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SCIENCE, FRANKENSTEIN, AND MYTH

THEODORE ZIOLKOWSKI

THE history of postwar German drama might suggest to the casual observer that the contemporary theater is populated by a group of frustrated physicists. Writers of every generation, from Germany East and West as well as German-speaking Switzerland and representing every theatrical vogue, have turned to nuclear physics for their subject matter. Carl Zuckmayer used the case of atomic spy Klaus Fuchs as the basis for a realistic drama entitled *Cold Light*, which portrays the career of a young German émigré who is trained in England as a physicist, comes to the United States to work on the Manhattan project, and turns over classified information to the Russians. In *The Physicists* Friedrich Dürrenmatt takes us into a madhouse where two of the patients think that they are Newton and Einstein while the third, Möbius, imagines that he is visited by the spirit of King Solomon. It turns out that all three patients are sane: Möbius is a brilliant physicist who has made a discovery so potentially destructive that he has had himself committed to the asylum in order to avoid exploitation; "Newton" and "Einstein" are intelligence agents from opposing governments who feign madness in order to approach Möbius and win his services. The play ends when the three men, having agreed to preserve their secret in the interests of humanity, learn that they are in the hands of the sanatorium director, who is totally insane: having used her position to acquire Möbius's knowledge, she has set up a vast cartel with which she intends to take over the world. Heinar Kipphardt's *In the Matter of J. Robert Oppenheimer* is a documentary drama based on the proceedings initiated against the father of the atomic bomb in 1954 by the Per-

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sonnel Security Board of the Atomic Energy Commission. Bertolt Brecht wrestled with the problem of the scientist and ideology for almost twenty years in the three versions of his *Life of Galileo*. At the end of his life, moved by the death of Albert Einstein in 1955, he attempted to address the problem through a more contemporary material. Only a few fragments remain of his planned *Life of Einstein*—enough, however, to show that Brecht intended to focus on the dilemma of the theorist and pacifist who was compelled to put his knowledge at the disposal of war and who, having fled Nazi Germany, “found a new Potsdam in Washington.” Brecht’s ideas were subsequently worked out by his followers in East Germany. In Karl Mickel’s libretto for Paul Dessau’s opera *Einstein* the aging physicist, in his American exile, has come to the conclusion that both Germany and the United States are eager to use his discoveries to build weapons that threaten humanity; but Germany drove him into exile, and the United States refuses to heed his political advice. So he burns up the manuscript containing a second great formula, lest it too be used against mankind.

It is immediately apparent that these dramatists are interested not in physics as such but in the ethical implications of a science that has suddenly come out of the laboratory into the public domain. As Zuckmayer explains in his afterword to *Cold Light*, “the theme of the play is not the splitting of the atom but the crisis of faith.” It is the particular appeal of ideological betrayal, according to Zuckmayer, that it produces a conflict of conscience which finds its closest analogy in times of religious wars. In Kipphardt’s drama *Oppenheimer* puts the same thought another way: “It isn’t the fault of the physicists that brilliant ideas always lead to bombs nowadays. As long as that is the case, one can have a scientific enthusiasm for a thing and, at the same time, as a human being, one can regard it with horror.” Mickel’s surrealist opera culminates in the hero’s decision to destroy the results of his research rather than permit it to be used

for inhuman purposes. And, in the most general statement of ethical principle, Dürrenmatt appends to his play "21 Theses" in which we read: "The content of physics is the concern of physicists, its effect the concern of all men."

The popularity of this theme, found in several other German dramas of the sixties, is easy to understand. First, it is a subject with large and urgent implications. In the decades following Hiroshima and Nagasaki no theatergoer needed to be persuaded that the topic was worthy of his attention. Second, while the basic dilemma is by its nature an international one, many of its leading characters were German—a fact that engaged the interest of German audiences. Finally, as citizens of countries that were not themselves atomic powers yet were vulnerable and exposed by their geographical location, German and Swiss dramatists keenly sensed the dangers of the cold war and sought to analyze them according to their various ideologies. While Zuckmayer was basically concerned with the crisis of belief experienced by any decent man, his play is written from an explicitly western point of view. Zuckmayer, who spent the war years in the United States, views Russia and communism as the enemy, and his values are weighted accordingly. Karl Mickel, in contrast, writing from the German Democratic Republic, places the emphasis quite differently. His *Einstein*, like Brecht's, feels betrayed both by Germany and by the United States; the melody of the Internationale, introduced at the end of the opera, suggests that the only possible salvation lies in a communist society. Kipphardt, displaying the skepticism of a left-oriented West German, detects little innocence in the Oppenheimer affair: both the FBI and the military come off badly in his dramatization; he impugns the motives of many of the witnesses; and Oppenheimer's own integrity is questioned. Dürrenmatt, from his vantage in neutral Switzerland, leaves his audience with the distinct impression that all the nations involved in the struggle for nuclear power are either unscrupulous or insane or both.

Yet, despite the shifts of political emphasis from one play to the next, a remarkably consistent pattern underlies all of them. In each case we encounter a scientist who initially pursues his science in a state of brash innocence, with no thought for the consequences. The discovery in each case is objectively value-free and a distinct contribution to human knowledge. But the political misuse of the discovery arouses the scientist from ethical innocence to a state of consciousness which necessitates a political act. Seen at this level of abstraction, the plays are all based on an ambivalent conception of scientific knowledge, and this ambivalence enables us to grasp perhaps the most compelling reason for their success—a reason more subliminally insistent than the superficially urgent political factors. They all represent modern manifestations of a powerful archetypal structure familiar from myth and literature. We will come later to the religious implications of the structure, which are evident in the images that instinctively spring to the characters' minds when they reach the moment of insight in each play. But we must first deal with a more immediate source in which the archetypal situation assumed its exemplary shape for the modern imagination.

On October 29, 1949, following a meeting of the Atomic Energy Commission with Oppenheimer's advisory committee on the hydrogen bomb, David E. Lilienthal noted in his *Journals* that James B. Conant flatly opposed the project on the grounds that "we built one Frankenstein." Although the name Frankenstein does not occur in the German plays—the story of Dr. Frankenstein and his monster is an Anglo-Saxon invention—it occurred frequently in the discussions in this country surrounding the conflict between pure scientific research and its social implications. In the early sixties Dr. Philip Abelson, the director of the Geophysical Lab of the Carnegie Institution, warned that "government money has been the Frankenstein of big science, and in many instances, the monster has invaded the universities." When Herbert J.

Muller wrote "A Primer on Modern Technology and Human Values," in which he argued that man can control the technology that he has created, he entitled it *The Children of Frankenstein*. In all of these representative cases the image is used loosely. It is never completely clear whether the speakers understand the difference between Dr. Frankenstein and his (nameless) monster. But that very ambiguity attests to the power of myth. Most people citing Frankenstein as exemplary for the scientist who in his search for knowledge creates a monster have never read Mary Shelley's novel. Instead, they have in mind the numerous "Frankenstein" movies that have been filmed since 1910 and that constitute an ineradicable aspect of American culture. Although even the most trivialized film version or comic book preserves the structure of the archetype, it is to Mary Shelley's novel of 1818 that we must turn for the true analogue to the German dramas that we have considered.

Whereas moviegoers today regard Frankenstein films as a venerable form of the fantastic, Mary Shelley based her novel on what she believed to be the most up-to-date scientific theories. To the extent that her narrative is consistent with, and a logical extension of, existing scientific cognition, it is an example of science fiction in the most rigorous sense of the word. When her husband wrote his preface to the work, he reminded his audience that "the event on which this fiction is founded has been supposed, by Dr. Darwin and some of the physiological writers of Germany, as not of impossible occurrence." For our purposes it is unnecessary to recapitulate the circumstances of composition: the competition among the four young romantics spending the summer of 1816 in Switzerland—Byron, Shelley, his wife Mary, and their friend Polidori—to write a ghost story. What matters is that Mary Shelley, as she tells us in her *Author's Introduction* of 1831, listened to conversations between Byron and her husband, who was fascinated by the latest scientific

theories concerning the "principle of life" and the possibility of creating life by electricity. (As a student at Eton Shelley almost electrocuted himself in the attempt to reproduce Franklin's experiment with the kite.) "Perhaps a corpse would be reanimated; galvanism had given token of such things: perhaps the component parts of a creature might be manufactured, brought together, and endued with vital warmth." In her novel Mary Shelley gave exemplary form to a romantic dream embodied in the German *Naturphilosophie* and shared by such writers as Novalis and Hoffmann—of making animate the inanimate, of creating spirit from inert matter.

The scientific rationalization of the novel must be stressed, for if *Frankenstein* were purely fantastic—that is, based on the intrusion of the irrational into the rational world—there would be no grounds for comparison with the contemporary German plays. Like them, however, it is based on what was considered the most exciting science of the day. Like them, moreover, it appears at a critical moment in the history of science—at the moment, namely, when decades of progress and achievement had rendered science secure and unquestioning in its accomplishments. Edward Teller, the father of the H-bomb, once remarked: "I believed in the possibility of developing a thermonuclear bomb. My scientific duty demanded exploration of that possibility." This absolute faith in the right and, indeed, the duty to pure inquiry—what Erwin Chargaff has called the Devil's Doctrine: "What can be done, must be done"—is an attitude that emerged during European romanticism. Until the Renaissance, science, like the other intellectual disciplines, had served principally as a handmaiden of theology. The history of sixteenth- and seventeenth-century science is in no small measure an account of the struggle between religious authority and scientific discovery. By the end of the eighteenth century, however, as Carl Becker and other students of the period have pointed out, a naive faith in the authority of nature and reason had all but replaced the au-

thority of the church. It was one of the principal achievements of romanticism, and especially of the great reforms that established in early nineteenth-century Germany the first modern universities, to insist upon the right of scholarship in general and science in particular to pursue its free inquiry, uninhibited by any authority, spiritual or secular. Mary Shelley's *Frankenstein* expresses society's concern at what it perceived to be the mindless pursuit of knowledge with no thought for its social implications.

Mary Shelley tells the story of a brilliant young scientist, Victor Frankenstein, who succeeds in fulfilling the romantic dream of creating life from inert matter. But the monster he creates is so foul that he abandons it on the very night when he brings it to life. Lusting for vengeance, the creature kills all those who are dearest to Frankenstein and finally, after months of torment, destroys his creator himself. But the novel is much subtler than this stark outline suggests, and its subtlety is reflected in the complexity of its organization.

The novel consists not of a simple straightforward narrative but of a double framework. The outer framework comprises a group of letters written from Russia by a young British explorer, Robert Walton, to his sister in England. Half a year into a journey of discovery to the Arctic Walton encounters, drifting on an ice floe, an exhausted human being who turns out to be Frankenstein. During the days of his convalescence Frankenstein tells Walton the story of his life. The first five chapters recount Frankenstein's childhood and youth in Switzerland and his studies in Germany—notably his early obsession with the arcane researches of Albertus Magnus and Paracelsus, which leads to his pursuit at the university of the latest developments in “real” science. These studies culminate in the construction of a huge, sallow, yellow-eyed creature into which he manages to “infuse a spark of being.” Chapters six through ten describe Frankenstein's illness produced by the shock of his creation, the news that his brother has been murdered, the trial and execution of an

innocent servant-girl of the family, and Frankenstein's confrontation with the monster on a glacial field just beneath Mont Blanc.

At this point Frankenstein's narrative is interrupted for six chapters in which the creature recounts his own adventures during the intervening months: how he learned to talk by observing a family from his hideaway, how he educated himself by studying the literary classics, and how his attempts to enter human society by means of kind deeds were always repulsed by people horrified at his savage appearance. He ends his account by asking Frankenstein to create a female partner with whom he might share his loneliness in a self-imposed exile. The narrative now returns to Frankenstein, who tentatively agrees to the bargain and sets up a laboratory on "one of the remotest of the Orkneys." But at the last moment, overcome by the thought that he might be enabling the monster to propagate itself and destroy the human race, Frankenstein tears apart the still lifeless body he has assembled and flees. Now the monster's rampage of terror begins: in quick succession he kills Frankenstein's best friend and his bride; Frankenstein's father dies of grief. For months Frankenstein pursues his creature, but the monster manages to stay just ahead of him, from "the wilds of Tartar" to the Arctic wastes, always making sure that his creator catches sight of him often enough to continue his fanatical pursuit and that he receives enough food and shelter to keep himself barely alive. When the monster realizes that Walton is taking Frankenstein back to England to recover in safety, he boards the ship and murders his maker. In a final confrontation he assures Walton that, his vengeance now complete, he intends to destroy his own body on a funeral pyre so that "its remains may afford no light to any curious and unhallowed wretch who would create such another as I have been." The novel ends as the monster springs from the cabin window and bounds away through the icy wastes, leaving behind a sobered Walton, who forsakes, at the expense of his family and his crew, his bold dreams of scientific glory.

Mary Shelley was telling not one story but three—not just the story of Victor Frankenstein but also that of his creature and of Robert Walton. Why does she spend six chapters—a quarter of the book—recapitulating the monster's adventures, which are unrelated to the rest of the plot? She wants us to understand that Frankenstein's creation is not evil in itself but has been made that way by society. Frankenstein's monster is not the plodding dull-witted creature as conceived by Boris Karloff. Though hideously ugly, it is awesomely strong and lithe, able to bound across mountain crags or Arctic wastes at superhuman speed. The creature's inherent intellectual abilities are so great that it learns—without assistance and within a matter of months—to speak a mellifluous Miltonic prose. Its sensibilities, nourished by the study of *Paradise Lost*, *The Sorrows of Young Werther*, and Plutarch's *Lives*, are noble; and its overtures to human society are all originally and instinctively beneficent. But every good act is rewarded with horror and violence by a society terrified at the creature's appearance. As he explains to Walton at the end of the novel, paraphrasing Milton's Satan: "Evil thenceforth became my good." "When I run over the frightful catalogue of my sins, I cannot believe that I am the same creature whose thoughts were once filled with sublime and transcendent visions of the beauty and the majesty of goodness. But it is even so; the fallen angel becomes a malignant devil."

What we have here is more than the familiar topos of natural man or the equally popular romantic notion that creatures created or born outside human history do not partake of original sin. We also find an emphatic statement that scientific creation is morally neutral, with a pronounced capacity—indeed, even a predisposition—for good, until it is corrupted by human society. This strong statement is necessary to balance Walton's narrative. For Frankenstein uses the account of his own experience to persuade Walton to renounce his dreams of discovery and scientific glory. "Seek happiness in tranquillity and avoid ambition, even if it be

only the apparently innocent one of distinguishing yourself in science and discoveries.”

Situated between the inner narrative, which portrays the corruption of a good creation by society, and the outer framework, which depicts the enthusiasm and ambition of scientific discovery, Frankenstein's own story stands out in its full ambivalence. When we first hear Frankenstein's voice, shortly after he is rescued by Walton, it is the voice of a man utterly disenchanted with science. “You seek for knowledge and wisdom, as I once did; and I ardently hope that the gratification of your wishes may not be a serpent to sting you, as mine has been.” Having seen the monster destroy his personal happiness, he has come to believe that it represents a threat to the entire human race. “My rage is unspeakable when I reflect that the murderer, whom I have turned loose upon society, still exists.” But we must not forget that Frankenstein's entire narrative is colored by his ghastly experiences. The young Frankenstein, in contrast, was motivated by a passionate lust for knowledge. “The world was to me a secret which I desired to divine. Curiosity, earnest research to learn the hidden laws of nature, gladness akin to rapture, as they were unfolded to me, are among the earliest sensations I can remember.” When we combine these remarks with the knowledge that the creature, while ugly, is by no means inherently evil, we begin to realize that scientific discovery, according to Mary Shelley, becomes evil only when the scientist refuses to assume responsibility for his creation—that is, when he turns it loose to be acted upon by an uncomprehending society. If Victor Frankenstein had not been overcome by his initial disgust, if he had responded to his creature with love and understanding, it might have become an instrument of good rather than evil.

It would be inconsistent with everything we know about European romanticism to think that Mary Shelley meant her novel as a blanket indictment of the pursuit of knowledge per se. Instead it is a cautionary tale against a science di-

vorced from ethical responsibility. Whereas the Enlightenment and early German romanticism had often carried the obsession with science for science's sake to extremes, and while religion, in reaction against the Enlightenment, had sometimes revealed its hostility to scientific discovery from astronomy to geology and biology, later European romanticism was inspired by an awareness of the ambivalence of scientific discovery and the quest for truth. Victor Frankenstein is the linear ancestor of the physicists in the modern German dramas. Motivated at the outset by the quest for pure knowledge, he makes a discovery that involves an enormous potential for good. But because he renounces the responsibility for his discovery, it is subverted by society and becomes a tool of evil. At that point the scientist rejects his earlier attitude of pure investigation and makes the "political" decision to destroy his findings and to dissuade others from similar investigations.

Students of popular culture have observed that the figure of the scientist as represented in works of pop-science—notably comic books, monster movies, and television series—is overwhelmingly negative in our time. And the figure of Victor Frankenstein, as it emerges in most of the popular versions of the story, has suffered from this contamination. To the extent that Frankenstein himself is characterized as evil in the films, it is usually left to an enraged populace to destroy the monster—a democratic uprising that has no parallel in Mary Shelley's more elitist romantic text. The figure of the romantic scientist is much more subtle and partakes of all the ambiguity attached to the questions of scientific ethics stirred up by the events surrounding the atomic bomb. But how did this ambivalence arise? I suggest that it emerges from the uncomfortable synthesis of two conflicting traditions regarding science and knowledge.

One of these traditions is specified by the subtitle of the novel: *Frankenstein, or the Modern Prometheus*. As Ray-

mond Trousson has shown in his magisterial study *Le thème de Prométhée*, Prometheus was one of the figures most appealing to the poets of European preromanticism, from Shaftesbury and Rousseau to Goethe and Herder. Moreover, during the very years when Mary Shelley was writing *Frankenstein*, her husband was composing his lyrical drama *Prometheus Unbound*. Yet after the title page the novel contains not a single reference to the mythological figure. It remains for the reader to deduce in what respects Victor Frankenstein can be said to be a modern Prometheus. The frequent references in the novel to electricity and lightning remind us that Prometheus incurred the wrath of the gods by stealing fire for mankind. A further analogy can be detected in the legend according to which Prometheus created the human race by fashioning men of clay. But that is as far as the analogy can be pursued. For his theft of fire Prometheus was punished by being chained to a mountain in the Caucasus, where each day an eagle appeared to eat away his liver, which renewed itself for the eagle's delectation every day for thirty thousand years. Unlike Frankenstein, however, Prometheus never succumbs to his punishment. He was beloved by the romantics precisely because of his titanic spirit of rebelliousness. Far from being beset by doubts, the romantic Prometheus is, in Shelley's words, "the type of the highest perfection of moral and intellectual nature, impelled by the purest and the truest motives to the best and noblest ends." What distinguishes him from such rebels as Satan and makes him more poetical, Shelley continues in the preface to *Prometheus Unbound*, is the fact that "in addition to courage, and majesty, and firm and patient opposition to omnipotent force, he is susceptible of being described as exempt from the taints of ambition, envy, revenge, and a desire for personal aggrandisement." These words could hardly be applied to Victor Frankenstein, who apart from his obsession with fire is a Prometheus *manqué*: he creates a man, to be sure, but it is a flawed man. Instead of serving society,

Frankenstein becomes its nemesis, having created a monster that threatens its destruction. Indeed his name itself has become anathema, the very definition of the evil scientist. The ambivalence of Mary Shelley's modern Prometheus is produced, I would argue, through its contamination by a parallel legend from a totally different source: the biblical Adam.

Here the text does help us, for although it lacks specific references to the myth of Prometheus, it is replete with images borrowed from the first few chapters of Genesis. Most frequently, to be sure, it is the monster himself, fresh from his study of *Paradise Lost*, who sees himself as a new Adam, rambling in the fields of Paradise but soon abandoned by his creator. In this analogy, of course, Frankenstein is equivalent to God the Creator. But in several other passages Frankenstein uses biblical imagery to characterize his own situation. At one point, after the monster has warned him that he will seek him out on his wedding night, Frankenstein thinks of his beloved Elizabeth. "Some softened feelings stole into my heart and dared to whisper paradisaical dreams of love and joy; but the apple was already eaten, and the angel's arm bared to drive me from all hope"—a clear allusion to the sin of knowledge, which Frankenstein took upon himself by his search for forbidden knowledge.

This cluster of images alerts us to another dimension of the novel. Adam, like Prometheus, is both functionally and by etymological designation a scientist. He performs the typically scientific functions of naming and classifying nature. And, as the serpent tells Eve, if she and Adam will eat of the fruit of the Tree of Knowledge, they will become as gods, knowing (*scientes*) good and evil. There is an essential difference, however. Whereas Prometheus was venerated for his scientific achievements, Adam was lamented. From the sixth century B.C. the quest for scientific knowledge provided one of the most powerful motivations for Greek culture. The Hebrews had an entirely different conception. "In much

wisdom is much grief; and he that increaseth knowledge [the Vulgate uses the term *scientia*] increaseth sorrow" (Ecclesiastes 1:18). The ambivalence regarding science that we encounter in *Frankenstein* results from a conflation of these two opposing views. In both cultures we encounter the paradigm of the scientist who seeks to increase knowledge by probing hitherto forbidden secrets; in both cases new consciousness is brought to the human race as a result of the scientific discovery; and both scientists receive typically political punishment for their transgressions: Prometheus is imprisoned and Adam is sent into exile. But the difference between their respective reactions to their fates produces the ambivalence toward science in our modern society, which arises from the dual traditions of Judeo-Christian and Greco-Roman culture: Adam skulks out of Eden, ashamed of his knowledge and deplored for all eternity for his fall, while Prometheus remains defiant in his attitude, cheered by the gratitude of the human race, until he is ultimately liberated by a tyrannical Zeus.

The analogy between the two myths has been recognized by theologians and poets since the Renaissance—especially the parallel between the temptresses Eve and Pandora. Milton, for instance, speaks of Eve "in naked beauty more adorned,/More lovely than Pandora, whom the gods/Endowed with all their gifts" (*Paradise Lost*, 4. 713–715). Dora and Erwin Panofsky have shown, in their iconographical study of *Pandora's Box*, how fruitful the association became for post-Renaissance art. In the nineteenth century the interest shifted to the analogy between Adam and Prometheus, who were seen to exemplify the differences between Nazarene and Hellene that had been made popular by Heinrich Heine and Matthew Arnold, among others. This tradition culminates in Nietzsche, who argues in *The Birth of Tragedy* that the myth of Prometheus has the same characteristic significance for "Aryan" man as does the myth of the Fall for Semitic man. In both cases, Nietzsche suggests, mankind

achieves its highest goal, cognition, through an act of sacrilege. In the Greek myth the sacrilege is perpetrated consciously in the interest of human achievement and dignity; in the Hebrew myth, in contrast, it is prompted by idle curiosity and the reaction is shame.

We can now see that Mary Shelley's novel represents a surprisingly early conflation of the two representative myths. It is well known that during the composition of the novel Mary Shelley and her husband studied *Paradise Lost* and *Prometheus Bound*—that the Bible and Aeschylus' drama were therefore very much in her mind as she worked. But it has not been sufficiently stressed that her inability to reconcile the conflict inherent in her two sources—between pride and shame in cognition—produced for the first time that ambivalence toward scientific knowledge that we have come to regard as characteristically modern.

We can go a step further in our analysis. The myths of the Fall and of Prometheus, while they stand close to the beginning of their respective mythological traditions, at the crucial juncture between cosmology and human history, are in fact relatively late interpolations that go back to earlier oriental sources. Homer was aware of various legends attached to Prometheus, but he did not bother to include them in his mythology. Hesiod was the first of the Greeks to tell the story, but his version, related in his *Theogony* (ll. 517–616) and again in *Works and Days* (ll. 43–105), is patchy and inconsistent. We read of Prometheus' attempt to deceive Zeus at the feast of gods and men and Zeus's decision to punish mankind by withholding fire from them; we hear of the theft of fire; we are told about the displeasure of the gods, who send Pandora to marry Prometheus' brother, Epimetheus. But there is no symbolic interpretation of the events: the fire is still specifically alimentary in function and not symbolic of knowledge in general. The first consistent version of the legend was written by Aeschylus shortly before the middle of the fifth century B.C. In *Prometheus*

Bound Aeschylus strips the archetype of all nonessentials—notably the motif of Pandora and Epimetheus. Moreover the detail concerning Prometheus as the creator of men—the feature that particularly appealed to the romantic poets—was a late addition, inspired by conflation of Prometheus with a local Attic god of pottery, that had not yet entered the legend. For Aeschylus, Prometheus is first and foremost a culture-hero: the Titan who, out of his love for mankind, brought knowledge—that is, science and the arts—to man symbolically through the gift of fire (ll. 436–506). Before Prometheus gave them “understanding and a portion of reason,” men lived like children. “Seeing they saw not, and hearing they understood not.” Prometheus did not simply steal fire for them: he taught them to build houses and to weave fabrics, to understand the seasons, and to know the stars; to count and to write; to tame beasts and to build ships. “All human arts are from Prometheus.” (The image of fire that we associate with Prometheus became so central to the archetype of the scientist that we can trace it through the crackling electrical instruments and lightning flashes that dominate every Frankenstein film right down to Robert Oppenheimer at Los Alamos, who allegedly reacted to the first explosion of the atomic bomb by reciting to himself the words from the *Bhagavad-Gita* that described the “radiance of a thousand suns”—a clear instance of the extent to which our imagination is shaped by cultural images or, to put it more crudely, life imitates art.) For Aeschylus science and knowledge may bring suffering; but the acquisition of knowledge stems from a decision consciously made, with dignity and with the full acceptance of ethical responsibility for the act.

The legend of the Fall also occurs relatively late in the formation of Hebrew thought. It is generally agreed that its author, the so-called Yahwist, was writing after the time of Solomon—that is, following the events depicted in the Old Testament down to the times of Chronicles II. Most of the

elements of the story—including a garden of paradise with its serpent, a tree of knowledge, and a temptress—had long been present in a variety of Near Eastern sources, such as the Gilgamesh Epic. The Hebrews were no doubt aware of these tales, but it was not until the tenth century B.C., well after the ethical system of Judaism was firmly established and the race already had a long history, that it seemed desirable or useful to include the story of the Fall as the background of human history. When the narrator of Genesis did incorporate those ancient legends, he shifted their emphasis in a manner that stamps them unmistakably as Hebrew. In Genesis, as opposed to the Gilgamesh Epic, it is sin, not fate, that causes man's "Fall." In Sumero-Akkadian mythology it was perfectly acceptable for man to have divine understanding; Enkidu achieves godlike wisdom through his union with the priestess of love. It was eternal life that the gods prohibited; Gilgamesh seeks the herb of immortality, not the Tree of Knowledge. In Genesis, of course, the circumstances are reversed; God is content for Adam and Eve to eat of the Tree of Life—at least, until they have sinned by tasting the fruit from the forbidden Tree of Knowledge.

What I am suggesting is this: the two great myths of knowledge and responsibility, of science and ethics, are "relatively simultaneous" in Spengler's sense and therefore analogous in their cultural function. Although the constitutive elements of both myths had long been present in both cultures, the myths themselves received their authoritative form—in Genesis and in Aeschylus' *Prometheus Bound*—at that moment in the history of their peoples when consciousness had developed to a point at which man had become aware of its problematic nature. It has often been pointed out that paradise or Golden Age myths arise from an urban nostalgia for the lost joys of rural life—more or less the conditions in the sophistication of Solomon's Jerusalem or the so-called Greek Enlightenment of fifth-century Athens. At a certain point, in any case, the myths were introduced retrospectively into

the existing mythological systems in order to explain etiologically each society's attitude toward scientific advances.

If this model is correct, we can see it verified at other points in history. We have already noted that *Frankenstein*, to the extent that it was a response to an unrestrained commitment to "pure" science, fulfilled precisely the same function for romanticism. If we glance for a moment at the other great modern myth of the scientist—the legend of Faust, who signs a pact with the Devil to obtain knowledge not accessible by ordinary scientific means—we see that precisely the same analogy obtains. I am speaking, of course, not of Goethe's *Faust*, a late treatment of the theme that expresses the romantic ambivalence toward science and knowledge, but of the original sixteenth-century chapbook of 1587, in which *The Historie of the damnable life, and deserved death of Doctor John Faustus* was first completely recorded.

In its original form the chapbook of Faust was a Reformation tract aimed at the untrammelled scientific investigations of the Renaissance that threatened to undermine traditional bourgeois values. For these reasons the Faust of the chapbooks is portrayed in the foulest possible light: he is not merely a charlatan and a magician, but also a ruffian and a pederast. The author of the tract wants to make sure that we have absolutely no sympathy for Faust, who is not yet the noble figure—"the branch that might have grown full straight"—that he was to become only a few years later in Marlowe's tragedy. This Faust is a degenerate, and his lust for forbidden knowledge, like his lust for food or women or young boys, is simply another example of his degeneracy. It is fitting, therefore, that he ends up ignominiously.

But when it was day, the Students that had taken no rest that night, arose and went into the hall in which they left Doctor Faustus, where notwithstanding they found no Faustus, but all the hall lay besprinkled with blood, his brains cleaving to the wall: for the Devil had

beaten him from one wall against another, in one corner lay his eyes, in another his teeth, a pitiful and fearful sight to behold. Then began the Students to bewail and weep for him and sought for his body in many places: lastly they came into the yard where they found his body lying on the horse dung, most monstrously torn, and fearful to behold, for his head and all his joints were dashed in pieces.

Faust, in short, is the Protestant equivalent of the Hebrew myth of the Fall. In both cases a stern and ascetic religious attitude vents its abhorrence of the quest for knowledge that it considers forbidden. When, during the romantic age, the puritanical Judeo-Christian attitude was mollified by the introduction of the Greco-Roman tradition and the story of Prometheus, a new image of the scientist emerged from that synthesis: Goethe's *Faust*, in which the scientist, for all his faults, is redeemed; and Mary Shelley's *Frankenstein*, in which the quest for scientific knowledge attains the classic expression of its modern ambivalence.

We can draw several conclusions from these examples. First of all, our survey has shown that the details change in accordance with the currently fashionable science: the hero may be a stealer of fire like Prometheus, a magician like Faust, a galvanist like Frankenstein, a physicist like Einstein, or in some drama yet to be written a biochemist cloning a new homunculi. But the archetypal pattern remains remarkably constant from Adam to Einstein. In every case humanity looks on with wonder and awe as the seeker strives after forbidden knowledge and, following its acquisition, is appalled at the ethical implications of his science. There has been a gradual internalization of the story, from works in which scientists are punished drastically by such external agents as gods or the devil to the other extreme at which the scientist suffers only the pangs of his own conscience. But this arche-

typal myth, in the various forms it assumes over the ages, provides the exclamation mark that punctuates the prose of the history of science. The legends mark those moments in the growth of human consciousness when mankind, forced to the outer limits by startling new developments in scientific knowledge, must grapple with its conscience to establish the delicate balance between progress and ethics. People are not disturbed by technological advance: the man who reckons his income tax with a pocket calculator can come to terms with the most sophisticated computer; anyone who has flown in a jet can cope imaginatively with space flight. It is new ideas that cause the leaps in consciousness: the notion that the earth revolves around the sun and that man is therefore no longer the center of creation; that matter is composed of energy and that therefore the atom can be split; that life can be created *in vitro* or altered by genetic engineering.

We should be alerted, therefore, when the figure of Frankenstein begins to be invoked frequently and almost routinely in public discussions, for his name—as we have seen in the case of the atomic bomb—is one of the code words that signal a profound cultural malaise. Time does not stand still. In the rhetoric of our nightmares the ominous mushroom cloud of Hiroshima has been displaced by the delicate coils of the double helix. In the summer of 1976, when heated debates were taking place on the campuses of many universities concerning recombinant DNA research, Mayor Alfred Vellucci of Cambridge, Massachusetts, voiced his strong opposition to a so-called P3 facility that Harvard proposed to construct on the fourth floor of its biology laboratory. “We want to be damned sure the people of Cambridge won’t be affected by anything that could crawl out of that laboratory. . . . They may come up with a disease that can’t be cured, even a monster. Is this the answer to Dr. Frankenstein’s dream?” With his inspired allusion Mayor Vellucci seems to have touched an archetypal sore spot. Ever since, poor Frankenstein has again enjoyed a remarkably bad press

—yet a press quite consistent with his actual function as the creator of new life. The *Washington Star* headlined its report on the Cambridge controversy: “Is Harvard the Proper Place for Frankenstein Tinkering?” Later that year a correspondent wrote to *Science* magazine: “Are we really that much further along on the path to comprehensive knowledge that we can forget the overwhelming pride with which Dr. Frankenstein made his monster? . . . Like the physicists before us, we have entered the realm of the Faustian bargain, and it behooves all of us biologists to think very carefully about the conditions of these agreements before we plunge ahead into the darkness.” Michael Rogers entitled a chapter of his book *Biohazard* “The Frankenstein Syndrome.” And at the beginning of their study of genetic engineering, *Who Should Play God?*, Ted Howard and Jeremy Rifkin justified their topic by saying: “Once, all of this could be dismissed as science fiction, or the mad ravings of a Dr. Frankenstein. No more.” It was no doubt such examples as these that led William Barrett to conclude in *The Illusion of Technique* that “the suspicion of technology has become so widespread that the dominant myth of our time may become that of Frankenstein’s monster.”

Donald D. Brown, director of the Carnegie Institution, completely misses the point when he objects that “Frankensteinian spectres raised by proponents of restriction are mostly emotional, political, rhetorical and unscientific.” Of course they are! Yet to a much greater extent than reason is often willing to acknowledge, our thinking—not to mention our voting!—is governed by emotion and rhetoric, no matter how unscientific they may be.

It behooves us, therefore, to ponder these ancient myths and their underlying patterns. Science has provided us with a number of images that have been applied more or less illuminatingly to human affairs: we speak of relativity in morals, entropy in business, a quantum leap in political relations, or the uncertainty principle in human psychology.

Conversely men seem to need myth in order to cope with the human implications of scientific discovery: the biochemists talk of Frankenstein while Oppenheimer chants Vedic poetry. In the beginning science *was* the science of ethics: Adam came away from the Tree of Knowledge knowing precious little about physics or biochemistry but a great deal about Good and Evil. Down to the eighteenth century science was largely subordinated to theology. During the Age of Reason science gradually liberated itself from that domination until, in the nineteenth century, it attained the romantic goal of a value-free science. Frankenstein, anticipating the physicists of the German dramas, stresses the initially playful and, in the loftiest sense, ethically irresponsible aspect of his research.

But doubts—perhaps a nagging theological conscience—have clouded “pure” scientific inquiry from its romantic beginnings. Since Hiroshima science has become increasingly public, social, and hence explicitly ethical again. Its issues are a matter of urgent concern not just to theologians and philosophers but also to the general public. Citizens want to know whether or not they are exposed to biological danger from the laboratory next door, to radiation from the nuclear power reactor down the road, or to falling fragments from a disintegrating Skylab. The scientists themselves participate in the controversy. The epoch-making Asilomar Conference on the ethics of genetic manipulation in 1975 produced the NIH guidelines that catalyzed the public debates in 1976. The records of almost any hearings on biohazards—e.g. the Academy Forum of March 7–9, 1977, sponsored by the National Academy of Sciences—attest to the scientists’ own perplexity and ambivalence on the proper relationship between the ideal of absolute freedom of inquiry and their responsibility to society. (So far the discussion has been liveliest in the United States. But in Germany recently the debate has been complicated by references to the “absolute freedom of inquiry” enjoyed and perpetrated by scientists in the Nazi concentration camps.) Concerned groups

have established such forums as the Hastings Institute of Society, Ethics, and the Life Sciences and the Center for Bioethics in Washington. The National Endowment for the Humanities has sponsored a series of seminars in which scientists meet representatives of various disciplines in order to explore the social and ethical dimensions of their research. Frankenstein, in short, has emerged from his laboratory to attend the town meetings. Faust has swapped his flying wine keg for the jet that spirits him from conference to conference. The question concerning the ethics of science once again enjoys the urgency that it did in the misty beginnings of western civilization. It may well turn out that the conclusions of these conferences on the most timely scientific advances will produce little more than variations and elaborations on the ancient myths of Adam and Prometheus, on the legends of Faust and Frankenstein. We would therefore do well to look again and again at those tales in the light of present experience, if we wish to understand the public response to scientific discovery. Science may change, but man remains constant, and myth is the record of that constant, eternal humanity. In the last analysis nothing is more modern than myth.