by pressure and strain. The phenomena of radio-activity have opened up a new world, and no achievement of science is, to my mind, more wonderful than the way in which a modern physicist can measure the velocity and count the number of inconceivably minute particles that fly off from a morsel of radio-active matter.

For many purposes the steam engine has been outdistanced. The energy now available from modern engines is much greater than was at one time thought practicable. The best triple-expansion steam engines gave back as mechanical energy only 17 per cent. or 18 per cent. of the energy represented by the combustion of the fuel, the remaining 82 per cent. and 83 per cent. being lost, or, at all events, is mechanically inefficient, as heat. A human muscle gives as mechanical energy 25 per cent. of the energy of the food, but the remaining 75 per cent. of heat is necessary for the life of the muscle, so that, in this aspect, it is superior to the steam engine.

I have often been struck with the wonderful economy of nature. She attains her ends usually by the simplest and most direct method and with the smallest expenditure of matter and energy, and one cannot help thinking that future inventions—I mean inventions during the next two or three centuries—will be in this direction. The electric organ of an electric eel, at rest, may show so small an electromotive force as to require a good galvanometer to detect it, but a nervous impulse from nerve-cells in its spinal cord may suddenly raise a potential of many volts, and this with little heat and with so small an expenditure of matter as to defy the most expert chemist to weigh it. The electric organ is in no sense a storage battery, but rather a contrivance by which electrical energy is liberated at the moment it is required. The fire-flies, the glow-worms, and many deep-sea fishes can produce light without heat and at a cost which would make the price of a wax vesta an extravagant outlay. Plants, possibly aided by micro-organisms, or at all events by ferments (enzymes), can produce alkaloidal substances at a low temperature and by slow processes; but, on the other hand, to produce these synthetically the organic chemist requires all the resources of his laboratory, high temperatures, acids, and other potent agencies. Many other examples might be given of the economy of nature all establishing the truth that the principle of least action holds good everywhere—a principle which some have thought was a greater, at all events a wider, generalisation than that of the conservation of energy.

There is another department of science to which I must refer in this brief survey. I refer to bacteriology, a branch which deals with the life-history of minute organisms that play a very important part in the economy of nature. In the public mind there is a widespread impression that bacteria and other organisms are the enemies of man, but this is far from being the case with the great majority of these humble plants. Of the thousand or fifteen hundred species now known, probably only fifty or so are inimical to men. The others are highly beneficent. Some are engaged in taking nitrogen from the air for the use of the higher plants: others in splitting up complex substances existing in the bodies of dead plants and of dead animals, and in restoring simpler substances to the soil: others purify our rivers and lakes; even the ocean is the theatre of their activities: and others have to do with the varied phenomena of fermentation. A knowledge of the life-history of these microbes has enabled the physician and surgeon not only to do much in the way of preventive medicine, but to benefit mankind in the treatment of many diseases; and, what is probably of even greater interest, we now recognise that the *rôle* played by these living beings is of the greatest importance in many industries. Such are the industries connected with fermentations, brewing, distilling, baking; the processes of the dairy, as in butter-making and cheese-making; and the important industry of tanning or making leather. In those industries and in scientific agriculture the services of microbes are being more and more called to our aid. Bacteriologists can now make pure cultures of micro-organisms that are useful, and practical men may sow these in approximate media where they do their useful work. In this way the soil of the farmer may be enriched, the growth of particular cereals, leguminous plants, and roots may be facilitated, and the products of the dairy may be made more wholesome. There can be no doubt that in the future many industrial processes, such as these of tanning, paper-making, and others, will be improved as we are able to call these humble beings to our assistance. This, I think, is one of the fairy tales of scientific achievement.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. W. G. Fearnsides has been appointed demonstrator of petrology, and Mr. F. J. M. Stratton assistant in astrophysics.

Mr. E. M. Wellisch has been elected to the Clerk Maxwell scholarship.

The general board of studies recommends that Mr. K. J. J. Mackenzie be appointed as university lecturer in agriculture for five years, and that he receive a stipend of 200*l.* a year, payable out of the agricultural education fund.

Dr. Stein will deliver a lecture in Cambridge on Thursday, January 20, at 5 p.m., on his explorations in Asia.

LONDON.—A new syllabus in chemistry is to come into force at the matriculation examination on and after January, 1911. In the new syllabus greater emphasis is attached to the theoretical basis of the science and to physical phenomena, such as the development of heat in chemical reaction. The general characteristics of the metals, including an elementary study of sodium, calcium, and iron, and their common compounds, are introduced, while the elementary organic chemistry and a part of what was termed the "chemistry of common life" has been taken out of the syllabus.

OXFORD.—The news of the impending retirement of Dr. E. B. Tylor, F.R.S., professor of anthropology, will be received with universal regret. It is perhaps not easy for the present generation to realise how much the science of anthropology owes to the unwearied labours of Prof. Tylor, continued for the space of full fifty years. The importance which the subject has now attained among the studies of Oxford is in large measure due to the energy and enthusiasm with which, on his appointment in 1883 as keeper of the university museum, and afterwards as reader and professor, Dr. Tylor threw himself into the work of arousing and maintaining interest in the scientific history of the arts and institutions of mankind. Under his careful management, and with the able help of the curator of the splendid Pitt-Rivers collection, Mr. H. Balfour, and of other younger workers, the study of anthropology in Oxford has during the last quarter of a century been completely transformed. Prof. Tylor's kindliness and geniality have secured to him the affection of a large circle of friends, whose good wishes will follow him into his retirement.

THE second annual dinner of the Old Students' Association of the Royal College of Science will be held on Friday, January 7, 1910. Tickets may be obtained from the secretary of the association, Mr. T. L. Humberstone, 3 Selwood Place, South Kensington. Sir Thomas H. Holland, K.C.I.E., F.R.S., has consented to nomination as president of the association for the year 1910, in succession to Mr. H. G. Wells.

SPEAKING at the Strand School, King's College, on December 10, Sir William White said that it is not putting a narrow or improper meaning on the word "education" to say that it must have relation, in the case of the vast majority of men and women, to their getting a livelihood. An examination which is passed by means of cramming is mischievous. In many cases boys crammed for an examination have obtained for themselves positions for which they are totally unfitted. Some men spoil their lives by cramming for examinations; they take away all the freshness of life by simply accumulating different kinds of knowledge for reproduction in a match against time. On the other hand, there are many excellent men who, directly they get into the examination room, can never do themselves justice. Examinations, therefore, do not always find

out the best men; but in the circumstances of the present time it seems impossible to find a substitute.

A REUTER message from Brisbane states that the ceremony of the dedication of Government House buildings as the home of Queensland University was performed on December 10 by Sir W. MacGregor, the Governor of Queensland. Sir W. MacGregor read a message from the King congratulating the people of Queensland and expressing the hope that the enterprise and loyalty which have marked the first fifty years of the existence of Queensland may be an abiding heritage, and that the prosperity of the State will be multiplied abundantly in years to come. The Governor said that he was gratified at participating in a gathering of such importance, establishing as it did the corner-stone of a system of State education. In no other country can the pursuits of professional and economic life be followed to greater advantage than in Queensland, which has an extraordinary multiplicity of resources. The university course includes arts, without unduly encroaching upon more modern developments of direct utility. The plan of the University is an elastic one, and capable of unlimited expansion. Sir W. MacGregor assented, on behalf of the King, to the University Bill, and unveiled a tablet dedicating the building. The gift was accepted on behalf of the people by Mr. Bell, the Speaker of the Legislative Assembly. Speeches were also delivered by Profs. David, of Sydney, and Stirling, of Adelaide Universities. Mr. Kidston announced that 50,000*l.* has been set aside for initial expenditure and 10,000*l.* annually for working expenses, and there will be sixty foundation scholarships.

A RECENT report to the Middlesex Education Committee by its secretary and inspector of schools provides particulars concerning an experiment in operation in Strassburg on employment bureaux for children of school-leaving age. In Strassburg the education authorities work in conjunction with the labour bureaux and the employers. A card is handed to the child on leaving school, which, when filled up, contains all particulars necessary for intending employers. This information is supplied by the parents, the headmaster, and the medical officer. It is obvious that little can be done without the cooperation of employers of labour. Most Strassburg employers now prefer to engage a boy through the bureau, as they are able at a glance to obtain a fair estimate of his capabilities from trustworthy sources, and are in this way safeguarded from employing one who may be unequal to the work required. When a boy is engaged the date is noted, and a record of his career as an employee is kept by the bureau, and this is of great benefit to future employers. The success of this scheme has justified the experiment. Every year a large percentage of children of both sexes find suitable employment in this way. Parents, employers, teachers, and apprentices all speak highly of the scheme. The bureau does not confine its attention to children only, but deals with adults, and is part of a widely spread system, with branches in many parts of Germany as well as in other European countries, and has enabled the authorities to find employment for a large percentage of applicants. The bureau being in direct telephonic communication with every other centre, an applicant is found work in the shortest possible time. With a complete record of a man's career there is little risk of imposture, and no hesitation is made in advancing the railway fare to his work in other towns when necessary.

THE prizes and certificates at the Northampton Polytechnic Institute were distributed on December 10 by Sir John Wolfe-Barry, K.C.B., who in the course of his address spoke of technical education as scientific instruction in the useful arts. It was not, he remarked, until about 1870 that we began to realise that all was not well with the trade of England and with English methods. At that period primary education was at a very low ebb, and scientific education was in the possession of very few. Technical education for the masses was unknown, and was scarcely desired. The late Prince Consort played a prominent part in rousing the country to the necessity of altering its methods and fostering technical education. In 1877 the City and Guilds of London Institute led the way in a systematic manner in developing the new movement. Since they put their hands to the plough they have spent 800,000*l.* of their own property, and are still spending at the rate of from 23,000*l.* to 25,000*l.* a year in developing the movement which they set on foot more than thirty years ago, which has materialised into the Central Technical College at South Kensington, the Finsbury Technical Institute, and their art school at Kennington. Turning to the work of the Northampton Polytechnic Institute, Sir John Wolfe-Barry gave the history of its development from its initiation some fifteen years ago. After referring to the assistance given by the City Parochial Foundation, the Skinners' Company, and the Saddlers' Company, he emphasised the debt which it owes to the London County Council. Dealing specially with the subject of technical optics, he expressed the hope that the much delayed development would be proceeded with before another year had passed, for such development would deal with an important branch of a scientific trade, and a trade in which we ought more than to hold our own with foreign competitors. Returning to the general subject of technical education, he indicated its limitations, and showed how one of its chief objects is to enlarge the army of scientific workers, and thus to enlarge the area from which the leaders and generals of industrial life are to be drawn, tending thus to substitute intelligent methods for the rule of thumb and to make man less and less an animated machine. Technical instruction, he concluded, must follow the abstract sciences, and not attempt to limit them. In the course of the evening the head of the mechanical engineering department, Mr. C. E. Larard, gave a lecture on the twisting of materials to destruction. He directed attention to a remarkable testing machine which has been installed in his department, and embodied in his lecture the results of his researches on the behaviour of various qualities of steel when twisted to destruction. By means of this machine specimens of steel up to 3½ inches in diameter can readily be twisted to destruction.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, December 1.—Prof. W. J. Sollas, F.R.S., president, in the chair.—W. G. **Fearnsides**: The Tremadoc slates and associated rocks of south-east Carnarvonshire. Results obtained in making a detailed map of the country about Portmadoc, Tremadoc, and Criccieth in Carnarvonshire, and a description of the stratigraphy of the Cambrian and Ordovician rocks there exposed. The sedimentary series are described in the order of their formation. The succession is tabulated. The folding, cleavage, faulting, and jointing of the rocks are described, and an attempt is made to show some relationship between the stress-phenomena which have produced these structures. The great fault through Penmorfa is interpreted as a thrust-plane hading gently to the north-east. It is supposed to form the lowest sole of the group of thrust-planes which follow the southern margin of the Snowdonian mountain-tract. The well-known pisolitic iron ore of Tremadoc is shown to follow the line of this fault. Direct evidence of overthrusting has been got from a study of the graptolite-bearing Llandeilo rocks of Tyddyndicwm, which have been exposed in two artificial trenches dug for the purpose, and the distribution of the andesitic volcanic series in lines of detached lenticles among the Grey Slates is described as evidence of a similar re-duplication of the newer rock-series of the north-eastern district on a more extended scale. It is noted that the dolerites are (1) unaffected by cleavage and faulting, and (2) have metamorphosed rocks which were already cleaved, cut, and re-duplicated by the thrust-faulting at the time of their intrusion. The Glacial and post-Glacial accumulations are also described in outline.—E. S. **Cobbold**: Some small trilobites from the Cambrian rocks of Comley (Shropshire). Most of the trilobites were obtained during the progress of the excavations referred to in the report of the Geological Excavations Committee of the British Association, read at the Dublin meeting, 1908. The specimens were derived from the Olenellus Limestone of Comley, and from the Grey Limestones which intervene between that horizon and