THE USEFULNESS OF USELESS KNOWLEDGE

ABRAHAM FLEXNER, M.D.
New York, N.Y.

THE USEFULNESS OF USELESS KNOWLEDGE

ABRAHAM FLEXNER, M.D.
New York, N.Y.

This paper was first delivered as a commencement address at Bryn Mawr College on June 2, 1937, and was first published in the Bryn Mawr Alumnae Bulletin in July, 1937.

On Oct. 11, 1938, Dr. Flexner presented it as an address on the occasion of the opening of the Squibb Institute for Medical Research; it was republished as a part of the Proceedings of that occasion.

IT IS a strange contradiction that in the midst of a world torn by irrational hatreds that threaten civilization itself we are this afternoon dedicating this Institute and the services of devoted young men and women to the extension of knowledge, to the cure of disease, and to the amelioration of suffering. Life has never been logical—neither the life of nations nor the life of individuals. It is perhaps fortunate that illogicality can do something to rationalize and beautify human existence.

I shall speak to you for a few moments on a few aspects of irrationalism, for surely it is an irrational fact that it so often happens that the ceaseless quest for the useless should—sometimes soon and sometimes later—result in conferring some great practical boon upon harassed and floundering mankind. It is said with tiresome iteration that ours is a materialistic age and that its main concern should be the wider distribution of material goods and worldly opportunities. Let us accept this point of view. To whom shall we go for this nearer approach to the millennium? Not assuredly to those who are primarily engaged in the manufacture of goods or in the creation of concrete opportunities. The men and women who are today making the largest contribution to human happiness and human health are the quiet workers in laboratories and libraries and who in the pursuit of a devoted career do not pause to ask themselves, "what is the use?"

I recall a conversation which I had some years ago with Mr. George Eastman on the subject of use. Mr. Eastman, a wise and gentle, far-seeing man, gifted with exquisite taste in music and art, had been saying to me that he meant to devote his vast fortune to the promotion of education in useful subjects. I ventured to ask him whom he regarded as the most useful worker in science in the world. He replied instantaneously, "Marconi." I surprised him by saying:

"Whatever pleasure we derive from the radio or however wireless and the radio may have added to human life, Marconi's share was practically negligible."

I shall not forget his astonishment on this occasion. He asked me to explain. I replied to him:

"Mr. Eastman, Marconi was inevitable. The real credit for everything that has been done in the field of wireless belongs, as far as such fundamental credit can be definitely assigned to anyone, to Professor Clerk Maxwell, who in 1865 carried out certain abstruse and remote calculations in the field of magnetism and electricity. Maxwell reproducted his abstract equations in a treatise published in 1873. Other discoveries supplemented Maxwell's theoretical work during the next fifteen years. Finally in 1887 and 1888 the scientific problem still remaining—the detection and demonstration of the electromagnetic waves which are the carriers of wireless signals—was solved by Heinrich Hertz, a worker in Helmholtz's laboratory in Berlin. Neither Maxwell nor Hertz had any concern about the utility of their work; no such thought ever entered their minds. They had no practical objective. The inventor in the legal sense was of course Marconi, but what did Marconi invent? Merely the last technical detail, the now obsolete receiving device called a coherer, almost universally discarded."

Hertz and Maxwell invented nothing, but it was their apparently useless theoretical work which was seized upon by a clever technician and which has created new means of communication, utility, and amusement by which men whose merits are relatively slight have obtained fame and earned millions. Who were the fundamentally useful men? Not Marconi, but Clerk Maxwell and Heinrich Hertz. Hertz and Maxwell were geniuses without thought of use. Marconi was a clever inventor with no thought but use.

The mention of Hertz's name recalled to Mr. Eastman the Hertzian waves, and I suggested that he might ask the physicists of the University of Rochester precisely what Hertz and Maxwell had done; but one thing I said he could be sure of, namely, that they had done their work without thought of use and that throughout the whole history of science most of the really great discoveries which had ultimately proved to be beneficial to mankind had been made by men and women who were driven, not by the desire to be useful, but merely by the desire to satisfy their curosity.

"Curiosity?", asked Mr. Eastman.

"Yes," I replied, "curiosity, which may or may not eventuate in something useful is probably the outstanding characteristic of modern thinking. It is not new. It goes back to Galileo, Bacon, Sir Isaac Newton, and to the Greeks, and it must be absolutely unhampered. Institutions of learning and institutions of research should be devoted to the cultivation of curiosity and the less they are deflected by considerations of immediacy of application, the more likely they are not only to contribute to human welfare, but to the equally important satisfaction of intellectual interest which may indeed be said to have become the ruling passion of intellectual life in modern times."

What is true of Heinrich Hertz working quietly and unnoticed in a corner of Helmholtz's laboratory in the later years of the nineteenth century may be said of scientists the world over for several centuries past. We live in a world that would be helpless without electricity. Called upon to mention a discovery or invention of the most immediate and far-reaching practical use we might well agree upon electricity. But who made the fundamental discoveries out of which the entire electrical development of more than one hundred years has come?

The answer is interesting. Michael Faraday's father was a blacksmith; Michael himself was apprenticed to a book-binder. In 1812—when he was already twenty-one years of age—a friend took him to the Royal Institution where he heard Sir Humphrey Davy deliver four lectures on chemical subjects. He kept notes and sent a copy of them to Davy. The very next year—1813—he became an assistant in Davy's laboratory, working on chemical problems. Two years later he accompanied Davy on a trip to the continent. In 1825, when he was thirty-four years of age, he became Director of the Laboratory of the Royal Institution, where he spent fifty-four years of his life.

Faraday's interest soon shifted from chemistry to electricity and magnetism, to which he devoted the rest of his active life. Important but puzzling work in this field had been previously accomplished by Oersted, Ampère, and Wollaston. Faraday cleared away the difficulties which they had left unsolved and by 1841 had succeeded in the induction of the electric current. Four years later, a second, equally brilliant, epoch in his career opened when he discovered the effect of magnetism on polarized light. His earlier discoveries have led to the infinite number of practical applications by means of which electricity has lightened the burdens and increased the opportunities and resources of modern life.

His later discoveries have thus far been less prolific of practical results. What difference did this make to Faraday? Not the least. At no period of his extraordinary career was he interested in utility. He was absorbed in disentangling the riddles of the universe—at first, chemical riddles, in later periods, physical riddles. As far as he cared, the question of utility was never raised. Any suspicion of utility would have restricted his restless curiosity. In the end, utility resulted, but it was never a criterion to which his ceaseless experimentation could be subjected.

Let us look in another direction. In the domain of medicine and public health the science of bacteriology has played for half a century the leading rôle. What is its story? Following the Franco-Prussian War of 1870 the German Government founded a great university at Strasbourg. Its first professor of anatomy was Wilhelm von Waldeyer, subsequently professor of anatomy in Berlin. In his "Reminiscences" Waldeyer relates that among the students who went with him to Strasbourg during his first semester, there was a small, inconspicuous, self-contained youngster of seventeen, by name of Paul Ehrlich. The usual course consisted of dissection and microscopic examination of tissues. Ehrlich paid little or no attention to dissection, but, as Waldeyer remarks in his "Reminiscences":

"I noticed quite early that Ehrlich would work long hours at his desk, completely absorbed in microscopic observation. Moreover, his desk gradually became covered with colored spots of every description. As I saw him sitting at work one day, I went up to him and asked what he was doing with all his rainbow array of colors on his table. Thereupon this young student, in his first semester, supposedly pursuing the regular course in anatomy, looked up at me and blandly remarked, 'Ich probiere.' This might be freely translated, 'I am trying' or 'I am just fooling.' I replied to him, 'Very well. Go on with your fooling.' Soon I saw that without any teaching or direction whatsoever on my part I possessed in Ehrlich a student of unusual quality."

Waldeyer wisely left him alone. Ehrlich made his way precariously through the medical curriculum and ultimately procured his degree mainly because it was obvious to his teachers that he had no intention of ever putting his medical degree to practical use. He went subsequently to Breslau where he worked under Professor Cohnheim, the teacher of our own Dr. Welch, founder and maker of the Johns Hopkins Medical School. I do not suppose that the idea of use ever crossed Ehrlich's mind. He was interested. He was curious. He kept on "fooling." Of course his "fooling" was guided by a deep instinct—but it was a purely scientific, not a utilitarian motivation. What resulted? Koch and his associates established a new science—the science of bacteriology. Ehrlich's experiments were now applied by a fellow student, Weigert, to staining bacteria and thereby assisting in their differentiation. Ehrlich himself developed the staining of the blood film with the dyes on which our modern knowledge of the morphology of the blood corpuscles, red and white, is based. Not a day passes but that in thousands of hospitals the world over Ehrlich's technique is employed in the examination of the blood. Thus the apparently aimless fooling in Waldeyer's dissecting room in Strasbourg has become—without anyone's suspecting the result—a main factor in the daily practice of medicine.

I am not for a moment suggesting that everything that goes on in laboratories will ultimately turn to some unexpected practical use or that an ultimate practical use is its actual justification. Much more am I pleading for the abolition of the word "use" and for the freeing of the human spirit. To be sure, we will thus free some harmless cranks. To be sure, we will thus waste some precious dollars, but what is infinitely more important is the fact that we will be striking the shackles off the human mind and setting it free for the adventures which in our own day have taken Hale and Rutherford and Einstein and their peers millions upon millions of miles into the uttermost realms of space and loosed the boundless energy imprisoned in the atom. What Rutherford and others like Bohr and Millikan have done out of sheer curiosity in the effort to understand the construction of the atom has released forces which may transform human life, but this ultimate and unforeseen and unpredictable practical result is not offered as a plea in justification of their careers. Let them alone. No educational administrator can possibly direct the channels in which these or other gifted men shall work. The waste, I admit again, looks prodigious. It is not really so. All the waste that could be summed up in developing the science of bacteriology is as nothing compared to the advantages which have accured from the discoveries of Pasteur, Koch, Ehrlich, Theobald Smith, and scores of others—advantages that could never have accrued if the idea of possible use had governed their minds. These great artists—scientists and bacteriologists—disseminated the spirit which prevailed in laboratories in which for all they and others knew they were simply following the line of their own natural curiosity.

In this connection and in the atmosphere which envelopes the world today it is perhaps timely to emphasize the fact that the part played by science in making war more destructive and more horrible was an unconscious and unintended by-product of scientific activity. Lord Rayleigh, president of the British Association for the Advancement of Science, in a recent address points out concretely how the folly and stupidity of man, not the intention of the scientist, is responsible for the destructive use of the agents employed in modern warfare. The innocent study of the chemistry of carbon compounds, which has led to infinite beneficial results, incidentally showed that the action of nitric acid on substances like benzene, glycerine, cellulose, etc., resulted not only in the beneficent aniline dye industry but in the creation of nitroglycerin, which has uses good and bad. Somewhat later Alfred Nobel, turning to the same subject, showed that by mixing nitroglycerin with other substances, solid explosives which could be safely handled could be produced—among others, dynamite. It is to dynamite that we owe our progress in mining, in the making of such railroad tunnels as those which now pierce the Alps and other mountain ranges; but of course dynamite has been abused by politicians and soldiers.

Scientists are, however, no more to blame than they are to blame for an earthquake or a flood. The same thing can be said of poison gas. Pliny was killed by breathing sulphur dioxide in the eruption of Vesuvius almost two thousand years ago. Chlorine was not isolated by scientists for warlike purposes, and the same is true of mustard gas and dynamite. These substances could be limited to beneficient use, but when the aeroplane was perfected, men whose hearts were poisoned and whose brains were addled perceived that the aeroplane, an innocent invention, the result of long, disinterested and scientific effort, could be made an instrument of destruction, of which no one had ever dreamed and at which no one had ever deliberately aimed.

What then must be the spirit and policy determining the course of the new Squibb Institute? The answer is easy: the fearless and unhampered search for truth, the unlimited cultivation of the natural curiosity of human beings within the field of science. It is almost certain that efforts aiming at the immediately practical will fail unless they are based upon a long succession of experiments and endeavors that have no such practical use in mind.

Unquestionably, disinterested scientists have accumulated knowledge which can and should be brought together for the purpose of relieving suffering, as happened, for example, in the case of insulin.

The history of science for two thousand years proves conclusively that no one can foretell or predict or plan the outcome of the untrammeled roving of the human spirit, searching for truth and truth alone. Whether these practical results shall be good or ill is no concern of those who have founded this institute. That is something that depends upon civilization. Civilized men will resolutely refuse the ill and embrace the good and, unless the world can be governed by the ideals of civilization, nothing can save it from ultimate destruction. If the destination of these resources is to be determined by the spirit and ideals of the men who have founded this institute and the men who are enlisted in it, then we can look forward to a world in which peace and beauty and health and all the other good things of the human spirit may determine the conduct and the character of our lives.

Let us therefore continue our quest for the useless as well as the useful, confident that in the long run both will inure to the benefit of humanity, as they have already done in the instances which I have given earlier in this address.