The Reenchantment of the World

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God and philosophy could not live together peacefully; can philosophy survive without God? Once its adversary has disappeared, metaphysics ceases to be the science of sciences and becomes logic, psychology, anthropology, history, economics, linguistics. What was once the great realm of philosophy has today become the ever-shrinking territory not yet explored by the experimental sciences. If we are to believe the logicians, all that remains of metaphysics is no more than the nonscientific residuum of thought—a few errors of language. Perhaps tomorrow's metaphysics, should man feel a need to think metaphysically, will begin as a critique of science, just as in classical antiquity it began as a critique of the gods. This metaphysics would ask itself the same questions as in classical philosophy, but the starting point of the interrogation would not be the traditional one before all science but one after the sciences.

—Octavio Paz, Alternating Current
Introduction:  
The Modern Landscape

You see all round you people engaged in making others live lives which are not their own, while they themselves care nothing for their own real lives—men who hate life though they fear death.

—William Morris, News from Nowhere (1891)

For several years now I have intended to write a semipopular book, dealing with certain contemporary problems, and based on my knowledge of the history of science. In an earlier work, a very technical monograph, I was able only to hint at some of the problems that characterize life in the Western industrial nations, problems that I find profoundly disturbing. I began that study in the belief that the roots of our dilemma were social and economic in nature; by the time I had completed it, I was convinced that I had omitted a whole epistemological dimension. I began to feel, in other words, that something was wrong with our entire world view. Western life seems to be drifting toward increasing entropy, economic and technological chaos, ecological disaster, and ultimately, psychic dismemberment and disintegration; and I have come to doubt that sociology and economics can by themselves generate an adequate explanation for such a state of affairs.
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The present book, then, is an attempt to take my previous analysis one step further; to grasp the modern era, from the sixteenth century to the present, as a whole, and to come to terms with the metaphysical presuppositions that define this period. This is not to treat mind, or consciousness, as an independent entity, cut off from material life; I hardly believe such is the case. For purposes of discussion, however, it is often necessary to separate these two aspects of human experience; and although I shall make every effort to demonstrate their interpenetration, my primary focus in this book is the transformations of the human mind. This emphasis stems from my conviction that the fundamental issues confronted by any civilization in its history, or by any person in his or her life, are issues of meaning. And historically, our loss of meaning in an ultimate philosophical or religious sense—the split between fact and value which characterizes the modern age—is rooted in the Scientific Revolution of the sixteenth and seventeenth centuries. Why should this be so?

The view of nature which predominated in the West down to the eve of the Scientific Revolution was that of an enchanted world. Rocks, trees, rivers, and clouds were all seen as wondrous, alive, and human beings felt at home in this environment. The cosmos, in short, was a place of belonging. A member of this cosmos was not an alienated observer of it but a direct participant in its drama. His personal destiny was bound up with its destiny, and this relationship gave meaning to his life. This type of consciousness—what I shall refer to in this book as “participating consciousness”—involves merger, or identification, with one’s surroundings, and bespeaks a psychic wholeness that has long since passed from the scene. Alchemy, as it turns out, was the last great coherent expression of participating consciousness in the West.

The story of the modern epoch, at least on the level of mind, is one of progressive disenchantment. From the sixteenth century on, mind has been progressively expunged from the phenomenal world. At least in theory, the reference points for all scientific explanation are matter and motion—what historians of science refer to as the “mechanical philosophy.” Developments that have thrown this world view into question—quantum mechanics, for example, or certain types of contemporary ecological research— have not made any significant dent in the dominant mode of thinking. That mode can best be described as disenchantment, nonparticipation, for it insists on a rigid distinction between observer and observed. Scientific consciousness is alienated consciousness: there is no ecstatic merger with nature, but rather total separation from it. Subject and object are always seen in opposition to each other. I am not my experiences, and thus not really a part of the world around me. The logical end point of this world view is a feeling of total reification: everything is an object, alien, not-me; and I am ultimately an object too, an alienated “thing” in a world of other, equally meaningless things. This world is not of my own making; the cosmos cares nothing for me, and I do not really feel a sense of belonging to it. What I feel, in fact, is a sickness in the soul.

Translated into everyday life, what does this disenchantment mean? It means that the modern landscape has become a scenario of “mass administration and blatant violence,” a state of affairs now clearly perceived by the man in the street. The alienation and futility that characterized the perceptions of a handful of intellectuals at the beginning of the century have come to characterize the consciousness of the common man at its end. Jobs are stupefying, relationships vapid and transient, the arena of politics absurd. In the vacuum created by the collapse of traditional values, we have hysterical evangelical revivals, mass conversions to the Church of the Reverend Moon, and a general retreat into the oblivion provided by drugs, television, and tranquilizers. We also have a desperate search for therapy, by now a national obsession, as millions of Americans try to reconstruct their lives amidst a pervasive feeling of anomie and cultural disintegration. An age in which depression is a norm is a grim one indeed.

Perhaps nothing is more symptomatic of this general malaise than the inability of the industrial economies to provide meaningful work. Some years ago, Herbert Marcuse described the blue- and white-collar classes in America as “one-dimensional.” “When technics becomes the universal form of material production,” he wrote, “it circumscribes an entire culture; it projects a historical totality—a ‘world.’” One cannot speak of alienation as such, he went on, because there is no longer a self to be alienated. We have all been bought off, we all sold out to the System long ago and now identify with it completely. “People recognize themselves in their commodities,” Marcuse concluded; they have become what they own.

Marcuse’s is a plausible thesis. We all know the next-door neighbor who is out there every Sunday, lovingly washing his car
with an arder that is almost sexual. Yet the actual data on the
day-to-day life of the middle and working classes tend to refute
Marcuse's notion that for these people, self and commodities have
merged, producing what he terms the "Happy Consciousness." To
take only two examples, Studs Terkel's interviews with hundreds
of Americans, drawn from all walks of life, revealed how hollow
and meaningless they saw their own vocations. Dragging them-
selves to work, pushing themselves through the daily tedium of
typing, filing, collecting insurance premiums, parking cars, inter-
viewing welfare applicants, and largely fantasizing on the job—
these people, says Terkel, are no longer characters out of Charles
Dickens, but out of Samuel Beckett. The second study, by Sennett
and Cobb, found that Marcuse's notion of the mindless consumer
was totally in error. The worker is not buying goods because he
identifies with the American Way of Life, but because he has
enormous anxiety about his self, which he feels possessions might
assuage. Consumerism is paradoxically seen as a way out of a
system that has damaged him and that he secretly despises; it is a
way of trying to keep free from the emotional grip of this system.

But keeping free from the System is not a viable option. As
technological and bureaucratic modes of thought permeate the
deepest recesses of our minds, the preservation of psychic space
has become almost impossible. "High-potential candidates" for
management positions in American corporations customarily
undergo a type of finishing-school education that teaches them
how to communicate persuasively, facilitate social interaction, read
body language, and so on. This mental framework is then im-
ported into the sphere of personal and sexual relations. One thus
learns, for example, how to discard friends who may prove to be
career obstacles and to acquire new acquaintances who will assist
in one's advancement. The employee's wife is also evaluated as an
asset or liability in terms of her diplomatic skills. And for most
males in the industrial nations, the sex act itself has literally be-
come a project, a matter of carrying out the proper techniques so as
to achieve the prescribed goal and thus win the desired approval.

Figure 1. R. D. Laing's schematic drawing of healthy interaction (from Laing, The
Divided Self, p. 81).

But once the ethos of technique and management has permeated the
spheres of sexuality and friendship, there is literally no place left to
hide. The "widespread climate of anxiety and neurosis" in which
we are immersed is thus inevitable.

These details of the inner psychological landscape lay bare the
workings of the System most completely. In a study that purported
to be about schizophrenia, but that was for the most part a pro-
file of the psychopathology of everyday life, R. D. Laing showed
how the psyche splits, creating false selves, in an attempt to protect
itself from all this manipulation. If we were asked to characterize
our usual relations with other persons, we might (as a first guess)
describe them as pictured in Figure 1 (see above). Here we have
self and other in direct interaction, engaging each other in an im-
mediate way. As a result, perception is real, action is meaningful,
and the self feels embodied, vital (enchanted). But as the discus-
sion above clearly indicates, such direct interaction almost never
takes place. We are "whole" to almost no one, least of all ourselves.
Instead we move in a world of social roles, interaction rituals, and
elaborate game-playing that forces us to try to protect the self by
developing what Laing calls a "false-self system."

In Figure 2, the self has split in two, the "inner" self retreating
from the interaction and leaving the body—now perceived as false,
or dead (disenchanted)—to deal with the other in a way that is pure
theater, while the "inner" self looks on like a scientific observer.
Perception is thus unreal, and action correspondingly futile. As
Laing points out, we retreat into fantasies at work—and in
"love"—and establish a false self (identified with the body and its
half the patients in American mental hospitals are under twenty-one. In 1977, a survey of nine- to eleven-year-olds on the West Coast found that nearly half the children were regular users of alcohol, and that huge numbers in this age group regularly came to school drunk. Dr. Darold Treffert, of Wisconsin’s Mental Health Institute, observed that millions of children and young adults are now plagued by “a gnawing emptiness or meaninglessness expressed not as a fear of what may happen to them, but rather as a fear that nothing will happen to them.” Official figures from government reports released during 1971–72 recorded that the United States has 4 million schizophrenics, 4 million seriously disturbed children, 9 million alcoholics, and 10 million people suffering from severely disabling depression. In the early 1970s, it was reported that 25 million adults were using Valium; by 1980, Food and Drug Administration figures indicated that Americans were downing benzodiazepines (the class of tranquilizers which includes Valium) at a rate of 5 billion pills a year. Hundreds of thousands of the nation’s children, according to The Myth of the Hyperactive Child by Peter Schrag and Diane Divoky (1975), are being drugged in the schools, and one-fourth of the American female population in the thirty-to-sixty age group uses psychoactive prescription drugs on a regular basis. Articles in popular magazines such as Cosmopolitan urge sufferers from depression to drop in to the local mental hospital for drugs or shock treatments, so that they can return to their jobs as quickly as possible. “The drug and the mental hospital,” writes one political scientist, “have become the indispensable lubricating oil and reserving factory needed to prevent the complete breakdown of the human engine.”

These figures are American in degree, but not in kind, Poland and Russia are world leaders in the consumption of hard liquor; the suicide rate in France has been growing steadily; in West Germany, the suicide rate doubled between 1966 and 1976. The insanity of Los Angeles and Pittsburgh is archetypal, and the “misery index” has been climbing in Leningrad, Stockholm, Milan, Frankfurt and other cities since midcentury. If America is the frontier of the Great Collapse, the other industrial nations are not far behind.

It is an argument of this book that we are not witnessing a peculiar twist in the fortunes of postwar Europe and America, an aberration that can be tied to such late twentieth-century problems as inflation, loss of empire, and the like. Rather, we are witnessing the inevitable outcome of a logic that is already centuries old, and
which is being played out in our own lifetime. I am not trying to argue that science is the cause of our predicament; causality is a type of historical explanation which I find singularly unconvincing. What I am arguing is that the scientific world view is integral to modernity, mass society, and the situation described above. It is our consciousness, in the Western industrial nations—uniquely so—and it is intimately bound up with the emergence of our way of life from the Renaissance to the present. Science, and our way of life, have been mutually reinforcing, and it is for this reason that the scientific world view has come under serious scrutiny at the same time that the industrial nations are beginning to show signs of severe strain, if not actual disintegration.

From this perspective, the transformations I shall be discussing, and the solutions I dimly perceive, are epochal, and this is all the more reason not to relegate them to the realm of theoretical abstraction. Indeed, I shall argue that such fundamental transformations impinge upon the details of our daily lives far more directly than the things we may think to be most urgent: this Presidential candidate, that piece of pressing legislation, and so on. There have been other periods in human history when the accelerated pace of transformation has had such an impact on individual lives, the Renaissance being the most recent example prior to the present. During such periods, the meaning of individual lives begins to surface as a disturbing problem, and people become preoccupied with the meaning of meaning itself. It appears a necessary comitant of this preoccupation that such periods are characterized by a sharp increase in the incidence of madness, or more precisely, of what is seen to define madness. For value systems hold us (all of us, not merely "intellectuals") together, and when these systems start to crumble, so do the individuals who live by them. The last sudden upsurge in depression and psychosis (or "melancholia," as these states of mind were then called) occurred in the sixteenth and seventeenth centuries, during which time it became increasingly difficult to maintain notions of salvation and God's interest in human affairs. The situation was ultimately stabilized by the emergence of the new mental framework of capitalism, and the new definition of reality based on the scientific mode of experiment, quantification, and technical mastery. The problem is that this whole constellation of factors—technological manipulation of the environment, capital accumulation based on it, notions of secular salvation that fueled it and were fueled by it—has apparently run its course. In particular, the modern scientific paradigm has become as difficult to maintain in the late twentieth century as was the religious paradigm in the seventeenth. The collapse of capitalism, the general dysfunction of institutions, the revulsion against ecological spoilage, the increasing inability of the scientific world view to explain the things that really matter, the loss of interest in work, and the statistical rise in depression, anxiety, and outright psychosis are all of a piece. As in the seventeenth century, we are again destabilized, cast adrift, floating. We have, as Dante wrote in the Divine Comedy, awoken to find ourselves in a dark woods.

What will serve to stabilize things today is fairly obscure; but it is a major premise of this book that because disenchantment is intrinsic to the scientific world view, the modern epoch contained, from its inception, an inherent instability that severely limited its ability to sustain itself for more than a few centuries. For more than 99 percent of human history, the world was enchanted and man saw himself as an integral part of it. The complete reversal of this perception in a mere four hundred years or so has destroyed the continuity of the human experience and the integrity of the human psyche. It has very nearly wrecked the planet as well. The only hope, or so it seems to me, lies in a reenchantment of the world.

Here, then, is the crux of the modern dilemma. We cannot go back to alchemy or animism—at least that does not seem likely; but the alternative is the grim, scientific, totally controlled world of nuclear reactors, microprocessors, and genetic engineering—a world that is virtually upon us already. Some type of holistic, or participating, consciousness and a corresponding sociopolitical formation have to emerge if we are to survive as a species. At this point, as I have said, it is not at all evident what this change will involve; but the implication is that a way of life is slowly coming into being which will be vastly different from the epoch that has so deeply colored, in fact created, the details of our lives. Robert Heilbroner has suggested that a time might come, perhaps two hundred years hence, when people will visit the Houston computer center or Wall Street as curious relics of a vanished civilization, but this will necessarily involve a dramatically altered perception of reality. Just as we recognize in a medieval tapestry or alchemical text a world vastly different from our own, so may those people who visit Houston or the tip of Manhattan two centuries
from now find our own mental outlook, from the assumptions of nineteenth-century physics to the practice of behavior modification, quite baroque, if not downright incomprehensible.

Willis Harman has called our outlook the “industrial-era paradigm,” but the Industrial Revolution did not begin its “take-off” until the second half of the eighteenth century, whereas the modern paradigm is ultimately the child of the Scientific Revolution. For lack of a better term, then, I shall refer to our world view as the “Cartesian paradigm,” after the great methodological spokesman of modern science, René Descartes. I do not wish to suggest that Descartes is the lone architect of our current outlook, but only that modern definitions of reality can be identified with specific planks in his scientific program. To understand the nature and origins of the Cartesian paradigm, then, will be our first task. We shall then be in a position to analyze more closely the nature of the enchanted world view, the historical forces that led to its collapse, and finally the possibilities that exist for a modern and credible form of reenchantment, a cosmos once more our own.
Two archetypes pervade Western thinking on the subject of how reality is best apprehended, archetypes that have their ultimate origin in Plato and Aristotle. For Plato sense data were at best a distraction from knowledge, which was the province of unaided reason. For Aristotle, knowledge consisted in generalizations, but these were derived in the first instance from information gathered from the outside world. These two models of human thinking, termed rationalism and empiricism respectively, formed the major intellectual legacy of the West down to Descartes and Bacon, who represented, in the seventeenth century, the twin poles of epistemology. Yet just as Descartes and Bacon have more in common than apart, so too do Plato and Aristotle. Plato's qualitative organic cosmos, described in the Timaeus, is Aristotle's world as well; and both were seeking the underlying "forms" of the phenomena observed, which were always expressed in tel-
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Aristotle would not agree with Plato that the "form" of a thing existed in some innate heaven, but nevertheless the reality of, let us say, a discus used at the Olympic games was its Circularity, its Heaviness (inherent tendency to fall to the center of the earth), and so on. This metaphysic was preserved through the Middle Ages, an age noted (from our point of view) for its extensive symbolism. Things were never "just what they were," but always embodied a nonmaterial principle that was seen as the essence of their reality.

Despite the diametrically opposed points of view represented by Bacon's *New Organon* and Descartes' *Discourse on Method*, they possess a commonality that marks them off quite sharply from both the world of the Greeks and that of the Middle Ages. The fundamental discovery of the Scientific Revolution—a discovery epitomized by the work of Newton and Galileo—was that there was no real clash between rationalism and empiricism. The former says that the laws of thought conform to the laws of things; the latter says, always check your thoughts against the data so that you know what thoughts to think. This dynamic relationship between rationalism and empiricism lay at the heart of the Scientific Revolution, and was made possible by the translation of each approach into a concrete tool. Descartes showed that mathematics was the epitome of pure reason, the most trustworthy knowledge available. Bacon pointed out that one had to question nature directly by putting it in a position in which it was forced to yield up its answers. *Natura vexata*, he called it, "nature annoyed": arrange a situation where yes or no must be given in response. Galileo's work illustrates the union of these two tools. For example, roll a ball down an inclined plane and measure distance versus time. Then you will know, precisely, how falling objects behave.

Note that I said how they behave, not why. The marriage of reason and empiricism, of mathematics and experiment, expressed this significant shift in perspective. So long as men were content to ask why objects fell, why phenomena occurred, the question of how they fell or occurred was irrelevant. These two questions are not mutually exclusive, at least not in theory; but in historical terms they have proven to be so. "How" became increasingly important, "why" increasingly irrelevant. In the twentieth century, as we shall see, "how" has become our "why."

Viewed from this vantage point, both the *New Organon* and the *Discourse* make for fascinating reading, for we recognize that each author is grappling with an epistemology that has become part of the air we now breathe. Bacon and Descartes interlock in other ways as well. Bacon is convinced that knowledge is power and truth utility; Descartes sees certainty as equivalent to measurement, and wants science to become a "universal mathematics." Bacon's goal, of course, was realized by Descartes' means: precise measurement not only validates or falsifies hypotheses, it also enables the construction of bridges and roads. Hence another crucial seventeenth-century departure from the Greeks: the conviction that the world lies before us to be acted upon, not merely contemplated. Greek thought is static, modern science dynamic. Modern man is Faustian man, an appellation that goes back, even before Goethe, to Christopher Marlowe. Dr. Faustus, sitting in his study ca. 1590, is bored with the works of Aristotle which are spread out before him. "Is to dispute well logic's chiefest end?" he asks himself aloud. "Affords this art no greater miracle? / Then read no more..." 1 In the sixteenth century Europe discovered, or rather decided, that to do is the issue, not to be.

One thing that is conspicuous about the literature of the Scientific Revolution is that its ideologues were self-conscious about their role. Both Bacon and Descartes were aware of the methodological changes taking place, and of the direction in which things would inevitably move. They saw themselves as leading the way, even possibly tipping the balance. Both made it clear that Aris totelianism had had its day. The very title of Bacon's work, *New Organon*, the new instrument, was an attack on Aristotle, whose logic had been, in the Middle Ages, collected under the title *Organon*. Aristotelian logic, specifically the syllogism, had been the basic instrument for apprehending reality, and it was this situation that prompted the complaint of Bacon and Dr. Faustus. Bacon writes that this logic is "no match for the subtlety of nature"; "it gains assent to the proposition, but does not take hold of the thing." Thus it "is idle," he exclaims, "to expect any great advancement in science from the superinducing and engrafting of new things upon old. We must begin anew from the very foundations, unless we would revolve forever in a circle with mean and contemptible progress." 2 Escaping from this circularity involved, as far as Bacon was concerned, a violent shift in perspective, which would lead from the unchecked use of words and reason to the hard data accumulated through the experimental testing of nature. Yet Bacon himself never performed a single experiment,
and the method he proposed for ascertaining the truth—compiling tables of data and making generalizations from them—was certainly poorly defined. As a result, historians have erroneously concluded that science grew up “around” Bacon, not through him.\(^3\) Despite the popular conception of the scientific method, most scientists know that truly creative research often begins with wild speculation and flights of fancy that are then subjected to the twin tests of measurement and experiment. Pure Baconianism—expecting results to fall out of the data as if by sheer weight—never really works in practice. Yet this heavily empirical image of Bacon is in fact a result of the nineteenth-century assault on speculation, and the accompanying overemphasis on Bacon’s data-collecting side. In the seventeenth and eighteenth centuries, Baconianism was synonymous with the identification of truth with utility, specifically industrial utility. Breaking the Aristotelian-Scholastic circle meant, for Bacon, stepping into the world of the mechanical arts, a step that was literally incomprehensible prior to the mid-sixteenth century. Bacon leaves no doubt that he regards technology as the source of a new epistemology.\(^4\) He tells us that scholarship, which is to say Scholasticism, has stood still for centuries, while technology has made progress; surely it has something to teach us.

The sciences [he writes] stand where they did and remain almost in the same condition; receiving no noticeable increase…. Whereas in the mechanical arts, which are founded on nature and the light of experience, we see the contrary happen, for these… are continually thriving and growing, as having in them a breath of life.\(^5\)

Natural history, presently understood, says Bacon, is merely the compilation of copious data: descriptions of plants, fossils, and the like. Why should we value such a collection?

A natural history which is composed for its own sake is not like one that is collected to supply the understanding with information for the building up of philosophy. They differ in many ways, but especially in this: that the former contains the variety of natural species only, and not experiments of the mechanical arts. For even as in the business of life a man’s disposition and the secret workings of his mind and affections are better discovered when he is in trouble than at other times; so likewise the secrets of nature reveal themselves more readily under the vexations of art [i.e., artisanry, technology] than when they go their own way. Good hopes may therefore be conceived of natural philosophy, when natural history, which is the basis and foundation of it, has been drawn up on a better plan; but not till then.\(^6\)

This is a truly remarkable passage, for it suggests for the first time that the knowledge of nature comes about under artificial conditions. Vex nature, disturb it, alter it, anything—but do not leave it alone. Then, and only then, will you know it. The elevation of technology to the level of a philosophy had its concrete embodiment in the concept of the experiment, an artificial situation in which nature’s secrets are extracted, as it were, under duress.

It is not that technology was something new in the seventeenth century; the control of the environment by mechanical means in the form of windmills or plows is almost as old as homo sapiens himself. But the elevation of this control to a philosophical level was an unprecedented step in the history of human thought. Despite the extreme sophistication of, for example, Chinese technology down to the fifteenth century A.D., it never had occurred to the Chinese (or to Westerners, for that matter) to equate mining or gunpowder manufacture with pure knowledge, let alone with the key to acquiring such knowledge.\(^7\) Science did not, then, grow up “around” Bacon, and his own lack of experimentation is irrelevant. The details of what constituted an experiment were worked out later, in the course of the seventeenth century. The overall framework of scientific experimentation, the technological notion of the questioning of nature under duress, is the major Baconian legacy.

Although it may be reading too much into Bacon, there is a dark hint that the mind of the experimenter, when it adopts this new perspective, will also be under duress. Just as nature must not be allowed to go its own way, says Bacon in the Preface to the work, so it is necessary that “‘the mind itself be from the very outset not left to take its own course, but guided at every step; and the business be done as if by machinery.” To know nature, treat it mechanically; but then your mind must behave mechanically as well.

René Descartes also took his stand against Scholasticism and philosophical verbiage, and felt that nothing less than certainty would do for a true philosophy of nature. The Discourse, written some seventeen years after the New Organon, is in part an intellectual autobiography. Its author emphasizes the worthlessness of the ancient learning to himself personally, and in doing so implicates the rest of Europe as well. I had the best education France
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had to offer, he says (he studied at a Jesuit seminary, the Ecole de La Flèche); yet I learned nothing I could call certain. "As far as the opinions which I had been receiving since my birth were concerned, I could not do better than to reject them completely for once in my life time..." 8 As with Bacon, Descartes' goal is not to "engraft" or "superinduce," but to start anew. But how vastly different is Descartes' starting point! It is no use collecting data or examining nature straight off, says Descartes; there will be time enough for that once we learn how to think correctly. Without having a method of clear thinking which we can apply, mechan-ically and rigorously, to every phenomenon we wish to study, our examination of nature will of necessity be faulty. Let us, then, block out the external world and sort out the nature of right-thinking itself.

To start with, says Descartes, it was necessary to disbelieve everything I thought I knew up to this point. This act was not undertaken for its own sake, or to serve some abstract principle of rebellion, but proceeded from the realization that all the sciences were at present on shaky ground. "All the basic principles of the sciences were taken from philosophy," he writes, "which itself had no certain ones." Since my goal was certainty, "I resolved to consider almost as false any opinion which was merely plausible." Thus the starting point of the scientific method, insofar as Descartes was concerned, was a healthy skepticism. Certainly the mind ought to be able to know the world, but first it must rid itself of credulity and medieval rubbish, with which it had become inordinately cluttered. "My whole purpose," he points out, "was to achieve greater certainty and to reject the loose earth and sand in favor of rock and clay."

The principle of methodical doubt, however, brought Descartes to a very depressing conclusion: there was nothing at all of which one could be certain. For all I know, he writes in the Meditations on First Philosophy (1641), there could be a total disparity between reason and reality. Even if I assert that God is good, and is not deceiving me when I try to equate reason with reality, how do I know there is not a malignant demon running about who confuses me? How do I know that 2 + 2 do not make 5, and that this demon does not deceive me, every time I make the addition, into believing the numbers add up to 4? But even if this were the case, concludes Descartes, there is one thing I do know: that I exist. For even if I am deceived, there is obviously a "me" who is being deceived. And thus, the bedrock certainty that underlies everything; I think, therefore I am. For Descartes, thinking was identical to existing.

This postulate is, of course, only a beginning. I want to be certain of more than just my own existence. Confronted with the rest of knowledge, however, Descartes finds it necessary to demonstrate (which he does most unconvincingly) the existence of a benevolent Deity. The existence of such a God immediately guarantees the propositions of mathematics, which alone among the sciences relies on pure mental activity. There can be no deception when I sum the angles of a triangle; the goodness of God guarantees that my purely mental operations will be correct, or as Descartes says, clear and distinct. And extrapolating from this, we see that knowledge of the external world will also have certitude if its ideas are clear and distinct, that is, if it takes geometry as its model (Descartes never really did define, to anybody's satisfaction, the terms "clear" and "distinct"). Science, says Descartes, must become a "universal mathematics"; numbers are the only test of certainty.

The disparity between Descartes and Bacon would seem to be complete. Whereas the latter sees the foundations of knowledge in sense data, experiment, and the mechanical arts, Descartes sees only confusion in such subjects and finds clarity in the operations of the mind alone. 9 Thus the method he sets forth for acquiring knowledge is based, he tells us, on geometry. The first step is the statement of the problem that, in its complexity, will be obscure and confused. The second step is breaking the problem down into its simplest units, its component parts. Since one can perceive directly and immediately what is clear and distinct in these simplest units, one can finally reassemble the whole structure in a logical fashion. Now the problem, complex though it may be, is no longer unknown (obscure and confused), because we ourselves have first broken it down and then put it back together again.

Descartes was so impressed with this discovery that he regarded it as the key, indeed the only key, to the knowledge of the world. "Those long chains of reasoning," he writes, "so simple and easy, which enabled the geometricians to reach the most difficult demonstrations, had made me wonder whether all things knowable to men might not fall into a similar logical sequence." 10

Although Bacon's identification of knowledge with industrial utility and his grappling with the concept of experiment based on technology certainly underlie much of our current scientific thought, the implications drawn from the Cartesian corpus exer-
cised a staggering impact on the subsequent history of Western consciousness and (despite the differences with Bacon) served to confirm the technological paradigm—indeed, even helped to launch it on its way. Man's activity as a thinking being—and that is his essence, according to Descartes—is purely mechanical. The mind is in possession of a certain method. It confronts the world as a separate object. It applies this method to the object, again and again and again, and eventually it will know all there is to know.

The method, furthermore, is also mechanical. The problem is broken down into its components, and the simple act of cognition (the direct perception) has the same relationship to the knowledge of the whole problem that, let us say, an inch has to a foot: one measures (perceives) a number of times, and then sums the results.

This method may properly be called "atomistic," in the sense that knowing consists of subdividing a thing into its smallest components. The essence of atomism, whether material or philosophical, is that a thing consists of the sum of its parts, no more and no less. And Descartes' greatest legacy was surely the mechanical philosophy, which followed directly from this method. In the Principles of Philosophy (1644) he showed that the logical linking of clear and distinct ideas led to the notion that the universe was a vast machine, wound up by God to tick forever, and consisting of two basic entities: matter and motion. Spirit, in the form of God, hovers on the outside of this billiard-ball universe, but plays no direct part in it. All nonmaterial phenomena ultimately have a material basis.

The action of magnets, attracting each other over a distance, may seem to be nonmaterial, says Descartes, but the application of the method can and will ultimately uncover a particulate basis for their behavior. What Descartes does, really, is provide Bacon's technological paradigm with strong philosophical teeth. The mechanical philosophy, the use of mathematics, and the formal application of his four-step method enable the manipulation of the environment to take place with some sort of logical regularity.

The identification of human existence with pure ratiocination, the idea that man can know all there is to know by way of his reason, included for Descartes the assumption that mind and body, subject and object, were radically disparate entities. Thinking, it would seem, separates me from the world I confront. I perceive my body and its functions, but "I" am not my body. I can learn about the (mechanical) behavior of my body by applying the Cartesian method—and Descartes does this in his treatise On Man (1662)—but it always remains the object of my perception. Thus Descartes depicted the operation of the human body by means of analogy to a water fountain, with mechanical reflex action being the model of most, if not all, human behavior. The mind, res cogitans ("thinking substance"), is in a totally different category from the body. res extensa ("extended substance"), but they do have a mechanical interaction that we can diagram as in Figure 3, below.

If the hand touches a flame, the fire particles attack the finger, pulling a thread in the tubular nerve which releases the "animal spirits" (conceived as mechanical corpuscles) in the brain. These then run down the tube and jerk the muscles in the hand.11

There is, it seems to me, an uncanny similarity between this diagram and that of Laing's "false-self system" depicted in the Introduction (see Figure 2). Schizophrenics typically regard their bodies as "other," "not-me." In Descartes' diagram, too, brain (inner self) is the detached observer of the parts of the body; the interaction is mechanical, as though one saw oneself behaving as a robot—a perception that is easily extended to the rest of the world. To Descartes, this mind-body split was true of all perception and behavior, such that in the act of thinking one perceived oneself as a separate entity "in here" confronting things "out there." This schizoid duality lies at the heart of the Cartesian paradigm.

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*Figure 3. Descartes' conception of mind-body interaction.*
Descartes' emphasis on clear and distinct ideas, and his basing of knowledge on geometry, also served to reaffirm, if not actually canonize, the Aristotelian principle of non-contradiction. According to this principle, a thing cannot both be and not be at the same time. When I strike the letter “A” on my typewriter, I get an “A.” The cup of coffee sitting to the right of me could be put on a scale and found to have a weight of, say, 5.24 ounces, and this fact means that the object does not weigh ten pounds or two grams. Since the Cartesian paradigm recognizes no false-contradictions in logic, and since logic (or geometry), according to Descartes, is the way nature behaves and is known to us, the paradigm allows for no false-contradictions in nature.

The problems with Descartes' view are perhaps obvious, but for now, it will suffice to note that real life operates dialectically, not critically. We love and hate the same thing simultaneously, we fear what we most need, we recognize ambivalence as a norm rather than an aberration. Descartes' devotion to critical reason led him to identify dreams, which are profoundly dialectical statements, as the model of unreliable knowledge. Dreams, he tells us in the Meditations on First Philosophy, are not clear and distinct, but invariably obscure and confused. They are filled with frequent self-contradictions, and possess (from the viewpoint of critical reason) neither internal nor external coherence. For example, I might dream that a certain person I know is my father, or even that I am my father, and that I am arguing with him. But this dream is (from a Cartesian point of view) internally incoherent, because I am simply not my father, nor can he be himself and someone else as well; and it is externally incoherent, because upon waking, no matter how real it all seems for a moment, I soon realize that my father is three thousand miles away, and that the supposed confrontation never took place. For Descartes, dreams are not material in nature, cannot be measured, and are not clear and distinct. Given Descartes' criteria, then, they contain no reliable information.

In summation, rationalism and empiricism, the twin poles of knowledge so strongly represented in Descartes and Bacon respectively, can be regarded as complementary rather than irrevocably conflicting. Descartes, for example, was hardly opposed to experiment when it served to adjudicate between rival hypotheses—a role it retains to this day. And as I have argued, his atomistic approach, and his emphasis on material reality and its measure-

ment easily lent themselves to the sort of knowledge and economic power that Bacon envisaged as possible for England and Western Europe. Still, this synthesis of reason and empiricism lacked a concrete embodiment, a clear demonstration of how the new methodology might work in practice; the scientific work of Galileo and Newton provided precisely such a demonstration. These men were concerned not merely with the question of methodological exposition (though each certainly made his own contribution to that subject), but sought to illustrate exactly how the new methodology could analyze the simplest events: the stone falling to earth, the ray of light passing through a prism. Through such specific examples the dreams of Bacon and Descartes were translated into a working reality.

Galileo, in his painstaking studies of motion carried out in the twenty years preceding the publication of the New Organon, had already made explicit what Bacon only implied as an artificial construct in his generalizations about the experimental method. Frictionless planes, massless pulleys, free-fall with zero air resistance—all of these 'ideal types' that form the basic problem sets in freshman physics are the legacy of that Italian genius, Galileo Galilei. Galileo is popularly remembered for an experiment he never performed—dropping weights from the Leaning Tower of Pisa—but in fact he conducted a far more ingenious experiment on falling objects—an experiment that exemplifies many of the major themes of modern scientific inquiry. The belief that large or dense objects should strike the ground faster than light ones follows as a direct consequence of Aristotle's teleological physics, and was widely held throughout the Middle Ages. If things fall to the ground because they seek their 'natural place,' the earth's center, we can see why they would accelerate as they approach it. They are excited, they are coming home, and like all of us they speed up as they approach the last leg of the journey. Heavy objects drop a given distance in a shorter time than light ones because there is more matter to become excited, and thus they attain a higher speed and strike the ground first. Galileo's argument, that a very large object and a very small one would make the drop in the same time interval, was based on an assumption that could neither be proven nor falsified: that falling objects are inanimate and thus have neither goals nor purposes. In Galileo's scheme of things, there is no 'natural place' anywhere in the universe. There is but matter and motion, and we can but observe and measure it. The proper
subject for the investigation of nature, in other words, is not why an object falls—there is no why—but *how*; in this case, how much distance in how much time.

Although Galileo's assumptions may seem obvious enough to us, we must remember how radically they violated not only the common-sense assumptions of the sixteenth century, but common-sense observations in general. If I look around, and see that I am rooted to the ground, and that objects released in midair fall to the floor, isn't it perfectly reasonable to regard "down" as their natural, that is to say inherent, motion? In his studies of childhood cognition, Swiss psychologist Jean Piaget discovered that until about age seven at the latest, children are Aristotelians.\(^\text{14}\) When asked why objects fell to the floor, Piaget's subjects replied, "because that is where they belong" (or some variation of this idea). Perhaps most adults are emotional Aristotelians as well. Aristotle's proposition that there is no motion without a mover, for example, seems instinctively correct; and most adults, when asked to react immediately to the notion, will affirm it. Galileo refuted the proposition by rolling a ball down two inclined planes, juxtaposed as in Figure 4:

![Figure 4. Galileo's experiment for showing that motion does not require a mover.](image)

The ball rolls down B and up A, but not to quite the same height from which it began. Then it rolls back down A and up B, again losing height; back and forth, back and forth, until the ball finally settles in the "valley" and comes to rest. If we polish the planes, making them smoother and smoother, the ball stays in motion for a longer and longer period of time. In the limiting case, where friction = 0, the motion would go on forever; hence, motion without a mover. But there is one problem with Galileo's argument: there is no limiting case. There are no frictionless planes. The law of inertia may state that a body continues in motion or in a state of rest unless acted upon by an outside force, but in fact, in the case of motion, there is always an outside force, if nothing more than the friction between the object and the surface over which it moves.\(^\text{15}\)

The experiment Galileo designed to measure distance against time was a masterpiece of scientific abstraction. To drop weights from the Leaning Tower, Galileo realized, was absolutely useless. Simon Stevin, the Dutch physicist, had tried a free-fall experiment in 1586 only to learn that the speed was too fast for measurement. Thus, said Galileo, I shall "dilute" gravity by rolling a ball down an inclined plane, made as smooth as possible to reduce friction. If we were to make the slope steeper by increasing the angle \(\alpha\), as in Figure 5, we would reach the free-fall situation that we seek to explore at the limiting case, in which \(\alpha = 90\) degrees. Hence let us take a smaller angle, say \(\alpha = 10\) degrees, and let it serve as an approximation. Galileo first used his pulse as a timer, and later a bucket of water with a hole in it which permitted the water to drip at regular intervals. By running a series of trials, he finally came up with a numerical relationship, that distance is proportional to the square of the time. In other words, if an object—any object, light or heavy—falls a unit distance in one second, then it falls a distance of four times that in two seconds, nine times that in three seconds, and so on. In modern terminology, \(s = kt^2\), where \(s\) is distance, \(t\) time, and \(k\) a constant.

Both of these inclined plane experiments illustrate the highly ingenious combination of rationalism and empiricism which was Galileo's trademark. Consult the data, but do not allow them to confuse you. Separate yourself from nature so you can, as Descartes would later urge, break it into the simplest parts and extract the essence—matter, motion, measurement. In general terms, Galileo's was not an altogether new contribution to human history, as we shall see in Chapter 3; but it did represent the final stage in the development of nonparticipating consciousness, that state of mind in which one knows phenomena precisely in the act of distancing oneself from them. The notion that nature is alive is clearly a stumbling block to this mode of understanding. For when we regard material objects as extensions of ourselves (alive, endowed with purpose) and allow ourselves to be distracted by the sensuous
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details of nature, we are powerless to control nature, and thus, from Galileo’s point of view, can never really know it. The new science enjoins us to step outside of nature, to reify it, reduce it to measurable Cartesian units; only then can we have definitive knowledge of it. As a result—and Galileo was not interested in ballistics and materials science for nothing—we shall supposedly be able to manipulate it to our advantage.

Clearly, the identification of truth with utility was closely allied to the Galilean program of nonparticipating consciousness and the shift from “why” to “how.” Unlike Bacon, Galileo did not make this identification explicit, but once natural processes are stripped of immanent purpose, there is really nothing left in objects but their value for something, or someone, else. Max Weber called this attitude of mind _zweckrational_, that is, purposively rational, or instrumentally rational. Embedded within the scientific program is the concept of manipulation as the very touchstone of truth. To know something is to control it, a mode of cognition that led Oskar Kokoschka to observe that by the twentieth century, reason had been reduced to mere function. This identification, in effect, renders all things meaningless, except insofar as they are profitable or expedient; and it lies at the heart of the “fact-value distinction,” briefly discussed in the Introduction. The medieval Thomistic (Christian-Aristotelian) synthesis, that saw the good and the true as identical, was, in the first few decades of the seventeenth century, irrevocably dismantled.

Of course, Galileo did not regard his method as merely useful, or heuristically valuable, but uniquely true, and it was this epistemological stance that created havoc with the church. For Galileo, science was not a tool, but the true path to truth. He tried to keep its claims separate from those of religion, but failed: the church’s historical commitment to Aristotelianism proved to be too great. In this conflict Galileo, as a good Catholic, was understandably worried that the church, by insisting on its infallibility, would inevitably deal itself a serious blow. Galileo’s life, in fact, is the story of the prolonged struggle, and failure, to win the church over to the cause of science; and in his play _Galileo_, Bertolt Brecht makes this theme of the irresistibility of the scientific method central to the story. He has Galileo wander through the drama carrying a pebble, which he occasionally drops to illustrate the power of sensory evidence. “If anybody were to drop a stone,” he asks his friend Sagredo, “and tell [people] that it didn’t fall, do you think they would keep quiet? The evidence of your own eyes is a very seductive thing. Sooner or later everybody must succumb to it.” And Sagredo’s reply? “Galileo, I am helpless when you talk.” The logic of science had a historical logic as well. In time all alternative methodologies—animism, Aristotelianism, or argument by papal fiat—crumbled before the seductiveness of free rational inquiry.

The lives of Newton and Galileo stretch across the whole of the seventeenth century, for the former was born in the same year that the latter died, 1642, and together they embrace a revolution in human consciousness. By the time of Newton’s death in 1727, the educated European had a conception of the cosmos, and of the nature of “right thinking,” which was entirely different from that of his counterpart of a century before. He now regarded the earth as revolving around the sun, not the reverse; believed that all phenomena were constituted of atoms, or corpuscles, in motion and susceptible to mathematical description; and saw the solar system as a vast machine, held together by the forces of gravity. He had a precise notion of experiment (or at least paid lip service to it), and a new notion of what constituted acceptable evidence and proper explanation. He lived in a predictable, comprehensible, yet (in his own mind) very exciting sort of world. For in terms of material control, the world was beginning to exhibit an infinite horizon and endless opportunities.

More than any other individual, Sir Isaac Newton is associated with the scientific world view of modern Europe. Like Galileo, Newton combined rationalism and empiricism into a new method; but unlike Galileo, he was hailed by Europe as a hero rather than having to recant his views and spend his mature years under house arrest. Most important, the methodological combination of reason and empiricism became, in Newton’s hands, a whole philosophy of nature which he (unlike Galileo) was successful in stamping upon Western consciousness at large. What made the eighteenth century the Newtonian century was the solution to the problem of planetary motion, a problem that, it was commonly believed, not even the Greeks had been able to solve (the Greeks, it should be noted, took a more positive view of their own achievement). Bacon had decided the ancient learning, but he did not speak for the majority of Europeans. The strong revival of classical learning in the sixteenth century, for example, reflected the belief that despite the enormous problems with the Greek cosmological model, their epoch was and would remain the true Golden Age of mankind. Newton’s precise
mathematical description of a heliocentric solar system changed all that; he not only summed up the universe in four simple algebraic formulas, but he also accounted for hitherto unexplained phenomena, made accurate predictions, clarified the relation between theory and experiment, and even sorted out the role of God in the whole system. Above all, Newton’s system was atomistic: the earth and sun, being composed of atoms themselves, behaved in the same way that any two atoms did, and vice versa. Thus both the smallest and the largest objects in the universe were seen to obey identical laws. The moon’s relationship to the earth was the same as that of a falling apple. The mystery of nearly two millennia was over: one could be reassured that the heavens that confront us on a starry night held no more secrets than a few grains of sand running through our fingers.

Newton deliberately titled his major work, popularly called the Principia, the Mathematical Principles of Natural Philosophy (1686),19 the two adjectives serving to emphasize his rejection of Descartes, whose Principles of Philosophy he regarded as a collection of unproven hypotheses. Step by step he analyzed Descartes’ propositions about the natural world and demonstrated their falsity. For example, Descartes envisaged the matter of the universe circulating in whirlpools, or vortices. Newton was able to show that this theory contradicted the work of Kepler, which seemed quite reliable; and that if one experimented with models of vortices by spinning buckets of fluid (water, oil, pitch), the contents would eventually slow down and stop, indicating that on Descartes’ hypothesis the universe would have come to a standstill long ago. Despite his attacks on Descartes’ views, it is clear from recent research that Newton was a Cartesian right up to the publication of the Principia; and when one reads the work, one is struck by an awesome fact: Newton made the Cartesian world view tenable by falsifying all of its details. In other words, although Descartes’ facts were wrong and his theories insupportable, the central Cartesian outlook—that the world is a vast machine of matter and motion obeying mathematical laws—was thoroughly validated by Newton’s work. For all of Newton’s brilliance, the real hero (some would say ghost) of the Scientific Revolution was René Descartes.

But Newton did not have his triumph so easily. His entire view of the cosmos hinged on the law of universal gravitation, or gravity, and even after it had been given an exact mathematical formulation, no one knew just what this attraction was. Cartesian thinkers pointed out that their own mentor had wisely restricted himself to motion by direct impact, and ruled out what scientists would later call action-at-a-distance. Newton, they argued, has not explained gravity, but merely stated its effects, and thus it really is, in his system, an occult property. Where is this “gravity” that he makes so much of? It can be neither seen, nor heard, nor felt, nor smelled. It is, in short, as much a fiction as the vortices of Descartes.

Privately, Newton agonized over this judgment. He felt that his critics were correct. Early in 1692 or 1693 he wrote his friend the Reverend Richard Bentley the following admission:

That gravity should be innate, inherent and essential to matter, so that one body may act upon another at a distance through a vacuum, without the mediation of anything else, by and through which their action and force may be conveyed from one to another, is to me so great an absurdity that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it. Gravity must be caused by an agent acting constantly according to certain laws, but whether this agent be material or immaterial I have left to the consideration of my readers.20

Publicly, however, Newton adopted a stance that established, once and for all, the philosophical relationship between appearance and reality, hypothesis and experiment. In a section of the Principia entitled “God and Natural Philosophy,” he wrote:

Hitherto we have explained the phenomena of the heavens and of our sea by the power of gravity, but have not yet assigned the cause of this power. This is certain, that it must proceed from a cause that penetrates to the very centers of the sun and planets…. But hitherto I have not been able to discover the cause of those properties of gravity from phenomena, and I frame no hypotheses; for whatever is not deduced from the phenomena is to be called a hypothesis, and hypotheses, whether metaphysical or physical, whether of occult qualities or mechanical, have no place in experimental philosophy.21

Newton was echoing the major theme of the Scientific Revolution: our goal is how, not why. That I cannot explain gravity is irrelevant. I can measure it, observe it, make predictions based on it, and this is all the scientist has to do. If a phenomenon is not measurable, it can “have no place in experimental philosophy.” This philosophical position, in its various forms called “positivism,” has been the public face of modern science down to the present day.22

The second major aspect of Newton’s work was best delineated
in the *Opticks* (1704), in which he was able to wed philosophical atomism to the definition of experiment which had been crystallizing in the minds of scientists throughout the previous century. As a result, Newton's researches on light and color became the model for the correct analysis of natural phenomena. The question was, is white light simple or complex? Descartes, for one, had regarded it as simple, and saw colors as the result of some sort of modification of the light. Newton believed white light was in fact composed of colors that somehow cancelled each other out in combination to produce the effect of white. How to decide between these two claims?

In the experiment illustrated in Figure 6, Newton took white light, broke it into parts with a prism, selected one of the parts, and showed that it could not be further broken down. He did this with each color, demonstrating that monochromatic light could not be subdivided. Next, Newton ran the experiment in the opposite direction: he broke the ray of white light into its parts, and then recombined them by passing them through a convex lens (see Figure 7). The result was white light. This atomistic approach, which follows Descartes' four-step method exactly, establishes the thesis beyond doubt. But as in the case of gravity, the Cartesians took issue with Newton. Where, they asked, is your *theory* of light and color, where is your *explanation* of this behavior? And as in the previous case, Newton retreated behind the smokescreen of positivism, I am looking for laws, or optical facts, he replied, not hypotheses. If you ask me what "red" is, I can only tell you that it is a number, a certain degree of refrangibility, and the same is true for each of the other colors. I have measured it: that is enough.

In this case too, of course, Newton struggled with possible explanations for the behavior of light, but the combination of (philosophical) atomism, positivism, and experimental method—in short, the definition of reality—is still very much with us today. To know something is to subdivide it, quantify it, and recombine it; is to ask "how," and never get entangled in the complicated underbrush of "why." It is, above all, to distance yourself from it, as Galileo pointed out; to make it an abstraction. The poet may get uncritically effusive about a red streak across the sky as the sun is going down, but the scientist is not so easily deluded: he knows that his emotions can teach him nothing substantial. The red streak is a number, and that is the essence of the matter.

To summarize our discussion of the Scientific Revolution, it is necessary to note that in the course of the seventeenth century Western Europe hammered out a new way of perceiving reality. The most important change was the shift from quality to quantity, from "why" to "how." The universe, once seen as alive, possessing its own goals and purposes, is now a collection of inert matter, hurrying around endlessly and meaninglessly, as Alfred North Whitehead put it. What constitutes an acceptable explanation has thus been radically altered. The acid test of existence is quantifiability, and there are no more basic realities in any object than the parts...
into which it can be broken down. Finally, atomism, quantifiability, and the deliberate act of viewing nature as an abstraction from which one can distance oneself—all open the possibility that Bacon proclaimed as the true goal of science: control. The Cartesian or technological paradigm is, as stated above, the equation of truth with utility, with the purposive manipulation of the environment. The holistic view of man as a part of nature, as being at home in the cosmos, is so much romantic claptrap. Not holism, but domination of nature; not the ageless rhythm of ecology, but the conscious management of the world; not (to take the process to its logical end point) “the magic of personality, [but] the fetishism of commodities.”24 In the mind of the eighteenth and nineteenth centuries, medieval man (or woman) had been a passive spectator of the physical world. The new mental tools of the seventeenth century made it possible to change all that. It was now within our power to have heaven on earth; and the fact that it was a material heaven hardly made it less valuable.

Nevertheless, it was the Industrial Revolution that put the Scientific Revolution on the map. Bacon’s dream of a technological society was not realized in the seventeenth century or even in the eighteenth, although things were beginning to change by 1760. Ideas, as we have said, do not exist in a vacuum. People could regard the mechanical world view as the true philosophy without feeling compelled to transform the world according to its dictates. The relationship between science and technology is very complicated, and it is in fact in the twentieth century that the full impact of the Cartesian paradigm has been most keenly felt. To grasp the meaning of the Scientific Revolution in Western history we must consider the social and economic milieu that served to sustain this new way of thinking. The sociologist Peter Berger was correct when he said that ideas “do not succeed in history by virtue of their truth but by virtue of their relationships to specific social processes.”25 Scientific ideas are no exception.