

## INTRODUCTION

*Titan! to whose immortal eyes  
The sufferings of mortality,  
Seen in their sad reality,  
Were not as things that gods despise;  
What was thy pity's recompense? . . .*

*Thy Godlike crime was to be kind,  
To render with thy precepts less  
The sum of human wretchedness  
And strengthen Man with his own mind . . .  
Thou art a symbol and a sign  
To Mortals of their fate and force;  
Like Thee, Man is in part divine,  
A troubled stream from a pure source . . .*

—George Gordon, Lord Byron,  
from “Prometheus,” 1816

IN 1992, John Orem, professor of physiology at Texas Tech Health Sciences University, was asked by science reporter Ron Kaufman to comment on the Animal Enterprises Protection Act, a law passed by Congress to make vandalism of animal research laboratories a federal crime. Orem, whose laboratory had been trashed by vandals on July 4, 1989, and who was to endure years of harassment by animal rights activists who objected to his sleep research on cats, commented that although FBI involvement in investigating these crimes might aid local police, “the real ques-

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tion to ask in order to stop the ALF [Animal Liberation Front] is what fuels this deep distrust of scientists? What is behind the disaffection that would turn people violently opposed to biomedicine?"

These questions have seldom been asked by those who have sought to defend biomedical research against its critics. But they provide a key to understanding not only the rage of those few individuals who have vandalized laboratories and harassed scientists, but also the uneasiness of many members of the public and the nonscientific establishment who generally support biomedical research, with occasional reservations. To answer these questions we must journey into the past, as far back as 1816, when a young woman with impeccable literary and political bloodlines sat down to write a story on a dare—and provided the world with an enduring image of demonic science.

### GENEVA, 1816

THE CLOCK strikes two and a woman is writing. Candlelight flickers over the page as she dips her pen into the inkwell. Shadows wrestle on the uneven walls of the villa, and outside a rising wind rustles though the leaves, foreshadowing another torrential rain. A flash of lightning illuminates the room as the woman's sleeping lover stirs in the big curtained bed behind her. The woman writes feverishly, committing her own nightmare to paper. A man, brilliant and obsessed, imagining that he will find a way to overcome death forever. A creature, assembled from disparate parts, a patchwork of corpses, stitched together by the scientist and galvanized into life by an electrical current. The creature's agony and his creator's horror; death not overcome but immeasurably increased.

Mary Godwin Shelley was nineteen years old when she wrote the novel that was to make her name, and that of her creation, immortal. Daughter of two radical eighteenth-century writers, Mary Wollstonecroft and William Godwin, the young woman had

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eloped with another visionary artist, the poet Percy Shelley, in July 1814. Though still young, Mary had already experienced tragedy, including the death of her mother when she was only a few days old and the loss of her first baby. During the summer of 1816, she and Shelley met and befriended another English poet, George Gordon, Lord Byron, who was renting a neighboring villa in Geneva. Soon after they met, Byron read to Mary, Shelley, and his other guests a newly completed poem about Prometheus, who had stolen fire from the gods and been condemned to eternal torment for his crime. In one version of the Greek myth, Prometheus had offered the sacred fire to human beings, who until then had lived like animals, lacking both heat and light; in another version he had used the divine spark to create man. But in both cases, Prometheus had stolen that which belonged to the gods alone, and for that hubris he was punished.

Many years later, Mary Shelley described the environment in which she had conceived her monstrous progeny. "Many and long were the conversations between Lord Byron and Shelley, to which I was a devout but nearly silent listener," she wrote. "During one of these, various philosophical doctrines were discussed, and among others the nature of the principal of life, and whether there was any probability of its ever being discovered and communicated." Byron's guests, who included his physician, John Polidori, speculated that it might be possible to reanimate a corpse. "Galvanism had given token of such things; perhaps the component parts of a creature might be manufactured, brought together and imbued with vital warmth."

Retiring to bed one night soon after Byron had challenged each of his guests to write a tale of horror, Mary lay sleepless. "I busied myself to think of a story—a story to rival those which had excited us to this task. One which would speak to the mysterious fears of our nature, and awaken thrilling horror." Soon enough, her mind produced a vision that would haunt not only her own generation, but each successive generation—a figure who combined atavistic fears of the corruption of the grave and decay and death with a nascent suspicion of human efforts to overcome

these ancient terrors. Over the weeks and months that followed, Mary Shelley poured all of the intellectual intensity of her heritage and social circle into her scientist hero. He was to be the modern Prometheus, and in his name she married brightness with shadow, just as in his character she wove strands of heroism and villainy. She called him Victor, the triumphant one. But the name by which he and his creation would be remembered was his shadowy surname, heavy and Germanic. No doubt she whispered the name to herself as she wrote in the dim room that stormy summer of 1816: Frankenstein.

"I saw—with shut eyes, but acute mental vision—I saw the pale student of unhallowed arts kneeling before the thing he had put together. Frightful must it be; for supremely frightful would be the effect of any human endeavor to mock the stupendous mechanism of the Creator of the world." Mary Shelley wrote those words fifteen years later, in the introduction to the 1831 edition of her novel. Perhaps one of the reasons her creation has flourished and endured, compulsively reworked by other artists, endlessly parodied and imitated and discussed, is that the primal awe and dread expressed so compellingly by Mary Shelley at the dawn of the research era remain inextinguishable components of human psychology today. We retain the primitive sensibilities of our ancestors, one of which is an instinctive shrinking from activities we suspect are taboo. Individuals who violate these taboos, whether by cutting into the dead bodies of humans or the living bodies of animals, have traditionally been viewed with both awe and terror. Science may have rejected the metaphysical tenets of shamanism, but that does not mean that scientists have not assumed the cultural role of the shaman, the hero who ventures into the liminal world between life and death to heal disease and to preserve life and health. Such underworld voyagers have always been simultaneously respected and feared.

"To examine the causes of life, we must first have recourse to death," Shelley's fictional scientist avows. "Darkness had no effect upon my fancy; and a churchyard was to me merely the receptacle of bodies deprived of life, which from being the seat of

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beauty and strength, had become food for the worm.” This bold embrace of materialism, and rejection of any supernatural realms beyond the grave, is coupled in Shelley’s novel (as it was in real life) with a new source of terror. “Who shall conceive the horrors of my secret toil, as I dabbled among the unhallowed damps of the grave, or tortured the living animal to animate the lifeless clay,” Frankenstein tells Captain Walton, his all but silent listener. “I collected bones from charnel-houses; and disturbed, with profane fingers, the tremendous secrets of the human frame.”

In an era when “resurrection men” were removing fresh corpses from graves and selling them to scientists for dissection, and opposition to animal experimentation was related to fear of one’s corpse being sold for dissection, Shelley’s ghoulish scientist was a new kind of bogey to haunt the dreams of adults and children alike. Over the course of the next two centuries, as biomedical researchers ever more successfully probed “the tremendous secrets of the human frame,” scientists’ stature grew and they were no longer perceived as villains by most people. Yet somehow, rather than being assuaged by science’s greatly expanded understanding of human physiology and increasing power to combat disease and death, certain anxieties have multiplied as the boundaries of the “natural” continually recede and science’s powers, the type of powers once termed “occult,” increase. The word *Frankenstein* remains a compelling metaphor for many at the turn of the millennium, as we contemplate placing animal organs in human bodies as substitute parts, manipulating the humane genome to treat or prevent disease, and remaking human and animal bodies from the inside out.

“In a culture in which organ transplants, life-extension machinery, microsurgery, and artificial organs have entered everyday medicine, we seem on the verge of practical realization of the seventeenth-century imagination of body as machine,” writes postmodern philosopher Susan Bordo. “Western science and technology have now arrived, paradoxically but predictably (for it was an element, though submerged and illicit, in the mechanist

conception all along), at a new, postmodern imagination of human freedom from bodily determination. Gradually and surely, a technology that was first aimed at the replacement of malfunctioning parts has generated an industry and an ideology fueled by fantasies of rearranging, transforming, and correcting, an ideology of limitless improvement and change, defying the historicity, the mortality, and indeed the very materiality of the body."

Over one hundred years ago, Charles Darwin showed that humans are a kind of animal. But we are the animal that is not content with the pleasures and limits of animal life. Instead, we push beyond the limits imposed by nature and seek to remake the world, our bodies, and our fates. We seek the powers of gods—and science has given us those powers, producing tremendous benefit and equal anxiety. Scientists, like Prometheus, attempt to acquire knowledge to enhance the lives of human beings. But as the myth of Prometheus and the similar myth of Faust teach us, such knowledge is only acquired at great cost—the cost of one's soul. Whether one believes in the soul as a metaphysical reality or as a shorthand term used to signify an acceptable moral and ethical outlook, for many critics of biomedical research, this loss of "soul" has been clearly evident in the use of animals as the subjects of scientific research and the related objectification and identification of the human person with his or her body.

As the ancient but limited practice of vivisection (experimentation on living animals) was developed into a systematic mode of biological study in the nineteenth century, and knowledge of the body and its workings in health and disease began to grow, critics arose to denounce both the assumptions on which the new methodology was based and the characters of the men wielding the scalpels. Like Victor Frankenstein, these researchers often appeared ghoulish and irreligious to their contemporaries by immersing themselves in matter, oblivious to both the pain they were inflicting on animals and the God-given revulsion their critics thought should prohibit such explorations. Early antivivisectionists contended not only that vivisection was morally wrong

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but that experiments on animals would inevitably lead to experiments on human beings. Others denied that vivisection served any useful purpose, contending that the practice was simple sadism dressed up in the language of science. The assumption behind all criticism, whether spoken or implicit, was that animal experimentation was “unnatural,” that it violated some crucial taboo in a way that even a carnivorous diet did not.

In the nineteenth century, the antivivisection movement in England included some of the most influential and respected members of the British cultural establishment, including the writers Browning, Tennyson, Carlyle, and Ruskin, the great social reformer Lord Shaftesbury, and many other eminent jurists and churchmen. Queen Victoria herself made no secret of her sympathy for the movement. Literary opposition to the practice of animal experimentation even then had a long history; Voltaire and Samuel Johnson and, later, Victor Hugo and George Bernard Shaw were only a few of the writers who spoke out against the practice.

H. G. Wells is an interesting figure to contemplate when considering this topic. Mary and Percy Shelley were prototypical Romantics. But Wells, born over half a century later, was a student of Thomas Huxley and an avid proponent of the benefits of science and technology. His vision of the science-saturated world of the future was often utopian. Yet even this friend of science was compelled to create a scientist hero who is similar in many ways to the complex figure envisioned by Mary Shelley eighty years earlier, and a world in which scientific research unleashed from ethical constraints creates only horror.

In *The Island of Dr. Moreau*, published in 1896, Wells gives full expression to the nebulous anxieties and existential dread of a post-Darwin culture just beginning to grapple with the implications of evolution. The dawning understanding that humans, too, were animals, together with the rapid growth of animal experimentation following the successful experiments of bacteriologists and the development of vaccines for certain infectious diseases shared by humans and animals, created a dilemma. In Moreau’s

laboratory, animals are painfully vivisected in order to be made nearly human, but as Prenderick, a man cast adrift on the island, soon realizes, the process could be reversed. Humans could be made into animals. Prenderick's horror as he hears the screams of a puma being vivisected echoes the anguish experienced by many people when they are first confronted with the high price of scientific knowledge in animal life and suffering—and the inchoate terror of the human animal that imagines itself an equally helpless experimental subject.

"It was as if all the pain in the world had found a voice," Wells wrote, "yet had I known such pain was in the next room, and had it been dumb, I believe—I have thought it since—I could have stood it well enough. It is when suffering finds a voice and sets our nerves quivering that this pity comes troubling us." Lacking a voice themselves, laboratory animals have been represented by the angry, anguished voices of antivivisectionists and other activists who echo Moreau's experimental subjects in naming the research laboratory a "house of pain." This movement has waxed and waned and waxed again over the past hundred and fifty years, but it has never entirely died out and perhaps never will, because at some level antivivisectionists express a discomfort common to many people when they are confronted with the reality of animal suffering and its roots in experimentation to acquire knowledge of human disease.

Biomedical scientists have traditionally carried out work that many people have found disturbing. Unlike the slaughtering of animals for food, which until two generations ago was part of many people's experience, biological experimentation has always been the province of a self-selected elite. Dissecting dead human beings to understand anatomy and creating disease in animals and cutting them open to discover how the body's organs and systems are affected are perceived as gruesome work by many non-scientists, and no amount of Promethean rhetoric has ever been enough to convince some people that they are justified. Even those willing to grant the necessity of these activities often do not wish to know too much about laboratories or the animals who live



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and die there. A kind of “don’t ask, don’t tell” policy has long been in effect, whereby society will permit animal experimentation—and certain types of research on human subjects—as long as it is protected from the details.

Lay criticism and attempts to control research activities are not new phenomena, nor are the determined efforts of scientists to free themselves from public criticism and political control. This conflict has existed from the early years of biomedical research and is not universally based on concerns about animal welfare. What is new is the way in which public and academic suspicion of science has allied itself with the condemnation of the Enlightenment culture that gave birth to both modern science and democracy, colonialism and technology. Christopher Columbus, Isaac Newton, Louis Pasteur, and Thomas Jefferson are now viewed equally, in some quarters, as the bearers of tainted gifts. New worlds were discovered, but at what cost? And wouldn’t it be better if human beings had stayed in the old world, where they belonged—the world of natural limits in which new continents were left unspoiled, animals uncaged, indigenous peoples unenslaved, and viruses free to frolic in their hosts, reducing the number of avaricious Westerners infesting the earth?

This is a tongue-in-cheek summary of some of the most extravagant claims of a motley collection of cultural critics, sometimes designated “the academic left” by their adversaries, though not all are academics. The perspectives espoused by various critics of modernity, science, and technology may lend themselves to parody, yet the genuine scholarly contribution to our understanding of both the positive and negative aspects of Enlightenment culture that underly their critique is valid. For too long, only the positive aspects of this legacy were acknowledged, but over the past thirty years, much that was once denied or repressed has come to light and has been hotly debated in the pages of scholarly journals and in the media. Initially, biomedical scientists ignored this type of criticism. Immersed in their own research, many were unaware that the work of various feminist, Afrocentric, or

postmodern literary scholars had any relevance at all to their own work, work that they firmly believed was not only useful but also ethically sound.

But as the number of academic papers and books and scholarly journals and articles propounding a perspective that is at best suspicious of science's hegemony grew, a few researchers charged forth from their laboratories to counter the enemy. In *Higher Superstition: The Academic Left and Its Quarrels with Science*, published in 1994, biologist Paul R. Gross and mathematician Norman Levitt state in their preface that "the writing of *Higher Superstition* was undertaken only when it became clear to us, from separate but remarkably similar experiences at our respective universities, that something new and unwelcome had found its way into the academic bloodstream and thence into lecture rooms, journals, books and faculty chit-chat: the systematic disparagement of modern science. A public response was clearly needed."

However valiant their attempts to counter the attacks of disaffected humanists and activists Gross and Levitt failed, like many other scientists before them, to ask and address the simple question expressed so powerfully by John Orem in 1992: "What fuels this deep distrust of scientists?" In the face of the measurable improvements that biomedical research in particular has made, and is making, in improving human life and health—many formerly lethal diseases conquered and life spans increased—"What is behind the disaffection that would turn people violently opposed to biomedicine?"

This book is an attempt to answer that question fairly, with respect to both science and its critics. As a science writer, I am fully aware of the value of biomedical research and the role that animal experimentation has played in enhancing human (and animal) health, and I will attempt to describe a few of those contributions. There can be no doubt that the scientific revolution and its aftermath, the age of scientific medicine in which we live, have vastly improved life for millions of human beings. Any critique of science that does not take into account the astounding

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advances in human health over the past hundred and fifty years—infectious diseases like smallpox wiped out, once dreaded killers of children like diphtheria and polio conquered, common illnesses easily treated in most cases—must be viewed with suspicion.

However, I also share some of the concerns expressed by those who assert that we have paid, and will continue to pay, a price for this knowledge and that profound ethical and philosophical dilemmas pervade the enterprise. It was not until late in the twentieth century that the rights of either animal or human subjects of research were seriously debated, and even today the nature of those rights in many instances remains a matter of contention. The costs of viewing animals and humans as biological machines and nature as an inexhaustible reservoir of resources for human manipulation and consumption are by now apparent to all but the most opaque observers. Nonetheless, the sweeping condemnation of “Western culture” implicit in revolutionary critiques such as deep ecology, ecofeminism, and animal rights exhibits the same flaws as every other totalizing ethic in human history. Those who embrace a pure vision, whether of a world redeemed by science or one destroyed by it, are blind to ambiguity and unwilling to ask the wrenching questions that accompany each new discovery. At present, particularly in the field of genetic medicine, these questions are especially painful and difficult to answer.

For anyone committed to the democratic tradition in which competing philosophies and practices are permitted to flourish, the debate surrounding the scientific use of animals and its connection to larger issues is bound to be problematic. At times it seems that scientists and those committed to the scientific worldview stand on one side of a great gulf, and many writers, philosophers, and activists on the other. This schism between the humanities and the sciences was identified by C. P. Snow in *The Two Cultures and the Scientific Revolution*, published in 1960. Snow, who was both a scientist and a novelist, noted that scholars in the humanities are, like the public, often ignorant of basic

scientific facts, and that those who know little of science are in a very weak position to analyze and critique it. However, it is also true that a great deal of the resentment that one finds directed against science and scientists is linked to the kind of elitist disparagement of lay concerns that permeates science. This tendency to dismiss all criticism as uninformed and unfounded is evident in books like *Higher Superstition*, which attempts to counter challenges posed by fellow academics, and is even more pronounced when the scientific community is confronted by individuals who do not possess academic credentials but nonetheless have legitimate questions about both the means and the ends of research.

At times it appears that it will be impossible to bridge the chasm that separates those who believe that under no circumstances is it permissible for animals to be used in scientific experimentation (or for humans to order the natural world according to their own needs and desires) from those to whom the natural world, including even the human genome, is a plastic and infinitely malleable tool. We may soon have within our grasp the power to remake ourselves, at the most basic level. What might be the outcome of this experiment none can now foresee. But it is certain that history has something to teach us about the dangers of both scientific hubris and public ignorance of science. Somehow these two problems seems a matched set, both a cause of the conflict described in the pages of this book, and its direct result.

A few years after Mary Shelley wrote *Frankenstein, or The Modern Prometheus*, her husband published a work that championed the opposing perspective. In his great poem *Prometheus Unbound*, Percy Bysshe Shelley expressed a hope that he shared with William Godwin: a world set free by the power of science and reason. Mary Shelley was aware of her father's desire for a society freed from ancient superstition and religious orthodoxy, a rational utopia. But in her own masterpiece, she delineated the horrifying outcome when reason is divorced from feeling and science from ethics. She dedicated her book, with its masterful

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depiction of the pain caused by rationality and intellect unleavened by compassion, to her father. Rather than viewing this family quarrel as a purely personal matter, it may be helpful to see it as one manifestation of an ongoing struggle, one that neither side can ever win but that is nonetheless necessary and appropriate.

“When Shelley pictured science as a modern Prometheus who would wake the world to a wonderful dream of Godwin, he was alas too simple,” commented physicist Jacob Bronowski as he contemplated the wreckage of Nagasaki. “But it is as pointless to read what has happened since as a nightmare. Dream or nightmare, we have to live our experience as it is, and we have to live it awake. We live in a world which is penetrated through and through by science, and which is both whole and real. We cannot turn it into a game simply by taking sides.”