The False Images of Science

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ADVENTURES OF THE MIND

The False Images of Science

By GERALD HOLTON
The False Images of Science

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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.

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-
poetic function; that is, it generates an
intellectual mythos that makes it pos-
sible and provides some of the meta-
physical foundations of our narrative con-
tentions of our ideology.

As a conclusion, the methods of argu-
ment of science, its conceptions and its
models, permeate first the intellectual
culture of the time, then the tenets and
visions of everyday life. Our language of
deeds, for example, owes a debt to the
science of statics and hydraulics and the
textile science of the Renaissance to
powerful analogies 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, inertia, complementarity—enrich the general arsenal of
imaginative concepts to which we can
look; share with science the need 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 two preceding, of organiza-
tion 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.

Some extent science was pushed in this
direction by the neurotic tendency of
some philosophers to perceive the scientific problems which science could not solve at the
time. Newton himself, who was deeply
interested in theology, wrote, "It is not to
certainty that mere mechanical causes
could do it; but that the power of
actions (in the solar system). . . . This is so
beautiful a system of causes that even
most remarkable could only proceed from
the counsel and domination of an intelligent and powerful Being."

The same attitude governed thought
creation in the first stage of the entwan-
ing of the theory of geological evolution,
the development of the research in bio-
logical evolution, and the origin of the
galaxy before modern cosmology.

This aspect of the conflict between sci-
ence and religion results largely from a
mutual misunderstanding shared by both
religion and science. To base one's religious belief on an essential element of
criticism as is so facilely as it is blameworthy. The re-
versal of this idea that criticism is an original
of science, is equally precarious, for sci-
technological knowledge considerably,
outright or to a large extent, not to
secure foundation for religious belief, as
so isolated, as necessary. Then the eschatological
fact remains a prime target of
revelation.

The fear behind this attitude is genuine,
but not confined to science. It is also
directed against writers, artists, philoso-
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reason for one's existence, just as it is as
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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 instabilities of the older physics disappeared.

But the impact of science as an ecologi-
cal 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 safe anchor? A priori absolutes still stand all

globe in completely contradic-
tory vacuums. Most of the holistic philoso-
tory have been carried out under the banner of some absolutist philosophy, from the Arcte mass sacrificial to the auto da fe of the Spanish Inquisition, from the massacre of the Hittites to the Nazi gas chambers. It is at best an optical il-
lusion which makes the fourteenth cen-
tury look so sincere and desirable to mod-
ern critics of the recent, "scientific" periods, just as the life of the "noble sav-
ages," so esteemed by eighteenth-century philosopheers has been exacted of every sci-
ern anthropologists to be based largely on

dead and money.

If, therefore, some of the new phi-
losophies, inspired rightly or wrongly by science, reject earlier bases of authority as faulty—the founders of this nation did—they point out that "abundance" and contradistinction another, scien-
ces cannot be blamed. The faults were

there all the time.

In looking for a new and sounder basis on which to rest the world, we shall find science indispensable. We can hope to reach the desired goal by a recovery of society to the needs and potentials of people only if we know more about the inner workings of man. Already science has much to say that is valuable and im-
portant, and it is not the solutions to problems. One must not be obsessed with the details, the techniques, the inter-
ships, from dietetics, to immunology, from agriculture, by far the largest part of our scientific and technical effort. We must take stock of what science is and what it is to do and the problems that are faced by society and by science. To a large extent, the world is science. To a large extent, the world is science.

Among the social studies, for example, there are some vicissitudes of the seductive idea that the mathematical sciences offer the only permissible models for success-
fully predicting society. Among the social studies, for example, there are some vicissitudes of the seductive idea that the mathematical sciences offer the only permissible models for success-
fully predicting society.

A far more significant symptom of science is the growing identification of scientific values with the status and important things that differ from science, and that science's traditional forms of understanding have only limited uses. The shift from science, and that science's traditional forms of understanding have only limited uses. The shift

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." To
day 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 scientists and technicians are grouped around a set of multimillion-dollar machines; the money comes from the government whose ultimate aim is national defense.

Science has 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 to date. 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. The results are

are merely indications that we are passing through a revolutionary change in the nature of science. The effective cause was the proliferation and dis-
section of scientific research by teams of specialists with widely different training and interests. The result has been a splendid increase in scientific knowl-
edge, but the side effects are analogous to those of sudden and rapid urbanization—a strain on educational, administrative, bureaucratic, the depersonalization of some human rela-
tionships. To a large extent, the world is science. To a large extent, the world is science.

The same science that has shaped and scien-
tific research has a new kind of scientist. The unorthodox, withdraws in-
dividuals, none of whom great scientific discoveries have been made in the past, does not well into the new system. We must develop a new scientist, a scientist who needs to be specialized to commit his life to science as such.

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know-nothing breed of scientists that diverge from the scientific facts about the world, from the scientific facts about the world.

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

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

HOLTON, GERALD, Editor
Science and Its Conceptual Mind
Beacon Press
$14.00

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

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

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

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 be-
cause it is an important part of the whole jigsaw puzzle of knowledge. This would require continual, thorough planning at every level of education—for example, a good part of every day's work, as used to be the role in good colleges fifty years ago. It would demand imaginative new curricula, strengthened standards of achievement, more recognition of excel-
ence—whether exhibited by instructors or by students. Adult education, including the teaching of science, is an important part of the cultural aspects of science through mass media, is another obvious measure merit-
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ing the support and participation of our best minds.

Here and there, to be sure, some efforts are being made in the right direction, but the total is pitiful small. Virtually no

body has been courageous enough to face the magnitude of the problem squarely, so large is the range and amount of knowl-
edge needed before one can "know science" in any real sense. The converse need—namely, the humanistic education of scientists—is also urgent, but at least in principle it can be served with existing methods of instruction. The tools of hu-

manistic study are still in touch with our

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