The False Images of Science

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The False Images of Science

By GERALD HOLTON

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The False Images of Science

By Gerald Holton

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

About the Author

Gerald Holton, professor of physics at Harvard University, is active in three fields—physics, teaching and scholarly editing. Doctor Holton pursues experimental research on the properties of materials under high pressures; he teaches and writes in the fields of physics and the history and philosophy of science; and he is also editor-in-chief of Daedalus, 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 mytho-
peocic function; that is, it generates an im-
novative culture; and it informs and shapes our
perceptions and provides some of the meta-
physical underpinnings of our culture. It is an
elementary and indispensable part of our
ideology.

As a consequence, the methods of argu-
ment, the concepts of science, its conceptions and its
models, permeate first the intellectual life of
the time, then the tenets and usages of
everyday life. Our language of ideas, for
example, owes a debt to the sciences of
statics and hydraulics and the model of
mechanization has spread far and wide. Powerful
analogs in many fields of study. Guiding ideas—such as conditions of equilibrium, centrifugal forces,
conservation laws and the balance of energy or power, feedback, invariance as
complementary—enrich the general arsenal of imaginative tools we ¾nd in
thought. All philosophy conveys and shares the need to work with concepts such as space, time, quantity, matter, order, law, causality,
verification, reality.

A valued image of science must, there-
fore, embrace this third function, in addi-
tion to the second and the first. Science is
to thinking 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.

For some extent science was pushed in this direction by the advent of a new
dangerous tendency of some philosophers to propagate science as a closed system,
problems which science could not solve at the
time. Newton himself, who was deeply
interested in theology, wrote, "It is not to be
considered that mere mechanical causes
could or should be known so as to make
distinctions (in the solar systems). . . . This
most beautiful system of the solar system
could only proceed from the counsel and
discretion of an intelligent and powerful
Being.

The same attitude governed thought
concerning the religious formation before the
time of theological evolution, the descent
of the species in the age of biological
evolution, and the origin of our galaxy before cosmic evolution.

This aspect of the conflict between sci-
ence and religion results largely from a
paradox in the scientific method, which is
as foible as it is blameworthy. The rev-
olution of the world views is not a scienti-
fic fact of nature; it is equally precarious, for
scientific knowledge continually grows,
superseding the knowledge of yesterday.
How can science, which is so secure in its
foundation for religious belief, as a
Paracelsus or a Kepler has taught, be either
neglect or the limits of his science—but fact.

Today political overtakes a wider
understanding of the message and becomes
urgent and more difficult. "Religious
propaganda," a recent dispatch from Iran
Certain authorities advised, must be
counteracted by "scientific authentic propo-
ganda" distributed by local societies for
"the dissemination of political and scient-
ung information."

The iconoclastic image of science has,
however, been unbalanced, neither the
problem of a minor matter, nor the
number of plants and animals to die. One
calls the underestimation of the scale of
by accident, to initiate an ecological change that now
encodes the only conceivable basis for a stable state. In the words of theologian
Jacques Maritain, the "deadly disease"
science brings to civilization is "the death
of eternal truth and absolute values.

How did this change come about? The
main steps are usually presented in this
way. Before modern science, man knew of
himself as the ultimate purpose and the
end of all the center of creation. Absolute
knowledge showed our planetary system to
be heliocentric, and man stripped from his
throne. In the words of theologian
scientific investigation, society cannot
drive science as we drive a horse in
our own sake.

Worst of all, the argument concludes,
though science cannot help us distinguish
between good and evil, it nevertheless
fails to make decisions and solving problems and
time. Science replaced puritanical in-
creased our material comforts, it has also
that such absolutes as space, time and
moodings.

It can be noted in passing that most
applications of scientific concepts outside
science merely reveal ignorance about sci-
ence, and: for example, reliance on non-
ence fields is based on farfetched
analyses. As Cass Brinton put it in The
Shaping of the Modern Mind, "For the
government, Einstein was not merely
the tribal magician of our time; he was
the man who stood for relativism; for the
nation that things locked different to
observers at different places at different
times. . . . In this view of the seeker of truth, that a
man moving at a constant velocity is doing
something quite different from a man moving
at another rate, that, in short, there is no
absolute motion, but only relative
targets.

This is precisely how the General
theory of relativity worked out. Before
physicists did not find that everything is
reducible to the contrary, relativistic theory
reformulated the laws of physics so that
they would hold good for every observer,
no matter how he moves or where he stands.
Not everything depends on one's point of
view; rather, the most valued truths are
wholly independent of the point of view.
Ignorance of science is also the only
excuse for adopting rapid changes within
science as models for antithetical atti-
des. The real field of thought is more conservativ than sci-
nce, and that while nothing new it posses previous knowledge. Science grows
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 implications 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, has it not been used for a purpose that we never knew what we were about? The scientists who have used the atomic bomb, for example, may have been conscious of the damage they were doing, but it was the consequence of the power of science that they were trying to use.

Not long ago the typical scientist worked alone or with a few students and colleagues and built his own equipment with "love, sweat and tears." 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 physicists and technicians are grouped around a set of multimillion-dollar machines; the money comes from government agencies whose ultimate aim is national defense.

Many social and political scientists of university science, industry and the military establishment have been asked to satisfy all three. Science has thereby become a large-scale operation with a potential for immediate and world-wide effects. It is not frivolous to call physics the liveliest political science today. If for some reason all physicists in the United States headed for a no-man’s-land, 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 inauguration of a new kind of research by teams of specialists with widely different training and interests. The result is a spurious increase in scientific knowledge — a strange feat of organization facilities, a vast increase of an administrative bureaucracy, the depersonalization of some human relationships. To a large degree, every student of modern science knows this: the new science is not the old science. The old science was an individual phenomenon. Since the new science is the science of the future, it is necessary for everyone to study science in order to understand what has happened in the past.

Not only does this new kind of science introduce new problems, but it also requires new kinds of research. The scientist must be able to understand and appreciate new methods and new ideas. It is necessary for the scientist to learn how to think scientifically. As the scientist becomes more familiar with the new methods and new ideas, he will be able to understand and appreciate them.

The new science requires a new kind of scientist. The scientist who emerges from this new science will be a different kind of scientist. He will no longer be able to think only in terms of the old science, but will be able to think in terms of the new science. He will be able to understand and appreciate the new methods and new ideas, and will be able to think scientifically. This is why the new science is the science of the future, and why it is necessary for everyone to study science in order to understand what has happened in the past.

What remedies suggest themselves? At the least, science must again be made a natural part of every intelligent man’s common literacy — not because science is more important than other fields, but because it is an important part of the whole jigaw puzzle of knowledge. This would require social, through work at every level of education — for example, a good part of every college and university, so that it would be the rule in good colleges fifty years ago. It would demand imaginative new curricula, strengthened standards of achievement, more recognition of excellence — whether exhibited by instructors or by students. Adult education, including the professional education of scientists — is also urgent, but at least in principle it can be served with existing methods of instruction. The tools of humanistic study are still in touch with our sensibilities. This, unhappily, is no longer so in science.

Great age has been shaped by intellectuals such as Jefferson and Franklin, who would have been horrified by the idea of cultivating men and women turning out not thoughtful, but innumerable, broken. Few intellectuals are now prepared to act as spokesmen. And while sophisticated advances faster and faster every day, widening the rift between science and culture.

To restore some kind of reintegration of the old and the new, that last important of the field of the common culture — that is the great challenge before intellectuals today. And nothing better illustrates the urgency and difficulty of this task than the false images prevailing about science.

For readers who wish to pursue the subject further, the following books are recommended:

HORNA, ROGER Introduction to Concepts and Theories in Physical Science Addison-Wesley Publishing Company $7.50

HORNA, ROGER, Editor Science, Science, and the Mind Beacon Press $2.00

FRANKEL, CHARLES The Case for Modern Man Beacon Press $1.75

BROOKS, JACOB The Common Sense of Science Harvard University Press $2.00

BLAINE, PAUL, Editor Education in the Age of Science Basic Books $4.30

For readers who wish to pursue the subject further, the following books are recommended: