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HIGHER ENDEAVOR IN SCIENCE[1]

PHILADELPHIA, Princeton and Menlo Park are the beginning, the middle, and the end of a tiny strip of territory which is the cradle of American history. No other spot in the vast territory of these United States reminds us of so many great historical events. No names of Americans remind us of so many great events in the history of American science as the following names: Benjamin Franklin, of Philadelphia, Joseph Henry, of Princeton, and Thomas Edison, of Menlo Park. Just as the achievements of the continental congresses in Philadelphia, and Washington's victories at Trenton and Princeton laid the foundation of these United States, so the scientific achievements of Franklin, of Joseph Henry and of Edison laid the foundation and added some of the superstructures of earlier American science.

The tiny state of New Jersey and the tiny strip of its territory on which we are standing to-day can justly claim the lion's share of the glory of these great achievements. The Battle Monument at Princeton, speaking in accents modulated by the chisel of Macmonnies, tells the story of a great victory; these buildings the cornerstones of which we are laying to-day will be monuments which will tell a wonderful story of great achievements in American science and of a victory which was one of the crowns of these achievements. This victory, just like that of the battle of Princeton, was won right here at Princeton. It is seemly that on this memorable occasion I recite a bit of this story.

Prior to Franklin's time the natural philosopher riveted his attention upon electricity at rest. Franklin's discovery that lightning is a motion of electricity revolutionized the mental attitude of the natural philosopher of Franklin's time, and motion of electricity became the favorite subject of his inquiry. Just as during the century preceding Franklin the genius of Galileo and of Newton had revealed a new universe, the universe of matter moving in obedience to simple laws, so during the century which Franklin's discovery inaugurated a new universe was revealed; it is the universe of electricity in motion obeying simple laws of electrical action. The discovery and formulation of these laws are the greatest scientific glory of the century which began with Franklin's discovery.

[1] Address on the laying of the cornerstones of an engineering building and a chemical laboratory at Princeton University, on May 12, 1927.

Joseph Henry's discovery of the inertia of electricity is one of the greatest contributions to the glory of this remarkable century. His great electro-magnet which gave birth to this discovery is still here in Princeton. Grateful science, recognizing the eminent value of this work, named the unit of electro-magnetic inertia after Henry, and thus assigned to him a place of honor in the Hall of Fame of Science. In this Hall of Fame is the Valhalla where Joseph Henry and other immortals like Volta, Ohm, Ampère and Faraday dwell. Just think of it! Princeton, a little village in a little state, represented by Henry among the immortals in the Valhalla of Science. Think of it, and it will recall to your mind another glorious picture, the picture of little Cambridge represented by Newton in the same Valhalla of Science.

Just as the spirit of Newton has been the scientific spirit of Cambridge during the last two hundred years, so the spirit of Joseph Henry has been the scientific spirit of Princeton during the last hundred years. That transformed little Cambridge and little Princeton into mighty cities in the world of science.

What is that spirit of Princeton which is guided by the spirit of Joseph Henry, the patron saint of Princeton's science? It is not as generally known as it ought to be that Joseph Henry is the inventor of the electromagnetic telegraph which he, nearly a hundred years ago, operated between his house and his laboratory here at Princeton. This was the beginning of the present art of electrical communications which enables us to-day to speak at any time to any person in the United States. Would that Washington and Lincoln could have foreseen this new power for the consolidation of the American Union! Henry knew the practical value of his invention, but that did not divert him from the pursuit of a new truth the vision of which appeared to him in the activities of moving electricity. He let the practical men like Wheatstone and Morse develop the practical applications of his electromagnetic experiments; he worshipped at the temple dedicated to the eternal truth of science, and there he found the revelation of the inertia of moving electricity, a new glimpse of the eternal truth never caught before by the eye of man. There he found the immortality which gave him a place in the Valhalla of Science. This devotion to the eternal truth and scientific idealism was the expression of Joseph Henry's spirit. It manifested itself in all his work at Princeton and later in his scientific leadership as secretary of the Smithsonian Institution and as president of the National Academy of Sciences. He, assisted by his personal friend, immortal Lincoln, organized the National Academy and with the aid of its distinguished members he inaugurated, sixty years ago, the historic movement for higher endeavor in American science. Higher endeavor in science was Henry's motto, and it was also the motto of Young and Brackett, and of all the scientists of Princeton of former days and of to-day. Higher endeavor in philosophy was the motto of McCosh, president of Princeton, when sixty years ago he, a Presbyterian clergyman, lectured on evolution. The scientific spirit of Princeton inspired this brave and extraordinary gesture. Loyal to the spirit of Joseph Henry, its patron saint in science, Princeton to-day just as in the days of McCosh worships at the altar of scientific idealism, of fearless and of unselfish devotion to the eternal truth. Princeton's mission is to cultivate this idealism and make it effective in the life of the American democracy.

No elaborate statistical figures are needed to demonstrate the value of higher endeavors in science. Every industry in the land recognized this value long ago. The practical value of the eternal truth is known to-day to the practical man just as its spiritual value was known to the prophets of several thousand years ago. The same eternal truth which according to the prophets promises spiritual freedom promises to-day economic freedom also. American industries are craving to-day for the revelation of scientific truth, and the only problem which faces us to-day is the problem of training our generation in the science and in the art of revealing new scientific truth. Pure science research and the engineering discipline which will apply efficiently the findings of pure science to the development of our industries and of our daily life is now our national motto; it is the motto of our universities as well as of our industries. Scientific research laboratories are springing up on every side in our American industries; they are by universal consent the most effective arms of our national defense. They call for trained men capable of searching for the primordial energies hidden in the mysterious structure of matter. He who has a new glimpse of the eternal truth can unlock these hidden energies and make them willing servants of man, the most powerful defenders of his freedom. These two buildings will be new training camps for such men. The spirit of Princeton's patron saint in science, the spirit of Joseph Henry, will be with them and will guide them just as it has always guided the highest scientific endeavors of Princeton.

The proud citizens of many cities of ancient Greece sacrificed a hundred oxen to the Olympian gods whenever one of their fellow citizens had discovered a new theorem in geometry. Let the proud citizens of the state of New Jersey and the friends of Princeton think of the many revelations in science which appeared here first on the sacred ground on which Nassau Hall stands, and they will find no difficulty

in deciding what sacrifices they should bring to these new altars of the God of eternal truth.

M. I. PUPIN

COLUMBIA UNIVERSITY

THE UNIVERSITY AND MEDICAL EDUCATION[1]

WITHIN a comparatively few years medical education in America has come to be commonly regarded as a function of the university, and the movement in this direction has already progressed so far as to make it unnecessary to discuss the abstract desirability of this tendency. Nor is it any longer necessary to make comparisons between the university and non-university types of medical education. I shall therefore assume that this congress is interested mainly in the use to which the university may be expected to put the rich heritage it has already received, and in the contribution to be made by the university to the improvement of the practice of medicine by improving medical education.

I do not propose to deal at length here with the much-debated question as to whether medicine is to be classified as a science or as an art. Incidentally I may remark, however, that this question is a much older one than is commonly recognized and that much that appears in the current discussions is simply a repetition of what has been actively discussed for many years. Scientific medicine first became self-conscious about the middle of the last century, or a few decades after the universities of Central Europe had consciously adopted research, or increasing the domain of knowledge, as one of their primary functions. It is therefore only natural that long ago there should have occurred, particularly in the middle European countries, active discussion as to the relationship of medicine to science, and as to the function of the universities with respect to medical education.

Naunyn[2] in his inaugural address at the University of Dorpat, in 1869, took as his central theme that "only in science lies the salvation of medicine." Billroth[3] took much the same point of view, and in his classical monograph on the medical sciences summarized most of the discussion which took place up to the beginning of the fourth quarter of the century. In view of the fact that most of what I have to say was current in Germany more than fifty years ago, and since most of it has been repeated at times by many writers during these fifty years, I wish to disclaim any pretense of originality in my remarks to-day.

The union of medical education and the university which has progressed so rapidly in America within the past two decades is in fact, although it has not always been consciously recognized as such, a tacit recognition of the scientific aspirations of American medicine. I propose, therefore, to examine into the further implications of this movement, and to see, so far as I can, what responsibilities the university has for the future, and how we may expect the university to meet them. While recognizing the great responsibility of the university for the advancement of knowledge in medicine, I propose to limit myself to its immediate concern with the education of students in candidacy for the M.D. degree.

It is clear that in taking over the affairs of medical education the university assumes a double function in education, the function of the university and the function of the medical school. The medical school, by tradition and in fact, has the responsibility of furnishing the people with well-trained physicians in sufficient numbers; the university, as such, is concerned only with research and with the conservation and propagation of knowledge, without immediate concern for the use to which its product is to be put. This is an extreme statement of the case, for the purpose of emphasis, but it is well to admit at the outset, as Billroth did,[4] that at times conflicts between these two functions will be inevitable, and that valid objection to the university's conception of its function can and will be made on the basis that "at times too much emphasis may be put on scholarship, at the expense of the practical, sound training, the actual training of the physician."

Since the American university is not a single, well-defined concept, we must expect to find among the individual universities a diversity of attitudes toward these functions. In some, particularly where the immediate responsibility toward the community is more or less fixed, we may expect to find that the attitude of the medical school will dominate. In others, free to follow the dictates of their own conceptions and with future rather than immediate needs in mind, we shall undoubtedly find that the university attitude will determine the course to be followed. I prefer to speak to-day from the standpoint of the university, which, not unmindful of the requirements of the school, will nevertheless conceive of its function in medical education in terms of the university.

This ideal and perhaps idealized university will

[1] An address delivered before the Annual Congress on Medical Education, Medical Licensure and Hospitals, Chicago, February 14, 1926.

[2] Naunyn, S. B., "Errinerungen, Gedanken und Meinungen," Munich, 1925, p. 190.

[3] Billroth, T., "The Medical Sciences in the German Universities" (English translation), New York, 1924.

[4] Billroth, T., *l.c.*, p. 28, p. 92.