Yet in very truth there is nothing to prevent the University of Wisconsin, or any other of a hundred like institutions, without awaiting the rare advent of some far-sighted benefactor, from having, not ten, but all her professorships made research professorships—nothing, alas, but the deep-seated and seemingly uneradicable conviction of the boards of control, that the endowments committed to their charge are for some other purpose.

A true university from the point of view of scientific productiveness is a body of scholars, that is to say, of men devoting themselves solely to the advancement of learning. Everyone in it, from top to bottom, should be an investigator. The entire income of a university should be expended in the promotion of science, *i.e.* of knowledge. Teaching is a necessary factor in the advancement of learning, and so a function of the university. University teaching should be done by investigators, not only because more investigators are to be developed, but because the promotion of science, on the scale which the future demands, means that science shall not remain narrowly academic, but shall more and more pervade the life of the people.

From the point of view of American institutions such a definition of the university is revolutionary, but it cannot be said to be impracticable or Utopian, for upon precisely such ideals the most successful university systems in the world have been built.

That this type will bear transplanting to American soil was triumphantly demonstrated in the work of Daniel C. Gilman, who gave the Johns Hopkins University at its inception the essential characteristics of the German universities as regards research. This successful experiment should have marked an epoch in the history of higher education, but a generation has passed and we have not as yet a university system devoted primarily to the advancement of learning. We still consider investigation merely as a desirable adjunct to university activities, never as the thing for which the university exists.

Germany, on the other hand, has for a century consistently developed the university as a centre of research, and through the promotion of pure science in the university has made German civilisation what it is to-day.

I would not be understood as urging German or other European methods in all details upon a country where quite different conditions exist, but one general principle is of universal application. In whatever we have to do, whether it be municipal administration, sanitation, road-making, the construction of water-ways, the development of industries, or the conservation of natural resources, the fullest and latest scientific knowledge should be utilised. Practice should not be permitted to lag indefinitely behind theory, and that they may go hand in hand public work and private enterprises should be in the hands of *those who know*. At the same time, science should be persistently advanced by every possible agency.

To my mind, the future of science in America, as elsewhere, is essentially a question of the future of the universities. It is conceivable that institutions may so long continue blind to their chief function as to be supplanted by some new agency called into existence to take up their neglected work. Already great endowments for the promotion of research, quite without any pedagogical feature, have come into existence. For all such science has need, and will have increasing need, as the situation becomes more acute and we are brought closer to the great crisis.

But it will be found that the conditions for maximum scientific productiveness are precisely those which would exist in the ideal university. All attempts at a machine-made science are doomed to failure. Science-making syndicates are likely to meet shipwreck on the very rocks on which the American educational system is already aground. No autocratic organisation is favourable to the development of the scientific spirit. No institution after the commercial models of to-day is likely to be generously fertile. You can contract for a bridge according to specifications. If a railway is to be built and operated, a highly organised staff with superintendents and foremen and an elaborate system reaching every detail may be made to yield the desired results. No one, however, can draw up specifications for a scientific discovery. No one can contract to deliver it on a specified day for a specified price. No employee can be hired to produce it in return for wages received.

To the investigator the considerations I have endeavoured to present are unimportant. Science for its own sake is his sufficient incentive; but it is all-important for the community at large to realise that no real addition to knowledge is useless or trivial; that progress depends on scientific productiveness; that science, which must be fostered if we are to continue to prosper, is a republic the watchwords of which are *liberty, equality, fraternity*.

World power in the near future is to be a question of knowledge—not of battleships—and what is now spent on armaments is to be devoted to its pursuit. Beyond lies that future in which it will no longer be a question of supremacy among nations, but of whether the race is to maintain its foothold on the earth.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

To perpetuate the memory of the late Sir George Livesey it is proposed to endow a Livesey professorship in gas engineering and fuel at the Leeds University. The committee having the matter in hand announces that contributions to the fund should be sent to the secretary of the Institution of Gas Engineers, 39 Victoria Street, Westminster. A sum of at least 10,000*l.* is required for the object in view.

THE University of Liverpool has received an offer from Mr. Alexander Elder, of Southport, formerly of Elder, Dempster, and Co., Liverpool, to contribute 12,500*l.* for the establishment of a chair of naval architecture in the University. The proposal will be considered by the University council at its next meeting. The foundation of such a professorship would of necessity mean a great expenditure in fitting and equipping lecture-rooms and laboratories, and in maintaining the work of the new department. It is hoped that other gifts will be forthcoming to make it possible for the council to accept Mr. Elder's generous offer.

THE Rev. Lord William Cecil is proceeding to China at the request of an influential committee of graduates of Oxford and Cambridge to try to found a Christian and educational university there. At present much educational work is being done by the American missions, but very little by the English. It is thought that one union university will be more efficient and more economical than many smaller establishments working without method. It is hoped to avoid the difficulties of divergent religious teaching by founding a university on the lines of Oxford and Cambridge. While each college of the university will be under the control of some mission body, the university itself, like Oxford and Cambridge, will not be attached to any one denomination. The university will concern itself chiefly with the teaching of arts, science, and engineering. The university is not intended to be a permanent foreign settlement in China. With the growing body of Chinese Christians, it is expected that the chairs may be filled soon with those who have been students in the university.

WE have received a printed copy of a lecture delivered by M. Jules Gautier, director of secondary education in France, last October, under the auspices of the British Education Section of the Franco-British Exhibition, on the progress of secondary education in France since the time of Napoleon I. It is interesting to notice in the lecture that science was introduced in the curriculum of French secondary schools so far back as 1821, while in 1829 the idea was prevalent that Latin and science formed a suitable training for young men wishing to enter the Army or the Diplomatic Service. In 1852 the system was introduced of dividing pupils, after the preliminary stages, into two groups, those who wanted a literary or classical education and those who wanted a scientific education, but this system was short-lived. It was not until 1902 that the present system was inaugurated. To-day French secondary education is divided into two cycles; the first is concerned with the years from ten to fourteen, and the second with the remaining school years. In the first cycle science is

taught in varying amounts, and in the second cycle science is included in each of the four different courses open to pupils.

THE University of London has arranged several series of advanced lectures in science for the spring term. The lectures are addressed to advanced students of the University and to others interested in the subject dealt with. Admission is free, without ticket. A course of eight lectures on "Physical Chemistry, and its Bearing on Biology," will be given by Dr. J. C. Philip at the Imperial College of Science and Technology, S.W., on Mondays at 5 p.m., from January 25 to March 15. Four lectures on "The Use of Vertebrate Fossils in Stratigraphical Geology" will be given by Dr. A. Smith Woodward, F.R.S., at the Imperial College of Science and Technology on Mondays at 5 p.m., beginning on February 1. The reader in meteorology, Dr. W. N. Shaw, F.R.S., will give ten lectures on "The Climates of the British Possessions" at the London School of Economics on Fridays at 5 p.m., beginning on January 22. Three lectures on "The Anatomy and Zoological Relationships of the Anthropoid Apes," by Prof. Arthur Keith, will be given at the Royal College of Surgeons, Lincoln's Inn Fields, on Friday, January 15, Thursday, January 21, and Friday, January 29, at 5 p.m. Three Chadwick lectures on "The Medical Aspects of Recent Advances in Hygiene as connected with Sewering" will be delivered at the University by Dr. Louis C. Parkes on Tuesdays at 4 p.m., beginning on February 2.

THE Governor of Bombay recently addressed a long letter to the registrar of the Bombay University propounding a new scheme of science teaching. According to the *Pioneer Mail*, the letter concludes:—The Governor in Council is well aware of the difficulties which must attend so drastic a revision of the University curriculum as in his opinion is urgently required, and he fully recognises that the essential reforms must be gradually carried out. He is confident, however, that the Senate will approach with a single eye to the efficiency of higher education in the Presidency, the proposals which in reply to the request contained in their letter of August 8 last he now lays before them, and will share with him the earnest desire that the University of Bombay should be brought into line with the great developments in educational methods which have assumed practical form in recent years, and they will not fail to realise the bearing of these developments upon national advancement. The recent splendid benefactions towards the improvement of science teaching have removed some of the obstacles to the movement in the required direction. The most pressing questions, therefore, to which the Senate will doubtless give the earliest consideration are those relating to the proposed changes in the science courses. So soon as an agreement has been reached on the principles involved, it will be possible to take the initial steps for starting an institute in which the teaching of science can eventually be concentrated and rendered worthy of the Presidency of Bombay.

INTERESTING statistics concerning the registration of students in American universities last October are given by Prof. Rudolf Tombo, jun., in *Science* of December 25, 1908. Comparing the figures for 1908 with those of the previous year, Prof. Tombo shows that, in spite of the prevailing economic depression, only two American universities, Harvard and Stanford, show a slight loss in enrolment, whereas two years ago five universities suffered a decrease. Taking the total attendance into consideration, *i.e.* including the summer session, the greatest gains of students have been made by the universities of Chicago, Columbia, Wisconsin, Indiana, Pennsylvania, Cornell, California, and Minnesota, each one of these having gained more than four hundred students; omitting the summer session attendance, the largest increases have been registered by the universities of Columbia, Minnesota, Cornell, Northwestern, Wisconsin, Pennsylvania, and Ohio, in the order given, the growth in each case being one of more than three hundred students. The only institutions that have registered a decrease in the number of students studying science are Harvard, Kansas, Nebraska, and Virginia, and of these the first mentioned is the only one that shows a loss as compared with 1902, this being due to the fact that the baccalaureate degree is now required for admission to the Harvard engineering schools. The gain in the number of science students since 1902 is in several instances remarkable, *e.g.* from 597 to 1352 at Michigan University. The largest number of students of science is still found at Cornell University, Michigan and Illinois being the only others that attract more than one thousand students to their scientific schools; these are followed by Yale, Ohio State, Wisconsin, California, Pennsylvania, Minnesota, Columbia, Missouri, Nebraska, and Princeton, each of these universities having more than five hundred students in attendance at their scientific schools.

THE report of the British Education Section of the Franco-British Exhibition, 1908, has now been printed and circulated. Although exhibits of our educational system and its results have formed part of the several international exhibitions which have been held in various countries during the past twenty-five years, no adequate demonstration of the wide scope of the aims of British educational activity, the variety of its methods, and the magnitude of its results had ever been brought before the public within the United Kingdom before that in connection with the exhibition of last year. The exhibits were contributed by some 160 organisations in all parts of the kingdom, and were drawn from more than 1550 schools, colleges, and other educational institutions. The important place in our educational system now filled by technical instruction claimed for it special treatment. This was secured by a large collective exhibition, representative of the various types of work done by the respective technical schools and institutes of the country, the organisation of which was undertaken by the council of the Association of Technical Institutions, while the City and Guilds of London Institute showed, by an exhibit of the statistics of its department of technology, the uninterrupted progress that has been made in the organisation of practical instruction in the different branches of industrial work. Large parties of teachers from Manchester, Bolton, Nottingham, Newcastle-on-Tyne, Darlington, Wakefield, Stockton, Middlesbrough, Rochdale, Grimsby, Barry, Wimborne, and other places visited and inspected the section during August and September. Moreover, special commissioners, appointed by their respective Governments to study the methods and results of British education, came from China, Japan, Spain, Algiers, Hungary, Cuba, New South Wales, New Zealand, and other countries, while amongst the most frequent visitors in the autumn months were many teachers from the United States and Canada.

THE annual meeting of the Geographical Association was held at the London School of Economics on January 6. The morning was devoted to technical papers on methods of geographical instruction. The excellent work which the association is doing in the direction of applying scientific methods to the teaching of geography is indicative of the new spirit which is inspiring schoolmasters and schoolmistresses. Until recently it was customary to rely wholly upon the teacher's explanations, and the pupils were expected to listen and remember merely; nowadays, in the best schools, the pupil is made to take an active part in the work and to deduce geographical principles from practical exercises based on maps, the graphing of curves, the reading of measuring instruments, and many other branches of the subject. The character of the morning papers read to a large and interested audience of teachers reflected this gratifying change. The afternoon session also was largely attended. It was announced that the membership had increased by 250 during last year, and is now 793. In his presidential address Mr. Douglas Freshfield said he had brought one satisfactory item of news from the Royal Geographical Society, namely, that the council of the Royal Geographical Society and the University of Oxford have agreed to maintain their respective contributions to the Oxford School of Geography for another period of five years. The school grows in size and reputation, and it only remains for some pious benefactor, some city company, or colonial millionaire to build himself a lasting monument by providing the school with a suitable

home worthy of the first school of geography in the British Empire. At Cambridge also the geographical spirit is active, and new developments may be expected. Extension meetings in the summer spread university teaching far and wide, and everywhere there are signs that teachers who take an interest in their subject are multiplying, and that the conception of geography as a study for mental discipline is spreading. No one in touch with education speaks apologetically nowadays of geography. It has won its place, in comparison with physical science and history, as a science full of problems as well as facts, a mental exercise of no mean order. It is not only to the classical student, but to the man of science, the economist, and the statesman, and Mr. Freshfield added, to the elector, that a just knowledge of geographical conditions may prove serviceable. The abysmal ignorance of the British Empire in large classes of our countrymen who are allowed a share in controlling its destinies is not the least of our national dangers. Dr. H. R. Mill delivered a lecture on the rainfall of the British Isles, and Mr. G. W. Palmer, of Clifton College, gave a lantern exhibition of a set of views of the Dora Baltea.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 12, 1908.—"The Natural Mechanism for evoking the Chemical Secretion of the Stomach." By J. S. **Edkins** and M. **Tweedy.** Communicated by Prof. E. H. Starling, F.R.S.

By a special method, elsewhere described, the authors were able to restrict the introduction of food material to definite portions of the stomach and intestine. It was therefore possible to test how these different regions behaved as channels for absorption, and what the comparative value of different food substances was in respect of the evoking of the chemical mechanism of secretion of gastric juice. The fundus of the stomach was found to be non-functional in absorption, the pyloric end of considerable value, and absorption in the duodenum also stimulated the fundus to secrete. It was observed that acid alone is but a slight stimulus; dextrin has a marked effect similar to that shown by dextrose and maltose. Commercial peptone and the meat extract devised by Herzen, of Geneva, were found most potent of the substances experimented on.

No evidence was found of any negative hormone passing into the circulation tending to inhibit gastric secretion. The pyloric end of the stomach and the duodenum are to be regarded as the normal channels of such absorption as liberates the gastric hormone. The fundus is definitely excluded.

Royal Microscopical Society, December 16, 1908.—Mr. Conrad Beck, vice-president, in the chair.—(1) A workshop microscope for the examination of opaque objects; (2) a simple method of illuminating opaque objects: J. E. **Stead.**—Mounting rotifers and Protista in Canada balsam: Rev. Eustace **Tozer.**

EDINBURGH.

Royal Society, December 21, 1908.—Prof. Crum Brown in the chair.—A photographic apparatus for automatically recording the readings of the scale and vernier of any instrument: Dr. J. R. **Milne.** The apparatus was a specialised form of camera. When the observer wished to make a reading he pressed a small lever, which set in motion the automatic mechanism. The shutter was first opened and closed, and then the plate was moved on a step so as to bring a fresh part of its surface into position. A 5-inch by 4-inch plate could in this way be covered with seventy small photographs of the scale and vernier, and these could be read off at leisure afterwards. Not only was the work of the observer much lightened, but his eyes were spared much fatigue, while a permanent record was obtained in which there could be no error due to bias or a mistake in reading. The author had used this camera for some time in connection with a polarimeter, and had found it of great advantage in recording the readings of the Nicol.—The friction at the extremities of a short bar subjected to a crushing load, and its influence upon the apparent compressive strength of the material: G. H. **Gulliver.** As regards the effect of the friction of the crushing plates upon the yield point of short compression specimens, it was found that with plates harder than the material under test the end friction caused an increase in the apparent yield-point stress. This increase was calculated approximately as 20 per cent. for wrought iron and mild steel, 20 per cent. for cast iron, and from 50 per cent. to 200 per cent. for stones, bricks, and concrete. These figures, except the first, might apply almost equally well to the crushing strength, but they required experimental verification. The corresponding inclinations of the surfaces of sliding were $-37°$ for wrought iron and steel, 36° for cast iron, and 27° to 18° for stone, &c. The first value was seldom obtained, but the others agreed fairly well with average experimental results. With the crushing plates of softer material than that under test, the lateral flow of the former diminished the apparent strength of the specimen. For stones crushed between lead plates the calculation indicated a strength from 0·35 to 0·15 of that obtained with iron or steel crushing plates. Experiment gave from 0·65 to 0·45 as the value of the ratio, but the specimens did not rupture by shearing in the manner contemplated in the theoretic discussion. The total crushing load of a short specimen of cast iron was increased by diminishing the length of the piece, but the crushing stress per unit area was simultaneously decreased.

January 4.—Dr. R. H. Traquair, F.R.S., in the chair.—The fossil Osmundaceæ, part iii.: Dr. R. **Kidston** and D. T. **Gwynne-Vaughan.** The paper contained a detailed description of three osmundacean fossils from the Permian of Russia. In the most important, *Thamnopteris Schlechtrudalii*, the protostele of the stem has a solid central mass of xylem. The most central tracheæ are short, vesicular and reticulate, and are regarded as being transitional to a parenchymatous pith. On leaving the stele the xylem of the leaf trace is oval in transverse section with a mesarch protoxylem, and on its way through the cortex it gradually changes into the adiaxially curved C-shaped trace of the Osmundaceæ. These changes are held to represent the phylogeny of the adiaxially curved C-shaped trace in general. The stem stele of the Zygopterideæ is held to be phylogenetically connected with that of the Osmundaceæ.—Supplementary report on the hydroids of the Scottish National Antarctic Expedition: James **Ritchie.** Twenty-five species, mostly from the sub-Antarctic and temperate seas, have been added to the list already recorded, bringing the total number of the species and varieties in the *Scotia* hydroid collection up to sixty-one. Several new forms were described, and the known ranges of distribution of many species have been considerably extended.

PARIS.

Academy of Sciences, January 4.—M. Bouchard in the chair.—Certain systems of linear differential equations: Gaston **Darboux.**—The possible danger of turning over in the steering of aëroplanes: L. F. **Bertin.** From an examination of the aëroplanes in current use the author comes to the conclusion that there is a real danger of the whole machine turning over, either by the action of the wind or by the lateral pressure caused by steering out of the straight line. It is pointed out that further experimental data are needed.—Prof. Zirkel was elected a correspondant in the section of mineralogy in place of the late Carl Klein.—The multiform integrals of algebraical differential equations of the first order: Pierre **Boutroux.**—Directed waves in wireless telegraphy: Albert **Turpain.** A reclamation of priority as regards the work of M. Blondel.—Polar magnetic storms and the aurora borealis: Kr. **Birkeland.** Reproductions of eleven photographs are given, in which the phenomena of the aurora are experimentally imitated.—Modifications of the difference of contact potential of two aqueous solutions of electrolytes under the action of a continuous current: M. **Chanoz.** The passage of a continuous current through the contact surface of two aqueous solutions of electrolytes, MR, M′R′, is capable of modifying the difference of potential between the two liquids. This variation of potential produced depends, both for intensity and sign, not only on the nature of the solutions, but also on the direction of the passage