The day of the great lone wolves, embattled heretics, and outsiders—the Faradays, the Galileos, the Pasteurs, toiling away in modest laboratories and private garrets with makeshift equipment—is gone. Bigness, thickly structured professionalism, and government-corporation subvention have become indispensable to the progress of both research and development.

It is roughly a century since European art began to experience its first significant deflections from the standards of painting and sculpture that we inherit from the early Renaissance. Looking back now across a long succession of innovative movements and stylistic revolutions, most of us have little trouble recognizing that such aesthetic orthodoxy of the past as the representative convention, exact anatomy and optical perspective, the casement-window canvas, along with the repertory of materials and subject matters we associate with the Old Masters—that all this makes up not "art" itself in any absolute sense, but something like a school of art, one great tradition among many. We acknowledge the excellence which a Raphael or Rembrandt could achieve within the canons of that school; but we have grown accustomed to the idea that there are other aesthetic visions of equal validity. Indeed, innovation in the arts has become a convention in its own right with us, a "tradition of the new," to such a degree that there are critics to whom it seems to be intolerable that any two painters should paint alike. We demand radical originality, and often confuse it with quality.

Yet what a jolt it was to our great-grandparents to see the certainties of the academic tradition melt away before their eyes. How distressing, especially for the academicians, who were the guardians of a classic heritage embodying time-honored techniques and standards whose perfection had been the labor of genius. Suddenly they found art as they understood it being rejected by upstarts who were unwilling to let a single premise of the inherited wisdom stand unchallenged, or so it seemed. Now, with a little hindsight, it is not difficult to discern continuities where our predecessors saw only ruthless disjunctions. To see, as well, that the artistic revolutions of the past were, at their best, only opening our minds to a more global conception of art which demanded a deeper experience of light, color, and form. Through their work, too, the art of our time has done much to salvage the values of the primitive and...
childlike, the dream, the immediate emotional response, the life of fantasy, and the transcendent symbol.

In our own day, much the same sort of turning point has been reached in the history of science. It is as if the aesthetic ground pioneered by the artists now unfolds before us as a new ontological awareness. We are at a moment when the reality to which scientists address themselves comes more and more to be recognized as but one segment of a far broader spectrum. Science, for so long regarded as our single valid picture of the world, now emerges as, also, a school: a school of consciousness, beside which alternative realities take their place.

There are, so far, only fragile and scattered beginnings of this perception. They are still the subterranean history of our time. How far they will carry toward liberating us from the orthodox world view of the technocratic establishment is still doubtful. These days, many gestures of rebellion are subtly denatured, adjusted, and converted into oaths of allegiance. In our society at large, little beyond submerged unease challenges the lingering authority of science and technique, that dull ache at the bottom of the soul we refer to when we speak (usually too glibly) of an "age of anxiety," an "age of longing." The disease is as yet largely unmentionable, like the cancer one would rather ignore than reveal for diagnosis. The political leadership, the experts and academicians, the publicists and opinion makers prefer for the most part to regard the condition of spiritual disintegration in which we live (if they admit that there is a problem at all) as no worse than a minor ailment for which some routine wonder drug will soon be found. Modern man—so runs the by now journalistic commonplace—is "in search of a soul." But this, like all the snags in the system, only attracts its quota of "problem-solvers," the fair-haired young men with bright new techniques for filling "the meaning-and-purpose gap." Presidents summon together blue-ribbon committees on "national goals," and major corporations open up lunchtime "therapy tanks" for vaguely distraught employees. Specialists in "future shock" step forward to recommend strategies for adapting bedazzled millions to the mad pace of industrial progress. Always, always it is another dose of R&D, another appeal to expertise that will cure us.

Another point that helps to obscure the cultural crisis of our time. One need only glance beyond the boundaries of the high industrial heartland to see our science-based technics rolling across the globe like a mighty juggernaut, obliterating every alternative style of life. It is difficult not to be flattered by our billions of envious imitators. Though they revile the rich white West, we nonetheless know that we are the very incarnation of the "development" they long for. And if all the world wants what we have got, must we not then be right? Are we not the standard for all that progress and modernity mean?

But it is a pathetic self-deception to beguile the impotent and hungry with our power and opulence, and then to seek the validation of our existence by virtue of all that is most wretched in them . . . their dire need, their ignorance of where our standard of development leads, their desperate covetousness. Such easy self-congratulation has no proper place in a serious assessment of our condition. There are those of our fellows who still struggle to enter the twentieth century. Their search for human dignity sets them that task, perhaps as a necessary stage in cultural evolution. There are those of us who are now in the century (who have indeed made this century), and our task is another—possibly one which the underdeveloped will scarcely appreciate. They pin their highest hopes to science and technique, even as our ancestors did. Our job is to review the strange course that science and technique have traveled and the price we have paid for their cultural triumph.

We must consider the devolution of the scientific tradition, which is destined, I think, to be the most important cultural event of our generation. For many, the decline and fall of scientific orthodoxy may seem—if it is conceivable at all—like a despicable reversion to barbarism, a betrayal of reason that threatens a new dark age. But there is another way to view the matter. The barbarian may be at the gate because the empire has decayed from within. We may even come to voice well-justified grievances which, for the good of our souls, we dare not ignore.

If along the countercultural fringes of our society, science now loses its ability to shape the consciousness of people, I believe this is for reasons that emerge from within science itself. It is due to serious failures and limitations that can be traced to the heart of the scientific enterprise, but which only the achievement of cultural supremacy could make vividly apparent. These might be called the negative potentials of the scientific world view, long hidden from sight but now unmistakably visible. Taken together, they explain why our unavailing commitment to single vision has led us not to the promised New Jerusalem but to the technocratic trap we find closing about us.

Science, like all things human, has its history. It too suffers the ironies of change, and probably in no respect more obviously than in its institutional development. Especially since to the end of World War II, science, as a profession, has become big, official, capital intensive, and bureaucratic, which is to say, its heroic age has ended. The day of the great lone wolves, embattled heretics, and outsiders—the Faradays, the Galileos, the Pasteurs, toiling away in modest laboratories and private garrets with makeshift equipment—is at least two generations behind us and not only gone, but never to be recovered.

Bigness, thickly structured professionalism, and
government-corporation subvention have become indispensible to the progress of both research and development. Science, being objective, is cumulative; its "knowledge detaches from the knower (supposedly without loss) and piles up. Thus science exhausts intellectual terrain as it races forward. This is what "progress" means in the world of scientific research; this is the peculiar pride of the discipline. Metaphysicians may still dispute questions drawn from Plato or St. Thomas. Artists may re-compose still lives as old as Vermeer. But in science, problems get solved; as Thomas Kuhn would put it, the paradigms get filled in and the profession moves on to occupy new ground. Each solution may, of course, raise new questions, so that the province of the unknown remains always there to challenge study. But the new questions are further out; they recede as an ever expanding frontier. Therefore, it requires more intensive specialization, more teamwork, more sophisticated equipment to catch hold of a piece of that traveling frontier. So, as time goes on, there must be more scientists, more money, more coordination of research, more administrative superstructure, and, all together, more political maneuvering within the scientific community, as well as between science and its society.

"Just as the Church of the Renaissance Popes was a far cry from the Church of the martyrs in their catacombs, so the science of what Norbert Wiener once called "the science factories" is hardly that of Galileo in his workshop. It is a very different institution, and of necessity a far less appealing one. It has forfeited its human scale, and that is a grave loss. It means that science, too, joins in the ethos of impersonal gigantism, which is among the most oppressive features of our Kafkaesque modern world. When the layman views science today, he no longer finds there a community of self-actualizing men and women pursuing their chosen calling with style, daring, and simple passion. Such individuals may, of course, be there; but they are lost from sight within an establishment of baroque complexity, an acronymous labyrinth of official hierarchies and elite conferences, of bureaus and agencies filled with rich careers and mandarin status.

Already the world of Big Science has seen instances of opportunistic lobbying that reach the level of major scandal. The infamous Mohole Project of the mid-sixties which wasted nearly a hundred million dollars in a futile attempt to drill a hole through the earth's crust is but the most notable example of how willing scientists can be to bamboozle their way aboard the federal gravy train. Mohole was sanctimoniously justified as "pure research" at every appropriation along the way, but finally collapsed without result in the midst of several highly suspect subcontracting concessions. The purposeful obfuscation and special pleading that have long surrounded the AEC's extravagant nuclear-testing programs (overground and underground) and the unseemly competition of the universities for the federal funding of high-energy accelerators offer further melancholy examples of major scientific talent taking expensive advantage of the public gullibility.

Nor have the natural scientists been alone in their haste to gain official patronage. The several behavioral science professions have been every bit as eager (if less successful) to cut themselves in on the prestige of government sponsorship. They have long lobbied for a nicely endowed National Foundation for the Social Sciences to match the National Science Foundation. Meanwhile they have accepted the support of military and paramilitary agencies to finance high-cost, computerized research in counterinsurgency warfare or behavioral modeling. At times, their arguments have been as barefacedly nationalistic as that of any bomb physicist—as when Professor Kingsley Davis argued before Congress in 1967 that "the first nations which breaks through the barrier and manages to put social science on a footing at least as sound as that of the natural sciences will be way ahead of every other nation in the world. I would like to see the United States be that nation. . . ."

Oviously, clever minds continue to enter Big Science; we know they must be clever because their colleagues tell us so, and all the colleagues reward one another grandly. But it is as Daniel Greenberg, author of The Politics of Pure Science, observes:

With the mechanization of much scientific research, it is now possible to function and thrive in scientific research without the sense of inspiration and commitment that characterized the community in its impecunious days. Science was once a calling; today it is still a calling for many but for many others, it is simply a living, and an especially comfortable one. . . .

Unavoidably, this routinizing and collectivization of research deprive us of the element of sympathetic personality in science—the clear perception of outstanding, often eccentric individuality. More and more, those of us on the outside see Big Science (like Big Business) as a featureless personnel—te groups, committees, staffs arranged around entrepreneurial leaders. But more important, such routinization selects a different breed of scientist, an organization man whose work is delicately geared to the technocratic imperatives: efficient group dynamics, submission to the powers, a proper respect for official channels and institutional procedures. As Michael Reagan, author of Science and the Federal Patron, observes, "Today, team research might even be said to require some unimaginative plodders," and therefore "some net loss in free-wheeling imagination, some tendency to shy away from the high-risk projects because future support might be endangered by failure to achieve positive results."

Is there, in fact, anyone in our society who has a keener awareness than the scientist and technician of
how incomparably productive the technocratic style can be—or of how richly rewarding “careerwise”? Of course the protest arises, “But contemporary science and technology are inconceivable without minute specialization, teamwork, sophisticated equipment, and much official patronage.” Perhaps so. But if so, then the last place we must expect to look for an alternative to technocracy is among the scientists and technicians, for whom technocratic forms of organization and finance have become their professional life’s blood.

Further, with the advent of Big Science and Big Technics, there is the growing congestion of discovery and invention. So much of everything . . . and too much to keep track of. Inevitably hangs over every breakthrough; if it had not come this year, then surely next. For with enough money and brains applied to the task, are not “positive results” bound to follow? So there is more and more the cloying sense that innovation has become routine, the spectacular ordinary. The excitement of the scientific enterprise cannot help diminishing with overstimulation. True, the public still gasps and blinks at the achievements unveiled before it; it has little else to expend its wonderment upon in the artificial environment. But even the admiration descends to cliché: the words “miracle” and “marvel” come too readily to the lips. One begins to expect the miraculous—an obvious contradiction—to such an extent that it takes a near disaster (like that of Apollo 13) to remind us that the wizards are yet fallible. Then, at the price of great risk, some touch of “human interest” is lent to the well-oiled project. And there is too much lime-lighted posturing by the astronauts and the research teams and the Nobel Prize laureates—all of them playing the same tiresome role over and again: the boyish modesty, the understatement, the winsome embarrassment at the applause. Meanwhile, on the other side, there are those of us who grow fatigued with endlessly applauding. One simply cannot send up a cheer for every last item that comes tumbling off the mass-production conveyor belt.

It is just this sense one has of intellectual impaction within the world of science that has led several observers (Eugene Wigner, Alvin Weinberg, Bentley Glass, Kenneth Boulding) to speculate that scientific research may fast be approaching the point of diminishing returns in its hyper-productivity. Perhaps there is an absolute limit of research, an “entropy trap,” as Boulding calls it, where the difficulties of communication and data retrieval monopolize all available energy. “It is quite easy to visualize a situation, perhaps in 100 years,” Boulding remarks, “in which the stock of knowledge will be so large that the whole effort of the knowledge industry will have to be devoted to transmitting it from one generation to the next.”

Already, Alvin Weinberg comments, it is nearly a full-time job for those at the top of their profession to keep up with the expansion of general theory in science. The standard journals can no longer process the glut; the use of semiprivate mailing lists, informal newsletters, conference abstracts, and preprint circuits increases by the year. By the time new knowledge has had the chance to be assimilated further down the hierarchy, it has often been undone or modified at the top. Accordingly, Weinberg has suggested the creation of “information centers” filled with “brokers” and “packers of literature,” whose role will be no more than to tally, file, and pass along the inflow of knowledge. There have been numerous proposals of the kind, a sure sign of overdevelopment.

Perhaps such conjectures about the limits of professional expansion—like the recurrent rumors one hears of entire fields of study such as high-energy physics being played out—are exaggerated. But the mass-production character of Big Science is real enough and lies heavy as a pall over its public image. Never a week goes by but another ingenious astonishment is launched out of the research mills and across the front pages. The scene begins to smell of press agentry and public relations. One cannot help wondering where the genuine research and development leave off and the journalistic grandstanding begins.

Our ecological troubles are now common knowledge and hot politics; they require no detailed review here. What does need emphasis is the critical relationship between our environmental bad habits and the devolution of the scientific tradition.

It might seem unfair to lay the blame for impending environmental disaster at the doorstep of the scientists. Granted, the rape of the environment has been carried out, not by scientists, but by profit-seeking industrialists and myopic developers, with the eager support of a burgeoning population greedy to consume more than nature can provide and to waste more than nature can clear away. But to absolve the scientific community from complicity in the matter is quite simply to ignore that science has been the only natural philosophy the Western world has known since the age of Newton. It is to ignore the key question: who provided us with the image of nature that invited the rape and with the sensibility that has licensed it? It is not, after all, the normal thing for people to ruin their environment. It is extraordinary and requires extraordinary incitement.

The scientific community cannot claim credit for our exponential economic and technical growth, and then beg off responsibility for what that impetuous growth has cost us in environmental stability. Nor can science, for all the good intentions that have motivated its labors, be excused for abetting the arrogance that still blinds so many to the values of alternative world views.
a liberal political ethic in Western society, it is easy to overlook how systematically the scientific community has managed to disparage such alternatives over the past two centuries—until, at last, there is nowhere else our society has been able to look but to science for authoritative instruction about nature. To turn elsewhere has meant being written off as witlessly superstitious or inane “Romantic.” There are many subtle ways to enforce cultural orthodoxy; the scientists have done it by encouraging a smug airtight consensus around the power and plenty that flow from their kind of knowledge. What has fallen outside that consensus has been treated with cold neglect or crushing ridicule. For example, in one of the standard anthropology texts of the past generation, Alfred Kroeber without hesitation identifies the adoption of the scientific attitude as a prime criterion of cultural “progress.” The alternative to science is “magic and superstition,” and “in proportion as a culture disengages itself from reliance on these, it may be said to have registered an advance.” Where deviation from scientific rationality occurs in our society, he observes, it is “chiefly among individuals whose social fortune is backward or who are psychotic, mentally deteriorated, or otherwise subnormal.” Obviously, the views of “the most ignorant, warped and insane” among us are not to be taken seriously. “Or,” Kroeber asks rhetorically, “are ourdiscard, insane, and hypersuggestibles right and the rest of us wrong?”

It is just this stubborn prejudice in favor of single vision which has for so long closed our science off from that wise sense of natural harmony and wholeness, that knowledge of vital transaction between people and nature, which we now associate with the study of ecology. Surely the most remarkable fact about ecology is how late it arrived upon the scientific scene as a well-developed, publicly influential discipline. It was only in the very late nineteenth century that special studies of plant and animal ecology began to appear in biology, but without any great impact on science as a whole. No one, for example, has ever claimed for their fields the “revolutionary” importance granted to quantum theory, even though the ecological sensibility is a far sharper break with tradition.

As for the more critical, comprehensive study of Human Ecology (which is the style of ecology that now commands so much public attention), this does not emerge from the natural sciences at all. Rather, it traces back to a remarkable book published in 1864, Man and Nature: Physical Geography as Modified by Human Action. Its author, George Perkins Marsh, was not a scientist, but a diplomat and linguist; yet his work stands as the source of the modern conservation movement. His was the first significant study of how much damage human beings can do to their environment by “operations which, on a large scale, interfere with the spontaneous arrangements of the organic or the inorganic world,” and the first prominent appeal to the industrial societies for “the restoration of disturbed harmonies” in nature. Closely to our own time, Human Ecology—both the name and the discipline—takes its origin from the writing of the offbeat sociologist Robert Ezra Park, who gave the study its vogue during the 1920s and 1930s. But after this brief, rather modish period of popularity, Human Ecology drifted to the margins of intellectual life, leaving little mark on the standard university curriculum. Only the recent panic reaction to the environmental crisis has ushered the ecologists, at last, into their proper, central place in the sciences.

At what point before the present eleventh hour did our natural philosophers step forward in creditable numbers to support the simple compassion of conservationists and nature lovers? From Bacon and Descartes to the present day, the same unhealthy images of the scientific project have been repeated with dismal insistence. Either we have the picture of the human being standing apart from nature as isolated spectator, or we have the picture of mankind aggressively asserting itself against nature as (in Descartes’ phrase) “lords and possessors.” One can easily imagine the protest: the task of the scientist is to tell us how nature works, not how it is to be used well. But is science then to be pardoned on the grounds that it has systematically taught our society to regard knowledge as a thing apart from wisdom? Surely, where our ecological debacle is concerned, that is not a defense, but a confession of guilt.

The Judeo-Christian estrangement from nature was absorbed into the psychology of scientific knowledge, there to find a new epistemological dignity. Objective knowing is alienated knowing; and alienated knowing is, sooner or later, ecologically disastrous knowing. Before the earth could become an industrial garbage can, it had first to become a research laboratory.

When Bacon first called upon mankind “to unite forces against the nature of things, to storm and occupy her castles and strongholds and extend the bounds of human empire,” the ambition, though unbecoming, could be safely entertained. There was relatively little damage the human race could then do to its environment. The arrogance was as innocuous as it was exhilarating. But within the past few generations the scale of applied science has become global, and more than great enough to reveal the once negligible implications of Human Philosophy. Just as infinitesimal blemishes in a photograph may become prominent only when the picture is sufficiently enlarged, so the vastness of contemporary technical enterprise has magnified the innermost meaning of the scientific world view and revealed its full ecological ignorance.

We deal now in a technology that alters the climates of entire continents and threatens to murder the flora and fauna of whole oceans. Compulsively optimistic technicians may continue to talk of finding a quick technological fix for every problem; but does it not grow out of our understanding of the green revolution?
Science: A Technocratic Trap

it not grow clearer by the day that they are woefully out of tune with the environment they claim to understand? They promise to feed the hungry by way of green revolutions and the harvest of the seas. But the World Health Organization reports that what most immediately results from the saturation use of DDT as part of green revolution technique (monocultures dependent on chemical fertilizers and heavy pesticidal treatment) is the ruinous contamination of mothers’ milk. Perhaps in societies where nursing is common and prolonged this might be regarded as a grisly form of population control imposed surreptitiously by the demands of progress, a sort of developmental sleight of hand which increases the crops and poisons the babies. Meanwhile, the rising levels of oil, pesticides, nitrate runoff, and methyl mercury in the lakes and oceans threaten to eliminate fish from the diet of an underfed world long before the seas will be harvested.

The importance of the environmental crisis for the future of our culture is that it forces upon all of us in urban-industrial society a terrible, inescapable awareness of how intolerably high the price is of our Baconian power-knowledge. At the very least, all of us must suffer the immediate discomforts of “development blight” (quaint phrase!), the noise, the foul smells, the corrosive anguish of the eyes and throat, the devastation of amenities. For most people, ecological politicking still seems to reach no further than such issues, taken up piecemeal as necessity dictates and always with the hope that minor adjustments will serve—like building the airport or freeway somewhere else. But even this superficial sense of the problem can be enough to raise bothersome doubts about the meaning of industrial progress. For once real issues are joined and the easy ecological platitudes evaporate, are not the government and the corporate spokesmen quick to castigate the comfort- and amenity-conscious citizenry for being Luddites and to warn them that the clock must not be turned back? Suddenly, it becomes a subversion of progress to assert the commonsensible principle that communities exist for the health and enjoyment of those who live in them, not for the convenience of those who drive through them, fly over them, or exploit their real estate for profit. After all, the argument runs, the factories, freeways, and airports must be built somewhere, must they not? The economy depends on them. And so it does. Given the life-style demanded by the artificial environment, the economy is bound to be anti-environmental. As that realization sinks into the general awareness, the great Western myth of progress and the science that is tied to it suffer skeptical examination. In what sense have we “progressed” if we now come to such a pass? By what right do we claim to possess a uniquely reliable knowledge of nature? Operational success has, supposedly, been the ultimate validation of scientific knowledge. Science is true, we have been told over and over again, because it works. "But now we discover that the scientific world view does not work. Not if our outlook is holistic. Not if we consider the long run—which, in the case of industrial society, seems to be about two centuries. More and more it looks as if the future were not destined to be an endless escalator of improvement. Rather, we may yet take our place in folk memory as the Age of the Great Sacrilege, which was smitten from on high for its wanton ways. And children will cringe to hear how vile in the sight of God was our existence.

Currently, the most ecologically involved young people in our society appear to be learning more about their proper place in nature from American Indian lore, Zen, and Tantra than from Western science. Science seems at best able to furnish them with many microscopic details that assume meaning only when assimilated into a primordial wisdom. This is a startling fact of our time. Surely it is a strange kind of progress, then, which brings us to the point where under pressure of dire emergency, urban-industrial society must look beyond its own science to such primitive and exotic traditions for a life-enhancing natural philosophy. 

THE DREAMER, THE DREAM

After the sleeper has burst his night pod climbed up out of its silky holdings the dream must stumble alone now must mope in the hard eye of morning

in search of some phantom outcome while on both sides of the tissue the dreamer walks into the weather past time in September woods in the rain

where the butternuts settle around him louder than tears and in fact he comes upon great clusters of honey mushrooms breaking the heart of old oak

a hundred caps grotesquely piggyback on one another, a caramel mountain all powdered with their white spores printing themselves in no notebook

and all this they do in secret climbing behind his back lumbering from their dark fissure going up like a dream going on.

by Maxine Kumin