This connection does not yet seem to have been made, though, and meanwhile chiropractors are continuing their fight to coexist with and gain the kind of recognition accorded to establishment medicine. Their next goal, of course, is to get themselves in on proposed National Health Insurance. So far the outlook is not very good. Although files of congressmen concerned with health affairs are jammed with fervent testimonials from chiropractic patients, no serious consideration has been given to extending coverage to these services. It seems likely that evaluation of such coverage will have to wait until some results from the NINDS initiatives start to trickle in. So far about the only major research directly related to chiropractic is being conducted at the University of Colorado where C. H. Suh, a biomechanical engineer, has spent the past few years working on computer-assisted x-ray techniques and on constructing a computerized mathematical model of the spine. Not only is basic research sadly lacking, but hardly any objective clinical studies have been made. One of the few, reported in 1972 in *The Lancet* by researchers at the University of Utah College of Medicine, found that patients treated for neck and spinal injuries did just as well with chiropractors as they did with medical doctors.

The AMA would probably counter that studies could be engineered to show that patients also did just as well by consulting faith healers, or following the indications of their astrological charts. But chiropractic has been around long enough that it doesn't deserve to be swept under the rug before it has been subjected to a thorough and long-overdue evaluation.

—CONSTANCE HOLDEN

Science and Its Critics: Must Rationality Be Rationed?

Anti-science is synonymous, or nearly so, with anti-reason, and it is not surprising if the anti-science movement often appears an inchoate striving, too protean to yield to inspection and analysis. But the recent writings of critics such as Theodore Roszak have articulated the strong anti-science urges of the age with clarity and strength enough to make a case. The summer issue of *Daedalus*,* journal of the Boston-based American Academy of Arts and Sciences, is an attempt to diagnose what is troublesome about the scientific enterprise in its own eyes and in those of its critics.

Several different aspects of the science-society relationship are discussed in the issue, including the interaction between science and the press, by David Perlman, and the academic isolation of agricultural scientists, by André and Jean Mayer. But the philosophical center of the debate is held by Theodore Roszak and physicist Steven Weinberg of Harvard.

The principal theme of Roszak's previous critiques (see *Science*, 1 December 1972) is that the objectivity of scientific inquiry is not merely a convenient tool for arriving at agreed results, but rather an ingrained philosophical attitude, cold, depersonalized, and spirit-sapping, which dehumanizes science and indeed aridifies Western civilization itself, since the scientific view of reality has succeeded in ousting all others.

In his *Daedalus* article Roszak goes on to say that the trouble with science is that it provides only information about the world, without the meaning. Real knowledge, which Roszak calls "gnosis," avoids the Cartesian apartheid which science has imposed on itself and seeks the "meaningfulness of things which science has been unable to find as an objective feature of nature."

Gnosis is an older and larger kind of knowledge, from which, by an impoverishment of the sensibilities over the last three centuries, science has been derived. Ironically, Roszak notes, the scientific revolution of the 16th and 17th centuries was launched by men such as Copernicus, Kepler, and Newton, whose thought was steeped in the mystical, as well as scientific, branches of gnosis. "Our science, having cut itself adrift from gnosis, contents itself to move along the behavioral surface of the real—measuring . . . but never penetrating to the visionary possibilities of experience."

Weinberg, who like several other contributors considers Roszak among the most serious critics of science, finds much in his writings that is "pertinent, and even moving." But Weinberg is puzzled to know what he as a scientist is expected by Roszak to do. If Roszak is asking that science should change in some fundamental way so as to incorporate other modes of knowledge, the answer is "that science cannot change in this way without destroying itself, because however much human values are involved in the scientific process or are affected by the results of scientific research, there is an essential element in science that is cold, objective and non-human."

Weinberg goes on to say: "We didn't want it to come out this way, but it did. . . . The search for these laws [of nature] forces us to turn away from the ordinary world of human perception, and this may seem to the outsider to be a needless specialization and dehumanization of experience, but it is nature that dictates the direction of our search."

The end result of this search, Weinberg says, is the discovery of harmony and order. This does not satisfy Roszak, who, having read Weinberg's paper in draft, seizes on his admission that scientists didn't want things to come out this way. "One cannot help admiring the candor of such an answer —and grieving a little for the pathos of its resignation." Roszak then spells out what he wants done. Have scientists never noticed, he asks, "how the lay public hangs upon these professions of wonder and ultimate belief, seemingly drawn to them with even more fascination than to the great discoveries?" People want more from science

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sistency of the U.S. position at the Law of the Sea negotiations, that is, the position that other nations should have access to some fish stocks in the 200-mile zone. During the otherwise motionless negotiations at Caracas all summer, the only agreement reached was that some economic controls should be extended by coastal states to 200 miles. But vigorous disagreement remains as to whether such controls would include jurisdiction over fish. The Commerce Committee was not about to wait for future sessions to resolve these points, and it reported the bill out of committee. The bill is now with the foreign relations committee, which must act before September 18—or it will go on the calendar for a full Senate vote.

The ocean mining bill is a new incarnation of one drafted by the American Mining Congress about 4 years ago. It would protect the investments of such companies as Tenneco, Inc., and Kennecott Corp., both of which have plans to mine the seabed, and Summa Corp. (Howard Hughes's giant), which already is mining. No one knows who owns the minerals on the mid-ocean floor, and how they should be recovered is one of the most heated disputes at the Law of the Sea meeting. Like the fishing bill, the mining legislation is opposed by U.S. negotiators.

The Interior Committee reported the mining bill out of committee unanimously in July while most experts on the issue were in Caracas, and the bill is now in line to come to the Senate floor for a vote. The foreign relations committee could stop this, if they persuaded the Senate leadership that it should examine the legislation first. Pat Holt, chief of staff for the committee, says the committee is considering doing this.

But the issue is not just whether the committee will give U.S. negotiators a break by being fast on its feet in the next few weeks. The reports coming from the Caracas meeting, which closed on 29 August, are that it will take at least through the meeting in Geneva next spring, and through one in Caracas again next winter, to even draft a treaty. Once a treaty is drafted, ratification by the 148 nations will take years. Hence both the Senate and the State Department have to decide how they will deal with the affected industries in the meantime—D.S.

than fact and theory. They want to know the meaning of their existence, "not out of childish weakness of mind, but because we sense . . . that it is there, a truth that belongs to us and completes our condition." Roszak goes on to say:

> It is precisely at this point—where we turn to scientists for a clue to our destiny—that they have indeed a Promethean role to perform, as has every artist, sage and seer. If people license the scientist's unrestricted pursuit of knowledge as a good in its own right, it is because they hope to see the scientists yet discharge that role; they hope to find gnosis in the scientist's knowledge. To the extent that scientists refuse that role, to the extent that their conception of what science is prevents them from seeking to join knowledge to wisdom, they are confessing that science is not gnosis, but something far less. And to that extent they forfeit—deservedly—the trust and allegiance of their society.

Roszak's thesis is paralleled at some points by the contribution from Edward Shils, the University of Chicago sociologist, although the two arrive at completely divergent conclusions. Like Roszak, Shils traces the anti-science movement back to 19th century romantics who condemned science for tearing the veil of beauty from nature. As Roszak himself exemplifies, Shils believes that scientists have become the heirs of the need for certitude once reposed in priests, a burden that is not without danger to the bearer. The public has faith in scientists because it sees them as disinterested seekers after truth; should the disinterest ever appear as a guise for partisan ends, the believers could easily turn against science and scientists.

Shils does not think this is likely to happen, nor does he much fear the other possible dangers to science he examines. If the public ceased to believe in the link between science and material well-being, support for science would diminish. But the link is accepted because there is a mood to accept it. The "will to believe" in science is deep in our cultural heritage and "is not likely to be dislodged by a decade of bitter criticism by academic humanists and journalists." Such criticism, Shils believes, is a marginal phenomenon, espoused by fewer prominent intellectuals now than in the 19th century. The present irrationalist current "will not therefore ignite the mass of society, which, although disillusioned about much in today's society, does not seem to be disillusioned about the value of earthly gratification, social stability, and a relatively ordered existence. . . ."

For denying the ultimate seriousness of the contemporary challenge to science, Shils has an ally in political scientist Don K. Price of Harvard. There is no doubt, Price says, that politicians have lost faith in the automatic beneficence of technology—the political clout of the environmentalists is testimony to that. But how far have politicians really been influenced by the disillusion of the academic critics of science? Laymen and politicians are more likely to take notice of cracks in the collective morale of the scientific community than to be persuaded by "esoteric theories." Price doubts that practical public policy toward science is "for the time being very deeply affected by philosophic qualms."

The editor of the *Daedalus* issue is Gerald Holton, a physicist and science historian at Harvard, who complains that scientists are under attack from two opposite directions, one group of attackers wanting to expand the allowable limits of scientific rationality and the other to narrow it. Scientific discovery can be considered as a two part process—the intuitive inference whereby a hypothesis is created and the deductive process whereby it is established. Philosophers of science such as Karl Popper and his school consider the intuitive part of this process a matter of personal psychology of no interest to philosophy. On the other hand, critics such as Roszak and Charles Reich, author of *The Greening of America*, believe the intuitive leap—by convention ignored in the scientific literature—is the kind of mental process that should be emphasized.

Reich, Holton believes, carries dislike of objective procedures to the point of solipsism, while the Popperians, in turning their backs on the scientist's cry of *heureka*, are displacing the baby with the bath water. "Caught in between," he warns, "scientists, virtually without exception, pay no attention to either side, not even to defend themselves against grotesque distortions of what it is they really do."

Science so dominates the age, both as an explanatory system and as a determinant of material conditions, that it is the obvious, and maybe in part appropriate, target for those discontent with Western civilization in its present avatar. The purpose of the *Daedalus* issue is to understand and be prepared for such challenges.

—NICHOLAS WADE