qualities. But the principle of continuity may be used the other way up—it may be argued that if a lump of protoplasm can perform the essential functions of a living thing to all appearances without consciousness, the supposed value of consciousness in Man is an illusion. This is the doctrine of animal automatism so brilliantly treated by Mr. Huxley.[1] He is chiefly concerned with the value of consciousness to an organism—a question into which I cannot enter. What concerns us now is that, however we use the doctrine of continuity, it gives support to belief in a psychic element in plants. All I contend for at this moment is that there is nothing unscientific in classing animals and plants together from a psychological standpoint. For this contention I may quote a well-known psychologist, Dr. James Ward,[2] who concludes that mind "is always implicated in life." He remarks, too (*ibid.* p. 287), "it would be hardly going too far to say that Aristotle's conception of a plant-soul . . . . is tenable even to-day, at least as tenable as any such notion can be at a time when souls are out of fashion."

This is a path of inquiry I am quite incapable of pursuing. It would be safer for me to rest contented with asserting that plants are vegetable automata, as some philosophers are content to make an automaton of Man. But I am not satisfied with this resting-place. And I hope that other biologists will not be satisfied with a point of view in which consciousness is no more than a bye-product of automatic action, and that they will in time gain a definite conception of the value of consciousness in the economy of living organisms. Nor can I doubt that the facts we have to-night discussed must contribute to the foundation of this wider psychological outlook.

LESSONS FROM GERMANY.

WE are glad to see that many public men are directing attention to the relationship between scientific investigation and industrial progress, and urging reforms which were advocated in these columns, and by men of science generally, long before the present position was reached. There is no question now that resolute efforts must be made if Great Britain is to hold her own during the twentieth century. Already we have lost supremacy in several branches of industry, and we shall probably be surpassed in others by America and Germany unless our commercial men learn to realise that science is the source of energy of all sustained industrial movements.

It is the business of scientific research to extend natural knowledge, and the investigator is not usually concerned with the commercial aspects of his work. The application of scientific results to industrial developments is for the manufacturer and merchant to consider, but they are unable to appreciate the possibilities of such results unless they have themselves had a scientific education. A discovery which to one man appears trivial may be made by another the nucleus of a great industrial development. Commercial history can afford numerous instances of the connection between science and prescience and the influence which the two combined exert upon progress. Mr. R. B. Haldane, M.P., mentions a few cases of this kind in an article in the November number of the *Monthly Review*. He selects the brewing industry as one instance of a change which should cause national concern. Thirty years ago Germany exported no beer, to-day she exports almost as much as Britain. The advance is due to the discovery and application of scientific method. When the "Brauerbund" was formed, it was definitely decided to make science with practice and practice with science the principle to work upon. Scientific stations were established in which technical problems confronting the practical brewer could be studied, brewing schools were founded, each with laboratories, experimental maltings and a brewery attached to them, and every effort was made to provide for the education of brewers with scientific as well as technical knowledge. The result of this thorough provision for educating scientific brewers is that German beer is a very active rival of English beers in our own country, and in France it almost monopolises the market.

This is one example given by Mr. Haldane to show how the industrial life in Germany is in close contact with the academic life. The case of the aniline dyes is too well known to need to be described here again, but our loss may be understood by the fact that 80 per cent. of the coal-tar colours used by the Bradford Dyers' Association now comes from Germany.

It is, however, not only through the school that the man of science in Germany comes to the aid of industry, but also through the experiment stations or central bureaus of scientific opinion. The German, remarks Mr. Haldane, "is aware of the enormous extent to which he is dependent upon high science, and, further, that the best high science cannot be bought by the private firm or company. Accordingly the rival German explosives manufacturers several years ago combined to subscribe about 100,000*l*. and to found close to Berlin what they call their Central-Stelle. This establishment, which is maintained by subscription at a cost of about 12,000*l*. a year, is presided over by one of the most distinguished professors of chemistry in the University of that city, with a staff of highly-trained assistants. To it are referred as they arise the problems (in this industry these abound) by which the subscribers in their individual work are confronted. By it is carried on a regular system of research in the field of production of explosives, the fruits of which are communicated to the subscribers."

Compare this organised system of determining the best methods and processes with the narrow spirit in which most of our commercial work is carried on. Trade rivalry exists in Germany as much as here, but it does not prevent combination having for its object the scientific study of subjects related to industries and manufactures.

The universities, technical schools and other academic institutions are all part of an organised system, and though the aim is culture, the application of the highest knowledge to commercial enterprise is borne in mind, and everything is done to encourage it. It is not necessary for us to copy Germany in everything, but we need more of the spirit which has built up such a splendid system of study and brought science, education and industry into such close relationship. It is the duty of the State to do far more than it has hitherto done to promote this connection by assisting research, organising and extending scientific education, and encouraging men to devote their lives to the extension of natural knowledge.

THE BICENTENNIAL OF YALE UNIVERSITY.

THE two hundredth anniversary of the foundation of the University was celebrated by a series of imposing ceremonies at the end of last month. Representatives were present from many universities and colleges, and addresses of congratulation upon the past performances and future promise of Yale were read.

The following is the address written by the Public Orator, Dr. Sandys, and presented to Yale University by the delegates appointed to represent the University of Cambridge at the recent celebration. The delegates appointed were Sir Robert Ball, Fellow of King's and Lowndean professor of astronomy, the Hon. W. Everett, formerly of Trinity College (author of lectures "On the Cam," delivered in Boston, 1865), and Mr. John Cox, late Fellow of Trinity, professor of physics at Montreal. Sir Robert Ball was unavoidably prevented from attending the celebration.

"Litteris vestris, viri nomine non uno nobis coniunctissimi, trans oceanum Atlanticum ad nos nuper perlatis libenter intelleximus, Universitatem vestram, inter Musarum sedes transmarinas prope omnium vetustissimam, annis iam ducentis ab origine sua feliciter exactis, sacra saecularia paucos post menses esse celebraturam. Trans oceanum illum, non iam ut olim dissociabilem, plus quam sexaginta (ut accepimus) ante originem vestram annis, Insulae Longae e regione, Fluminis Longi inter ripas, Britannorum coloni Portum Novum invenerunt, ubi postea Collegio vestro antiquo nomine novo indito civis Londiniensis liberalitatem etiam illustriorem effecistis. Ergo et animi nostri fraterni in testimonium, et diei tam fausti in honorem, tres viros amicitiae foederi novo vobiscum feriundo libenter delegimus, primum Astronomiae professorem nostrum facundum, quem quasi nuntium nostrum sidereum, velut alterum Mercurium Pleiadis filium Atlantis nepotem, trans maria ad vos mittimus; deinde, e vestra orbis terrarum parte, non modo Universitatis Cantabrigiensis utriusque alumnum, cuius eloquentia olim Cami nostri nomen Angliae Novae inter cives magis notum reddidit, sed etiam Universitatis nostrae alumnum alterum, qui provinciae Canadensis Universitatum inter professores numeratur. Has igitur litteras a legatione nostra ad vos perferendas Mercurio nostro tradimus, in quibus Universitati vestrae florentissimae propterea praesertim gratulamur, quod

[1] "Science and Culture," Collected Essays, i.
[2] *Loc. cit.* p. 288.

nuper tam insigne vivacitatis documentum dedistis, ut ex alumnis vestris, quos quindecim milium ad numerum per annos ducentos laurea vestra coronastis, partem plus quam dimidiam adhuc inter vivos numerare potueritis. Valete atque etiam in posterum plurimos per annos felices vivite."

The doctorate of laws was conferred on President Roosevelt and forty-six others, including the following men of science and college presidents:—Prof. J. H. Biles (Glasgow), Dr. J. S. Billings (New York), President C. W. Dabney (Tennessee), Prof. D. W. Finlay (Aberdeen), Prof. Jacques Hadamard (Paris), Dr. S. P. Langley (Smithsonian Institution), Prof. A. A. Michelson (Chicago), Prof. W. Osler (Baltimore), President H. S. Pritchett (Massachusetts), President Ira Remsen (Baltimore), Prof. O. N. Rood (Columbia University), Prof. Wilhelm Waldeyer (Berlin), President J. B. Angell (Michigan), Principal William Peterson (McGill University), Mr. Seth Low (ex-president of Columbia University), President J. G. Schurman (Cornell), Mr. Franklin Carter (ex-president of Williams College), President W. R. Harper (Chicago), Mr. W. C. Harrison (Pennsylvania), President F. L. Patton (Princeton), President B. I. Wheeler (University of California).

On October 22, Dr. D. C. Gilman, a graduate of Yale, and for twenty-five years president of the Johns Hopkins University, delivered an address on the relations of Yale University to letters and science. The address is published in full in *Science* of November 1, from which we select a few notes on men of science who have been connected with Yale.

The Collegiate School of Connecticut was the beginning of Yale University; it became Yale College in 1718, and about the beginning of the nineteenth century developed into the University. During the last fifty years two new schools have sprung into existence—the Sheffield Scientific School and the School of Fine Arts—and the former has increased in importance in a most remarkable manner.

Prior to the Revolution the two men of more than provincial fame whose names are associated with Yale are Edwards, the naturalist, and Eliot. Before Yale College was fifty years old, Benjamin Franklin became its valued friend and was enrolled among its laureati in 1753. Four years previously he had presented the College with an electrical machine which enabled the young tutor, Ezra Stiles, to perform the first electrical experiments tried in New England. A Fahrenheit thermometer was a subsequent gift, and his influence led the University of Edinburgh to confer upon Stiles a doctor's degree.

At the dawn of scientific activity in New England the commanding and attractive figure of Manasseh Cutler stands out. Cutler, a man of the true scientific spirit, an observer of the heavens above and of the earth beneath, is the father of New England botany. He made a noteworthy contribution to the memoirs of the American Academy, collected and described between three and four hundred plants of New England, and left seven volumes of manuscript notes, which are now in the Harvard herbarium, awaiting the editorial care of a botanical antiquary.

Among others whose names are renowned in the world of science are Silliman, leader in chemistry, mineralogy and geology, equalled only by Agassiz; Olmsted, the patient, inventive instructor, whose impulses toward original investigation were not supported by his opportunities; Loomis, interpreter of the law of storms and master of the whirlwind; Dana, the oceanographer; Newton, devoted to abstract thought, who revealed the mysteries of meteoric showers and their relation to comets, not before suggested; and Marsh, the inland explorer, whose discoveries had an important bearing on the doctrine of evolution—these all, with the brilliant corps of the Sheffield Scientific School, were men of rare ability who expounded and illustrated the laws of nature with such clearness and force that the graduates of Yale are everywhere to be counted as for certain the promoters of science.

Two agencies are conspicuous in the second era of Yale, the *American Journal of Science* and the Sheffield Scientific School. Benjamin Silliman showed great sagacity when he perceived, in 1818, the importance of publication, and established of his own motion, on a plan that is still maintained, a repository of scientific papers, which through its long history has been recognised both in Europe and in the United States as comprehensive and accurate; a just and sympathetic recorder of original work; a fair critic of domestic and foreign researches; and a constant promoter of experiment and observation. In the profit and loss account, it appears that the College has never contributed to the financial support of the journal, but it has itself gained reputation from the fact that throughout the world of science Silliman and Dana, successive editors from the first volume, have been known as members of the faculty of Yale.

Agricultural science in the United States owes much to the influences which have gone out from the Sheffield School. J. P. Norton, J. A. Porter, S. W. Johnson, and W. H. Brewer are the followers in our generation of Jared Eliot, the colonial advocate of agricultural science.

In the thirties of last century there was an informal association which may be called a voluntary syndicate for the study of astronomy; and the example and success of these Yale brethren initiated that zeal for astronomical research which distinguishes America. The Clark telescope, acquired in 1830, was then unsurpassed in the United States. One of its earliest and noteworthy revelations was the appearance of Halley's comet, which was observed, from the tower in the Athenæum, weeks before the news arrived of its having been seen in Europe. This gave an impulse to observatory projects in Cambridge and Philadelphia, and college after college soon emulated the example of Yale by establishing observatories in embryo, for the study of the heavens. The most brilliant luminary in the constellation was E. P. Mason, a genius, who died at twenty-two, having made a profound impression on his contemporaries by discoveries, observations, computations and delineations. Under the leadership of Olmsted, Herrick, Bradley, Loomis and Hamilton L. Smith were associate observers, and they were afterwards reinforced by Twining, Lyman and Newton. Chauvenet became a writer and teacher of renown, and Stoddard carried to the Nestorians the telescope that he had made at Yale under the syndicate's influence.

In the science of mineralogy Yale has long maintined the American leadership. No one is likely to overestimate the influence of the collection in the Peabody Museum upon the mind of James D. Dana, nor to overestimate the value of his treatise on mineralogy which, revised and enlarged by able cooperators, continues to be a standard text-book in every country where mineralogy is studied. In view of its recent acquisition, the Museum may almost be described as the "House of the Dinosaur." Its choice collections give an epitome of the sciences of mineralogy, crystallography, meteoroids, geology, palæontology and natural history, from the days of Silliman to those of the Danas, Brush, Marsh and Verrill.

In controversial periods the attitude of Yale has been very serviceable to the advancement of truth. The Copernican cosmography was probably accepted from the beginning although elsewhere the Ptolemaic conceptions of the universe maintained their supremacy, and the notes which Rector Pierson made on physics when he was a student in Harvard come "between the Ptolemaic theory and the Newtonian" (Dexter). When geology became a science, its discoveries were thought to be in conflict with the teachings of the Scripture. Silliman stood firm in the defence of geology, and although some of the bastions on which he relied became untenable, the keep never surrendered, the flag was never lowered. When the modern conceptions of evolution were brought forward by Darwin, Wallace and their allies, when conservatists dreaded and denounced the new interpretation of the natural world, the wise and cautious utterances of Dana at first dissipated all apprehensions of danger and then accepted in the main the conclusions of the new biological school. Marsh's expeditions to the Rocky Mountains and his marvellous discoveries of ancient life made the Peabody Museum an important repository of geological testimony to the truth of evolution.

But there are many others whose work has promoted science at Yale, and the next centennial discourse will do justice to them. Among the departed whose careers were made outside the walls of Yale, Percival, the geologist of Connecticut and Wisconsin; J. D. Whitney, the geologist of California; Chauvenet, the mathematician; Hubbard, the astronomer; Sullivant, the chief authority in mosses as Eaton is in ferns; F. A. P. Barnard, the accomplished president of Columbia; Eli Whitney, the inventor of the cotton-gin; and S. F. B. Morse, whose name is familiar from its relation to the electric telegraph—are especially entitled to honourable mention in this jubilee. So is a much older graduate, David Bushnell, the inventor of submarine explosives—the precursor of the modern torpedists.

This is a record of which Yale may well be proud; and the series of volumes which has been issued in commemoration of the work of the University is really a stupendous monument to activity in all departments of knowledge. We are only concerned with the volumes containing papers from the scientific laboratories, but even these are of far too elaborate a character to be described adequately in this short article. Five volumes have been received, which can only be briefly noticed. Two of these, edited by Prof. F. A. Gooch, contain records of researches carried on in the Kent Chemical Laboratory of Yale University from the opening of the laboratory in 1888 to the present time. In one volume there are fifty-nine papers, and in the other forty-nine, together with a systematic index, index of authors and index of subjects. A consideration of the more familiar phenomena of optics is given by Prof. C. S. Hastings in a volume on "Light," which ought to receive the attention of students of the subject. The laboratory of invertebrate palæontology contributes a volume, edited by Prof. C. E. Beecher, on "Studies in Evolution," containing papers bearing on the investigation and study of the development of a number of invertebrate animals. The papers deal with the origin and significance of spines, structure and development of trilobites, development of the brachiopoda and miscellaneous studies in development. The fifth volume which has reached us is edited by Profs. S. L. Penfield and L. V. Pirsson, and it contains papers on the results of researches in mineralogy and petrography made in the Sheffield Scientific School of the University. The man of science needs no better evidence of the life and progress of a university than is afforded by volumes like these, which are published in New York by Messrs. Charles Scribner's Sons, and in London by Mr. Edward Arnold.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The president of Magdalen (Mr. T. H. Warren), who has always taken an active part in furthering the interests of science, has been elected a member of the Hebdomadal Council. Prof. Elliott has been elected a delegate of the University Museum.

CAMBRIDGE.—Dr. L. E. Shore, St. John's, has been reappointed University lecturer in advanced physiology, and Mr. F. F. Blackman, St. John's, University lecturer in botany. Mr. H. O. Jones, Clare, has been appointed demonstrator in organic chemistry to the Jacksonian professor, in place of the late Mr. Spivey. Mr. C. Shearer, advanced student, Trinity, has been appointed to occupy the University table in the Naples zoological station.

MR. W. MAITLAND (Aberdeen) has been appointed junior demonstrator of chemistry at University College, Sheffield, in succession to Dr. T. S. Price.

THE Report of the work of the Examinations Department of the City and Guilds of London Institute again directs attention to the fact that the general education of a large number of students who enter the technological classes is still defective, and they are consequently unable to profit, as they should do, by the special instruction they receive. Insufficient knowledge of the elementary principles of science, and particularly of such subjects as mensuration, geometry and drawing, is a frequent cause of failure of students to pass the examinations in technology. The preliminary course of instruction, and corresponding examinations, arranged by the Institute, provides a partial remedy for this defect; and the recent announcement that the Board of Education is prepared to consider suggestions from schools for grouped courses of instruction in branches of science cognate to certain trade subjects should do something to decrease the number of candidates without a knowledge of scientific principles. The Institute's Examination Committee strongly recommend students to attend courses in geometry, mathematics and elementary science, prior to, or concurrently with, the study of technology and workshop practice. "Technical instruction," it is wisely remarked, "fails altogether of its purpose if the student does not understand the 'why' and the 'wherefore' of the operations he performs. The aim of such teaching as is given in technological classes is not to make expert workmen, but to show how difficulties may be overcome, and how skill in drawing and a knowledge of the principles of science may, with sufficient practice, help to produce expert workmen. It is not the object of the Institute's examinations to test mere skill in workmanship. The craftsman's own work is the best certificate he can produce. But as evidence of training in the principles underlying the practice of his trade, the class certificate in technology has a distinct and recognised value."

THE current number of the *Record*, the organ of the National Association for the Promotion of Technical and Secondary Education, contains several interesting articles. Specimen lessons are given to show how interest in nature-knowledge may be encouraged, and how it may be assisted by Museums. It may be doubted, however, whether any useful purpose is served by creating an animistic attitude in the minds of children studying nature. The following statement, for instance, is, to say the least, misleading: "When the horse-chestnut feels winter coming on, it says to itself—you can hear the branches whispering during any autumn evening—'Dear me, my leaves will begin falling off in a minute, and there are those new leaves and things to see about in the spring; I must begin making buds this very instant.'" The child who is taught on these lines will believe that a hawthorn tree is really able to look ahead to a severe winter, and takes pains to provide plenty of haws for the birds during the forthcoming hard times.

THE funds available for purposes of technical education are the residue received under the Local Taxation (Customs and Excise) Act, direct aid from the rates, and grants from the Public Libraries rate. A Return has been issued showing the extent to which, and the manner in which, local authorities are applying these funds in (A) England, (B) Wales, and (C) Ireland. The results are summarised below, the amount shown for Wales and Monmouth, in line B, being exclusive of the amount—estimated at 43,203*l.*—to be devoted annually to intermediate and technical education under the Welsh Intermediate Education Act, 1889:—

	Total amount expended on technical education during the year 1898–99.	Total amount expended on technical education during the year 1899–1900.	Total amount raised by loan on the security of the local rate under the Technical Instruction Acts (or otherwise) during the years 1898–99 and 1899–1900 respectively.	
			Year 1898–99.	Year 1899–1900.
	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
(A)	830,404 17 2	876,436 6 11	104,301 2 4	80,347 10 7
(B)	35,658 11 4	33,526 1 11	1,000 0 0	—
(C)	4,549 3 1	5,172 6 3	—	10,000 0 0
	870,612 11 7	915,134 15 1	105,301 2 4	90,347 10 7

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 8.—Mr. T. H. Blakesley, vice-president, in the chair.—A paper on a voltameter for small currents was read by Dr. R. A. Lehfeldt. The instrument consists of a capillary tube about 25 cms. long completely filled with mercury with the exception of a bubble of mercurous nitrate solution about 1 cm. long placed near the middle of the tube. Connection with the two mercury columns is made by means of platinum wires passing through the side of the tube. To use the instrument it is placed in a vertical position, the anode being at the top, and the quantity of electricity which passes through is measured by the change in volume of either electrode. In a test experiment the change in volume was measured by means of a micrometer, and agreed within 0·6 per cent. with the amount deduced from the known value of the current. It is necessary that the currents should be small, so as to avoid complications due to polarisation. The chairman pointed out that the presence of air in the tube would render the readings inaccurate, and asked if it was necessary to apply any temperature correction. Dr. Lehfeldt said that it was quite easy to seal the tube without admitting air, and the temperature correction was negligible.—A note on a paper by Prof. Fleming and Mr. Ashton entitled "On a Model which Imitates