his results, illustrated by numerous photographic reproductions, in the current volume of the *Biologisches Centralblatt*.<sup>1</sup> His conclusions may be summarised as follows:—

*Azteca* not only makes use of internodal cavities already existing in the stem of *Cecropia peltata*, but excavates fresh spaces or enlarges existing ones at the expense of living tissues of the tree. Fritz Müller described certain pits in the stem of *Cecropia* where the wall is much thinner. These spots, he says, are selected by the female ant for the purpose of gaining access to the interior of the stem. But, according to Fiebrig, the ants effect their entrance into new internodal spaces by perforating the partitions in the stem before they have gnawed through the thin bottoms of the pits; moreover, openings to the exterior are often made irrespective of the situation of the pits, and when the latter are perforated the boring is, in certain cases, effected from within, and not from without. Neither the internodal spaces nor the pits can therefore reasonably be considered as myrmecophilous adaptations. Again, the alleged protection against leaf-cutting ants must often be superfluous, since the *Cecropia*, with its

inmates, is apt to be found in marshy situations where these enemies cannot reach it. Most of the trees in Paraguay are subject to the attacks of the leaf-cutting *Atta*, but, nevertheless, though unprotected by the presence of *Azteca*, they continue to maintain their existence, even if belonging to introduced, and not native, species. *Cecropia* itself is not tenanted by ants until it is some years old. The presence of colonies of *Azteca* does not prevent *Cecropia* from receiving much damage from the attacks of other insect enemies, and Fiebrig is of opinion that the constant loss suffered by the tree from the depredations of *Azteca* itself involves a more serious drain upon its vitality than the occasional raids of the leaf-cutters. Finally, the occupation of *Cecropia* by these ants not only fails to afford protection against enemies other than the leaf-cutters, but even encourages the assaults of such formidable foes as woodpeckers and internally feeding lepidopterous larvæ.

With regard to the association between *Acacia cavana* and *Pseudomyrma fiebrigi*, the author points out that this tree, in common with other species of *Acacia*, is protected against the ground-haunting *Atta* by the fact that it grows only in situations which are constantly liable to inundation. The thorns in which the ants take up their abode have frequently been already hollowed out and furnished with apertures of access by lepidopterous larvæ; moreover, the spaces tenanted by the ants are not confined to the thorns, but extend also to the stem. In neither situation do they occur naturally, but in both they are excavated, as in *Cecropia*, whether by ants or caterpillars, at the expense of the living tissues of the tree.

On these grounds Fiebrig concludes that, at any rate so far as the species observed by him are concerned, the benefits of the association between trees and ants are not mutual, but are enjoyed by the ants alone. There is no doubt that the reasons for his view adduced by Fiebrig are of great weight. At the same time, it cannot be said that these observations are sufficient of themselves to disprove altogether the existence of ant-plant symbiosis.

F. A. D.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following is the text of the speech delivered by Prof. Love in presenting Dr. G. E. Hale for the degree of D.Sc., *honoris causa*, at the Encænica on June 24:—

Inter Astronomos qui ea quæ in æthere solem circumfuso geruntur investigant nemini cedit Georgius Ellery Hale. Qui vir duodeviginti abhinc annos primus omnium fabricatus est instrumentum illud, ad lucis e solis puncto quovis emissæ naturam cognoscendam aptissimum, quo hodie utuntur omnes fere solis observatores. Hoc subsidio fretus potuit flammam illam excurrentem, quæ solis defectu plerumque cernuntur, sole pleno quasi in pictura exprimere: mox plagas lucidissimo candore fulgentes, quas faculas vocant, eodem modo repræsentare. Idem nuper docuit procellis hunc æthera vexantibus tenuissimas materiæ particulas quasi turbine quodam agitata vim magneticam miro modo gignere: quæ omnia nemo demonstrare potuit nisi excogitandi peritissimus, in observando patientissimus, in causis cognoscendis sagacissimus. Neque ei satis erat Naturæ arcana reserare, sed Observatoria duo in orbe terræ maxima fere et instructissima condidit atque ornavit: idem Ephemeridem, in qua recentissima de siderum natura ubique reperta pervulgantur, conscribendam curavit. Sodalitium denique maximum instituit quo omnes omnibus ex terris huius militiæ cælestis contubernales congregantur.

ST. ANDREWS.—Dr. William Nicoll, who has for some years carried out important researches on the parasites of birds, fishes, and other forms at the Gatty Marine Laboratory, has just been elected to the Ernest Hart memorial scholarship.

DR. J. C. IRVINE, lecturer on organic chemistry in the University, has been appointed by the University court to the chair of chemistry in St. Andrews, vacant by the resignation of Prof. Purdie.

<sup>1</sup> "*Cecropia peltata* und ihr Verhältnis zu *Azteca Alfari*, zu *Atta* sexdens und anderen Insekten. Ein kritischer Beitrag zur Ameisenpflanzen-Hypothese." By Karl Fiebrig (San Bernardino, Paraguay).

THE Viscountess Falmouth will present the prizes at the Horticultural College, Swanley, Kent, on Thursday, July 15. Sir John Cockburn will take the chair at 4 p.m.

A DISTINGUISHED American physicist, Prof. E. F. Nichols, of Columbia University, has been elected president of Dartmouth College, a leading New England institution with more than 1200 students. Dr. Nichols is a graduate of Cornell, and held chairs at Colgate and Dartmouth before being appointed to his present post at Columbia.

THE issue of *The Record*, the magazine of the South-Western Polytechnic Institute, Chelsea, London, for May, contains an account of this year's prize distribution, when Dr. H. A. Miers, F.R.S., the principal of the University of London, delivered an address. The report of the principal of the institute, an abstract of which is printed in the magazine, shows that there were 2573 students under his supervision during 1907-8.

THE King has consented to lay the foundation-stone of the new buildings of the Imperial College of Science and Technology, South Kensington, on July 8. The building is to accommodate the departments of mining and metallurgy of the Royal School of Mines, geology of the Royal College of Science, and the extension of the engineering department (City and Guilds College), and will be situated on the land in Prince Consort Road lying to the east of the Royal College of Music, and extending so far as Exhibition Road.

THE fourth annual issue of the "Girls' School Year Book (Public Schools)" has now appeared. The book becomes year by year more complete, and certainly provides a useful directory for those interested in the education of girls. It is, however, still difficult to understand the editors' method of selection of schools for detailed treatment. Among new features this year are articles on domestic science, teachers' registration, the teaching of music in public secondary schools, and a list of lecturers suitable for schools. The volume is published by the Year Book Press, c/o Messrs. Swan Sonnenschein and Co., Ltd., and its price is 2s. 6d. net.

A FULLY illustrated description of the college of engineering of the University of Illinois is contained in the issue of the *University of Illinois Bulletin* for March 8. Descriptions are provided of the work and equipment of the eight departments of the college, as well as those of the engineering experiment station and the school of railway engineering and administration. The college has been organised to give such training to young men as will enable them to do efficient work in the branch of engineering or architecture they may select, to meet the demand for highly specialised instruction and research, and to conduct investigations of value to the industrial enterprises of Illinois and distribute the knowledge gained.

IN the course of his recent presidential address to the Society of Chemical Industry, of which a short abstract appeared in NATURE of June 3, Prof. Meldola made the following appreciative remarks on the modern methods of laboratory instruction in chemistry:—"It is unnecessary here to dwell at too great a length upon the general practical training, although I should like to add that if the level has been raised, and if our teaching has become more philosophical, we are mainly indebted to a former occupant of this chair, Prof. Emerson Reynolds, who is unquestionably the pioneer reformer in the laboratory teaching of chemistry. I am glad of this opportunity of acknowledging the indebtedness of teachers to Prof. Reynolds, because, amidst the later clamour, his share in the development of chemical teaching has been overlooked." This address is published in full in the current number of the journal of the society.

EVIDENCE of the rapid development of the Chinese Empire will be found in an article in *Engineering* for June 18 dealing with the engineering and mining college at Tang Shan, North China. This college was founded in 1906 for the education of Chinese students, and is in connection with the Imperial Railways of North China, both being under imperial administration. The staff

consists of a president (Mr. S. S. Young), four English professors in mechanical engineering, civil engineering, mining, and physical faculties respectively, two Chinese *literati*, and a clerical staff. A four years' course was prescribed, and there are now more than 200 students in regular attendance from various parts of the country. Residential accommodation is provided for 160 students, together with houses for the staff, dining hall, and three educational buildings. All technical lectures are delivered in English. While the equipment is as yet far from being complete, it is indisputable that the existence of such an institution is a factor which cannot be disregarded when considering the future position of the Empire.

MR. DAVID BOYLE, the curator of the Provincial Museum of Toronto, had the degree of LL.D. of the University of Toronto conferred on him on June 12, for his eminent services in the cause of archæology and ethnology. Dr. Boyle has been incapacitated for some time, and as he was too ill to attend the regular Convocation, the authorities paid him the unique compliment of holding a special Convocation at his residence, and of conferring the degree while he was lying in bed. Dr. Boyle was presented by Prof. Galbraith, and in the absence of the president, who had sailed for England, the degree was conferred by the vice-president, Prof. Ramsay Wright. Dr. Boyle went to Canada in 1856, and in the face of great difficulties has built up the fine archæological and ethnological collections in the Provincial Museum of Toronto. He is best known to students as the editor of, and chief contributor to, the annual archæological reports of the museum. They were begun in 1898, and form a valuable record of Canadian archæology and ethnology. The later reports have been duly noticed in NATURE. We congratulate Dr. Boyle on this academic honour, which crowns a life of self-sacrificing and poorly remunerated toil for the subjects he has so much at heart.

THE proceedings at the inauguration of Mr. R. C. Maclaurin as president of the Massachusetts Institute of Technology have been reported at considerable length in the American Press. One of the chief speakers was Mr. Bryce, who greeted the new president as a fellow-Briton, a fellow-Scotsman, and a fellow-member of Lincoln's Inn. Mr. Bryce said that Englishmen and Scotsmen would naturally be sorry that Mr. Maclaurin was not serving their country "in one of the new institutions which we have lately founded to try to make up for lost time in the promotion of scientific instruction." Still, "a scientific inquirer and teacher helps the whole world by the work which he does anywhere in it." In his own inaugural address, President Maclaurin emphasised the following articles in his creed as an educator:—(1) that the end of education is to fit men to deal with the affairs of life honestly, intelligently, and efficiently; (2) that in the higher education of a large and increasing section of the community science should play a very prominent, if not a leading, part; (3) that science and culture must go hand in hand, science being studied and taught in such a way as to make for that broad and liberal outlook on the world that is the mark of the really cultured man; and (4) that "above all we must preserve in our students the freshness and vigour of youth, and see to it with all care that their natural powers of initiative are improved and not checked by our training."

IN recent years there has grown up in connection with local education authorities in all parts of the country systems of scholarships providing for the education of boys and girls of varying ages and attending schools of different grades, and also for young men and women anxious to continue their education after school days are over. The report of the higher education subcommittee on the scholarship scheme of the London County Council, recently adopted by the Council, provides an exhaustive account of the educational facilities offered in London to the sons and daughters of parents of limited incomes who have sufficient ability, as tested by examinations, to profit by continued attendance at school and college. The report indicates that in London, as elsewhere, there has been a disposition to multiply unduly the number of scholarships offered for competition, with the result that in certain districts there has had to be a marked lowering of standard

of efficiency so that the scholarships might be filled up. This danger, with others, has been under the consideration of the committee, and steps have been taken in the case of certain classes of scholarship to reduce the number available, so that an efficient standard may be maintained. In framing the regulations which will govern the award of scholarships and exhibitions during the next academic year, the committee has endeavoured to arrange that, so far as possible, "no child or young person shall be debarred by poverty from obtaining the kind of education which will prepare him for the career for which his talents and character best fit him, and that the pecuniary emoluments attaching to the scholarships shall be sufficient to enable students to obtain the kind of education, whether industrial, scientific, or literary, which is best suited to their needs and capacities, but not sufficient to induce them to undertake a particular course of study with the object of securing the pecuniary advantages attaching to the scholarship."

As indicating the wide scope of the London County Council scholarship scheme, which has recently been amended, it may be said that in 1905 the Council awarded (a) 2600 junior county scholarships to children between the ages of eleven and twelve, and that the annual cost of awarding one of these scholarships annually was 85*l.*; (b) 390 probationer scholarships, each costing 56*l.*, to children of thirteen to fourteen years of age; (c) 100 intermediate county scholarships, each costing 129*l.*, to boys and girls of from fifteen to seventeen years of age; (d) fifty senior county scholarships, each costing some 200*l.*, to students more than eighteen years of age; and (e) various scholarships in science, art, and technology, at an expenditure of more than 18,000*l.* To state the scholarships which are to be offered for competition this year will indicate some of the changes which have been made as the result of four years' experience. There are to be (a) 1800 junior county scholarships, costing each the same as in 1905, and 300 supplementary junior scholarships of lower value; (b) 300 intermediate county scholarships, but the value of each, for sufficient reasons, has been reduced to 72*l.*; and (c) 150 senior county scholarships, each as in 1905, costing 200*l.* But, whereas the total expenditure in 1905 was 283,940*l.*, the amount in 1909 has, notwithstanding the greater wisdom of the conditions of award in the scheme, been reduced to 263,080*l.* The report of the Education Committee gives very satisfactory evidence to show that the object the education authorities in London have in view is to secure a high quality in the results they obtain, rather than to spread an incomplete and rudimentary education far and wide.

A NUMBER of people interested in the teaching of household and domestic science visited Battersea Polytechnic on June 29 to see the domestic economy training department. Since the department was opened in 1894 more than 400 students have obtained diplomas, and are now occupying responsible positions in leading institutions and schools; the present number of students above eighteen years of age in the department is 130. Students of the department attend, in their first year, a course in "science as applied to household work," which includes physics, chemistry, physiology, and hygiene. This course is taken in addition to the purely practical work of the domestic arts. During the second session the scientific basis of knowledge thus obtained is applied in the practice kitchens, laundries, and housewifery rooms and hygiene laboratories. In the third year's course the same subjects are treated in greater detail, special attention being directed to bacteriology and the examination of food-stuffs. The main objects of the science work are:—(a) to explain, so far as possible, the chemical composition and properties of the materials dealt with in household work; (b) to explain the principal chemical and physical changes taking place in the common household operations involved in cookery, laundrywork, &c.; (c) to give a training in the principles of scientific method. Special stress is laid on the fact that household work generally is really an application of a number of facts and principles in chemistry, physics, hygiene, bacteriology, &c., and that, in order to understand the *rationale* of the ordinary household processes, a knowledge of the general principles of the branches of knowledge just mentioned is necessary.

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SOCIETIES AND ACADEMIES.

LONDON.

**Royal Society, May 27.**—Sir Archibald Geikie, K.C.B., president, in the chair.—Notes concerning tidal oscillations upon a rotating globe; Lord **Rayleigh**.—The absolute value of the mechanical equivalent of heat in terms of the international electrical units: Prof. H. T. **Barnes**. It is pointed out that the Clark cells used by the author in his determinations of the mechanical equivalent of heat in terms of the electrical units were prepared according to the old specifications. The absolute measurements of the Clark cell now being carried on with such precision in the various standardising laboratories are expressed in terms of the new form of cell with specially prepared mercurous sulphate. There is an important difference between the cells, which Wolff and Waters have shown amounts to 0.03 millivolts. The author has compared a set of modern cells with cells set up according to the old specifications, and finds the same constant difference. Taking 1.4330 international volts at 15° C. as representing the modern cells, then the cells made by the old specifications must be taken as 1.4333 international volts at 15° C. The author's measurements of the mechanical equivalent at different temperatures were calculated on the basis of a value for the Clark cell equal to 1.4342 international volts at 15° C. Re-calculating on the new basis, the value of the mean calorie is found to be 4.1849 joules. This agrees with Reynolds and Moorby's directly determined mean, which, expressed accurately for an interval of temperature between 0° C. and 100° C., comes to 4.1836 joules. Rowland's mean value between 5° C. and 35° C. is 4.185 joules, while the author's value between the same limits of temperature is 4.1826 joules. Thus, assuming the variation of the specific heat of water to be correctly determined, the value of the Clark cell, equal to 1.4330 international volts, brings the electrically determined mechanical equivalent into excellent agreement with the same constant measured by mechanical means.—An approximate determination of the boiling points of metals: H. C. **Greenwood**. Although high temperatures can now be easily attained by means of electric heating, no general investigation of the boiling points of metals has yet been carried out. Moreover, such values as are available have in most cases been deduced indirectly, and are very discordant. In the present investigation apparatus was devised for directly measuring the temperatures of ebullition under atmospheric pressure of a considerable number of metals, allowing of use up to 2700° C. Heating was effected electrically, and the metal, when unaffected by carbon, was contained in a thin-walled graphite crucible on the outside of which the temperature was estimated by means of a Wanner optical pyrometer. The difference in temperature between the internal and external surfaces of the crucible walls was found to be negligible. Accuracy of the temperature measurements was secured by checking the pyrometer against the "black body" melting points of specially purified strips of platinum, rhodium, and iridium. The following values were found:—aluminium, 1800° C.; antimony, 1440° C.; bismuth, 1420° C.; chromium, 2200° C.; copper, 2310° C.; iron, 2450° C.; magnesium, 1120° C.; manganese, 1900° C.; silver, 1955° C.; tin, 2270° C. In dealing with the metals aluminium, chromium, iron, and manganese, which readily combine with carbon, considerable difficulty was experienced in avoiding contact with carbon at the high temperatures in question. This was finally accomplished by the use of graphite crucibles brasqued with previously fused magnesia. In the absence of this protective lining the boiling point was very greatly modified by carburisation. The temperatures indicated for aluminium and manganese were far below those hitherto supposed necessary for ebullition.—Some results in the theory of elimination: A. L. **Dixon**. The eliminant of two quantics  $\phi(x), \psi(x)$ , each of the  $n^{\text{th}}$  degree, may be expressed as a determinant of the elements of which are  $(a_s, r_t)$ , where  $(a, r)$  is  $[\phi(a)\psi(r) - \phi(r)\psi(a)]/(a-r)$ , and  $a_1, \dots, a_n, r_1, \dots, r_n$  are two sets of  $n$  arbitrary quantities. For three quantics  $\phi(x, y), \psi(x, y), \chi(x, y)$ , each of the form  $\sum A_{rs}x^r y^s$  ( $r \leq n, s \leq m$ ), the eliminant is a determinant of the elements of which are  $F(a_s, b_s, a_t, \beta_t)$  where  $F(a, b, a, \beta) = (\phi(a, \beta)$