The Craftsman

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For Alan and Lindsay

travail, opium unique

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Acknowledgments

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Prologue: Man as His Own Maker

Pandora's Casket

Hannah Arendt and Robert Oppenheimer

Just after the Cuban Missile Crisis, the days in 1962 when the world was on the brink of atomic war, I ran into my teacher Hannah Arendt on the street. The missile crisis had shaken her, like everyone else, but it had also confirmed her deepest conviction. In *The Human Condition,* she had argued a few years previously that the engineer, or any maker of material things, is not master of his own house; politics, standing above the physical labor, has to provide the guidance. She had come to this conviction by the time the Los Alamos project created the first atomic bombs in 1945. Now, during the missile crisis, Americans too young for the Second World War had also felt real fear. It was freezing cold on the New York street, but Arendt was oblivious. She wanted me to draw the right lesson: people who make things usually don't understand what they are doing.

Arendt's fear of self-destructive material invention traces back in Western culture to the Greek myth of Pandora. A goddess of invention, Pandora was "sent to earth by Zeus as punishment for Prometheus's transgression."[1] Hesiod described Pandora in *Works and Days* as the "bitter gift of all the gods" who, when she opened her casket (or in some versions, her jar) of new wonders, "scattered pains and evils among

men."[2] In the working out of Greek culture, its peoples came increasingly to believe that Pandora stood for an element of their *own* natures; culture founded on man-made things risks continual self-harm.

Something nearly innocent in human beings can produce this risk: men and women are seduced by sheer wonder, excitement, curiosity, and so create the fiction that opening the casket is a neutral act. About the first weapon of mass destruction, Arendt could have cited a diary note made by Robert Oppenheimer, director of the Los Alamos project. Oppenheimer reassured himself by asserting, "When you see something that is technically sweet, you go ahead and do it and you argue about what to do about only after you have had your technical success. That is the way it was with the atomic bomb."[3]

The poet John Milton told a similar story about Adam and Eve, as an allegory for the dangers of curiosity, with Eve taking the Oppenheimer role. In Milton's primal Christian scene, the thirst for knowledge, rather than for sex, leads human beings to harm themselves. Pandora's image remains potent in the writings of the modern theologian Reinhold Niebuhr, who observes that it is human nature to believe that anything that seems possible should therefore be tried.

Arendt's generation could put numbers to the fear of self-destruction, numbers so large as to numb the mind. At least seventy million people perished in wars, concentration camps, and gulags in the first fifty years of the twentieth century. In Arendt's view, these numbers represent the compound of scientific blindness and bureaucratic power—bureaucrats minded just to get the job done, embodied for her by the Nazi death-camp organizer Adolf Eichmann, to whom she attached the label "the banality of evil."

Today, peacetime material civilization posts equally numbing figures of self-made self-harm: one million, for instance, represents the number of years Nature took to create the amount of fossil fuel now consumed in a single year. The ecological crisis is Pandoric, man-made; technology may be an unreliable ally in regaining control.[4] The

mathematician Martin Rees describes a revolution in microelectronics that creates at least the possibility of a robotic world beyond the powers of ordinary human beings then to rule; Rees envisions such exotica as self-replicating microrobots intended to clean smog that might instead devour the biosphere.[5] A more urgent example is genetic engineering of both crops and animals.

Fear of Pandora creates a rational climate of dread—but dread can be itself paralyzing, indeed malign. Technology itself can seem the enemy rather than simply a risk. Pandora's environmental casket was too easily closed, for instance, in a speech given by Arendt's own teacher, Martin Heidegger, near the end of his life, at Bremen in 1949. On this infamous occasion Heidegger "discounted the uniqueness of the Holocaust in terms of the 'history of man's misdeeds' by comparing 'the manufacture of corpses in the gas chambers and the death camp' to mechanized agriculture." In the historian Peter Kempt's words, "Heidegger thought that both should be regarded as embodiments of the 'same technological frenzy' which, if left unchecked, would lead to a world-wide ecological catastrophe."[6]

If the comparison is obscene, Heidegger speaks to a desire in many of us, that of returning to a way of life or achieving an imaginary future in which we will dwell more simply in nature. As an old man Heidegger wrote in a different context that "the fundamental character of dwelling is this sparing and preserving," against the claims of the modern machine world.[7] A famous image in these writings of his old age invokes "a hut in the Black Forest" to which the philosopher withdraws, limiting his place in the world to the satisfaction of simple needs.[8] This is perhaps a desire that could be kindled in anyone facing the big numbers of modern destruction.

In the ancient myth, the horrors in Pandora's casket were not humans' fault; the gods were angry. Pandora-fear in a more secular age is more disorienting: the inventors of atomic weapons coupled curiosity with culpability; the unintended consequences of curiosity are

hard to explain. Making the bomb filled Oppenheimer with guilt, as it did I. I. Raby, Leo Szilard, and many others who worked at Los Alamos. In his diary, Oppenheimer recalled the Indian god Krishna's words, "I am become Death, the destroyer of worlds."[9] Experts in fear of their own expertise: what could be done about this terrible paradox?

When Oppenheimer gave the Reith Lectures for the BBC, subsequently published as *Science and the Common Understanding,* in 1953—broadcasts intended to explain the place of science in modern society—he argued that treating technology as an enemy will only render humanity more helpless. Yet, consumed by worry over the nuclear bomb and its thermonuclear child, in this political forum he could offer his listeners no practical suggestions about how to cope with it. Though confused, Oppenheimer was a worldly man. He was entrusted at a relatively young age with the bomb project during the Second World War, he combined a first-class brain with the talent to manage a large group of scientists; his skills were both scientific and corporate. But to these insiders, too, he could provide no satisfying picture of how their work should be used. Here are his parting words to them on November 2, 1945: "It is good to turn over to mankind at large the greatest possible power to control the world and to deal with it according to its lights and its values."[10] The creator's works become the public's problem. As David Cassidy, one of Oppenheimer's biographers, has observed, the Reith Lectures thus proved "a huge disappointment for both the speaker and his listeners."[11]

If the experts cannot make sense of their work, what of the public? Though I suspect Arendt knew little about physics, she took up Oppenheimer's challenge: let the public indeed deal with it. She had a robust faith that the public could understand the material conditions in which it dwells and that political action could stiffen humankind's will to be master in the house of things, tools, and machines. About the weapons in Pandora's casket, she told me, there should have been public discussion about the bomb even while it was being made; whether rightly or wrongly, she believed that the secrecy of the technical process could have been protected even as this discussion occurred. The reasons for this faith appear in her greatest book.

The Human Condition, published in 1958, affirms the value of human beings openly, candidly speaking to each other. Arendt writes, "Speech and action . . . are the modes in which human beings appear to each other, not indeed as physical objects, but *qua* men. This appearance, as distinguished from mere bodily existence, rests on initiative, but it is an initiative from which no human being can refrain and still be human." And she declares, "A life without speech and without action is literally dead to the world."[12] In this public realm, through debate, people ought to decide which technologies should be encouraged and which should be repressed. Though this affirmation of talk may well seem idealistic, Arendt was in her own way an eminently realistic philosopher. She knew that public discussion of human limits can never be the politics of happiness.

Nor did she believe in religious or natural truths that could stabilize life. Rather, like John Locke and Thomas Jefferson, Arendt believed that a polity differs from a landmarked building or "world heritage site": laws should be unstable. This liberal tradition imagines that the rules issuing from deliberation are cast in doubt as conditions change and people ponder further; new, provisional rules then come into being. Arendt's contribution to this tradition turns in part on the insight that the political process exactly parallels the human condition of giving birth and then letting go of the children we have made and raised. Arendt speaks of *natality* in describing the process of birth, formation, and separation in politics.[13] The fundamental fact of life is that nothing lasts—yet in politics we need something to orient us, to lift us above the confusions of the moment. The pages of *The Human Condition* explore how language might guide us, as it were, to swim against the turbulent waters of time.

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As her student almost a half-century ago, I found her philosophy largely inspiring, yet even then it seemed to me not quite adequate to deal with the material things and concrete practices contained in Pandora's casket. The good teacher imparts a satisfying explanation; the great teacher—as Arendt was—unsettles, bequeaths disquiet, invites argument. Arendt's difficulty in dealing with Pandora seemed to me, dimly then and more clearly now, to lie in the distinction she draws a distinction between *Animal laborens* and *Homo faber.* (*Man* does not, clearly, mean just men. Throughout this book, when I have to deal with gendered language, I'll try to make clear when *man* refers generically to human beings and when it applies only to males.) These are two images of people at work; they are austere images of the human condition, since the philosopher excludes pleasure, play, and culture.

Animal laborens is, as the name implies, the human being akin to a beast of burden, a drudge condemned to routine. Arendt enriched this image by imagining him or her absorbed in a task that shuts out the world, a state well exemplified by Oppenheimer's feeling that the atomic bomb was a "sweet" problem, or Eichmann's obsession with making the gas chambers efficient. In the act of making it work, nothing else matters; *Animal laborens* takes the work as an end in itself.

By contrast, *Homo faber* is her image of men and women doing another kind of work, making a life in common. Again Arendt enriched an inherited idea. The Latin tag *Homo faber* means simply "man as maker." The phrase crops up in Renaissance writings on philosophy and in the arts; Henri Bergson had, two generations before Arendt, applied it to psychology; she applied it to politics, and in a special way. *Homo faber* is the judge of material labor and practice, not *Animal laborens*'s colleague but his superior. Thus, in her view, we human beings live in two dimensions. In one we make things; in this condition we are amoral, absorbed in a task. We also harbor another, higher way

of life in which we stop producing and start discussing and judging together. Whereas *Animal laborens* is fixated in the question "How?" *Homo faber* asks "Why?"

This division seems to me false because it slights the practical man or woman at work. The human animal who is *Animal laborens* is capable of thinking; the discussions the producer holds may be mentally with materials rather than with other people; people working together certainly talk to one another about what they are doing. For Arendt, the mind engages once labor is done. Another, more balanced view is that thinking and feeling are contained within the process of making.

The sharp edge of this perhaps self-evident observation lies in its address to Pandora's box. Leaving the public to "sort out the problem" after the work is done means confronting people with usually irreversible facts on the ground. Engagement must start earlier, requires a fuller, better understanding of the process by which people go about producing things, a more materialistic engagement than that found among thinkers of Arendt's stripe. To cope with Pandora requires a more vigorous cultural materialism.

The word *materialism* should raise a warning flag; it has become debased, stained in recent political history by Marxism and in everyday life by consumer fantasy and greed. "Materialistic" thinking is also obscure because most of us use things like computers or automobiles that we do not make for ourselves and that we do not understand. About "culture" the literary critic Raymond Williams once counted several hundred modern usages.[14] This wild verbal garden divides roughly into two big beds. In one, culture stands for the arts alone, in the other it stands for the religious, political, and social beliefs that bind a people. "Material culture" too often, at least in the social sciences, slights cloth, circuit boards, or baked fish as objects worthy of regard in themselves, instead treating the shaping of such physical things as mirrors of social norms, economic interests, religious convictions—the thing in itself is discounted.

So we need to turn a fresh page. We can do so simply by asking—though the answers are anything but simple—what the process of making concrete things reveals to us about ourselves. Learning from things requires us to care about the qualities of cloth or the right way to poach fish; fine cloth or food cooked well enables us to imagine larger categories of "good." Friendly to the senses, the cultural materialist wants to map out where pleasure is to be found and how it is organized. Curious about things in themselves, he or she wants to understand how they might generate religious, social, or political values. *Animal laborens* might serve as *Homo faber*'s guide.

In my own old age I've returned mentally to that street on the Upper West Side. I want to make the case my juvenile self could not then make to Arendt, that people can learn about themselves through the things they make, that material culture matters. As she aged, my teacher became more hopeful that *Homo faber*'s powers of judgment could save humanity from itself. In my winter, I've become more hopeful about the human animal at work. The contents of Pandora's box can indeed be made less fearsome; we can achieve a more humane material life, if only we better understand the making of things.

The Project

The Craftsman; Warriors and Priests; the Foreigner

This is the first of three books on material culture, all related to the dangers in Pandora's casket, though each is intended to stand on its own. This book is about craftsmanship, the skill of making things well. The second volume addresses the crafting of rituals that manage aggression and zeal; the third explores the skills required in making and inhabiting sustainable environments. All three books address the issue of *technique*—but technique considered as a cultural issue rather than as a mindless procedure; each book is about a technique for conducting a particular way of life. The large project contains a personal paradox that I have tried to put to productive use. I am a philosophically minded writer asking questions about such matters as woodworking, military drills, or solar panels.

"Craftsmanship" may suggest a way of life that waned with the advent of industrial society—but this is misleading. Craftsmanship names an enduring, basic human impulse, the desire to do a job well for its own sake. Craftsmanship cuts a far wider swath than skilled manual labor; it serves the computer programmer, the doctor, and the artist; parenting improves when it is practiced as a skilled craft, as does citizenship. In all these domains, craftsmanship focuses on objective standards, on the thing in itself. Social and economic conditions, however, often stand in the way of the craftsman's discipline and commitment: schools may fail to provide the tools to do good work, and workplaces may not truly value the aspiration for quality. And though craftsmanship can reward an individual with a sense of pride in work, this reward is not simple. The craftsman often faces conflicting objective standards of excellence; the desire to do something well for its own sake can be impaired by competitive pressure, by frustration, or by obsession.

The Craftsman explores these dimensions of skill, commitment, and judgment in a particular way. It focuses on the intimate connection between hand and head. Every good craftsman conducts a dialogue between concrete practices and thinking; this dialogue evolves into sustaining habits, and these habits establish a rhythm between problem solving and problem finding. The relation between hand and head appears in domains seemingly as different as bricklaying, cooking, designing a playground, or playing the cello— but all these practices can misfire or fail to ripen. There is nothing inevitable about becoming skilled, just as there is nothing mindlessly mechanical about technique itself.

Western civilization has had a deep-rooted trouble in making connections between head and hand, in recognizing and encouraging the impulse of craftsmanship. These difficulties are explored in the first

part of the book. It begins as a story about workshops—the guilds of medieval goldsmiths, the ateliers of musical instrument makers like Antonio Stradivari, modern laboratories—in which masters and apprentices, work together but as unequals. The craftsman's struggle with machines is portrayed in the eighteenth-century invention of robots, in the pages of that bible of the Enlightenment, Diderot's *Encyclopedia,* and in the nineteenth century's growing fear of industrial machines. The craftsman's consciousness of materials appears in the long history of making bricks, a history that stretches from ancient Mesopotamia to our own time, a history that shows the way anonymous workers can leave traces of themselves in inanimate things.

In its second part, the book explores more closely the development of skill. I make two contentious arguments: first, that all skills, even the most abstract, begin as bodily practices; second, that technical understanding develops through the powers of imagination. The first argument focuses on knowledge gained in the hand through touch and movement. The argument about imagination begins by exploring language that attempts to direct and guide bodily skill. This language works best when it shows imaginatively how to do something. The use of imperfect or incomplete tools draws on the imagination in developing the skills to repair and to improvise. The two arguments combine in considering how resistance and ambiguity can be instructive experiences; to work well, every craftsman has to learn from these experiences rather than fight them. A diverse group of case studies illustrates the grounding of skill in physical practice—the hand habits of striking a piano key or using a knife; the written recipes used to guide the neophyte cook; the use of imperfect scientific instruments like the first telescopes or puzzling instruments like the anatomist's scalpel; the machines and plans that can work with resistances of water, ambiguities on land. Developing skill in all these domains is arduous, but it is not mysterious. We can understand those imaginative processes that enable us to become better at doing things.

In its third part, the book addresses more general issues of motivation and talent. The argument here is that motivation matters more than talent, and for a particular reason. The craftsman's desire for quality poses a motivational danger: the obsession with getting things perfectly right may deform the work itself. We are more likely to fail as craftsmen, I argue, due to our inability to organize obsession than because of our lack of ability. The Enlightenment believed that everyone possesses the ability to do good work of some kind, that there is an intelligent craftsman in most of us; that faith stills makes sense.

Craftsmanship is certainly, from an ethical point of view, ambiguous. Robert Oppenheimer was a committed craftsman; he pushed his technical skills to the limit to make the best bomb he could. Yet the craftsman's ethos contains countervailing currents, as in the principle of using minimum force in physical effort. The good craftsman, moreover, uses solutions to uncover new territory; problem solving and problem finding are intimately related in his or her mind. For this reason, curiosity can ask, "Why?" and well as, "How?" about any project. The craftsman thus both stands in Pandora's shadow and can step out of it.

The book concludes by considering how the craftsman's way of working can give people an anchor in material reality. History has drawn fault lines dividing practice and theory, technique and expression, craftsman and artist, maker and user; modern society suffers from this historical inheritance. But the past life of craft and craftsmen also suggests ways of using tools, organizing bodily movements, thinking about materials that remain alternative, viable proposals about how to conduct life with skill.

* * *

The volumes that follow build on the character of craft set out in this first book. Pandora remains their provocation. Pandora is a goddess of aggressive destruction; the priest and the warrior are her representa-

tives, and in most cultures they entwine. In the second volume of the project I explore what might inflame or tame their combined power.

Religion and war are both organized through rituals, and I investigate ritual as a kind of craft. That is, I'm less interested in the ideologies of nationalism or jihad than in the ritual practices that train and discipline the human body to attack or pray, or the rituals that cause groups of bodies to deploy on the battlefield or within sacred spaces. Again, codes of honor become concrete by choreographing movement and gesture within the physical containers of walls, military camps, and battlefields on one hand, and shrines, burial grounds, monasteries, and retreats on the other. Ritual requires skill; it needs to be done well. The priest-craftsman or warrior-craftsman will share the ethos of other craftsmen when seeking to do the work well for its own sake. The aura surrounding ritual suggests that it is mysterious in origin, veiled in operation. *Warriors and Priests* seeks to see behind this veil, by exploring how the craft of ritual makes faith physical. My aim in this study is to understand how the fatal marriage of religion and aggression might possibility be altered by changing the ritual practices in each. This is a speculative enterprise, to be sure—but it seems more realistic to explore how concrete behavior might change or be regulated than to counsel a change of heart.

The final book in the project returns to more certain terrain, the earth itself. In both natural resources and climate change, we are facing a physical crisis largely of our own human making. The myth of Pandora has become now a secular symbol of self-destruction. To deal with this physical crisis we are obliged to change both the things we make and how we use them. We will need to learn different ways of making buildings and transport and to contrive rituals that accustom us to saving. We will need to become good craftsmen of the environment.

The word *sustainable* is now used to convey this kind of craftsmanship, and it carries a particular baggage. *Sustainable* suggests living more at one with nature, as Martin Heidegger imagined in his old age,

establishing an equilibrium between ourselves and the resources of the earth—an image of balance and reconciliation. In my view, this is an inadequate, insufficient view of environmental craft; to change both productive procedures and rituals of use requires a more radical self-critique. A stronger jolt to changing how we have used resources would come in imagining ourselves to be like immigrants thrust by chance or fate onto a territory not our own, foreigners in a place we cannot command as our own.

The stranger, remarks the sociologist Georg Simmel, learns the art of adaptation more searchingly, if more painfully, than people who feel entitled to belong, at peace with their surrounding. In Simmel's view, the foreigner also holds up a mirror to the society into which he or she enters, since the foreigner cannot take for granted ways of life that seem to natives just natural.[15] So great are the changes required to alter humankind's dealings with the physical world that only this sense of self-displacement and estrangement can drive the actual practices of change and reducing our consuming desires; the dream of dwelling in equilibrium and at peace with the world risks, in my view, leading us to seek escape in an idealized Nature, rather than confronting the self-destructive territory we have actually made. At least this is my starting point in trying to understand the techniques of environmental craft different kind, and why I've titled this third volume *The Foreigner*. That craft is now foreign to us.

* * *

This is in sum the project on material culture I envision. *The Craftsman, Warriors and Priests,* and *The Foreigner* tell together a story about the declaration made by Shakespeare's Coriolanus: "I am my own maker." Materially, humans are skilled makers of a place for themselves in the world. Pandora hovers over this story in objects, in rituals, and in the earth itself. Pandora can never be laid to rest; the Greek goddess represents inextinguishable human powers of mismanagement, self-

inflicted harm, and confusion. But these powers can perhaps be caged if understood materially.

I write within a long-standing tradition, that of American pragmatism, a tradition explained more fully at the end of this volume. Pragmatism has sought to join philosophy to concrete practices in the arts and sciences, to political economy, and to religion; its distinctive character is to search for the philosophic issues embedded in everyday life. The study of craft and technique is simply a logical next chapter in pragmatism's unfolding history.

A Note on History
The Shortness of Time

In this project my guide to using the record of history is a thought experiment proposed by the biologist John Maynard Smith. He asks us to imagine a two-hour film that clocks, greatly speeded up, evolution from the first vertebrates to the appearance of ourselves: "tool-making man would appear only in the last minute." Then he imagines a second two-hour film, charting the history of tool-making man: "the domestication of animals and plants would be shown only during the last half minute, and the period between the invention of the steam engine and the discovery of atomic energy would be only one second."[16]

The point of the thought experiment is to challenge the famous phrase that opens L. P. Hartley's novel *The Go-Between:* "The past is a foreign country." In the fifteen seconds of recorded civilization, there's no reason why Homer, Shakespeare, Goethe, or simply a grandmother's letters should be alien to our understanding. Culture's time in natural history is short. Yet in these same few seconds human beings have contrived enormously different ways to live.

In studying material culture, I've treated the historical record as a catalogue of experiments in making things, performed by experimenters who are not alien to us, whose experiments we can understand.

If in this way culture's time is short, in another way it is long. Because cloth, pots, tools, and machines are solid objects, we can return to them again and again in time; we can linger as we cannot in the flow of a discussion. Nor does material culture follow the rhythms of biological life. Objects do not inevitably decay from within like a human body. The histories of things follow a different course, in which metamorphosis and adaptation play a stronger role across human generations.

I might have conducted this exploration by writing a strict linear narrative, beginning with the Greeks, ending where we are now. Instead, I've preferred to write thematically, going between past and present, to assemble the experimental record. When I've judged that the reader needs detailed context, I've provided it; when not, not.

Material culture provides in sum a picture of what human beings are capable of making. This seemingly limitless view is bounded by self-inflicted harm whether occurring innocently, by intent, or by accident. Retreat into spiritual values is unlikely to furnish much help in coping with Pandora. Nature might be a better guide, if we understand our own labors as part of its being.

PART ONE Craftsmen

an NHS decisively reformed several times in a decade. Any organizational reform takes time to "bed in"; people have to learn how to put the changes into practice—whom now to call, which forms to use, what procedures to follow. If a patient is having a heart attack, you do not want to reach for your "Manual of Best-Practice Performances" to discover the latest rules about what you are supposed to do. The process of bedding in takes longer the bigger and more complex the organization in which one works. The NHS, Britain's biggest employer, consists of more than 1.1 million people. It cannot turn like a sailboat. Both nurses and doctors are still learning the changes proposed a decade ago.

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Embedding stands for a process essential to all skills, the conversion of information and practices into tacit knowledge. If a person had to think about each and every movement of waking up, she or he would take an hour to get out of bed. When we speak of doing something "instinctively," we are often referring to behavior we have so routinized that we don't have to think about it. In learning a skill, we develop a complicated repertoire of such procedures. In the higher stages of skill, there is a constant interplay between tacit knowledge and self-conscious awareness, the tacit knowledge serving as an anchor, the explicit awareness serving as critique and corrective. Craft quality emerges from this higher stage, in judgments made on tacit habits and suppositions. When an institution like the NHS, in churning reform, doesn't allow the tacit anchor to develop, then the motor of judgment stalls. People have no experience to judge, just a set of abstract propositions about good-quality work.

Proponents of absolutist standards of quality, however, have many worries about the interchange between tacit and explicit knowledge—as long ago as in Plato's writings on craftsmanship, the experiential standard is treated with suspicion. Plato views it as too often an excuse

for mediocrity. His modern heirs in the NHS wanted to root out embedded knowledge, expose it to the cleansing of rational analysis—and have become frustrated that much of the tacit knowledge nurses and doctors have acquired is precisely knowledge they cannot put into words or render as logical propositions. Michael Polanyi, the modern philosopher most attuned to tacit knowledge, has recognized the justice of this worry. Bedded in too comfortably, people will neglect the higher standard; it is by arousing self-consciousness that the worker is driven to do better.

Here, then, is an emblematic conflict in measures of quality, from which follow two different concepts of institutional craftsmanship. To take a generous view, the reformers of the NHS are crafting a system that works correctly, and their impulse to reform reflects something about all craftsmanship; this is to reject muddling through, to reject the job just good enough, as an excuse for mediocrity. To take an equally generous view of the claims of practice, it encompasses pursuing a problem—be it a disease, a bumper railing, or a piece of the Linux computer kernel—in all its ramifications. This craftsman must be patient, eschewing quick fixes. Good work of this sort tends to focus on relationships; it either deploys relational thinking about objects or, as in the case of the NHS nurses, attends to clues from other people. It emphasizes the lessons of experience through a dialogue between tacit knowledge and explicit critique.

Thus, one reason we may have trouble thinking about the value of craftsmanship is that the very word in fact embodies conflicting values, a conflict that in such institutional settings as medical care is, so far, raw and unresolved.

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An ancient ideal of craftsmanship, celebrated in the hymn to Hephaestus, joined skill and community. Traces of that ancient ideal are still evident today among Linux programmers. They seem an unusual,

marginal group because of three troubled ways in which craftsmanship is now organized.

The first trouble appears in the attempts of institutions to motivate people to work well. Some efforts to motivate good work for the sake of the group have proved hollow, like the degradation of Marxism in Soviet civil society. Other collective motivations, like those in postwar Japanese factories, have succeeded. Western capitalism has sometimes claimed that individual competition rather than collaboration most effectively motivates people to work well, but in the high-tech realm, it is firms that enable cooperation who have achieved high-quality results.

A second trouble lies in developing skill. Skill is a trained practice; modern technology is abused when it deprives its users precisely of that repetitive, concrete, hands-on training. When the head and the hand are separated, the result is mental impairment—an outcome particularly evident when a technology like CAD is used to efface the learning that occurs through drawing by hand.

Third, there is the trouble caused by conflicting measures of quality, one based on correctness, the other on practical experience. These conflict institutionally, as in medical care, when reformers' desire to get things right according to an absolute standard of quality cannot be reconciled with standards of quality based on embedded practice. The philosopher finds in this conflict the diverging claims of tacit and explicit knowledge; the craftsman at work is pulled in contrary directions.

We can understand these three troubles better by looking more deeply into their history. In the next chapter we explore the workshop as a social institution that motivates craftsmen. Following that, we look at the eighteenth-century Enlightenment's first efforts to make sense of machines and skills. Last, we look at tacit and explicit consciousness in the long history of crafting a particular material.

CHAPTER TWO

The Workshop

The workshop is the craftsman's home. Traditionally this was literally so. In the Middle Ages craftsmen slept, ate, and raised their children in the places where they worked. The workshop, as well as a home for families, was small in scale, each containing at most a few dozen people; the medieval workshop looked nothing like the modern factory containing hundreds or thousands of people. It's easy to see the romantic appeal of the workshop-home to socialists who first confronted the industrial landscape of the nineteenth century. Karl Marx, Charles Fourier, and Claude Saint-Simon all viewed the workshop as a space of humane labor. Here they, too, seemed to find a good home, a place where labor and life mixed face-to-face.

Yet this beguiling image is misleading. The medieval workshop-home did not follow the rules of a modern family guided by love. Organized into a system of guilds, the workshop provided other, more impersonal emotional rewards, most notably, honor in the city. "Home" suggests established stability; this the medieval workshops had to struggle for, since they could not assume they would survive. The workshop as home may also obscure this living scene of labor today. Most scientific laboratories are organized as workshops in the sense that they are small, face-to-face places of work. So, too, can workshop conditions be

carved out of giant enterprises: modern auto plants combine the assembly line with spaces reserved for small, specialist teams; the auto factory has become an archipelago of workshops.

A more satisfying definition of the workshop is: a productive space in which people deal face-to-face with issues of authority. This austere definition focuses not only on who commands and who obeys in work but also on skills as a source of the legitimacy of command or the dignity of obedience. In a workshop, the skills of the master can earn him or her the right to command, and learning from and absorbing those skills can dignify the apprentice or journeyman's obedience. In principle.

To use this definition we need to take account of authority's antonym: autonomy, self-sufficing work conducted without the interference of another. Autonomy has its own seductive power. We might easily imagine that the Soviet construction workers described in the previous chapter would have worked more diligently if they had held more control over their own labor. The British nurses and doctors certainly believed that they could get on better with a difficult job if left alone. They should be masters of their own house. No one working alone could figure out, however, how to glaze windows or to draw blood. In craftsmanship there must be a superior who sets standards and who trains. In the workshop, inequalities of skill and experience become face-to-face issues. The successful workshop will establish legitimate authority in the flesh, not in rights or duties set down on paper. In the failed workshop, subordinates like the Russian construction workers will become demoralized or, like British nurses at the medical convention, grow angry in the physical presence of those whom they must nonetheless obey.

The social history of craftsmanship is in large part a story of the efforts of workshops to face or duck issues of authority and autonomy. Workshops do have other aspects, in their dealings with markets, their quest for funds and profits. The social history of workshops emphasizes how the institutions have organized themselves to embody authority. A significant moment in the history of workshops occurred at the end of the medieval era—a particularly illuminating passage for the problems of authority today.

The Guild House

The Medieval Goldsmith

The medieval craftsman's authority rested on the fact that he was a Christian. Early Christianity had from its origins embraced the dignity of the craftsman. It mattered to theologians and laymen alike that Christ was the son of a carpenter, God's humble origins sending a signal about the universality of his message. Augustine thought Adam and Eve "fortunate to work in a garden. . . . Is there any more marvelous sight than the sowing of seeds, the planting of cuttings, the transplanting of shrubs?"[1] The religion embraced the work of the craftsman, moreover, because these labors could counteract the human propensity for self-destruction. As in the hymn to Hephaestus, craftwork seemed peaceable and productive rather than violent. For this reason, in the Middle Ages there appeared new craftsmen-saints. In Anglo-Saxon Britain, for instance, Saints Dunstan and Ethelwold were both metalworkers, venerated for their calm industry.

Although it respected craftwork, medieval Christian doctrine also feared the human Pandora, a fear that can be traced back to the faith's origins. Pagan Rome—in its belief that the work of one's hands can reveal much about the soul—represented a monumental folly. Augustine argued in the *Sermons* that *confessio* means "accusation of oneself; praise of God."[2] The principle of Christian retreat was founded on the conviction that the further a person can get from obsessing about material things, the closer he or she will come to discovering a timeless inner life not of human making. Doctrinally, the craftsman represents Christ's appearance to humankind but not his being.

The early medieval Christian craftsman found his spiritual home on earth in monasteries such as that of Saint Gall in what is now Switzerland, a walled mountain refuge within which monks gardened, practiced carpentry, and concocted herbal medicines as well as prayed. Saint Gall harbored lay craftsmen whose lives were almost equally subject to monastic discipline. In a nearby nunnery, nuns in strict seclusion nonetheless spent much of each day in the practical activities of weaving and sewing. Saint Gall and kindred monasteries were largely self-sufficient communities, "sustainable" we would say, producing most of what they needed for survival. The workshops of Saint Gall followed the precepts of authority according to the dual canon of the faith: the Holy Spirit can appear to men and women under these conditions; the Spirit is not, however, contained within the walls.

As cities developed in the twelfth and thirteenth centuries, the workshop became a different sort of space both sacred and profane. A contrast of the parish surrounding the Cathedral of Notre-Dame in Paris in 1300 to the monastery at Saint Gall three hundred years earlier, in 1000, shows some of the differences. The urban episcopal parish contained many private houses—"private" in that a workshop leased or bought premises from the parish and in that monks and religious officials could not enter these houses at will. The Bishop's Landing on the south side of the Seine served the religious community as a door for goods; Saint Landry's Landing on the north side served the intermingled lay community. When Jehan de Chelles began the final phase of building this urban community in the mid-thirteenth century, the State appeared in its inaugural celebrations as the equal partner of the Church. Together and equally these two authorities celebrated "the building trades, feting the carvers, glassblowers, weavers and carpenters who did the manual labor, and the bankers who financed the work."[3]

The guilds were corporations that attempted to translate the principle *rex qui nunquam moritur*—the king never dies—into profane

terms.[4] Legal documents partly sustained the guilds, but even more the hands-on transmission of knowledge from generation to generation aimed to make them sustainable. This "knowledge capital" was intended as the source of the guild's economic power. The historian Robert Lopez pictures the urban guild as "a federation of autonomous workshops, whose owners [the masters] normally made all decisions and established the requirements for promotion from the lower ranks [journeymen, hired helpers, or apprentices]."[5] The *Livre des métiers* of 1268 lists about a hundred crafts organized in this way, divided into seven groups: foods, jewelry, metals, textiles and clothiers, furs, and building.[6]

Still, religious authority of a hierarchical sort moved to town. Not only did religious rituals shape the daily routine of urban workers in guilds, but the master of each of Paris's seven major guilds claimed moral stature akin to that of an abbot. In the city, sheer necessity in part prompted this claim. There were no effective police in medieval towns, whose streets were violent both day and night. The equilibrium of the monastery was absent in the city; violence on the streets seeped into and among the workshops. The Latin word *auctoritas* stands for a personage who inspires fear and awe and so submission: the master of a workshop had to inspire such sentiments to keep order in his house.

Christian morality most shaped the "man" in the urban Christian craftsman. Early Church doctrine generally viewed free time as a temptation, leisure as an invitation to sloth. This fear applied particularly to women. Eve was the temptress, distracting man from his work. The Church Fathers imagined women as specifically prone to sexual license if they had nothing to occupy their hands. This prejudice bred a practice: female temptation could be countered by a particular craft, that of the needle, whether in weaving or embroidery, the woman's hands kept ever busy.

The needle as a remedy for female idleness traces traced back to the early Church Father Jerome. As is the way of prejudices that

mature in time, this sexual negative became by the early Middle Ages also a source of honor. As the historian Edward Lucie-Smith points out, "queens were not ashamed both to weave and to sew"; Edith, queen of Edward the Confessor, sewed simple clothes, as did Matilda, queen of William the Conqueror.[7]

Still, the "man" in craftsmanship excluded women from formal membership in guilds, even though women cooked and cleaned in the houses of the city's workshops.

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In the medieval guild, male authority was incarnate in the three-tiered hierarchy of masters, journeymen, and apprentices. Contracts specified the length of an apprenticeship, usually seven years, and the cost, usually borne by the young person's parents. The stages of progress in a guild were marked out first by the apprentice's presentation of the *chef d'oeuvre* at the end of his seven years, a work that demonstrated the elemental skills the apprentice had imbibed. If successful, now a journeyman, the craftsman would work for another five to ten years until he could demonstrate, in a *chef d'oeuvre élevé,* that he was worthy to take the master's place.

The apprentice's presentation focused on imitation: learning as copying. The journeyman's presentation had a larger compass. He had to show managerial competence and give evidence of his trustworthiness as a future leader. The difference between brute imitation of procedure and the larger understanding of how to use what one knows is, as we saw in the previous chapter, a mark of all skill development. The medieval workshop was distinctive in the authority invested in the teachers and judges of this progress. The master's verdicts were final, without appeal. Only rarely would a guild interfere in the judgments of individual masters in a workshop, for in his person the master united authority and autonomy.

Medieval goldsmithing is a good craft to study in this regard, because this craft had a peculiarity that makes it comprehensible rather than foreign to us. The apprentice goldsmith was place-bound while learning how to smelt, purify, and weigh precious metals. These skills required hands-on instruction from his master. Once the apprentice had locally presented his chef d'oeuvre, however, he could move from city to city as a journeyman, responding to opportunities.[8] The traveling goldsmith journeyman made his presentation elévé to the corporate body of master craftsmen in foreign cities. Through his managerial talents and moral behavior he had to convince these strangers that he could become one of them. The sociologist Alejandro Portes observes about modern economic migrants that they tend to be entrepreneurial in spirit; the passive stay home. This migratory dynamism was built into medieval goldsmithing.

It was for this reason that the goldsmith appealed in his own time to Ibn Khaldun, the first and still one of the greatest of sociologists. He was born in what is now Yemen but traveled extensively in Spanish Andalusia, at the time a mixed society of Jews, Christians, and Muslims, the last who ruled tenuously. The *Muqaddimah,* a vast enterprise, is in part a close observation of craftwork. In Andalusia Ibn Khaldun observed the wares of local Christian guilds, as well as the work of itinerant goldsmiths. The goldsmiths seemed to him like Berbers, made strong by travel and mobility. Sedentary guilds, by contrast, appeared to him inert and "corrupt." The good master, in his words, "presides over a travelling house."[9]

On the other side of the coin, migrant labor and the flow of international trade in the medieval era provoked some of the same fears we experience today. The great worry of urban guilds was a market flooded with fresh goods the guilds had not made. Guilds of medieval London and Paris in particular mounted defensive actions against the growth of trade in northern Europe. This threat they warded off by imposing punishing tolls and tariffs at the gates of cities and by strictly regulating the operations of fairs within cities. Itinerant guilds such as the

goldsmiths sought contracts that would maintain the same conditions of labor wherever a goldsmith worked. Like ancient Greek weavers, these medieval craftsmen sought to hand down craft practices intact from generation to generation. Hannah Arendt's rhythm of "natality" and extinction was their enemy, for reasons of keeping the craft practice internationally coherent.

The *Livre des métiers* mentions in passing masters who become journeymen "either on account of poverty or by choice."[10] The first kind of downward mobility we easily comprehend; failed masters become other people's servants. The second is perhaps explained by the wandering goldsmith—a master in other crafts who renounces his place in the hierarchy of guilds in one city in order to travel in search of opportunity.

If adult goldsmiths formed a kind of analogue to modern flexible workers, moving to where the work is, still guild members forged a strong sense of community. The guild network provided contacts for workers on the move. Equally important, the guilds emphasized the migrant's obligations to newly encountered goldsmiths. Elaborate ritual did the work of binding the guild members to one another. Many goldsmithing guilds had, moreover, associated fraternities that included women, the fraternities supplying help for workers in need, from organizing social occasions to buying burial plots for the dead. In an age when written contracts between adults had little force, when informal trust instead underpinned economic transactions, "the single most pressing earthly obligation of every medieval artisan was the establishment of a good personal reputation."[11] This was especially an urgent matter for itinerant goldsmiths, who were strangers to many of the places in which they worked. The ritual life of guilds and their fraternities provided a frame to establish their probity.

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"Authority" means something more than occupying a place of honor in a social web. For the craftsman, authority resides equally in the quality of his skills. And in the goldsmith's case, the good skills that established the master goldsmith's authority were inseparable from his ethics. This ethical imperative appeared in the very technological activity, the assay, that gave goldsmithing its economic value.

Corrupt, shaved, and false coins assailed the medieval economy. The goldsmith's role was to tell the truth about disguised substances, as well as to smelt gold from raw ore. The honor of the guild was meant to reinforce honesty; goldsmiths discovered to be dishonest were violently punished by other guild members.[12] The repute of the truthful craftsman mattered politically as well as economically, for he certified that the wealth of a nobleman or of a city government was genuine. To strengthen the craftsman's ethical sense, the gold assay by the thirteenth century became a religious rite, sanctified by special prayers, in which the content of gold was sworn by a master craftsman in the name of God. We may not now believe that faith makes for truth in chemistry; our forebears did.

The procedures of the gold assay were not scientific in the modern sense. Metallurgy was still yoked to the ancient belief in nature's four basic elements. Only at the end of the Renaissance could metallurgists effectively deploy the single test of "cupellation," in which a sample is scorched with hot air, oxidizing impurities like lead.[13] Before that, the medieval goldsmith had to use many tests to arrive at the judgment that the material he held in his hand was indeed gold.

In the assay, "hands-on" was no mere figure of speech to the goldsmith. The most important of his tests depended on his sense of touch. The goldsmith rolled and squeezed the metal, trying to judge from its consistency its nature. The sense of touch was itself in the Middle Ages endowed with magical, indeed religious properties, as in the "king's touch," the king laying hands on a subject to cure scrofula and leprosy.

In craft practice, the slower and more searchingly the goldsmith worked with his hands, the more truthful he appeared both to his peers and to his employers. Instant results employing a single test were suspect.

Ethics also shaped the relationship between goldsmiths and alchemists. Alchemy was not quite in the fourteenth and fifteenth centuries the foolishness we now take it for, because people believed that all solid elements shared the same fundamental "earth." Nor were those who practiced alchemy crooks—even in the late seventeenth century eminent figures like Isaac Newton dabbled in alchemy. "Most of the leading alchemists," the historian Keith Thomas writes, "thought of themselves as pursuing an exacting spiritual discipline, rather than a crude quest for gold."[14] They were in search of the principles of purification by which a substance of "noble value" could be extracted from crude earth, a model in turn for purification of the soul. Thus the goldsmith and the alchemist were often two faces, as it were, of the same coin, engaged in the same quest for purity.

Still, the medieval goldsmith served as the practical critic of alchemical claims, just as he was the counterfeiter's God-sworn enemy. Alchemical treatises abounded in the Middle Ages, some merely fanciful, other deeply serious investigations using the science of the time. In the assay, the goldsmith tested theory literally with his hands. His relation to the alchemical theorists resembles that of the modern British nurse, faced with a stack of paper "reforms," judging them in substance, in practice.

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Goldsmithing is perhaps most revealing in what it tells about the workshop conceived as a craftsman's home—a place that unites family and labor. All medieval guilds were based on the hierarchy of the family, but these were not necessarily blood ties. The master craftsman legally stood in loco parentis to the journeymen and apprentices below him

even if they were not his kin. A father entrusted his sons to the master craftsman as a surrogate parent most notably by transferring the right to punish misbehavior with physical violence.

Making the workplace into a surrogate family, however, also restrained the authority of the surrogate father. The master was enjoined by a religious oath that no father had ever to swear in words, that of improving the skills of his charges. This contract, notes the historian S. R. Epstein, protected apprentices against "the opportunism of their masters. They were [otherwise] liable to be exploited as cheap labor" without any benefit to themselves.[15] Correspondingly, the apprentice was contracted by religious oath to keep the secrets of his master. These legal and religious bonds brought emotional rewards that the biological bond could not furnish: they guaranteed the good apprentice that he could carry emblems or flags of the guild in civic parades and that he could enjoy a privileged place at banquets. The guilds' religious oaths established reciprocal *honor* between surrogate father and son rather than simple filial obedience.

Today, the dozen years or so of childhood are succeeded by an adolescence that seems to stretch out, agonizingly, another decade. Historians of childhood like Philippe Ariès have argued that in the Middle Ages there was no such stretched-out time of youth: children were treating as young adults from the age of six or seven, fighting alongside older people, frequently marrying before puberty.[16] Though Ariès's account has factual flaws, it explains the relations of authority and autonomy in guild life, for these relations turned on treating the child as an incipient adult.

Historical records show that many guilds privileged the biological sons of masters, but blood sons did not enjoy this privilege securely. Durable family businesses were the exception rather than the rule. By one large estimate, in the 1400s only about half of family businesses passed from generation to generation in the dense European belt of

workshops from Bruges to Venice. By the end of the 1600s, only a tenth of artisan sons took their father's place.[17] More precisely, about half the sons of barrel masters in Bruges took over their fathers workshops in 1375; by 1500, nearly none did.[18] Paradoxically, the surrogate father's sworn oath to pass on a skill was a surer guarantee than the biological father's power to pass on a business that the young adult could be master in his own house.

Surrogacy, as people experienced it eight hundred years ago, is not entirely a "foreign country," to recall the phrase of L. P. Hartley. Surrogate parenting is a modern reality in schools, where teachers dominate an ever-increasing portion of the human life cycle. Divorce and remarriage create another kind of surrogate parenting.

The medieval workshop was a home held together more by honor than by love. The master in this house based his authority, concretely, on the transference of skills. This was the surrogate parent's role in child development. He did not "give" love; he was paid to do his particular kind of fathering. As a mirror held up to ourselves, in loco parentis is both an inspiring and an unsettling image of fatherhood: the guild master had a clear role as a father figure, one that expanded a child's horizons beyond the accidents of birth. Moreover, in goldsmithing, the child was inducted into an adult code of honor that widened his horizons beyond that of the individual house, beyond the confines of a particular loved parent. The medieval surrogate father could be affectionate to his charges, but he had no need to love them. Love, in its inner twists and turns, in its sheer generosity, is not the point of craftsmanship. The surrogate father, we might be tempted to say, was a stronger father figure.

In sum, the medieval craftsman was both brother and stranger to the present. His work was migrant, yet he also sought stability through shared skill. Ethical behavior was implicated in his technical work. His craft was hands-on, like a clinical practice. His surrogate parenting reveals still-puissant virtues. Yet his workshop did not endure. Of the

many reasons for the decline of the medieval workshop, none is more important that its foundation of authority, the knowledge it could pass on by imitation, ritual, and surrogacy.

The Master Alone

The Craftsman Becomes an Artist

Probably the most common question people ask about craft is how it differs from art. In terms of numbers this is a narrow question; professional artists form a mere speck of the population, whereas craftsmanship extends to all sorts of labors. In terms of practice, there is no art without craft; the idea for a painting is not a painting. The line between craft and art may seem to separate technique and expression, but as the poet James Merrill once told me, "If this line does exist, the poet himself shouldn't draw it; he should focus only on making the poem happen." Though "what is art?" is a serious and endless question, lurking in this particular definitional worry may be something else: we are trying to figure out what autonomy means—autonomy as a drive from within that impels us to work in an expressive way, by ourselves.

This at least is how the historians Margot and Rudolf Wittkower saw the matter in their absorbing history *Born under Saturn,* which recounts the emergence of the Renaissance artist from the community of medieval craftsmen.[19] "Art" does a lot of heavy lifting in this version of cultural change. First of all, it stands for a new, larger privilege accorded subjectivity in modern society, the craftsman outward turned to his community, the artist inward turned upon himself. The Wittkowers emphasize Pandora's reappearance in the shift; self-destructive subjectivity was evinced by such suicides as the artists Francesco Bassano and Francesco Borromini.[20] In the minds of contemporaries, their genius drove these men to despair.

This version of change is not quite a tight story; the dark consequences of subjectivity were applied in Renaissance thinking more

broadly than to working artists, whether geniuses or not. Robert Burton's *Anatomy of Melancholy* (1621) explored the "saturnine temperament" as a human condition, rooted in the biology of the body, when the brooding, introspective "humour"—a "humour" being closest to what modern medicine would conceive as a glandular secretion—is allowed to flourish. Isolation, Burton explained, stimulated this secretion. His rambling masterpiece returned again and again to the fear that subjectivity turns to melancholy. The "artist" to him is but one instance of the risk of depression entailed by the workings of the human body in solitude.

Art seemed to the Wittkowers to place the artist on a more autonomous footing in society than the craftsman, and this for a particular reason: the artist claimed originality for his work; originality is the trait of single, lone individuals. Few Renaissance artists in fact worked in isolation. The craft workshop continued as the artist's studio, filled with assistants and apprentices, but the masters of these studios did indeed put a new value on the originality of the work done in them; originality was a value that was not celebrated by the rituals of medieval guilds. The contrast still informs our thinking: art seems to draw attention to work that is unique or at least distinctive, whereas craft names a more anonymous, collective, and continued practice. But we should be suspicious of this contrast. Originality is also a social label, and originals form peculiar bonds with other people.

The patrons of Renaissance artists and the market for their art changed as court society grew at the expense of medieval communes. Clients had an increasingly personal relationship to connection to the masters of the studios. Often they did not understand what the artists were attempting to achieve, yet they just as often asserted their authority to judge the work's worth. If original in his labors, the artist lacked a collective shield, as the member of a community, against these verdicts. The artist's only defense against intrusion was, "You do not understand me," a not entirely enticing selling point. Again

there is a modern resonance: who is fit to judge originality? Maker or consumer?

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The most famous goldsmith of the Renaissance, Benvenuto Cellini, confronted these issues in his *Autobiography,* which he began writing in 1558. His book opens confidently, with a sonnet boasting of two accomplishments. The first is about his life: "I have been involved in astounding exploits and I have lived to tell the tale." Born in Florence in 1500, Cellini was variously imprisoned for sodomy and the father of eight children; an astrologer; poisoned deliberately, once by powdered diamonds and later by a "delicious sauce" prepared by a "vicious priest"; the murderer of a postman; a naturalized French citizen who loathed France; a soldier who spied for the army he fought against; . . . the catalogue of such amazing incidents is endless.

The second advertisement is for his work. He boasts: "In my art / I have surpassed many and arrived at the level of the / only one who was my better."[21] One master—Michelangelo—and no equals; none of his peers is able to rise to his level nor is as original. A famous golden saltcellar that Cellini made in 1543 for Francis I of France (now in the Kunsthistorisches Museum, Vienna) served as evidence for this boast. Not even that haughty monarch could casually have taken salt from it. The bowl holding the salt is submerged in a golden clutter. On its crown male and female golden figures represents the Sea and the Earth (salt belonging to both realms), while on the ebony base bas-reliefs of figures represent Night, Day, Twilight, and Dawn plus four Winds (Night and Day pay direct homage to Michelangelo's sculpting of these same figures on the Medici tombs). This glorious object was meant to provoke amazement and it did.

Before inquiring into what might make this a work of art rather than a piece of craft, we should place Cellini among his fellows. Throughout the Middle Ages there were masters as well as journeymen who, as the

Livre des métiers noted, wished to set up on their own as individual entrepreneurs. These craft entrepreneurs wanted simply to pay assistants without being obliged to train them. Their prosperity depended on making a name for their goods as what we today would call a "brand label."

This last fact sent an ever-more personal signal of distinction. Medieval guilds did not tend to emphasize individual differences within a town's workshops; the guild's collective effort of control names where a cup or coat was made rather than who made it. In the material culture of the Renaissance, naming the maker became increasingly important to the sale of a wide variety of goods, even the most prosaic. Cellini's saltcellar falls within this general, branding pattern. The very fact that a dish to hold salt had become an elaborate object transcending any mere functional purpose called attention to it and to its maker.

Around 1100, a change in the relation of goldsmiths to other craftsmen slowly appeared, one remarked in Alan of Lille's *Anticlaudianus* in the early 1180s. Before this time, the forms of working gold into decorative objects had set the pace for painting and glassmaking, the gold frame orienting the objects within it. About this time, the craft historian T. E. Heslop observes, the process slowly began to reverse: "What we would call naturalism, most readily associated with painting and sculpture, came to dominate to such an extent that goldsmiths had to cultivate the arts of drawing and modelling as never before."[22] Cellini's pictures in gold are one result of this process: they are a "new" kind of goldsmithing, in part simply because they incorporate into metalwork another craft practice, that of drawing.

Cellini kept a certain allegiance to the craft workshops from which his art emerged. He was never ashamed of the foundry, its dirt, noise, and sweat. Moreover, he hewed to the traditional craft value placed on truthfulness. In the *Autobiography* he recounts the struggle to extract gold, real gold and lots of it, from masses of raw ore—whereas even his richest patrons would have been content with the illusion of surface

gilding. In carpenter's terms, Cellini hated veneers. He wanted "honest gold" and held to this same standard of truthfulness in the other materials he worked with, even in cheap metals like brass. It had to be pure, so that things would look what they are.

We'd thus risk vulgarizing Cellini's autobiography to see it simply as self-serving. Indeed, though in the economy of the time artisans of all sorts advertised the individual merits of their work, Cellini's book itself does not fall into the category of publicity. He chose not to publish the *Autobiography* in his lifetime; he wrote it for himself and left it to posterity. Yet, like many other goods, his saltcellar was taken to have public value because it exposed and expressed the inner character of its maker. Francis I certainly thought so, exclaiming, "Here is Cellini himself!"

Distinction of this sort carried material rewards. As the historian John Hale points out, many artists prospered thanks to the distinctiveness of their work: Lucas Cranach the Elder's house in Wittenberg was a small palace, as was Giorgio Vasari's in Arezzo.[23] Lorenzo Ghiberti, Sandro Botticelli, and Andrea del Verrocchio all trained as goldsmiths. So far as we can determine, they were wealthier than their peers who remained strictly within the guild orbit of assay and raw material production.

Authority in the generic sense relies on a basic fact of power: the master sets out the terms of work that others do at his direction. The Renaissance artist's atelier differed little in this from the medieval workshop or the modern scientific laboratory. In an artist's atelier, the master made the overall design in the painting and then filled in the most expressive parts, such as the heads. But the Renaissance studio existed in the first place because of the master's distinctive talents; the point was not to produce pictures as such but rather to create *his* pictures or pictures in his manner. Originality gave a particular importance to face-to-face relations in the studio. Unlike goldsmith assayers, the artist's assistants had to remain in the physical presence of their

masters; originality is hard to write down in a rulebook you might pack in your luggage.

"Originality" traces its origins back one Greek word, *poesis*, which Plato and others used to mean "something where before there was nothing." Originality is a marker of time; it denotes the *sudden* appearance of something where before there was nothing, and because something suddenly comes into existence, it arouses in us emotions of wonder and awe. In the Renaissance, the appearance of something sudden was connected to the art—the genius, if you will—of an individual.

We'd certainly err by imagining that medieval craftsmen were entirely resistant to innovation, but their craftwork changed slowly and as the result of collective effort. For instance, the immense Salisbury Cathedral began, in 1220–1225, as a set of stone posts and beams that established the Lady Chapel at one end of the future cathedral.[24] The builders had a general idea of the cathedral's eventual size, but no more. However, the proportions of the beams in the Lady Chapel suggested a larger building's engineering DNA and were articulated in the big nave and two transepts built from 1225 to about 1250. From 1250 to 1280, this DNA then generated the cloister, treasury, and chapter house; in the chapter house the original geometries, meant for a square structure, were now adapted to an octagon, in the treasury to a six-sided vault. How did the builders achieve this astonishing construction? There was no one single architect; the masons had no blueprints. Rather, the gestures with which the building began evolved in principles and were collectively managed over three generations. Each event in building practice became absorbed in the fabric of instructing and regulating the next generation.

The result is a striking building, a distinctive building embodying innovations in construction, but it is not original in the sense that Cellini's saltcellar is: an amazing blow, a painting in pure gold. As earlier remarked, the "secret" of originality here is that the two-dimensional practice of drawing has been transferred to the three dimensions of

gold, and Cellini pushed this transfer to an extreme that his contemporaries had not imagined possible.

But originality carried a price. Originality could fail to provide autonomy. Cellini's *Autobiography* is a case study of how originality could be new kinds of social dependence and, indeed, humiliation. Cellini left the guild realm of assay and metal production only to enter court life with all its intrigues of patronage. With no corporate guarantee for the worth of his work, Cellini had to charm, hector, and plead with kings and princes of the Church. These were unequal trials of strength. Confrontational and self-righteous as Cellini could be to patrons, ultimately his art depended on them. There was in Cellini's life a telling moment when this unequal trial of strength became clear to him. He sent Philip II of Spain the sculpture of a naked Christ in marble, to which the king rather wickedly added a fig leaf made of gold. Cellini protested that the distinctive character of the Christ was spoiled, to which Philip II replied, "It's mine."

We would say now this is a matter of integrity—the integrity of the thing in itself—but it's also a matter of the maker's social standing. Cellini, as he repeatedly stresses in his autobiography, was not to be measured like a courtier, by a formal title or a post at court. But any person who stands out still has then to *prove* him or herself to others. The medieval goldsmith furnished proof of his worth through communal rituals, proof about the work's worth through the process of proceeding slowly and carefully. These are irrelevant standards for judging originality. Put yourself in Philip II's elegant shoes: faced with an original and so unfamiliar object, how would you evaluate its worth? Confronted with Cellini's declaration, "I am an artist! Don't touch what I've done!" you, in your kingly majesty, might well think, "How dare he?"

A final, signal fact about Cellini's *Autobiography* is that his experiences of unrequited dependency and misunderstanding heightened his self-consciousness. Again and again in these pages, humiliation at the hands of a patron drives the writer to bouts of introspection. This

condition was just the opposite of the passive, and so brooding isolates pictured in the pages of Burton's *Anatomy of Melancholy.* Here the Renaissance artist may well be the emblematic first modern man: active, and so suffering, driven inward, searching for a refuge in his "autonomous creativity." In this view, creativity lies within us, no matter how society treats us.

That belief became powerfully grounded in Renaissance philosophy. It appeared in the writings of the philosopher Pico della Mirandola, who envisaged *Homo faber* to mean "man as his own maker." Pico was one of Hannah Arendt's (unacknowledged) sources; his *Oration on the Dignity of Man* of 1486 was based on the conviction that, as the force of custom and tradition wanes, people have to "make experience" for themselves. Each person's life is a narrative in which the author does not know how the story will turn out. Pico's figure for *Homo faber* was Odysseus, voyaging through the world, not knowing where he would land. A kindred idea of man as his own maker also appears in Shakespeare, when Coriolanus asserts, "I am my own maker," and thus defies the adage of Augustine, who warned, "Hands off the self! Touch it and you make a ruin!"[25]

Art plays a particular role in this life voyage, at least for artists. The work of art become like a buoy at sea, marking out the journey. Unlike a sailor, though, the artist charts his own course by making these buoys for himself. This is how, for instance, Giorgio Vasari proceeds in *The Lives of the Artists* (1568), one of the first books ever written to chart artistic careers. Vasari's "lives" concern artists who develop within, who brought forth works despite all impediments, artists whose creative urge is autonomous. Works of art are the evidence of an inner life sustained even in the face of humiliation and incomprehension—as indeed Cellini sometimes faced. Renaissance artists discovered that originality does not provide a solid *social* foundation of autonomy.

The scorned or misunderstood artist has a long trajectory in Western high culture, in all the arts. Cellini is the troubled ancestor of

Mozart in his dealings with the bishop of Salzburg in the eighteenth century, of Le Corbusier's struggles with a stodgy Harvard University in trying to construct the Carpenter Center for the Visual Arts in the twentieth. Originality brings to the surface the power relations between artist and patron. In this regard, the sociologist Norbert Elias reminds us that in court societies the bond of mutual obligation was distorted. The duke or cardinal paid the tradesmen's bills when it suited him, if at all; Cellini, like many others, died with large uncollected royal debts.

* * *

Cellini's story does, in sum, enable a certain a sociological contrast between craft and art. The two are distinguished, first, by agency: art has one guiding or dominant agent, craft has a collective agent. They are, next, distinguished by time: the sudden versus the slow. Last, they are indeed distinguished by autonomy, but surprisingly so: the lone, original artist may have had less autonomy, be more dependent on uncomprehending or willful power, and so be more vulnerable, than were the body of craftsmen. These differences still matter in their content to people who are not among the small band of professional artists.

Unmotivated workers like the Soviet construction workers, depressed workers like the British doctors and nurses suffer not so much from the work they do as by how it is organized. This is why we should not give up on the workshop as a social space. Workshops present and past have glued people together through work rituals, whether these be shared cup of tea or the urban parade; through mentoring, whether the formal surrogate parenting of medieval times or informal advising on the worksite; through face-to-face sharing of information.

The historical turn is for these reasons more complicated than a story of decline; a new, disturbing set of work values was added to the sociable workshop. Modern managerial ideology urges even the lowliest worker to work "creatively" and evince originality. In the past the

satisfaction of this command proved a recipe for distress. The Renaissance artist still needed a workshop, and his assistants in it undoubtedly learned from the example of their master. The master's own mastery changed in content; claims for his distinctiveness and originality now posed a motivational problem for him. He would need the will to fight in order to validate these claims. His honor took on an adversarial character. The workshop would serve him as a refuge from society.

"His Secrets Died with Him"
In Stradivari's Workshop

In the *Autobiography,* Cellini says that the "secrets of his art would die" with him.[26] His daring and innovation certainly could not be passed down through pageants, feasts, and prayers of earlier times; the value of the work lodged in its originality. So here was a concrete limit placed on the long-term viable life of the workshop. In modern parlance, knowledge transfer became difficult; the master's originality inhibited the transfer. This difficulty remains, in scientific laboratories as much as in artist's studios. Although in a lab the neophyte can be readily inducted in procedures, it's harder for a scientist to pass on the capacity to look suspiciously for new problems in the course of solving old ones or to explain the intuition formed from experience that a problem is likely to wind up a dead-end.

The difficulty of knowledge transfer poses a question about *why* it is should be so difficult, why it becomes a personal secret. This isn't the case in music conservatories, for instance; both through individual and master classes, and in workshop discussions, expression is constantly analyzed and refined. In the famous Class 19 conducted by Mstislav Rostropovich at the Moscow Conservatory in the 1950s and 1960s, the great cellist used all manner of weapons—novels, jokes, and vodka, as well as strict musical analysis—to bludgeon his pupils into becoming themselves more individually expressive.[27] Yet in the fabrication of musical instruments, the secrets of masters like Antonio Stradivari or Guarneri del Gesù have indeed died with them. Mountains of cash and endless experiments have failed to prize out the secrets of these masters. Something in the character of these workshops must have inhibited knowledge transfer.

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When Antonio Stradivari began making violins, he formed part of a tradition whose standards on carving the belly, backs, and peg boxes of stringed instruments had been set by Andrea Amati a century earlier. Subsequent luthiers (the word represents makers of varied stringed instruments) paid fealty to these Cremona masters and their Austrian neighbor Jacob Stainer. Many trained in the workshops of their disciples; others learned by repairing old instruments that came into their hands. Carving books existed from the origins of *lutherie* in the Renaissance, but the texts were expensive to produce and few in number; technical training involved hands-on contact with the instruments and on spoken explanation passed generation to generation. The young luthier would have held in his hands, copied, or repaired an Amati original or prototype. This was the method of knowledge transfer that Stradivari inherited.

Inside, the workshop of Stradivari also looked back in that, like that of other luthiers, the physical house was both a place of work and a home, filled with Stradivari's family and many young male apprentices and journeymen lodgers. Labor dominated all waking hours. The workshop operated from dawn to dusk, with the work team literally rooted to the benches, since the unmarried apprentices slept underneath them on bags of straw. As in the past, Stradivari's male children learning the business were subjected to the same formal rules as lodger apprentices.

Youngsters at work usually did such preparatory labor as soaking wood in water, rough molding, and rough cutting. Journeymen higher

up did finer belly cutting and neck assembly, and the master himself took charge of the ultimate installation of the parts and of varnishing, the protective coating of the wood being the ultimate guarantor of its sound. The master, however, was everywhere present in the production. We know, thanks to the researches of Tony Faber, that Stradivari occupied himself with the smallest details in the production of his violins. Though he rarely traveled, in the house he was in constant motion, not confined to an office—an imperious, even hectoring character who sometimes threw spectacular tantrums, oozing instructions and exhortations.[28]

Yet the medieval goldsmith would not have felt at home here. Like Cellini's, the Stradivari workshop revolved around the extraordinary talents of an individual. But Cellini might also have trouble understanding it: the master now presented himself to the open market, rather than to one or a few patrons. The number of luthiers and the volume of instruments had by Stradivari's time also radically expanded. Supply began to exceed demand. Even Stradivari, famous as he early on became, had to worry about markets because he dealt with many private clients and this market patronage proved fickle, especially at the end of his long life. In the general economic decline of the 1720s his workshop had to trim costs, and much of its output went into stock.[29] Cracks in the workshop hierarchy widened owing to the uncertainties of the open market; ambitious apprentices, seeing that even so famous a master had an uncertain fate, began to buy out or beg off the last years of their contracts. What was unusual in the time of the *Livre des métiers* had now become normal: the open market shrank the time frame of the master's dominion.

The market also deepened those inequalities whose seed was planted in the Renaissance branding of craft goods. As early as 1680, Stradivari's success put pressure on other families like the Guarneri, whose business was founded by Andrea Guarneri. The grandson Bartolomeo Giuseppe, known as "del Gesù," worked in the shadow of

Stradivari. "In contrast to Antonio Stradivari's vast international clientele," Guarneri's biographer tells us, his "customers were by and large . . . humble Cremonese players who [performed in] palaces and churches in and around Cremona."[30] As great a maker as Stradivari, del Gesù could sustain his workshop for only fifteen years; he had even more trouble holding onto the best apprentices.

When Antonio Stradivari died, he passed on the business to his two sons, Omobono and Francesco, who never married and who spent their adult lives in their father's house as his servant-heirs. They were able to trade on his name for several years, but the business eventually foundered. He had not taught, he could not teach either of them how to be a genius. (The work of theirs I've held and played is excellent, but no more than that.)

This is the brief outline of a workshop death. For nearly three centuries luthiers have struggled to revive this corpse in order to recover the secrets of Stradivari and Guarnieri del Gesú that died with them. Even while the Stradivari sons were alive, this investigation of originality began. Guarnieri del Gesú's imitators set to work about eighty years after his death, abetted by the false story that he made his greatest violins while in prison. Today analysis of the masters' work proceeds on three fronts: exact physical copies of the instruments' form; chemical analyses of the varnish; and work that reasons backward from the sound (the idea here being that one could copy the sound in instruments that do not look like a Strad or a Guarneri). Even so, as the violinist Arnold Steinhardt of the Guarneri String Quartet has remarked, the professional musician can almost instantly distinguish between the original and any copy.[31]

Missing in these analyses is a reconstruction of the workshops of the master—more precisely, one element that has irretrievably gone missing. This is the absorption into tacit knowledge, unspoken and uncodified in words, that occurred there and became a matter of habit, the thousand little everyday moves that add up in sum to a practice.

The most significant fact we know about Stravidari's workshop was that he was all over it, popping up unexpectedly everywhere, gathering in and processing those thousands of bits of information that could not signify in the same way to assistants who were doing just one part. The same thing has been true in scientific labs run by idiosyncratic geniuses; the master's head becomes stuffed with information only he or she can see the point of. This is why the secrets of the physicist Enrico Fermi as a great experimenter can't be fathomed by poring over the minutiae of his lab procedures.

To put this observation abstractly: in a workshop where the master's individuality and distinctiveness dominates, tacit knowledge is also likely to dominate. Once the master dies, all the clues, moves, and insights he or she has gathered into the totality of the work cannot be reconstructed; there's no way to ask him or her to make the tacit explicit.

In theory the well-run workshop should balance tacit and explicit knowledge. Masters should be pestered to explain themselves, to dredge out the assemblage of clues and moves they have absorbed in silence within—if only they could, and if only they would. Much of their very authority derives from seeing what others don't see, knowing what they don't know; their authority is made manifest in their silence. Would we then sacrifice Stradivari's cellos and violins for the sake of a more democratic workshop?

In the seventeenth century the person most alive to the problem of knowledge transfer was the poet John Donne. He couched the problem of singularity in terms of scientific discovery, imagining the innovator as a phoenix rising from the ashes of received truth and tradition, in these famous lines:

> Prince, Subject, Father, Son, are things forgot,
> For every man alone thinks he hath got
> To be a Phoenix, and that then can be
> None of that kind, of which he is, but he.[32]

Today the difficulty of recovering the secrets of genius illuminates the contrast we made in the first chapter between the two craft standards of quality: the absolute standard versus quality of practice. The masters set an absolute standard, one that often proves impossible to reproduce. But the democratic question just posed should be taken seriously. Why try to recover someone else's originality? The modern luthier wants to get on with the business of making violins; the luthier wants to make the best violins possible according to his or her bright-enough lights rather than be immobilized, imprisoned by fruitless imitation. This is the claim of practice against correctness. And yet. The Stradivarius Davidoff cello defines what a cello can be, what is possible; it sets a standard that, once you've heard it, you can never forget, particularly if you happen to be making a cello.

"His secrets died with him" casts a particular shadow in science. The sociologist Robert K. Merton sought to explain knowledge transfer in science by invoking the famous image of "standing on the shoulders of giants."[33] By that he meant two things: first, that the work of great scientists sets the terms of reference, the orbits, within which lesser standard scientists revolve; and second, that knowledge is additive and accumulative; it builds up in time as people stand on the giants' shoulders, like those human pillars in the circus.

In craftwork, Merton's idea would apply to the makers of Salisbury Cathedral, whose labors worked within the orbit of their forebears—whether giants or not. The idea would make sense of the rituals of the medieval goldsmiths; these celebrated the standards set by the monastic founders of the guild as fathers. Though his model illuminates medieval masons and goldsmiths, it is harder to apply to the more modern realm of Stradivari's workshop. The desire to stand on the luthier's shoulders has certainly existed ever since his death; finding a footing has proved frustrating; thinking about a giant can prove paralyzing. In practice we do something that is distinctive whenever we solve thorny practical issues, no matter how small. And yet a scientist

can no more forget Einstein's ambition than an instrument maker a Stradivarius's sound.

* * *

The history of the workshop shows, in sum, a recipe for binding people tightly together. The essential ingredients of this recipe were religion and ritual. A more secular age replaced these ingredients with originality—a condition separate in its practical terms from autonomy, originality implying in the workshop a new form of authority, an authority frequently short-lived and silent.

One mark of the modern world is that we have become as worried about paying obeisance to authority in this personalized form as to authority of an older, more religious sort. To quote just one instance of this worry: Cellini's near-contemporary Étienne de La Boétie was one of the first to question submission to higher authority through either admiration or imitation. In his view, people are more capable of freedom. In the *Discourse of Voluntary Servitude,* he wrote: "So many men, so many villages, so many cities, so many nations sometimes suffer under a single tyrant who has not other power than the power they give; who could do them absolutely no injury unless they preferred to put up with him rather than contradict him. . . . It is therefore the inhabitants themselves who permit, or rather, bring about their own servitude."[34] Servitude through admiration or tradition must be cast off. If correct, then the workshop cannot be a comfortable home for the craftsman, for its very essence lies in the personalized, face-to-face authority of knowledge. And yet it is a necessary home. Since there can be no skilled work without standards, it is infinitely preferable that these standards be embodied in a human being than in a lifeless, static code of practice. The craftsman's workshop is one site in which the modern, perhaps unresolvable conflict between autonomy and authority plays out.

CHAPTER THREE

Machines

The greatest dilemma faced by the modern artisan-craftsman is the machine. Is it a friendly tool or an enemy replacing work of the human hand? In the economic history of skilled manual labor, machinery that began as a friend has often ended up as an enemy. Weavers, bakers, and steelworkers have all embraced tools that eventually turned against them. Today the advent of microelectronics means that intelligent machines can invade realms of white-collar labor like medical diagnosis or financial services once reserved for human judgment.

The seduction of CAD lies in its speed, the fact it never tires, and indeed in the reality that its capacities to compute are superior to those of anyone working out a drawing by hand. Yet people can pay a personal price for mechanization; misuse of CAD programming diminished the mental understanding of its users. This seems a sad story, but perhaps it can be told in a different way. Might we, in our very comparative imperfection, learn something positive about being human?

Workers as much as writers struggled with this philosophical question at the dawn of the Industrial Age in the eighteenth century. Their observations and arguments were based on an experience of material culture that had long predated machine production.

As early as the fifteenth century, Europe had been suffused by what

the historian Simon Schama has called "an embarrassment of riches," a new cornucopia of material goods.[1] In the Renaissance, trade with non-Europeans and the ever-greater number of artisans working in towns swelled the goods at people's disposal. Jerry Brotton and Lisa Jardine evoke the "tide of new material objects" first flooding into Italian homes in the fifteenth century.[2] By the early 1600s in the Netherlands, Britain, and France, "there was an unprecedented demand for desks, tables, sideboards, sets of hanging shelves and cupboards, all suited to the housing and display of new possessions," in the words of John Hale.[3] As material abundance seeped downward, it extended to the most ordinary matters, like possessing several pots to cook with, different plates to eat off, more than a single pair of shoes to wear, and different clothes for varying seasons. Things that we now taken for granted as necessities were increasingly available to ordinary people.[4]

It was in chronicling this flood tide of things that Schama applied the phrase "an embarrassment of riches" to the sixteenth- and seventeenth-century Dutch, who were long used to scrimping and saving. The phrase can be misleading, since at the dawn of the modern era anxiety was often people's reaction to the wealth of things at their disposal. The enriched world of objects prompted intense theological worry in both Reformation and Counter-Reformation circles about material seduction; beneath the theological horizon, this fear attached even to such innocuous objects of daily life as children's toys.

In the late sixteenth and early seventeenth centuries European children first began to enjoy an abundance of toys. Previously—and strangely to us—adults amused themselves with dolls, toy soldiers, and the other artifacts of childhood; such toys were few in number and costly. As the cost went down the number of toys increased. In this process toy objects also became the distinctive property of children. The increase in toys introduced the first discussions—indeed the very concept—of "spoiling" children.

The advent of machines in the eighteenth century only increased

the anxiety of riches. Age-old questions of deprivation and lack did not go away—the masses of Europeans still lived in a scarcity society—but machine production of tableware, clothing, bricks, and glass added to this other dimension of worry: how to use these goods well, what abundance might be for, how not to be spoiled by possessions.

On balance, the eighteenth century embraced the virtue of abundance, mechanically produced, and so should we. As consumers the machine then promised and by the twenty-first century has infinitely improved the quality of our lives; more and better medicines, houses, food—an endless list. The material quality of life for the European working poor in modern times is in many ways higher than of the bourgeois classes of the seventeenth century. Even Martin Heidegger eventually installed electricity and modern plumbing in his Black Forest hut. What Enlightenment writers worried more about was the machine's productive side, its influences on the experience of making—and these worries remain.

To some figures in the Enlightenment, the superiority of machines was no cause for human despair. Isaac Newton had after all depicted all of nature as a giant machine, a view taken to an extreme in the eighteenth century by writers like Julien Offray de la Mettrie. Other writers subscribed to views of rational improvement, progress, and the "perfectibility of Man," modeled on the efficiency of new machinery like James Watt's steam engine. But still others thought in a different way about this model, and not as traditionalists refusing the new: rather, the comparison of man and machine caused them to think more about man. Human virtues of restraint and simplicity came to the fore as man's contribution to human culture; none of these sentiments could be called mechanical. People so minded had a particular interest in craftsmanship: it seemed to mediate between machined abundance and the modestly humane.

Socially, craftsmen took a new turn. Watt's eighteenth-century steam engine, originally built in workshop conditions that resembled the studio of Antonio Stradivari, soon came to be fabricated, and then

deployed, in a radically different social setting. The recipe for making a steam engine became entirely codifiable by 1823 in documents; the master—and Watt himself behaved like a Stradivari of engineering—no longer had secrets to keep. This mirrors a larger change in nineteenth-century engineering that has already appeared to us in the history of the blueprint: a movement from hands-on knowledge to the dominant authority of explicit knowledge. Workshop work of course continued in various forms, in the arts, in everyday commerce, as in the sciences, but the workshop seemed increasing merely the means to establishing another institution: the workshop as a way station to the factory.

As machine culture matured, the craftsman in the nineteenth century appeared ever less a mediator and ever more an enemy of the machine. Now, against the rigorous perfection of the machine, the craftsman became an emblem of human individuality, this emblem composed concretely by the positive value placed on variations, flaws, and irregularities in handwork. Eighteenth-century glassmaking had foreshadowed this change in cultural values; now the writings of John Ruskin, the great Romantic analyst of craft, regretted the loss of the workshops of the preindustrial past and made of the craftsman's labors in his own age a blazon of resistance—resistance to capitalism coupled with resistance to machines.

These cultural and social changes remain with us. Culturally we are still struggling to understand our limits positively, in comparison to the mechanical; socially we are still struggling with anti-technologism; craftwork remains the focus of both.

The Mirror Tool

Replicants and Robots

A mirror-tool—my coinage—is an implement that invites us to think about ourselves. There are two kinds of mirror-tools. These are the replicant and the robot.

The modern name for the first comes from the film *Blade Runner*, which features copies of human beings. The perfect women created in Ira Levin's novel *The Stepford Wives* are also replicants. In the real world, pacemakers for the heart serve as replicant machines, providing the energy charge needed for the heart to function as it should biologically. All these artifices mirror us by mimicking us.

By contrast, a robotic machine is ourselves enlarged: it is stronger, works faster, and never tires. Still, we make sense of its functions by referring to our own human measure. The little iPod possesses, for instance, the memory of a robot; currently, the machine is capable of containing more than thirty-five thousand minutes of music, nearly the entire written output of J. S. Bach, which is more than any human brain can remember. The robot is like a mirror in a fun fair, enlarging human memory to giant size. Yet this giant memory is organized technically to serve the small human measure of songs or other music of comprehensible length. iPod listeners never use the full memory capacity of the machine at a given moment.

An ambiguous zone exists between replicant and robot, between mimicking and enlarging. In the film *Blade Runner* the replicant copies of human beings enlarge the particularly brutal, vicious aspects of everyday life. Conversely Mary Shelley's *Frankenstein* recounts the story of a man-made giant who wants to be a replicant, treated just as a normal human being. But, in general, the replicant shows us as we are, the robot as we might be.

Size and scale provide two measures of how large is "enlarged." In architecture, very large buildings can seem on an intimate human scale, whereas some small-sized structures feel very big. To the historian Geoffrey Scott, vast Baroque churches seem intimate in scale because their undulating walls and decor mimic the motions the human body makes, whereas Bramante's motionless little Tempietto feels as big, as enlarged, as the Pantheon on which it is modeled.[5] Just the same distinction between size and scale applies to machines; the

kidney dialysis machine is a large replicant, the atmosphere-eating robots in the astrophysicist Martin Rees's cabinet of horrors are microrobots.

* * *

In the Enlightenment, when precise replicants began to be constructed, the machines seemed at first benign toys. In 1738 a shop in Paris displayed an extraordinary automaton constructed by Jacques de Vaucanson, a Jesuit-educated mechanical inventor. Vaucanson's Flute Player was a life-size figure five and a half feet tall that played the flute. The wonder was the flute itself, for a mechanical figure could much more easily play the harpsichord, which would require the machine only to strike a key. The problem with playing a flute is that the tone comes through breathing as well as finger action. Soon after, Vaucanson created his Shitting Duck, a mechanical creature that appeared to ingest grains with its mouth and defecate in short order at its anus. The Shitting Duck proved to be a fraud (the anus was stuffed), though an interesting one; the Flute Player was genuine.[6]

To make the Flute Player work, Vaucanson created, at the figure's base, a complicated system of nine bellows that passed into the robot's chest through three pipes, which provided the breath; a separate set of levers operated a mechanical tongue, and another set moved the lips in and out. The whole thing was a mechanical marvel. Voltaire evoked the awe it aroused in calling Vaucanson "the modern Prometheus."

But this machine remained a replicant because the Flute Player was no god. Vaucanson's automaton played no faster than a human flutist. As an artist it was limited, producing only simple loud-soft contrasts and unable to play legato, where one note dissolves liquidly into the next. So this was a reassuring replicant; its workings could be measured by the standards of human music making. The imaginative stimulus it afforded visitors to Vaucanson's shop lay in wondering about the means of mimicry: how could nine bellows attached to three pipes be akin to human breathing?

This replicant, unfortunately, bred a robot. Louis XV, though not scientifically minded, suspected that Vaucanson's talents could be put to better use than making an intriguing toy. In 1741 he gave the inventor charge of French silk manufacturing. The silk produced in early-eighteenth-century France, particularly in Lyon, was not of uniformly good quality: the tools were poor, the weavers poorly paid and often on strike. Drawing on his knowledge of the replicant, Vaucanson sought to produce a robot that would eliminate the human problem.

Vaucanson transferred the knowledge of breathing tension he had gained in The Flute Player to weaving machines that had to hold threads in tension. The shuttle action in his machines moved by minutely, precisely measuring the tension, and so the tightness, of weave; previously workers proceeded by "feel" and visual inspection. His loom in turn increased the number of colored strands of silk that could be held in equal tension during the weaving process, far more strands than could previously be managed by two human hands.

In Lyon, as elsewhere, investment in such machines became cheaper than investment in labor, as well as doing better work. Gaby Wood gets at the conundrum in observing that whereas the Flute Player "was designed for man's entertainment," Vaucanson's looms in Lyons were "meant to show man that he was dispensable."[7] Lyonnais weavers assaulted Vaucanson in the streets whenever in the 1740s and 1750s he dared appear. He provoked them further by designing a machine to weave an intricate design of flowers and birds, this complicated loom powered by a donkey.

Thus began the classic story of displacement of craftsman by the machine. Vaucanson's machines seem an economic germ that has sickened the modern artisan; the robot rather than the replicant taught this

negative, threatening story of human limits. What kindlier mirror-tools would show a more positive image?

The Enlightened Craftsman
Diderot's Encyclopedia

To unpack this question we will need to plunge into the word *Enlightenment* itself, and we could easily drown in the process. Literally, *enlightenment,* German *Aufklärung,* and French *éclaircissement* all mean "to shed light on"; one French phrase for the historical Enlightenment, *siècle des Lumières,* is "century of luminaries." Understood as the process of casting the light of reason over the manners and mores of society, Enlightenment became a buzzword in the eighteenth century (much as "identity" is today), the word becoming current in Paris in the 1720s and reaching Berlin a generation later. There was a midcentury American Enlightenment whose leading light was Benjamin Franklin and a Scottish Enlightenment composed of philosophers and economists seeking for mental sunlight in the mists of Edinburgh.

Perhaps the most concise way to frame "the Enlightenment's" relation to material culture, and in particular to the machine, is to travel mentally to Berlin. In December 1783, the theologian Johann Zöllner invited readers of the *Berlinische Monatsschrift* to respond to the question, "What is Enlightenment?" This newspaper series then ran for twelve years. Many contributors answered his question by invoking progress and improvement. The energy for Enlightenment lay in these words; man could take greater control over his material circumstances. Pastor Zöllner found quite troubling these responses, which celebrated the expansion of human powers rather than their limitation. His parishioners seemed studiously polite when he read out in church the Bible's stories about human sins; they were merely courteous when he spoke to them about the dangers facing their immortal souls. Tolerance had become the urbane cousin of condescension; confident reason was in a way worse than the fire-breathing, satanic heresies of the past.

The leading writers who responded to his appeal had a passion of their own: this was the human adult's capacity to live without dogma. The greatest statement of this passionate conviction came from Immanuel Kant, who wrote in the September 30 issue of the *Berlinische Monatsscrift* of 1784: "Enlightenment is mankind's exit from its self-incurred immaturity. *Immaturity* is the inability to make use of one's own understanding without the guidance of another. *Self-incurred* is this inability, if its cause lies not in the lack of understanding but rather in the lack of resolution and the courage to use it without the guidance of another. *Sapere aude!* Have the courage to use your own understanding! is thus the motto of enlightenment."[8] The emphasis here is on the *act* of reasoning. Freedom in reasoning improves the mind by casting off childish certainties.

Reasoning of this free sort has nothing mechanical about it. The eighteenth century, it is sometimes said, took too much to heart Newtonian mechanics. Voltaire did so by asserting that the machinery of nature explicated in Newton's pages, precise and exactly balanced, should serve as a model for the social order, physics providing society an absolute standard. This was not Kant's way of reasoning. He hoped of course that destructive superstitions would lose their hold on the adult mind but did not imagine the machine's routines as a substitute for prayer. The free mind will always subject its own regulations and rules to critical judgment and therefore change them; Kant's focus is on judging and reflection upon rather than on planning order. Can free reason degrade, then, to the opposite pole of disorder? As the French Revolution darkened, even political activists like Johann Adam Bergk wondered if disembodied free reasoning played a role in the collective chaos. In 1796, the *Berlinische Monatsschrift* shut down the subject.

The few sentences above allude to an immense sea in which reason, revolution, and tradition form the main currents. Lost in these

currents are those pages of the newspaper's debate in which culture of a more everyday material sort was discussed. The most Enlightening of these discussions came from Moses Mendelssohn. By origin a poor Jewish migrant to Berlin, intending there to become a rabbi, Mendelssohn came to reject the Talmudic training of the shuls as too narrow; he made himself into a philosopher who read German, Greek, and Latin. In 1767 he wrote *Phaidon,* a book breaking the faith of his fathers in order to declare his belief in a religion of Nature, a materialist Enlightenment. Mendelssohn's contribution to the newspaper debate about Enlightenment built on this materialism.

He devised an equation: *Bildung* = *Kultur* + *Aufklärung.*[9] *Bildung* implies at once education, the formation of values, and the behavior by which one steer's one's course in social relations. *Aufklarüng* is Kant's free reason. *Kultur,* says Mendelssohn, denotes the practical realm of "things done and not done," rather than good manners and refined taste.[10] Mendelssohn took a wide and generous view of practical culture. He believed that ordinary "things done and not done" are as worthy as any abstraction; in rationally reflecting upon them, we improve ourselves.

Bildung = *Kultur* + *Aufklärung* was a distillation of reading Mendelssohn had done in a remarkable book.[11] This was *The Encyclopedia, or Dictionary of Arts and Crafts,* edited principally by Denis Diderot. Appearing from 1751 to 1772, the thirty-five-volume *Encyclopedia* became a best-seller read by every one from Catherine the Great in Russia to merchants in New York.[12] Its volumes exhaustively described in words and pictures how practical things get done and proposed ways to improve them. There was a great difference in emphasis between the *encyclopédistes* and the German writers: for the French, daily practices of laboring are the focus rather than Kantian self-understanding or Mendelssohnian self-formation. From this emphasis followed the *Encyclopedia*'s credo. It celebrated those who are committed to doing work well for its own sake; the craftsman stood out as the emblem of

Enlightenment. But over these exemplary men and women hung the specter of Vaucanson's robots, their Newtonian ghosts.

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To understand this bible of craftsmanship one has to understand its author's motives. Diderot was a poor provincial who migrated to Paris, where he talked endlessly, had too many friends, and spent other people's money.[13] Much of Diderot's life was wasted in literary hackwork to pay his debts; the *Encyclopedia* seemed to him at first just another way to stave off his creditors. The project began as a translation into French of Ephraim Chambers's English *Universal Dictionary of Arts and Sciences* (1728), a charming and rather disorganized collection of pieces by a "virtuoso" of the sciences—a "virtuoso" meaning in the mid-eighteenth century an amateur with a lively curiosity. One trade of the literary hack consisted in feeding the curiosity of the virtuoso, providing digestible bits of information and perhaps a few well-turned phrases the virtuoso could produce as his own in polite conversation.

The prospect of translating several hundred pages of such tasty morsels quite rightly depressed a man of Diderot's gifts. Once launched into the work, he transformed it. Chambers's text was soon cast aside; collaborators were enlisted to provide longer and deeper entries.[14] The *Encyclopedia* aimed, it is true, at the general reader rather than serving as a technical manual for practitioners. Diderot's wanted to stimulate the philosopher rather than the virtuoso in his readers.

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In large, how could the *Encyclopedia* assert that the craftsman's labors were icons of Enlightenment?

First and foremost, by putting manual pursuits on an equal footing with mental labors. The general idea had a sharp edge; the *Encyclopedia* scorned hereditary members of the elite who do no work and so contribute nothing to society. By restoring the manual laborer to

something like his archaic Greek honor, the encyclopédistes mounted a challenge equal in force to Kant's attack on traditional privilege but different in character: useful labor rather free reason challenges the past. The very march of the alphabet aided the *Encyclopedia*'s belief in the ethical equivalence of manual work to supposedly higher pursuits. In French *roi* (king) lies near *rôtisseur* (a roaster of meats or fowl), just as in English "knit" follows upon "king." As the historian Robert Darnton observes, the *Encyclopedia* seized on such couplings as more than happy accidents; these take the authority of a monarch down a peg by making it prosaic.

The pages of the *Encyclopedia* then look more particularly at usefulness and uselessness. In one telling plate, a maid appears industriously at work on a lady's coiffure. The maid radiates purpose and energy while her mistress languishes in ennui; the skilled servant and her bored mistress compose a parable of vitality and decadence. Diderot believed boredom to be the most corrosive of all human sentiments, eroding the will (Diderot continued throughout his life to explore the psychology of boredom, culminating in his novel *Jacques the Fatalist*). In the *Encyclopedia,* Diderot and his colleagues celebrated the vitality rather than dwelled on the sufferings of those deemed socially inferior. Vigor was the point: the encyclopédistes wanted ordinary workers to be admired, not pitied.

This positive emphasis was grounded in one of the eighteenth century's ethical touchstones, the power of sympathy. As our forebears understood sympathy, it did not quite conform to the biblical moral injunction to "treat thy neighbor as thyself." As Adam Smith observed in *The Theory of Moral Sentiments:* "As we can have no immediate experience of what other men feel, we can form no idea of the manner in which they are affected by conceiving what we ourselves should feel in a like situation."[15] Entering into others' lives requires therefore an act of *imagination.* David Hume made the same point in his *Treatise of Human Nature:* "Were I present at any of the more terrible operations

of surgery, 'tis certain, that even before it began, the preparation of the instruments, the laying of the bandages in order, the heating of the irons, with all the signs of anxiety and concern in the patient and assistants, would have a great effect upon my mind, and excite the strongest sentiments of pity and terror."[16] For both philosophers, "empathy" meant imagining oneself as another, in all his or her difference, rather than simply likening him or her to ourselves. Smith thus invokes in *The Theory of Moral Sentiments* the "Impartial Spectator," a figure who judges others not by his own interests but rather by the impressions they make on him. It is this imaginative work of sympathy rather than reason that first enlightens us about people.

In Mendelssohn's Berlin, sympathy of this outward sort was made into a method in a parlor game current in the city's bourgeois salons. People spent the evening impersonating a famous character in literature or from history, trying to stay in character throughout the soirée. We are in Berlin, not in the Carnival at Venice, where it might have been no more than amusing for the Renaissance queen Marie de' Medici, heavily jeweled, to drink a glass of wine with a nearly naked, flabby Socrates; in Berlin, we are training ourselves to imagine what it is like to be another person, how they think, feel, and behave.[17] In Paris, the *Encyclopedia* aimed socially lower and asked readers in salons not to imitate but to admire ordinary people bustling at work.

The *Encyclopedia* sought to get its readers out of themselves and into the lives of artisan craftsmen in order, next, to clarify good work itself. Throughout, the volumes illustrate people engaged sometimes in dull, sometimes in dangerous, sometimes in complicated labor; the expression on all the faces tends to the same serenity. About these plates the historian Adriano Tilgher remarks on the "sense of peace and calm which flows from all well-regulated, disciplined work done with a quiet and contented mind."[18] These illustrations appeal to the reader to enter into a realm in which contentment with ordinary things made well reigns.

In ancient times, the gods' craft skills were glorified as weapons in an eternal warfare for mastery. Hesiod's *Works and Days* or Virgil's Georgics portray human labor reflecting some of this divine glory, work appearing as a heroic struggle. So, too, in our times, worker warriors appear in Nazi and Soviet kitsch art as titans of the forge or the plow. Philosophes during the mid-eighteenth century sought to break this warrior spell. The economic historian Albert Hirschmann found the counting house to be one scene that calmed the warrior spirit, the counting house replacing violence impulse by diligent reckoning.[19] Even more was this spell meant to be broken in the craftsman's workshop.

Diderot likened the pleasures of craftsmanship more to marital sex than to the excitements of an affair. The serenity appearing on the faces of Diderot's glassblowers and papermakers radiates also in Jean-Baptiste-Siméon Chardin's still-lifes—a quiet, steady satisfaction in material things well composed, well contrived.

* * *

This too-brief summary of the *Encyclopedia*'s origins and general aims sets the stage for probing what it is that people learn by learning their limits. The question of human limits was posed to Diderot the moment he, as it were, rose from his armchair. His method for finding out how people worked was, like a modern anthropologist, to ask them: "We addressed ourselves to the most skilled workers in Paris and the kingdom at large. We took the trouble to visit their workshops, to interrogate them, to write under dictation from them, to follow out their ideas, to define, to identify the terms peculiar to their profession."[20] The research soon ran into difficulty, because much of the knowledge craftsmen possess is tacit knowledge—people know how to do something but they cannot put what they know into words. Diderot remarked of his investigations: "Among a thousand one will be lucky to find a dozen who are capable of explaining the tools or machinery they use, and the things they produce with any clarity."

A very large problem lurks in this observation. Inarticulate does not mean stupid; indeed, what we can say in words may be more limited than what we can do with things. Craftwork establishes a realm of skill and knowledge perhaps beyond human verbal capacities to explain; it taxes the powers of the most professional writer to describe precisely how to tie a slipknot (and is certainly beyond mine). Here is a, perhaps *the,* fundamental human limit: language is not an adequate "mirror-tool" for the physical movements of the human body. And yet I am writing and you are reading a book about physical practice; Diderot and his collaborators compiled a set of volumes nearly six feet thick on this subject.

One solution to the limits of language is to substitute the image for the word. The many plates, by many hands, that richly furnish the *Encyclopedia* made this assist for workers unable to explain themselves in words, and in a particular way. In illustrations of glassblowing, for instance, each stage of blowing a glass bottle appears in a separate image; all the junk of an ordinary workshop has been eliminated, and the viewer focuses on just what hands and mouth need to do at this moment to transform the molten liquid into a bottle. The images, in other words, illuminate by clarifying and simplifying movement into a series of clear pictures of the sort the photographer Henri Cartier-Bresson called "decisive moments."

It might be possible to imagine an experience of enlightenment strictly as a visual experience following this photographic procedure, one that enables our eyes to do the thinking about material things. In silence, as in a monastery, communication among people would be reduced to a minimum for the sake of contemplating how an object is made. Zen Buddhism follows this nonverbal path, taking the craftsman to be an emblematic figure who enlightens by showing rather than telling. Zen counsels that to understand the craft of archery you need not become an archer; instead, silently compose its decisive moments in your mind.

The Western Enlightenment followed both the photographic procedure and another path to understanding. The limits of language can be overcome through active involvement in a practice. Diderot's solution to the limits of language was to become himself a worker: "There are machines so hard to describe and skills so elusive that . . . it has often been necessary to get hold of such machines, set them in operation, and lend one's hand to the work."[21] A real challenge for a man used to salons. We don't know precisely what manual skills Diderot attempted, though in his professional circumstances they were likely those of setting type and pulling etchings. His plunge into manual labor was logical if unusual for a culture in which the ethos of sympathy urged people to get out of themselves, enter other lives. However, enlightenment through practice—or as modern educators have it, learning by doing—raises the question of one's talent to act and so the possibility of learning little, because one is not good at actually doing the work.

Many of Diderot's collaborators were scientists for whom trial and error was a guiding method of experiment. Nicolas Malebranche, for example, imagined the process of trial and error as following a path from many to fewer errors, a steady and progressive improvement through experiment. "Enlightenment" dawns as error decreases. The commentary Diderot provides on his experiences in workshops seems at first to echo this scientific version of failure corrected: "Become an apprentice and produce bad results so as to be able to teach people how to produce good ones." "Bad results" will cause people to reason harder, and so improve.

But trial and error can lead to quite a different result if one's talents prove insufficient to ensure ultimate mastery. So it was for Diderot, who found that by plunging into practice, many of his faults and errors proved "irremediable." Exposing oneself to practice, daring to doing it, one may have then to make sense of *failure* rather than of *error,* reckon limits on skill one can do nothing about. In this light, learning by doing, so comforting a nostrum in progressive education, may in fact be a recipe for cruelty. The craftsman's workshop is indeed a cruel school if it activates our sense of inadequacy.

To the social philosopher, the intersection of practice and talent poses a general question about agency: we are minded to believe that engagement is better than passivity. The pursuit of quality is also a matter of agency, the craftsman's driving motive. But agency does not happen in a social or emotional vacuum, particularly good-quality work. The desire to do something well is a personal litmus test; inadequate personal performance hurts in a different way than inequalities of inherited social position or the externals of wealth: it is about you. Agency is all to the good, but actively pursuing good work and finding you can't do it corrodes one's sense of self.

Our ancestors too often turned a blind eye to this problem. The progressive eighteenth century strongly proclaimed the virtues of "careers open to talent"—talent rather than inheritance the just foundation of upward mobility in society. Proponents of this doctrine could easily neglect, in their drive to destroy inherited privilege, the fate of the losers in competition based on talent. Diderot was unusual in paying attention to such losers, from his earliest books to mature works like *Rameau's Nephew* and *Jacques the Fatalist;* in them, the inadequacy of talent rather than social circumstance or blind chance begets the most grinding form of ruin. Still, the effort of exposure and engagement has to be made. In a letter, Diderot remarks that only the rich can afford to be stupid; for others, ability is a necessity, not an option. Talent then runs its race. This is the outline of a tragedy, but in Diderot's pages the losers can gain something as well. Failure can temper them; it can teach a fundamental modesty even if that virtue is gained at great pain.

"Salutary failure" had earlier appeared in Michel de Montaigne's essays, pages in which God disciplines humanity through showing us what we cannot do. For Diderot, as for Montesquieu and—oddly—for

Benjamin Franklin, mere ordinariness could occasion the sentiment of salutary failure, in a dramatic way.

* * *

The machine creates this dramatic occasion both as a fact and as a figure in Diderot's *Encyclopedia*. The replicant teaches nothing about salutary failure, but the robot—just possibly—can. The replicant may stimulate reasoning about ourselves, about our own internal machinery. The more powerful, tireless robot may set the standard against which all human beings fail. Should we be depressed by this outcome?

Papermaking suggests not. Enlightened papermaking appears in the *Encyclopedia* at a factory, L'Anglée, about sixty miles distant from Paris near the town of Montargis. Paper pulping was in the eighteenth century a messy and stinking operation, the rags used often stripped from corpses, then further rotted in vats for two months to break down their fibers. The entry for L'Anglée shows how the craft could be improved, human and robot cooperating in the effort.

First something simple: mirroring the eighteenth century's obsession with sanitation, the floors are swept spotless. Next, no worker appears on the verge of vomiting, because the illustrator has drawn vats with hermetic seals—anticipating an innovation that in fact came into being a generation later. Then, in the room where the fibers are beaten to a pulp—the messiest of all activities—there are no human beings at all, just a stamping mill tending itself, a robot that seems to modern eyes a primitive sort of automation but a machine that, again, was shortly to be realized by the steam engine. Finally, in the room where the trickiest human division of labor occurred, the pulp in vats scooped into thin sheets of material set in tray molds, three craftsmen work with balletic coordination, their faces serene, even though this scooping operation was backbreaking work; the laborers have sorted out this task through rational analysis.

This portrait, a narrative composed of a sequence of still images, is

curious, just because it anticipates real innovations at L'Anglée. The writer and engraver's imagination has edited the papermaking process so that mechanical tools eliminate the most "bestial" labors; correspondingly, they show machines that enable human judgment and cooperation to come to the fore. The general principle for machine use here is that, if the human body is frail, the machine should aid it or supplant it. The robot is an alien body; this stamping mill works nothing like the human arm in stretching, compressing, and stamping the pulp. Alien, machinery superior to ourselves, but not inhumane.

If such a machine shows how to overcome human limits, still the productive outcome is successful. Here the relation between human and machine is one of relative inadequacy. Against this model of enlightened inequality, papermaking with its friendly robots, the *Encyclopedia* probes the craft of glassblowing in order to plumb salutary failure proper. To understand the relation of human and machine in this contrast, we need to know something about the substance of glass itself.

Glassmaking has been practiced for at least two thousand years. Ancient recipes combined sand with iron oxide, which produced a blue-green hue, the glass translucent rather than transparent. Eventually trial and error succeeded in making glass more transparent through the addition of fern-ash, potash, limestone, and manganese. Even so, glass was not of good quality, and its fabrication arduous. Medieval windows were fashioned by blowing the molten glass through a stem, twirling it rapidly so to produce a plate shape; this hot plate was then pressed down on a stone slab and cut into small square bits. So slow and costly was the process, however, that it proved uneconomic; because glass panes were so precious, the duke of Northumberland had them removed from his castle windows whenever he took a trip. In the Middle Ages, as in antiquity, oiled paper usually served instead of glass in the windows of most prosaic buildings.

The quest for clear, large windows has been driven by the need to

bring into houses while protecting them from wind, rain, and noxious street smells. In the late seventeenth century French glassmakers learned how to make larger sheets of glass, at the Saint-Germain glassworks under the direction of Abraham Thévart, who in 1688 cast sheets in one piece eighty to eighty-four inches high and forty to forty-seven inches wide. This was, the historian Sabine Melchior-Bonnet remarks, "a size heard of previously only in fairy tales," though the glass itself remained in its medieval chemical formula.[22] Technical change in sizing glass now speeded up: in the early eighteenth century the ovens used for heating glass improved. A more refined craft labor followed, in the manner of pouring, flattening, and refiring the glass. By the time the Abbé Pluche came to describe the results in his *Spectacle of Nature* of 1746, the making of big glass panels for windows had become economically feasible; these French innovations enabled the Saint-Gobain works in France to pull ahead of its long-standing rivals in Venice, the glassmakers of the island of Murano.

Whereas the traditional eighteenth-century glassmaker poured his glass into molds, like making bricks, the modern glassmaker wanted to roll his glass into sheets. This is what the *Encyclopedia* seeks to portray, drawing on contemporary experiments in Paris. The illustrator presents a study in contrasts. First he shows the traditional way of twirling, then flattening, a molten gob of glass into a windowpane; against it, we see another image of a glassblower working with a rolling machine to flatten the pane. This machine procedure set a higher standard of a perfectly flat pane than the glassblower could ever achieve by working traditionally; the machine rollers made the glass absolutely, uniformly thick.

In this latter version, the machine sets the terms of quality, raising the game to a standard the human hand and eye cannot achieve. We might here usefully draw a comparison to the work of goldsmithing presented in the last chapter, where goldsmiths' guilds were places for hands-on learning about quality. The apprentice goldsmith imbibed his craft by imitating the master at work; in the new way of making a pane

of glass, the glassworker cannot imitate the machine. Not only does the roller function differently than the eye, but it works to a standard that the glassblower could never achieve by visual inspection.

So glass seems just another material that Vaucanson's looms and their progeny would colonize for profit at the expense of the skilled artisan. What could the glassblower, or the *Encyclopedia*'s readers, find salutary about the new technology?

To answer this question we will digress, as is the philosopher's wont, to a general observation and then to a seemingly unrelated subject. The general issue lies in what we conceive the purpose of a model to be. Any model shows how something ought to be done. The model embodied by a perfect machine suggests that the work can indeed be done flawlessly; if the glass roller is more "talented" than the human eye, then the career of window-making ought, in all justice, to be the exclusive preserve of the machine. But this line of thinking mistakes the purpose of a model. A model is a proposal rather than a command. Its excellence can stimulate us, not to imitate, but to innovate.

To make sense of this formula, we should quit for a moment the eighteenth-century workshop and enter its children's nurseries. One of the everyday achievements of the Enlightenment lay in explaining parenting as a craft. The *Encyclopedia* is but one of hundreds of books that explained how to feed and to keep babies clean, how to medicate sick children, how to toilet-train toddlers efficiently, and, above all, how to stimulate and educate children from an early age. Folk wisdom about these matters was deemed inadequate; like all traditional knowledge, it seemed only to pass on prejudice, which in parenting seemed particularly malign since medical advances now made it possible for more babies to survive infancy if parents would only change their own practices. A generation after the *Encyclopedia,* inoculation became the focus of debate between parents who refused this medical advance on traditional grounds and parents who accepted the strict schedule of repeated inoculations that medicine then required.[23]

The matter of the model appeared in the training required to produce an enlightened child. In Jean-Jacques Rousseau's writings, notably in his novel *Julie: ou, la nouvelle Héloïse,* the "craft" of both parents teaching children to be free is seen in the mother encouraging the young to act spontaneously on natural feelings like sympathy and the father encouraging both boys and girls to think rationally rather than rely on received authority. The undertow of Rousseau's writing is, however, that each parent in his or her own way should behave as an exemplary model—"I am the adult you ought to become." Imitate me.

Diderot's friend Louise d'Épinay, in her letters of advice to her granddaughter, *Conversations d'Émilie,* confronted this version of model parenthood.[24] She disputed first of all Rousseau's parental division of labor. A mother who trusts to her own instincts alone will not do enough to form a child's character; a father who acts as a stern man of reason risks driving the child inside him- or herself. More to our purposes, she challenges Rousseau's ideal of the exemplary model-parent. She believes that adults need to accept being "good enough" parents rather than "perfect parents"—as does her heir, Benjamin Spock, author of the most useful guide to parenting in modern times. As matter of common sense, parents need to accept their limitations, a lesson that, in any event, independent-minded children will teach them. But the real issue is self-image that parents hold up to their children: rather than convey "be like me," better parental advice should be more indirect. "This is how I lived" invites the child to reason about that example. Such advice omits, "Therefore you should . . . ." Find your own way; innovate rather than imitate.

I don't mean to push Madame d'Épinay into the arms of philosophy, but her forgotten little book is largely provocative. It contains the same force as Kant's famous image of the "twisted timber of humanity," a call to recognize and accept limits. Returning in the direction of the glassworks, this call matters as much in the workshop as in the nursery or the library. The challenge in the workshop is be to treat the ideal

model as something people might use on their own terms, according to their own lights. The machined object, like the parent, makes a proposal about how something might be done; we ponder the proposal rather than submit to it. The model becomes a stimulus rather than a command.

That connection was drawn by Voltaire. He contributed anonymously to the *Encyclopedia,* though sporadically. The same Voltaire who subscribed to Newton's mechanical universe doubted that many of the machines depicted and described in its pages could themselves, alone, lead to Progress. Humankind has first to accept its own weakness and propensity to make a mess of things; if people really take to heart the fault lines in themselves, the perfect machine will seem less a commanding remedy; indeed, we will actively seek out an alternative to it. This view Voltaire advanced with panache in his novel *Candide.*

Voltaire's parable recounts one tale after another of rape, torture, slavery, and betrayal. The source of these disasters is Dr. Pangloss, a literary stand-in for the philosopher G. W. Leibniz, serving as a caricature of the man of reason who has no truck with mere mess. But Pangloss, like his real-life counterpart, is brilliant; he is a mechanist-celebrant of perfection whose explanations of why "all is for the best in the best of all possible worlds" are impeccable. The young Candide, an Odysseus in breeches and a wig, is dull-witted. Still, he eventually recognizes that the nostrums of his teacher are too dangerous. He finally, famously, concludes, "Il faut cultiver notre jardin"—simple work is good medicine for those battered by life.

Candide/Voltaire has certainly given good advice in counseling gardening rather than grieving. But the advice is not quite so simple. Of course, neither Candide nor Pangloss was likely to know how to fertilize a garden or even how to hold a shovel; they, too, were creatures of the salon; this novel is no policy brief for vocational training. Even if it were, the *Encyclopedia* had in any event shown the *salonier* that manual labor is much more complicated that it might seem looking out

the windows of the Palais Royal. The nub of the advice is to prefer what one can manage for oneself, to prefer what is limited and concrete, and so human. Voltaire's point is that only someone who accepts that he or she is likely to fall short of perfection is likely to develop realistic judgments about life, to prefer what is limited and concrete and so human.

The spirit of that advice is what Voltaire's era was beginning to encompass in its encounter with machines. In the article on glassblowing, the *Encyclopedia* argues that imperfect, handmade glass has virtues: these are irregularity, distinctiveness, and what the writer refers to vaguely as "character." The two sets of images for glassblowing are thus inseparable; only by understanding how something might be done perfectly is it possible to sense this alternative, an object possessing specificity and character. The bubble or the uneven surface of a piece of glass can be prized, whereas the standard of perfection allows no room either for experiment, for variation—and the pursuit of perfection, Voltaire adjures his fellow philosophes, may lead human beings to grief rather than to progress.

The *Encyclopedia* tacks back and forth in its different articles between the poles represented by the paper factory and the glassmaker's workshop, the one a reconciliation of human and robot, the other an affirmation of work that is other than perfect; perfect work should serve as a foil for another sort of labor that aims at a different kind of result. By a very different route than the Renaissance celebration of artistic genius, then, the Enlightened craftsman could both celebrate and achieve individuality. But to follow this path, the good craftsman had to take on board Voltaire's caution; he had to accept imperfection in himself.

* * *

Modernity's first encounter with the power of machines produced a dense and contradictory culture. Machines stuffed that cornucopia of

goods that began to fill in an earlier time. More materially endowed, now the Enlightenment idealized human beings as self-empowering, about to cast off submission to tradition; the promise that humanity might cast off these shackles appeared in the pages of the *Berlinische Monatsschrift*. Would the machine prove an alternative power demanding submission? And what sort of machine? People wondered at replicants and feared robots, those alien contrivances superior to the bodies of their makers.

Diderot's *Encyclopedia* plunged into this matter by acknowledging from the outset the most basic of human limits, those of language to encompass the workings of the human body, especially the craftsman's body at work. Neither the worker nor the analyst of labor can really explain what's happening. Engaging in the process of craft labor to inform himself, Diderot discovered a further limit, that of talent; he could not understand intellectually work he could not do well practically. He had entered the robot's dangerous lair, in which the machine's "talents" provide a model of perfection against which human beings measure their own inadequacy.

Only a generation after the *Encyclopedia* appeared, Adam Smith had concluded that machines would indeed end the project of enlightenment, declaring in *The Wealth of Nations* that in a factory "the man whose whole life is spend in performing a few simple operations . . . generally becomes as stupid and ignorant as it is possible for a human creature to become."[25] Diderot's circle reached for another conclusion, which I would formulate as follows:

The enlightened way to use a machine is to judge its powers, fashion its uses, in light of our own limits rather than the machine's potential. We should not compete against the machine. A machine, like any model, ought to propose rather than command, and humankind should certainly walk away from command to imitate perfection. Against the claim of perfection we can assert our own individuality, which gives distinctive character to the work we do. Modesty and an awareness of

our own inadequacies are necessary to achieve character of this sort in craftsmanship.

The reader will be aware that I have, like Diderot in the workshop, now spoken for him, and this is because the implications of Enlightenment are perhaps evident only two and a half centuries later. Sound judgment about machinery is required in any good craft practice. Getting things right—be it functional or mechanical perfection—is not an option to choose if it does not enlighten us about ourselves.

The Romantic Craftsman
John Ruskin Battles the Modern World

By the mid-nineteenth century, as the modern economic system crystallized, the enlightened hope dimmed that artisans could find an honored place in the industrial order. The long lines of labor's dealings with machinery are clearest in America and Britain, whose governments early on encouraged mechanical experiment for industrial development. In both countries the creation of machinery for large-scale production gradually threatened the standing of the most skilled laborers and increased the number of semi- or unskilled workers, the machinery tending to replace high-cost skilled labor rather than aiming, as the enlightened papermaking mill at L'Anglée, to eliminate unskilled, noisome tasks.

Steelworkers in the United States represented the change that occurred in many other basic industries. Steel is an alloy of iron and carbon hardening agents. The Bessemer converter, which came into use after 1855, mass-produced this alloy by a new kind of giant, oval oxidation chamber. Between 1865 and 1900 industrial design then focused on such technical feats as substituting sampling technology for the costly human skills that had judged and regulated the addition of materials for steel in the flow of the production process. Machinery of a very clever sort was also devised to substitute absolute numbers

for human judgment about how to manage the cooling of the liquid metal.[26]

In the nineteenth-century steel industry, skilled artisans faced two potential futures because of technological change: deskilling or dismissal. The first meant they at least remained employed. In American steel mills by 1900, about half its artisans had accepted this fate, the other half seeking careers as metalworkers of other sorts. The skills involved in making steel did not easily "transfer," however, to other foundry labor—a signal fact for many basic industries, then and now.

Highly specialized skills represent not just a laundry list of procedures but a culture formed around these actions. Steelworkers in 1900 had developed a set of communal understandings that allowed large groups of workers to labor in a deafeningly noisy, poorly lit environment. These ways of working safely did not transfer to small, tight spaces as in a specialized machine shop, where the worker had to focus more on his individual body. This was a different sort of problem than the difficulties of technology transfer faced by the eighteenth-century luthiers of Cremona. In the luthier's intimate workshop, the transmission of individual talent was the issue; in the metal factory, it was adapting an established skill to a new spatial culture. As I've elsewhere documented, a kindred problem was faced in 1995 by programmers displaced from working on mainframe machines to personal computers and gaming devices. The norms of the workplace rather than computation formed the difficulty of change.[27]

Craft workers have fought technological change on three fronts: the employers, the unskilled laborers who took their jobs, and the machines. The American Federation of Labor (AFL) became an emblematic union in this regard. Over its long life its various craft unions fought well against their employers: many unions came to an understanding with the largely immigrant, unskilled workers whom employers preferred. But on the third front they did not fight well against the machine. The unions under the AFL umbrella failed to invest in

alternative strategies of mechanical design; the craftsmen did not sponsor research or themselves design machines that would keep a large body of skilled operatives necessary. Mechanical change came *to* the labor force rather than from within the labor movement.

Failure on this third front has magnified the symbolic threat of the machine. Skilled operatives live with and through machines but rarely create them in modern industry. Technological advance comes in this way to seem inseparable from domination by others.

* * *

There was no more passionate Victorian protest against such mechanical domination than the English writer John Ruskin, who appealed to his readers to scorn the very idea of a mechanical civilization. Manual workers in medieval guilds seemed to him to lead better lives, in higher-quality institutions, than they do in modern factories. The radical nature of Ruskin's vision was to assert that modern society as a whole should and could return to the preindustrial past.

Ruskin was an unlikely champion of craft workers or indeed of any physical activity. Born into a prosperous, tight-knit family, he was an inward boy; his became the adult life of a sensitive, vulnerable man who found a refuge in the cloisters of Oxford but no inner peace. In part, physical objects and artisanal work served him as a release from self—but he in no way fitted the stereotype of a fussy aesthete. Ruskin's great modern biographer, Tim Hilton, presents him as a man who early on foreshadowed E. M. Foster's dictum "only connect," which in Ruskin's case meant connecting to other people through hand-made things.[28]

In early trips to Italy, particularly to Venice, Ruskin found an unexpected beauty in its rough-hewn medieval buildings. The gargoyles, arched doorways, and windows hewn by stonemasons appealed to him more than the abstract geometries of later Renaissance architecture or the perfect workmanship of eighteenth-century cabinetmakers. He drew these rough objects in the same spirit as he found them, beautifully evoking the irregularities of the stones of Venice in free-flowing lines on paper; by drawing, he discovered the pleasures of touch.

Ruskin's writing is intensely personal; he draws ideas and precepts from his own sensations and experience. The appeal he made we might formulate today as "get in touch with your body." His prose at its best has an almost hypnotic tactile power, making the reader feel the damp moss on an old stone or see the dust in sunlit streets. As his work progressed, his contrast of past and present became even more polemic: Italian cathedrals contrasted to British factories, Italians' expressive labor to English dull industrial routine. At Oxford in the 1850s and 1860s Ruskin put the command "get in touch with your body" into practice. He led troops of gilded youth out to the suburbs to work on road construction, their sore, callused hands virtuous signs of connecting to Real Life.

If "Ruskinism" involved an appreciation of rough-hewn beauty, and more than a tinge of eroticism in hard physical labor, it clarified an apprehension Ruskin's readers could name only with difficulty. The industrial age consummated the cornucopia, the machine pouring forth a cornucopia of clothes, domestic utensils, books and newspapers, machines to make other machines. Like their predecessors Victorians both wondered and felt anxious about this material abundance. The machine introduced a new element concerning the relation of quantity and quality. For the first time, the sheer quantity of uniform objects aroused concerns that number would dull the senses, the uniform perfection of machined goods issuing no sympathetic invitation, no personal response.

This inverse relation between quantity and quality expressed itself through waste—a problem only dreamed of by scarcity societies. We can work backward to this problem through the numbers that represent waste today, in products thrown out long before the end of their practical life. By one count, 92 percent of used cars on sale in Britain in 2005 had a serviceable future life of at least five years; 86 percent of the

buyers of new computers in 2004 ran the same programs they ran on their old computers. One explanation for such waste is that consumers buy the potential power of new objects rather than power they actually use; the new automobile can speed a hundred miles an hour, even though the driver is usually stuck in traffic. Another explanation of modern waste is that consumers are more aroused by anticipation than by operation; getting the latest thing is more important than then making durable use of it.[29] Either way, being able so easily to dispose of things desensitizes us to the actual objects we hold in hand.

Ruskin was not the first Victorian to perceive that sheer quantity might diminish the tactile qualities of material things. The problem of waste earlier appeared in Benjamin Disraeli's novel *Sybil, or the Two Nations,* in 1845. The point of this political tract cum novel was to attack the deprivation in which the masses of English people lived, a point sharpened by Disraeli's pictures of wealth as waste—half-consumed joints of beef, wines of which only a glass in a bottle might be tasted, clothes worn once or twice for the season and then cast aside. Many Victorian writers had depicted the horrors of poverty in itself. Disraeli's distinctive voice appears in how in this, and in the other two novels of which Sybil forms a part, he portrays waste as the negligence of privilege. Ruskin rang a bell in this overstuffed era on this account; the rooms he liked to live in were, for their time, relatively bare. As the good Victorian he was, he contrived a moral for this aesthetic spareness: the fewer things we display, the more we care about each one.

Quantity is measured by how big as well as how much. Big was symbolized to Ruskin's generation by one machine presented at the Great Exposition of 1851, the century's great celebration of the industrial cornucopia.

Conceived by the Prince Regent, the exposition itself was a massive display of modern machinery and industrial products set within a giant greenhouse designed and executed by Joseph Paxton. It encompassed everything from sophisticated steam engines and steam-driven tools to

porcelain toilets and machine-made hairbrushes. Objects made by hand were included, prominent in the sections devoted to crafts from Britain's colonies. The things made in Britain were presented to show the variety that an industrial "type-form" like a flush toilet could take, its bowl cast variously as a simple cup, a decorated urn, or (my favorite) a kneeling elephant.[30] In the first, heady burst of consumer industrial production, there was no strict correlation between function and form.

Paxton's immense greenhouse housing this paean to the industrial machine, inaccurately called the Crystal Palace, was itself a product of the innovations in glassmaking foreshadowed in the pages of the *Encyclopedia.* To achieve large panes of rolled glass that were sturdy enough for construction required a reformation of the material's soda-lime proportions and the invention of cast-iron rollers tolerant of constant high heat—requirements entirely foreign to crystal. These innovations finally appeared in the 1840s.[31] The arcades of Paris begun earlier in the century had glass roofs, but the panes of the arcades were smaller and the roof panels leakier. At the exposition, everything was glass—glass held tightly in metal frames. The building embodied an aesthetic possible only thanks to the work of the machine, an aesthetic of pure transparency, the visual division between inside and outside abolished.

The single object in the Great Exposition of 1851 that most dramatically defined the machine's dominion was a robot called Count Dunin's Man of Steel, named after its creator, a robot given pride of place in the Crystal Palace at the base of the speaker's rostrum. Seven thousand pieces of steel, forged into plates and springs, composed a metal man in the shape of the Apollo Belvedere whose one arm stretches out before him as for a handshake. At the turn of a crank this metal figure began to expand, the springs and wheels within him pushing out concealed plates, so that he retained the perfection of the Apollo Belvedere's form but became the size of a welcoming Goliath. It took only thirty seconds to inflate Count Dunin's Man of Steel to double life-size or to shrink him down again to normal scale.[32]

Unlike Vaucanson's Parisian replicants, the metal Greek did not imitate any human function; unlike Vaucanson's Lyonnais robots, the Man of Steel produced nothing save the impression of his own power. The ethos of the overpowered automobile was embodied in this Victorian robot: big, but for not purpose.

* * *

That impression of sheer mechanical power, the whole point of the Great Exposition, Ruskin sought to deflate. This was the radical, energetic context of his nostalgia; he felt anger rather than sighed in regret. His writings issued a call to arms to combat the modern cornucopia, to reinvigorate sensate reaction to objects. Equally, in his call to arms, he exhorted artisans to reassert their claims on society's respect.

In the mid-1850s Ruskin helped create a Working Men's College in a house in London's Red Lion Square. In a letter to his friend Pauline Trevelyan he described its students: "I want to give short lectures to about 200 at once in turn, [to] shop decorators—and writing masters—and upholsterers—and masons—and brickmakers, and glassblowers and pottery people." The purpose of his lectures was in part to strip away the decorative masks of type-form, to make his students aware of the essential uniformity of mechanical production. "I want to explode printing; and gunpowder—the two great curses of the age—I begin to think that abominable art of printing is the root of all mischief—it makes people used to have everything of the same shape." Ruskin proposed to wake up the craftsmen's senses by creating a room where they could contemplate a few truly individual objects made in the past, "a room where anybody can go in all day and always see nothing in it but what is good."[33] As well as late medieval painting and sculpture, he wanted his students to savor the irregularities of handmade goods like eighteenth-century glass.

Behind the Working Men's College lay a positive conception of craftsmanship—broadly conceived, applicable to people who use their

heads as well as their hands. This conception crystallized in the book that secured Ruskin's fame, *The Seven Lamps of Architecture,* in 1849. Gothic stonework, he says, is a "grammar," a "flamboyant" grammar, one form generating another sometimes by the stonemason's will, sometimes simply by chance; "flamboyance" is his cognomen for "experiment." In *The Stones of Venice* of 1851–1853 this word takes on a deeper cast. Now Ruskin is beginning to contemplate, as we have seen among Linux programmers, the intimate connection between problem solving and problem finding. A "flamboyant" worker, exuberant and excited, is willing to risk losing control over his or her work: machines break down when they lose control, whereas people make discoveries, stumble on happy accidents. The surrender of control, at least temporarily, now gives Ruskin a recipe for good craftsmanship and how it should be taught. In *The Stones of Venice* Ruskin invents this figure of a draftsman who has temporarily lost control of his work:

> You can teach a man to draw a straight line; to strike a curved line, and to carve it . . . with admirable speed and precision; and you will find his work perfect of its kind: but if you ask him to think about any of those forms, to consider if he cannot find any better in his own head, he stops; his execution becomes hesitating; he thinks, and ten to one he thinks wrong; ten to one he makes a mistake in the first touch he gives to his work as a thinking being. But you have made a man of him for all that, he was only a machine before, an animated tool.[34]

Ruskin's draftsman will recover, and his technique will be the better for the crisis he has passed through. Whether like the stonemason one leaves in the nicks and mistakes or whether like the draftsman one recovers the ability to make exact, straight lines, the craftsman is now become self-conscious. His is not the path of effortless mastery; he has had troubles, and he has learned from them. The modern craftsman should model himself or herself on this troubled draftsman rather than on Count Dunin's Man of Steel.

Ruskin's *Seven Lamps of Architecture* provided seven guides, or "lamps," for the troubled craftsman, guides for anyone who works directly on material things.[35] These seven are:

- "the lamp of sacrifice," by which Ruskin means, as I do, the willingness to do something well for *its* own sake, dedication;
- "the lamp of truth," the truth that "breaks and rents continually"; this is Ruskin's embrace of difficulty, resistance, and ambiguity;
- "the lamp of power," tempered power, guided by standards other than blind will;
- "the lamp of beauty," which for Ruskin is found more in the detail, the ornament—hand-sized beauty—than in the large design;
- "the lamp of life," life equating with struggle and energy, death with deadly perfection;
- "the lamp of memory," the guidance provided by the time before machinery ruled; and
- "the lamp of obedience," which consists of obedience to the example set by a master's practice rather than by his particular works; otherwise put, strive to be like Stradivari but do not seek to copy his particular violins.

As a vein of radical thought, Ruskin refuses the present, looks backward in order to look forward. Ruskin sought to instill in craftsmen of all sorts the desire, indeed the demand, for a lost space of freedom; it would be a free space in which people can experiment, a supportive space in which they could at least temporarily lose control. This is a condition for which people will have to fight in modern society. Ruskin believed that the rigors of the industrial age work against experiences of free experiment and salutary failure; had he lived long enough, he would have appreciated F. Scott Fitzgerald's observation that in America there are no second chances. For Ruskin, the craftsman serves as an emblem for all people in the very need of the opportunity for "hesitation . . . mistakes"; the craftsman must transcend

working by the "lamp" of the machine, become in his or her doubts more than an "animated tool."

What would Diderot have made of the seven lamps guiding the craftsman? Certainly the encyclopédiste would have appreciated Ruskin's humanity, but he would insisted that reason could play a greater role in it, and that the modern machine, even a robot, serves a purpose in human self-understanding. Ruskin might reply that Diderot had not yet learned the hard truth of industrial power. Diderot might counter that Ruskin's lamps illuminate how craftsmen have done their work well but offer no real guidance about the materials the modern craftsman has to hand. Put in modern terms, we might compare Ruskin to Heidegger; Ruskin did not yearn to escape to a dream-hut; he sought instead another sort of material practice and another sort of social engagement.

* * *

In its time, Ruskin's craftsman appeared a Romantic figure, and as a Romantic trope the craftsman served as a counterweight to the Romanticism embodied in the emblem of the artist as technical virtuoso.

In the early eighteenth century a virtuoso like Chambers, with wide-ranging interests, rather prided himself on his amateurism. In Chambers's day Antonio Stradivari would not have been labeled a virtuoso; his genius ran in one channel only. In Britain, the gentleman amateur has retained a certain snobbish cachet, as has his opposite number, the gentleman who evinces effortless, casual mastery. Faced with complicated cancer surgery, you would not want to trust your body to either. But the specialist virtuoso also has an unsettling relation to technique.

In music, the virtuoso obsessed by technique took to the public stage in the mid-eighteenth century. Sheer finger dexterity became a display that audiences paid to hear in the new realm of public concert performances; the amateur listener began to applaud—as an inferior.

This situation marked a contrast to the performances in courts in which Frederick the Great, for instance, played the flute parts in the compositions he commissioned from his hired musicians or, earlier, the role as lead dancer Louis XIV frequently took in the spectacles mounted at Versailles. Both kings were highly skilled performers, but in courts the line between performer and audience, technical master and amateur, was blurred. Diderot's novel *Rameau's Nephew* marks the firmness of this new line as it began to be drawn in his time. This dialogue in part asks what is technical mastery and answers that it is the fruit of heroic struggle, man's battles with an instrument. The dialogue then poses the question whether technical flamboyance compromises artistic integrity. In the history of music the answer to that question became ever more pressing, from Niccolò Paganini to Sigismond Thalberg to Franz Liszt in their public appearances during the first half of the nineteenth century. They dramatized the heroics of technique, Paganini and Thalberg diminishing thereby the musical virtues of simplicity and modesty.

By the 1850s the musical virtuoso appeared to be someone whose technical skill had developed to such perfection that amateur players in an audience felt small, almost worthless in comparison. The rise of the virtuoso on stage coincided with silence and immobility in the concert hall, the audience paying fealty to the artist through its passivity. The virtuoso shocks and awes. In exchange, the virtuoso unleashed in listeners passions they could not produce using their own skills.[36]

Ruskin loathed this ethos of the Romantic virtuoso. The craftsman's hesitations and mistakes have nothing in common with such a performance; the musical analogue to Ruskin's celebration of the craftsman would be *haus-musik,* in which amateurs learned the classics on their own terms. But Ruskin shifted the scene in which the compromised virtuoso appears, from the concert hall to the engineering works.

Engineers like Isambard Kingdom Brunel—who will make a more extended appearance later in these pages—embodied for Ruskin the ills of technical virtuosity. An engineer of steel ships, of long-span bridges and viaducts, Brunel was a technical virtuoso whose work in one way conformed to Ruskin's "lamps": it was experimental, and much of the experiment proved flawed. And Brunel was a committed, not to say passionate craftsman who could have made more money by being more prudent. Yet his work celebrates sheer technical prowess, which to Ruskin was unforgivable. This refusal amounted to something like a religious mania: virtuosity employing machines is everywhere and always inhumane.

Ruskin, in sum, sought to assert the claims of work that is neither amateur nor virtuoso. This middle ground of work is craftsmanship. And this figure of the craftsman, as a worker both defiant and doomed, has passed down from Ruskin's time to our own, though the explicit label "Romantic" has disappeared.

A decade after Ruskin's death in 1900, the American sociologist Thorstein Veblen celebrated the Ruskinian virtues of the handmade over the machine-made in *The Spirit of Workmanship,* in characteristically ornate prose: "The visible imperfections of hand-wrought goods, being honorific, are accounted marks of superiority, of serviceability, or both."[37] The Great Exposition he saw firsthand, in Chicago in 1893, seemed to mark the craftsman's passing; most of the craftwork on display came from places and peoples Veblen called—with a sense of the irony involved—"primitive" or "undeveloped." The civilized goods dominated in their profuse, uniform, machined numbers. As befits an economist, Veblen tied the craftsman's demise to consumption patterns; the London Great Exposition of 1851 was for him an early foretaste event in machine-enabled "conspicuous consumption," a first exercise in mass advertising. The good craftsman is a poor salesman, absorbed in doing something well, unable to explain the value of what he or she is doing.[38]

To Veblen's heir, C. Wright Mills, the machine too seems the instrument by which the craftsman—though deeply fulfilled by work, embracing experiment and irregularity, modest in intent, careful and particular—is doomed. "This model of craftsmanship," Mills declares, "has become an anachronism."[39] This, too, is Ruskinian. Perhaps this cast of mind explains why craftsmen themselves, like the skilled American steelworkers, did not try to engage through their unions in technological innovation—or perhaps menaced workers cannot fight on all fronts. Still, a fundamental issue is posed by this history. Between the Enlightened and the Romantic views of craftsmanship we ought certainly, I believe, to prefer those of the earlier time, when working with machines rather than fighting was the radical, emancipatory challenge. It remains so.

CHAPTER FOUR

Material Consciousness

At the meeting of the British Medical Association in 2006 when the passions of doctors and nurses boiled over, a room was found for the overflow of journalists, members of the public like me, and medical people who could not get into the hall. Some scientific presentation must have occurred in this room previously, for left on the giant screen in front of our seats was the full-color picture of a rubber-gloved hand lifting up a part of a patient's large intestine in a surgical operation. The journalists occasionally glanced at this monster image only to look away as though it were somehow obscene. The doctors and nurses in the room, however, seemed to pay it more and more attention, particularly at those moments when the voices of government officials wafted through the loudspeakers, droning on about reform.

Their rapt attention to whatever the gloved hand was doing to the large intestine is material consciousness. All craftsmen have it, even those who practice the most arcane art. The painter Edgar Degas is once supposed to have remarked to Stéphane Mallarmé, "I have a wonderful idea for a poem but I can't seem to work it out," whereupon Mallarmé replied, "My dear Edgar, poems are not made with ideas, they are made with words."

As might be imagined, "material consciousness" is a phrase that

causes philosophers to salivate. Is our consciousness of things independent of the things themselves? Are we aware of words in the way we feel an intestine by touch? Rather than get lost in this philosophical forest, it might be better to focus on what makes an object interesting. This is the craftsman's proper conscious domain; all his or her efforts to do good-quality work depend on curiosity about the material at hand.

I want to make a simple proposal about this engaged material consciousness: we become particularly interested in the things we can change. The giant image of the human intestine on the screen was intriguing because the surgeons were, it transpired, doing something odd to it. People invest thought in things they can change, and such thinking revolves around three key issues: metamorphosis, presence, and anthropomorphosis. Metamorphosis can be as direct as a change in procedure, as when potters switch from molding clay on a fixed platter to building it up on a rotating wheel; potters who do both will be conscious of the difference in technique. Presence can be registered simply by leaving a maker's mark, such as a brickmaker's stamp. Anthropomorphosis occurs when we impute human qualities to a raw material; supposedly primitive cultures imagine that spirits dwell in a tree, and so in a spear cut from its wood; sophisticates personalize materials when using words like *modest* or *sympathetic* to describe finishing details on a cabinet.

In this chapter, I shall investigate each of these forms of material consciousness more in depth, among craftsmen working with clay.

Metamorphosis
The Potter's Tale

The simplest way to make a pot is to coil a rope of clay up around the edge of a flat disk.[1] A small innovation is to place a cut gourd under the flat disk so that the pot can be turned more easily in the potter's

hands as the coil builds up around the sides. This small innovation suggests a much larger step, that of using a free-spinning wheel.

This step was taken about 4000 BCE in what is now Iraq and spread westward to the Mediterranean about 2500 BCE. Greek potters' wheels from about 1000 BCE onward were heavy wood or stone disks that rotated on a pointed stone support. A potter's assistant steadied and turned the wheel while the potter shaped the clay with both hands. The spinning wheel's momentum suggested an entirely new way of building up form than the rope coil; now the potter could raise a wet clay lump. If small, such a pot was structurally of one piece. Larger pots could be assembled by fitting together tubes shaped on the wheel. Whether small or large, the potter, after the pot began to dry, scraped off excess clay with a stylus while the pot turned on the wheel.

Archaic and ancient pottery certainly became more complex from about 800 BCE on. Sheer utility would not explain this logic, however, since rope building produced perfect serviceable objects, and it makes pots faster than wheel building. Nor would utility alone explain the decorative thinking that went into the surface of these pots.

All pottery can be decorated by the use of slips. These are highly refined clays of different colors that, once dried, can be mixed to create stronger colors and then be painted on the surface of a pot. Ancient slips differ from modern pottery glazes in lacking a high silica content. The Greeks, however, developed techniques for controlling firing in the kiln so that the surface achieved a vitreous shine. The modern potter Susanne Staubach has worked out how the Greek potter used the kiln as a chemistry laboratory to achieve these polychrome results. The kilns were heated to 900 degrees Celsius to oxidize the clay. Then sawdust was thrown into the kiln to begin the process of reduction. If left at this point, however, the slip would not register its distinctive color. The potter discovered a way to reoxidize the clay by opening the kiln's damper. The body of the pot now turned red while the figures