The False Images of Science

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The False Images of Science

By GERALD HOLTON
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Of the influences that shape man’s actions, none is more powerful than the images we carry in our heads. Every subject is apt to invoke in our minds a specific image, made up of concrete information, misinformation, folklore, desire and prejudice. Thus, how people see themselves as a nation determines to a large extent how they will respond to any new challenge. The roles we play in our family life, particularly with respect to our children, depend greatly on what roles we assign ourselves in the society around us.

In the same way, our images of science vastly affect the relationship between science and society. Practically, these images determine the level and the sources of financial support, the quality and quantity of instruction offered, and the development of new scientists. The effects on professional morale and the goals scientists set for themselves—in short, on the scientists’ image of their own work—are also considerable. But even more important is the role images play in deciding this urgent question: Can scientific activity be an integrated part of our culture, or will it be forced to develop independently? Right or wrong, ideas are powerful. Therein lies the chief danger of false images. Like bad grammar, bad images become dominant when they gain wide currency, and so undermine communication among thoughtful people. It is high time, therefore, to consider the prevailing public images of the role of science, using the most straightforward language possible.

Pure Thought and Practical Power. Each person’s image of science is different from the next, but all are composed of seven main elements. The first goes back to Plato and portrays science as a tonic with double benefits—science as pure thought helps the mind find truth, and science as power provides the tools for effective action. The main flaw in this image is that it omits a third vital aspect. Pure science allows us to understand the physical world and, through its applications, allows us to control and change physics and the history and philosophy of science; and he is also editor-in-chief of Danseker, the journal of the American Academy of Arts and Sciences. Born of Austrian parents, Doctor Holton is thirty-seven years old. Photograph by Arnold Newman.
that world. But science also has a metaphysic function; that is, it generates an inclusive world-view and provides some of the metaphysical constraints on our everyday life. Our language of ideas, for example, owes a debt to the sciences of statics and hydraulics and the model of the solar system. There are powerful analogies in many fields of study. Guiding ideas—such as conditions of equilibrium, centrifugal forces, conservation laws and the balance of energy or power, feedback, informational complementarity—enrich the general arsenal of imaginative power we have. All philosophers share the science with the need to work with concepts such as space, time, quantity, matter, order, law, causality, verification, reality.

A sound image of science must, therefore, embrace this third function, in addition to the first two; a function of good and evil, of analysis and to practical applications. However, ever more usually, only one of the three is recognized. For example, folklore sometimes depicts the life of the scientist as a lonely, isolated, divorced from life and beneficent action in the larger sense.

In this context of science as image, the vanishing tendency of some philosophers to prophesy the collapse of the whole problem which science could not solve at the time. Newton himself, who was deeply interested in theology, wrote, "It is not to be conceived that mere mechanical causes could give us knowledge as to the reasons of the motions (in the solar systems). . . . This most beautiful system of the suns in their orbit is at this moment as it was in the beginning or from all eternity. It could only proceed from the counsel and dominion of an intelligent and powerful Being." The same attitude governed the thought community of a century ago with the second image of long standing that is of the scientist as iconoclast. Indeed, almost every major scientist of the 19th century, from Newton to the postulation of universal gravitation, from the discovery of the circulation of blood to the perfection of anesthesia and vaccination, has been interpreted as a blow against religion.

To some extent science was pushed in this direction by a number of serious and dangerous tendencies of some philosophers to prophesy the collapse of the whole problems which science could not solve at the time. Newton himself, who was deeply interested in theology, wrote, "It is not to be conceived that mere mechanical causes could give us knowledge as to the reasons of the motions (in the solar systems). . . . This most beautiful system of the suns in their orbit is at this moment as it was in the beginning or from all eternity. It could only proceed from the counsel and dominion of an intelligent and powerful Being." The same attitude governed the thought community of a century ago with the second image of long standing that is of the scientist as iconoclast. Indeed, almost every major scientist of the 19th century, from Newton to the postulation of universal gravitation, from the discovery of the circulation of blood to the perfection of anesthesia and vaccination, has been interpreted as a blow against religion.

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Not long ago the typical scientist worked alone or with a few students and colleagues and built his own equipment with "low, string and sealing wax." Today he usually belongs to a group working under a contract with a sizable annual budget. In the research institute of one university more than 1,500 professors and technicians are grouped around a set of multimillion-dollar machines; the money comes out of Government budgets whose ultimate aim is national defense.

Many changes that mark the fourth industrial revolution of university science, industry and the military establishment have been made in a way satisfactory to all. Science has thereby become a large-scale operation with a potential for immediate and wide-scale effects. It is not frivolous to call physics the liveliest political science today. If for some reason all physicists in the United States helped to call a for a nonsensical policy, nobody would be more deeply disturbed than would the Congress and the State Department.

These are merely indications that we are passing through a revolutionary change in the nature of science. The effective cause was the perception and dismantling of basic research by teams of specialists with widely different training and interests. The result is a splendid increase in scientific knowledge, but the side effects are analogous to those of sudden and rapid urbanization—a strain on the organization facilities, a drag on the machinery's administrative bureaucracy, the depersonalization of some human relationships.

To a large extent, of course, the step was unavoidable. The new scientific revolution will justify itself by the flow of results and the material benefits that will no doubt follow. The danger, the point where the science of the next generation with the mechanism of scientific research may run into trouble, is in the self. The new science requires a new kind of scientist. The unattached, withdrawn individual, on whom most great scientific achievements have depended, is not well fitted into the new system. We must keep a strain on the seductive urge to adopt generally the patterns of organization of any industrial research establishment.

A far more significant symptom of science is the growing identification of scientists with information and technology. Now we are watching a process that I have mentioned before. The trend is not difficult to understand. Nearly half of all the men and women engaged in our national effort to work in industry or Government laboratories in universities, applied research and development constitute about half of all scientific work. Of the huge sums spent annually on science and technology—about $10,000,000,000 this year in the United States—more than 8 per cent is devoted to real basic research.