

# THE REFORMATION IN SCIENCE

By FRED HAPGOOD

The time seems right for an ambitious young playwright, out to make a mark, to rewrite the story of Galileo's persecution by the Church, casting Galileo as the villain. The debates between the physicist, who would be depicted as driven to follow his curiosity with no consideration of social costs, and a suave prince of the Church, who would insist that Galileo take responsibility for the cultural impact of his science, might or might not make good theater, but they would have a very modern ring.

Galileo would argue that it is noble to move closer to reality, to voyage into it, to make one's grasp of the world deeper and more true. The cardinal would reply that a tree bears fruit whether or not one knows the exact number of leaves on its branches. What is important is a knowledge of the *point* of what one sees, of its human meaning, and that sense of significance is a grace from God, not something sifted out of piles of facts. "There are many," the cardinal would say, "who have an accurate sense of life and who neither read nor cipher. And tell me this: Where will you stop? When will you be satisfied? If your answer is 'never,' and you have no

ends at all in view, why should you inflict your goal-lessness on mankind? And even if you will be satisfied—which we both know not to be the case—after you have solved ten or twenty more of these puzzles you set yourself, have you any reason to believe that you will then stand any closer to the meaning of the universe than you did as a child?"

If nothing else, such a play would give new dignity to the historical fact of Galileo's recantation; he would have throttled his science not from fear of torture but from genuine moral doubts. And potential producers might be enticed by pointing to the number of scientists who grapple, in their funding proposals and congressional testimony, with what our secular age can manage as the equivalent of these questions: Will your work bring us any closer to a cure for cancer or independence from Arab oil?

For some time now it has been obvious that profound changes are taking place in the public's attitude toward science. *Science* magazine reports that the words "basic research" have become a red flag to congressmen, who see no reason that some one should get thirty thousand a year for thinking about element abundances in interstellar dust grains when cities cannot afford

to pay one quarter that sum to hire someone to work in a hospital. The *Atlantic* ran an article recently by a primatologist who wrote that he hoped that the last species of primate likely to be discovered, the abominable snowman, would forever remain out of reach. He meant by that out of science's reach: that the yeti would never be studied, classified, have its stomach contents analyzed, its dominance hierarchies and breeding systems charted, and the like. What the primatologist was expressing was the intuition that science tames and domesticates nature, that a wild and free quality goes out of those parts of the world that fall under its procedures. He was expressing the sense of doom we feel at the prospect of a world in which "everything is explained."

Taken literally, there seems very little risk of that. Science is far more accurately understood as an enterprise which creates ignorance and uncertainty rather than solid explanations. I have yet to meet a scientist who does not feel that a successful experiment is one that opens up six new questions, and that the sweetest triumph of the business is to illuminate a whole new field of ignorance, to ask a question of a kind that no one even thought of asking before. Scientists always pose their

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Fred Hapgood is a science writer in the Harvard News Office.



questions as sweepingly and inclusively as possible, and present their answers cribbed up by more cautions and qualifications than one would think a human mind could endure. No doubt if we simply count the facts in our textbooks, we do know far more than the Victorians did; but set those facts against our sense of what we need to know but do not, calculate it on a net basis, and we are far more ignorant. This has not happened in spite of modern science but as an inevitable result of its normal operation.

Still, the intuitions suggested above, that scientists are a self-indulgent, quasiparasitic elite, demanding support from the public to pursue entirely private whims; and that science itself is destroying the most precious of our nonrenewable resources—a sense of the world's wonder—are based on something real. What could it be?

**F**or most of us—working scientists aside—science is one of those “senses of the intellect,” like literature or religion, which give us a gut feeling of what sort of world we live in and how we ought to behave in it. What is the natural, harmonious way of relating to the world? Science gives us many little dramas, about the stars, and trees, and the movements of the earth, that feed this need. Literature conducts experiments into the realities of human nature, with plausibility the confirming test. Religion wraps both into one big drama.

The science that we were all brought up on instructed us in and stood for a view of nature that was not dissimilar from the Victorian's view of Africa. Both could be colonized, their secrets assaulted, their frontiers thrown back, without any fear that a trespass had been committed. Scientists explored and penetrated and mastered; they won victories over a nature that had been wastefully locked away in mystery

until they came along, and penned up in a cage of determinist relations. We applauded and trusted this kind of achieving in all aspects of the culture.

Obviously the day of optimistic expansiveness is past. All our “intellectual senses,” science very much among them, are blinking yellow or red, communicating the idea that the world of realities (defined by William James as those things which, like it or not, must be taken account of) is vast, complex, and threatening. The right attitude to take toward it is therefore one of great thoughtfulness, skill, and care, with an emphasis on coping with our present position and not rushing off to any new adventures. Science has therefore suffered, especially nuclear science, with its atom-smashing, and molecular biology, which is usually presented in such terms as “penetrating the secrets of life itself.” The suspicion toward nuclear science has centered upon nuclear reactors; that toward “unrestrained biological research” upon recombinant DNA experiments, which involve transplanting a few genes from one organism into the genetic material of another.

Of course both the nuclear reactor and the recombinant issues are argued in terms of their effect on the public health, but one is never sure how seriously one should take such terms. We are a pragmatic society, suspicious of philosophy, which means only that we must translate metaphysical questions into issues of health and economics before we feel they can be properly raised. No one argues against the space program on the explicit grounds that it embodies the wrong assumptions about man and his correct relationship to the earth and the stars, but such grounds seem to me to lurk just below the surface of the debates about diverting funds from health care. We talk as though all that concerns us is the health of the body, but it is difficult for me to believe that we are not, in our own

fashion, just as concerned with the health of our souls as the members of every other civilization have been.

Some analysts, pre-eminent among whom is the prolific Ted Roszak, have argued that what we need is a return to the “ancient gnosis,” a rehabilitation of the more venerable, and directly theological, categories of spiritual mysteries and meanings. Perhaps unfairly, though, I cling to the typically American prejudice that the clock cannot be turned back. Rather, I think that what we need, and what is happening, is a reformation within the scientific church, splitting a world view that was once as seamless as the Catholic Church's before Luther into two, a Worms and a Rome.

**O**ne can see evidence of this change everywhere. First of all, scientific terminology has begun to move away from words which emphasize how nature can be trussed up. Particle physicists have been labeling the attributes of new particles they discover as “charm,” “color,” and “strangeness,” words which set off a radically different set of vibes from those of terms like pion and K meson. Molecular biologists now tend to give to the phenomena they study names that frame functions and actions, such as “repressor,” “operator,” and “reverse transcriptase,” rather than names (such as deoxyribonucleic acid) that highlight the dead world of chemical reactions.

Evolutionary biologists talk freely of animals “choosing” evolutionary strategies, and attempting to maximize their genetic representation in the next generation. Recently I attended a conference in which two virologists referred to their creatures not as “it” or “them,” nor even as “he” or “she,” but as “you” (as in “You might want to produce just so much of enzyme X and no more. Therefore what you could do is . . .”). There seems to be a virtual



collapse of that stern deterministic discipline so rigorously imposed on the science students of a generation ago: that one must never speak of natural things as though they cooked up purposes on their own. Instead I find a flippant anthropomorphism everywhere.

Second, a whole new set of sciences has been developing. These new sciences are environmental and ecological. They are conducted in the field as much as in the laboratory. They observe more than manipulate; monitor and survey and watch and listen rather than rush into testing the simplest theoretical system. One thinks of ethology, or sociobiology; and people like Dian Fossey, who spent ten years living with the Eastern Mountain gorillas, or Lindauer, who watched a single worker bee for 176 hours. Another example might be the MODE project, a vast international effort, sponsored by a dozen nations, to chart ocean dynamics; or the burgeoning efforts to track down the composition and processes of the atmosphere; or the surprising interest in extraterrestrial communication.

Finally, there are signs of a new kind of science writing, one that will stress what is, after all, one of the basic qualities of science: the contemplative, quasi-meditative relation of man to the universe which accepts the judgment attained from natural evidence as the supreme authority. In this writing (it can be found in Stewart Brand's new magazine, *CoEvolution Quarterly*) scientists do not triumphantly penetrate nature's secrets; they are given answers as a reward for managing to frame their questions on nature's terms. The emphasis is on illuminating new dramas, new phenomena, and less on flattening them into networks of cause-and-effect reactions. There is a very high tolerance for uncertainty, even a reveling in it.

By contrast, my daily newspaper recently carried a story about an experiment in which a cancerous mouse sperm was implanted in a mouse egg, and a normal embryo resulted. The story stressed the miraculous powers of the *scientists*, in such lines as "scientists announced today that they had mated a cancer cell with a mouse and produced a normal mouse." That is an example of the "old" school of science journalism: the scientist is the active agent; nature is the passive backdrop. A member of the "new" school would instead (assuming this was compatible with the facts) have stressed the marvelous powers of the egg in accepting a diseased sperm, returning it to health, and then continuing with it along the normal path of development. The role of the scientist would have been reduced to that of witness, or, at most, the architect of the stage on which the drama was presented.

I think the "scientist as hero" form of science writing (a good deal of which issues from the scientists themselves) is responsible for the near total inaccessibility of molecular biology to lay persons. This is not a trivial cultural deprivation. Nowhere else does one find such natural intelligence, such elaborate self-sufficiency, such a scale of complexity regulated with such a degree of precision, as one does in the cell. No doubt there is a general suspicion that all these molecules—amino acids, enzymes, and so on—are not natural, but artifacts, like gears and screws, developed by scientists as a way of expanding their "mastery" over nature. But—purely as a question of the public interest—to the extent that our culture needs a vision of nature as active, up to any number of contingencies, highly competent in pursuit of a very wide range of purposes, and entirely self-regulating, the parable of the cell ought to serve magnificently. That it has not suggests that the "new" sci-

ence writing has, as one of its first orders of business, an act of cultural damage to repair. Ultimately, it is probably impossible to grasp the cell at all unless one begins with the assumption that nature is full of active purposes.

There is another theory for the trouble that science is now in: that is, that we have lost our self-confidence, and with it, our belief that we can do anything right. Science has just been caught up in the general failure of nerve, and the emphasis on preserving the natural order, the "balance of nature," stems from a willingness to hand over the reins to some other, more competent, authority.

The theory I favor is that we sense that the world has changed enough to make a search for new ways of addressing the realities necessary, and that what we are seeing now is both the signs of the search and the emerging answers. Man is a uniquely generalized species; not only have we adapted to the arctic, the jungle, the seashore, the mountains, the central plains, and the river deltas, but we have adapted to a life of continuous migration, and, at other times, to a stable life, bound to a given place for generations. We have coped with high and low population pressures, with rich and poor lands, with environments that were high in risk and danger and those that were benign and peaceful. It is reasonable to believe that such an animal must have evolved ways of grasping the nature of this situation at its most abstract and dealing with it.

Perhaps that was the evolutionary origin of religion. If this is true, then perhaps what we are doing now is listening: pulling away from those sense organs that seem to be likely to block nature off, developing others that are more sensitive and open, trying to learn, as we no doubt have thousands of times before, what it is, this time, that the world wants us to become. □

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