mutual relations, to number, name, describe, and so on, in accordance with what he has been taught. I have myself a way of slipping into this set one object that the pupils have never seen, so far as I know their studies. The replies to this silent questioner frequently enable me to determine who are the best observers and most original thinkers, and very often point out clearly the difference between them and those who are merely the best students.

Whether this system is the best that can be devised or has only some praiseworthy feature, or is in reality but a poor substitute for a good one, I shall not pretend to decide. There are numbers of scientific teachers of great experience and learning present who have heard my arguments and must be our judges, but I think they will all indulgently agree that the teachers who have adopted and elaborated this method have tried to come as near to the ideals of objective work as the adverse circumstances of large classes and limited time would permit.

ALPHEUS HYATT.

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*ORIGINAL RESEARCH AND CREATIVE AUTHORSHIP THE ESSENCE OF UNIVERSITY TEACHING.**

THAT which is most characteristic of the present epoch in the history of man is undoubtedly the vast and beneficent growth of science. In things apart from science, other races at times long past may be compared to the most civilized people of to-day.

The lyric poetry of Sappho has never been equalled. The epic flavor of Homer, even after translation, comes down to us unsurpassed through the ages. Dante, the voice of six silent centuries, may wait six centuries more before his mediæval miracle of song finds its peer.

The Apollo Belvidere, the Venus of Milo, the Laocoön are the glory of antique, the despair of modern sculpture. To mention oratory to a schoolboy is to recall Demosthenes and Cicero, even if he has never pictured Cæsar, that greatest of the sons of men, quelling the mutinous soldiery by his first word, or with outstretched arm, in Egypt's palace window, holding enthralled his raging enemies, gaining precious moments, *time*, the only thing he needed to enable him to crush them under his dominant intellect.

There is no need for multiplying examples. The one thing that gives the present generation its predominance is science. The foremost factor in modern life is science. All criticisms of the scope of life, of the essence of education, made before science had taken its present place, or attempting to ignore its prominence, are obsolete, as are of necessity any systems of education founded on pre-scientific or anti-scientific conceptions.

Unfortunately there are still some people so dull, so envious, so unscientifiic, so stupid as to maintain that the highest aim of a university should be the *training* of young men and young women, where they use the word 'training' in its repressive, inhibitive sense. The most profound discoveries of modern science unite in replacing this old 'training' idea of education by one immeasurably higher, finer, nobler. We now know that the paramount aim of teaching at every stage, and preëminently of the final stage, at the university, should be to *help* the developing mind, the developing character, the developing personality. Judicious, delicate, sympathetic *help* is now the watchword. Even horses and dogs worth owning are no longer 'broken;' they are 'gentled.'

What has brought about this glorious change? *Science*, the greatest achievement of human life, the one thing that puts to-

* Inaugural Address by the President of the Texas Academy of Science, Dr. George Bruce Halsted, October 12, 1894.

day, the present, in advance of all past ages. Not only by having subjugated the forces of nature to the dominion of mind, but also by its intellectual influence, science is remodelling the life and thought of modern humanity.

Though science is the purest knowledge, yet even our estimate of knowledge has been changed by science. Mere acquirement is now considered an unworthy end or aim for endeavor. Action, production alone now receives our homage, now gives a life worth living; and, therefore, each must aim either at the practical application of his knowledge, or at the extension of the limits of science itself. For to extend the limits of science is really to work for the progress of humanity. This is a fitting crown to the sweet and symmetrical evolvement which true teaching aids—the unfailing spring of pure pleasure which it affords. The laws of physical, but, above all, of mental health, made clear by science, let every one realize how now our truest education stands ready to aid, to save, to satisfy endangered or craving bodies or minds. Nothing is more beautifully characteristic of young children than the desire to know the why and wherefore of everything they see. This natural spirit of inquiry needs only proper direction and fostering care to give us scientists. But no one can teach science who does not know it. For a teacher, however subordinate, to have the true informing spirit to vivify his book-knowledge, even of the very elements, it is found almost uniformly essential that he should have been in direct personal contact with some one of those great men whose joy it is to be able to advance the age in which they live, and lead on mankind to unexpected victories in the progressive conquest of the universe. But it is the highest function of a university to help the gifted young man on his way toward becoming one of these glorious creators, these men who make and who honor the age in which they live. A university should wish to feed the mental leaders of the next generation. For this nothing can take the place of contact with the living spirit of research, original work, creative authorship.

Without fostering and requiring such work of students and still more of all its professors, no institution can be a university of the first class. Intimate contact with a producer of the first rank is worth more than the whole world of so-called training by use of retailed convictions.

The most inspiring teacher must have known how to acquire conviction where no predecessor had ever been before him; to show others how to conquer new regions, he must himself have broken barriers for human thought. As Rector of the University of Berlin, Helmholtz said: "Our object is to have instruction given only by teachers who have proved their own power to advance science." There is no honest test or proof of scholarship or acquirement but production. The characteristic quality of all the highest teaching lies in the fact that it comes from a creator.

No more convincing demonstration of my thesis could be wished for than the work of Sylvester for America. On page 233, I., of his Höhere Geometrie, 1893, Felix Klein, as high an authority as any living, says: "Sylvester hat noch 1874 als 60 jähriger Mann den Mut gehabt an die Johns Hopkins University in Baltimore ueberzusiedeln und durch eine ganz specifische durch 10 Jahre fortgesetzte Lehrthätigkeit höhere mathematische Studien auf amerikanischen Boden zu initiiren."

The birth of higher mathematics in America will always date from Sylvester's advent at the Johns Hopkins. There and then with his mighty head he raised the whole western continent, and made it a worthy associate in the profoundest thought-life of our world. But few know that this

epoch-making period was not Sylvester's first advent in the United States. The immortal glory now belonging to the Johns Hopkins University might have been anticipated by another, and with the very same instrument.

An adequate life of James Joseph Sylvester has never been written, and probably never will be while he lives. At Cambridge he was most impressed by a classmate of his own, the celebrated George Green, who had already then produced the remarkable Green's Theorem, and much of the work which still stands as a foundation stone in the edifice of modern electrical science. As Sylvester would not sign the thirty-nine articles of the Established Church, he was not allowed to take his degree, nor to stand for a fellowship, to which his rank in the tripos entitled him.

Sylvester always felt bitterly this religious disbarment. His denunciation of the narrowness, bigotry, and intense selfishness exhibited in these creed tests was a wonderful piece of oratory in his celebrated address at the Johns Hopkins University. No one who saw will ever forget the emotion and astonishment exhibited by James Russell Lowell while listening to this unexpected climax. Thus barred from Cambridge, he accepted a call to America from the University of Virginia.

The cause of his sudden abandonment of the University of Virginia is often related by the Rev. Dr. R. L. Dabney, as follows: In Sylvester's class were a pair of brothers, stupid and excruciatingly pompous. When Sylvester pointed out one day the blunders made in a recitation by the younger of the pair, this individual felt his honor and family pride aggrieved, and sent word to Professor Sylvester that he must apologize or be chastised.

Sylvester bought a sword-cane, which he was carrying when waylaid by the brothers, the younger armed with a heavy bludgeon.

An intimate friend of Dr. Dabney's happened to be approaching at the moment of the encounter. The younger brother stepped up in front of Professor Sylvester and demanded an instant and humble apology.

Almost immediately he struck at Sylvester, knocking off his hat, and then delivered with his heavy bludgeon a crushing blow directly upon Sylvester's bare head.

Sylvester drew his sword-cane and lunged straight at him, striking him just over the heart. With a dispairing howl, the student fell back into his brother's arms screaming out, "I am killed!" "He has killed me." Sylvester was urged away from the spot by Dr. Dabney's friend, and without even waiting to collect his books, he left for New York, and took ship back to England.

Meantime a surgeon was summoned to the student, who was lividly pale, bathed in cold sweat, in complete collapse, seemingly dying, whispering his last prayers. The surgeon tore open his vest, cut open his shirt, and at once declared him not in the least injured. The fine point of the sword-cane had struck a rib fair, and caught against it, not penetrating.

When assured that the wound was not much more than a mosquito-bite, the dying man arose, adjusted his shirt, buttoned his vest, and walked off, though still trembling from the nervous shock. Sylvester was made head professor of mathematics of the Royal Military Academy at Woolwich, a position which he held until the early period set by the English military laws for conferring the life-pension.

He thus happened to be free to accept a position at the head of mathematics in the Johns Hopkins University at its organization. With British conservatism, he stipulated that his traveling expenses and annual salary of five thousand dollars should be paid him in gold, and this fixed, he came a second time to America.

The fame of his coming preceded him, for

by this time he was ranked by Kelland in the Encyclopædia Britannica as the very foremost living English mathematician. The only possible sharer of this proud preëminence was his life-long friend Cayley.

Appointed among the first twenty fellows at the organization of the Johns Hopkins University, and having an intense desire to study Sylvester's own creations with him, I became alone his first class in the new University. Sylvester gives in his celebrated address a graphic account of the formation of that first class as illustrating the mutual stimulus of student and professor.

The text-book was Salmon's Modern Higher Algebra, dedicated to Sylvester and Cayley as made up chiefly from their original work.

The professor broke every rule and canon of the Normal Schools and Pedagogy, yet was the most inspiring teacher conceivable. Every thing, from music to Hegel's metaphysics, linked into the theory of Invariants, combined with the precious personal data, and charming unpublished reminiscences of all the great mathematicians of the preceding generation.

Such a course in the creation of modern mathematics, with most precious, elsewhere unattainable, historic indications, will perhaps never be paralleled. It went on not only at the appointed hours, but the professor would send for his class at night, while at other times they took excursions together to Washington. The incidents of these two formative years, spent in most intimate association with one of the great historic personages of science, can never be forgotten. It was during this period that Sylvester founded the American Journal of Mathematics, and it is due to his particular wish that it was given the quarto form.

Then began a new productive period in his life, the astounding activity and marvelous results of which can be faintly estimated by consulting the pages upon pages taken up in the Johns Hopkins Bibliographia Mathematica, merely to enunciate the titles of the memoirs and papers produced. The very complete and profound historic and bibliographic account of the theory of Invariants given by Meyer in the Berichte of the deutsche mathematische Gesellschaft indicates very fairly Sylvester's final place in the history of that all-pervading subject. His original contributions to many other parts of the vast structure of modern pure analysis are of nearly as great weight.

Sylvester was completely of the opinion that no teaching for a real university can be ranked high which is not vitalized by abundant original creative work. He maintained that it was the plain duty of any mature man holding a professorship in a real university to resign at once if he had not already been copiously and creatively productive.

He believed that without unceasing original research and published original work there could be no real university teaching, and that any university professor who, without such a basis, pretended to be a good teacher, was, consciously or unconsciously, a selfish fraud.

On page 6 of his address delivered on Commemoration Day, 1877, he speaks of a university 'under its twofold aspect as a teaching body and as a corporation for the advancement of science.' He then continues; "I hesitate not to say that, in my opinion, the two functions of teaching and working in science should never be divorced.

"I believe that none are so well fitted to impart knowledge as those who are engaged in reviewing its methods and extending its boundaries . . . May the time never come when the two offices of teaching and researching shall be sundered in this University!"

This was spoken of the Johns Hopkins. Since then no university has voluntarily avowed an ideal not equally noble and exalted. Science, penetrating ever deeper, makes clear the conditions of progress, of true education, of finest teaching.

Only those who have produced can adequately fulfill its present motto: "I serve, I help."

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THE ARCHÆOLOGY OF SOUTHERN FLORIDA

THROUGH the investigations of Professor Jeffries Wyman, Mr. A. E. Douglass and lately of Mr. Clarence B. Moore, a large amount of accurate information about the mounds of central and southern Florida has been laid before the public. Especially noteworthy are Mr. Moore's explorations, which have been published with every desirable addition of maps, measurements and illustrations. They were conducted with a fidelity to the correct principles of mound excavation, which renders them models of their kind. The results were rich, instructive, often surprising, such as copper breastplates and ornaments, curiously decorated pottery, specimens of Catlinite, and little earthern images, very life-like, of the bear, squirrel, wildcat, and even the tapir, which latter had become extinct in Florida when the whites first explored it.

Nothing, however, which has been found in the mounds of Florida justify us in separating them as a class from other mounds in the Southern States; there is nothing in them 'extra-Indian,' as Mr. H. C. Mercer remarks in his review of the subject in the *American Naturalist* for January. He might have gone further and have said there is nothing extra-North American Indian. The pottery decoration does not reveal those arabesque designs which Mr. Holmes has pointed out in some of the more modern pottery of the Gulf coast, as indicating Caribbean or Antillean influence. If that arrived, its arrival was later than the construction of the older Floridian mounds.

But an obscurity certainly hangs over the ethnography of Florida at the period of the discovery.

A large part of the peninsula was peopled by a tribe whose language stood alone on the continent, the Timucuas, and which became extinct generations ago, though fortunately reserved in the works of a Spanish missionary, Father Pareja. They are described by the Spanish and French explorers of the sixteenth century as quite a cultured people, and at that time building mounds and erecting their houses upon them.

It is not certain that they extended to the extreme south, and therefore this portion of the peninsula is left blank on the languistic map of the region. That some tribe of advanced culture occupied the territory about the Carlosahatchie bay is revealed by a curious discovery due to the distinguished antiquary and explorer M. Alphonse Pinart, which he communicated to the former publisher of SCIENCE. In examining a rare work by Father Francisco Romero, published at Milan in 1693, entitled *Llanto Sagrado de la America Meridional que busca alivio en los reales ojos de Nuestro Señor Don Carlos III.*, he found the statement that a chieftain called Carlos, who lived on the bay of that name on the southwest coast of Florida, came across to Havana in a small canoe to be instructed in the Christian faith and baptized. On returning, the authorities promised to send a missionary to his people, but neglected to fulfill their agreement.

"Some time afterward," says the writer, "they recieved a letter written with characters entirely different from ours, and with a strange ink. This letter was brought across by a fisherman, who translated it. He stated that the Floridian chief, Carlos, sent by it his respectful homage to the authorities, and complained bitterly that the missionary had not been sent to him."