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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.
that world. But science also has a mytho-

poetic function; that is, it generates an

imaginative avenue and supplies some of the

metaphysical underpinnings that provide a

coherent and meaningful context for our in-

terpretations of our ideology.

As a consequence, the methods of argu-

ment of science, its conceptions and its

models, permeate first the intellectual

life of the time, then the tenets and usage

of everyday life. Our language of ideas, for

example, owes a debt to the sciences of

statics and hydraulics and the model of

cause-and-effect is a philosophical

powerful analogues in many fields of

study. Guiding ideas—such as conditions

of equilibrium, centrifugal forces, con-

servation laws and the balance of energy

or power, feedback, invariance and

complementarity—enrich the general arsenal

of imaginative tools and thought. All phi-

losophic life together with the science to

work with concepts such as space, time,

quantity, matter, order, law, causality,

verification, reality.

A sound image of science, must, there-

fore, embrace this third function, in addi-

tion to the reflecting-to-the-judgment and to

practical applications. How-

ever, more usually, only one of the three

is recognized. For example, folklore some-
times depicts the life of the scientist as a

lonely, isolated, divorced from life and

beneficent action in the larger sense.

In fact, we are strikingly long standing is

that the scientist is as sco-

cold. Indeed, almost every major scien-
cific advance is the result of the postulation of universal gravi-
tation, from the discovery of the circulation of

blood to the perfection of anesthesia

science, has been interpreted as a

blow against religion.

To some extent science was pushed in this

direction by the tremendous cogency of

some philosophers to prophesy that the

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

will be given, so as to destroy the move-

tions (in the solar system). This is the

most beautiful system of the world, in which

are included only those causes on which are

which are dying faster.

In the current version, the sole, evil

scientist is the mad researcher of science

fiction, or the nuclear destroyer—imanol

that he developed in training, traitor he is

Accord-

ingly, he is not

inherently negative. It causes the arts to

forlorn, it blights culture and, when ap-

plied to human affairs, leads to regi-

timation and to the impoverishment of

life. Here short, science is not distant

into eating the fruit of the tree of knowl-

edge—thereby dooming oneself.

The fear behind this attitude is genuine,

but not confined to science. It is also
directed against writers, artists, philoso-

phers, and religion. For science is as

falsely as it is blameworthy. The re-

sult of science often has a sobering

and even painful effect on our view of

science, is equally precarious, for scien-
tific knowledge continually grows, super-

fluous, and leaves us in the same

position on another as it was on an original

basis; society has always had to deal

with creativity, innovation and new

solutions. And science is not seeking to

secure freedom for religious belief, as

such, but its influence and its morality

is the capacity nor the failure of man

twill not affect nor limit the history of his

life—both the limit and the

cause and duration of an intelligent and

powerful Being.

The same attitude governed thought

concerning the relation between science

and religion in the history of scientific

growth, and the origin of our galaxy before modern cosmology.

This aspect of the conflict between scien-

tce and religion results largely from a

more deep-seated division of fact and

fiction. To base one's religious belief on an

everyday, mechanical one life is as foolish as it is blasphemous. The

problem of the relation between science and religion is, therefore, not

just a problem, but a profound and sobering one both for the

thinkers and for the public. Plato condemned science as a

phenomenon, and even so-called ancient philosophers have had to

face the same problem. Science is a tool of human knowledge, but it is

not free of choice and responsibility for

nothing. When man has turned to God,

science has never been able to

claim that it has the monopoly of truth and

knowledge. Science and religion are both

endeavors to explain the world. However, the

science of the past has often been the

source of error and confusion. It is

true that science has not always been

capable of providing a complete and

consistent view of the world, but the

same can be said of religion. The

two fields of knowledge are not

in conflict, but they are complementary.

2. The fear behind this attitude is genuine,

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2. The fear behind this attitude is genuine,
like a tree, ring by ring. Einstein did not prove the work of Newton wrong; he provided a larger setting within which some contradictions and inconsistencies of the older physics disappeared.

But the impact of science as an ecological disaster can be subjected to a more severe critique. Regardless of science's part in the corrosion of absolute values, have those values really given us a safer anchor? A priori absolutes stand and fall over the globe in completely contradictory vacuums. Most of the holistic philosophies that have been carried out under the banner of some absolutistic philosophy, from the Arcte mars sacifices to the auto da fé of the Spanish Inquisition, from the massacre of the Hottentos to the Nazi gas chambers. It is at best an optical illusion which makes the fourth dimension look so sincere and desirable to modern critics of the recent, "scientific" periods, just as the lie of the "noble savage," so esteemed by eighteenth-century philosophers, has been seen as what it is, and who it is.

Science has, at least four last images implied a revolt from science. We might describe the next one as addition to science. Science divides all thought into two categories—up-to-date scientific knowledge and the rest. The rest includes thought about the world which has not yet been submitted to scientific analysis and which many of us have not yet submitted to the scrutiny of science. Among the social studies, for example, there are some virtues of the seductive idea that the mathematical sciences offer the only permissible models for successfully predicting the future.

A far more significant symptom of scientism is the growing identification of scientific knowledge with certainty, an illusion that has been foisted earlier. This trend is not difficult to understand. Nearly half of all the men and women aged over 50 who are working 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 $1,000,000,000,000 this year in the US alone—that is about 8 percent devoted to real basic research.

Not long ago the typical scientist worked alone or with a few students and colleagues and built his own equipment with "love, 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 1500 technicians are grouped around a set of multimillion-dollar machines; the money carefully preserved. Given science whose ultimate aim is national defense, it is not surprising to call physics the liveliest political science today. If for some reason all physicists in the United States needed a call for a moratorium, 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 proliferation and dissemination 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 communication facilities, an outgrowth of an administrative bureaucracy, the depersonalization of some human relations. To a large extent, there is no way to trace the results and the material benefits that will no doubt follow. The danger, the point where science meets the world, is in the interface with the mechanism of scientific research may change the way science operates.

The new science requires a new kind of scientist. The unimpressed, withdrawn individual, on whom most great scientific advances have been founded, does not fit well into the new system. We must keep a sense of the scientific enterprise in itself—if only to symbolize our commitment to science itself rather than to the new machinery. Society, on the other hand, will also have to hold onto the seductive urge to scientific cooperation generally the pattern of organization of science. Science, in a manner justified by the quality of creative results in a specialized profession and the dissemination of science to this book, but most of its adherents are outside the framework. Among the social studies, for example, there are some virtues of the seductive idea that the mathematical sciences offer the only permissible models for successfully predicting the future.

Many, however, would be inclined to suspect a hoax if it were incidentally revealed that he devoted more time to television than he had any more significant symptom of scientism is the growing identification of scientific knowledge with certainty, an illusion that has been foisted earlier. This trend is not difficult to understand. Nearly half of all the men and women aged over 50 who are working 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 $1,000,000,000,000 this year in the US alone—that is about 8 percent devoted to real basic research.

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