The Craftsman

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CHAPTER ONE

The Troubled Craftsman

The Craftsman summons an immediate image. Peering through a window into a carpenter's shop, you see inside an elderly man surrounded by his apprentices and his tools. Order reigns within, parts of chairs are clamped neatly together, the fresh smell of wood shavings fills the room, the carpenter bends over his bench to make a fine incision for marquetry. The shop is menaced by a furniture factory down the road.

The craftsman might also be glimpsed at a nearby laboratory. There, a young lab technician is frowning at a table on which six dead rabbits are splayed on their backs, their bellies slit open. She is frowning because something has gone wrong with the injection she has given them; she is trying to figure out if she did the procedure wrong or if there is something wrong with the procedure.

A third craftsman might be heard in the town's concert hall. There an orchestra is rehearsing with a visiting conductor; he works obsessively with the orchestra's string section, going over and over a passage to make the musicians draw their bows at exactly the same speed across the strings. The string players are tired but also exhilarated because their sound is becoming coherent. The orchestra's manager is worried; if the visiting conductor keeps on, the rehearsal will move into overtime, costing management extra wages. The conductor is oblivious.

The carpenter, lab technician, and conductor are all craftsmen because they are dedicated to good work for its own sake. Theirs is practical activity, but their labor is not simply a means to another end. The carpenter might sell more furniture if he worked faster; the technician might make do by passing the problem back to her boss; the visiting conductor might be more likely to be rehired if he watched the clock. It's certainly possible to get by in life without dedication. The craftsman represents the special human condition of being *engaged*. One aim of this book is to explain how people become engaged practically but not necessarily instrumentally.

Craftsmanship is poorly understood, as I noted in the Prologue, when it is equated only with manual skill of the carpenter's sort. German employs the word *Handwerk,* French the word *artisanal* to evoke the craftsman's labors. English can be more inclusive, as in the term *statecraft;* Anton Chekhov applied the Russian word *mastersvo* equally to his craft as a doctor and as a writer. I want first to treat all such concrete practices as like laboratories in which sentiments and ideas can be investigated. A second aim of this study is to explore what happens when hand and head, technique and science, art and craft are separated. I will show how the head then suffers; both understanding and expression are impaired.

All craftsmanship is founded on skill developed to a high degree. By one commonly used measure, about ten thousand hours of experience are required to produce a master carpenter or musician. Various studies show that as skill progresses, it becomes more problem-attuned, like the lab technician worrying about procedure, whereas people with primitive levels of skill struggle more exclusively on getting things to work. At its higher reaches, technique is no longer a mechanical activity; people can feel fully and think deeply what they are doing once they do it well. It is at the level of mastery, I will show, that ethical problems of craft appear.

The emotional rewards craftsmanship holds out for attaining skill are twofold: people are anchored in tangible reality, and they can take pride in their work. But society has stood in the way of these rewards in the past and continues to do so today. At different moments in Western history practical activity has been demeaned, divorced from supposedly higher pursuits. Technical skill has been removed from imagination, tangible reality doubted by religion, pride in one's work treated as a luxury. If the craftsman is special because he or she is an engaged human being, still the craftsman's aspirations and trials hold up a mirror to these larger issues past and present.

The Modern Hephaestus

Ancient Weavers and Linux Programmers

One of the earliest celebrations of the craftsman appears in a Homeric hymn to the master god of craftsmen, Hephaestus: "Sing clear-voiced Muse, of Hephaestus famed for skill. With bright-eyed Athena he taught men glorious crafts throughout the world—men who before used to dwell in caves in the mountains like wild beasts. But now that they have learned crafts through Hephaestus famous for his art they live a peaceful life in their own houses the whole year round."[1] The poem is contrary in spirit to the legend of Pandora, which took form at roughly the same time. Pandora presides over destruction, Hephaestus over the craftsman as a bringer of peace and a maker of civilization.

The hymn to Hephaestus may seem to celebrate no more than a cliché, that of civilization commencing when human beings began to use tools. But this hymn was written thousands of years after the fabrication of such tools as knives, the wheel, and the loom. More than a technician, the civilizing craftsman has used these tools for a collective good, that of ending humanity's wandering existence as hunter-gatherers or rootless warriors. Reflecting on the Homeric hymn to

Hephaestus, a modern historian writes that because craftwork "brought people out of the isolation, personified by the cave-dwelling Cyclopes, craft and community were, for the early Greeks, indissociable."[2]

The word the hymn used for craftsman is *demioergos*. This is a compound made between public (*demios*) and productive (*ergon*). The archaic craftsman occupied a social slice roughly equivalent to a middle class. The *demioergoi* included, in addition to skilled manual workers like potters, also doctors and lower magistrates, and professional singers and heralds who served in ancient times as news broadcasters. This slice of ordinary citizens lived in between the relatively few, leisured aristocrats and the mass of slaves who did most of the work—many of whom had great technical skills but whose talents earned them no political recognition or rights.[3] It was in the middle of this archaic society that the hymn honored as civilizers those who combined head and hand.

Archaic Greece, like many other societies that anthropologists until quite recently labeled "traditional," took it for granted that skills would be handed down from generation to generation. This assumption is more remarkable than it might appear. Social norms counted for more than individual endowments in the traditional "skills society." Developing one's talents depended on following the rules established by earlier generations; that most modern of words—personal "genius"—had little meaning in this context. To become skilled required, personally, that one be obedient. Whoever composed the hymn to Hephaestus accepted the nature of this communal bond. As with deeply held values in any culture, it seemed self-evident that people will identify with other craftsmen as fellow citizens. Skill would bind them to their ancestors as to their fellows. In their gradual evolution, traditional skills thus seem exempt from Hannah Arendt's principle of "natality."

If the artisan was celebrated in the age of Homer as a public man or woman, by classical times the craftsman's honor had dimmed. The reader of Aristophanes finds a small sign of this change in the con-

tempt with which he treats the potters Kittos and Bacchios as stupid buffoons due to the work they do.[4] A graver portent of the artisan's darkening fortunes appears in the writings of Aristotle on the nature of craft. In the *Metaphysics,* he declares, "We consider that the architects in every profession are more estimable and know more and are wiser than the artisans, because they know the reasons of the things which are done."[5] Aristotle abandons the old word for the craftsman, *demi-oergos,* and uses instead *cheirotechnon,* which means simply hand-worker.[6]

This shift had a particular, ambiguous meaning for women workers. From earliest times, weaving was a craft reserved for women that gave them respect in the public realm; the hymn singles out crafts like weaving as practices that helped civilize the hunter-gatherer tribes. As archaic society became classical, still the public virtue of women weavers was celebrated. In Athens, women spun a cloth, the *peplos,* that they then paraded through the city streets in an annual ritual. But other domestic crafts like cooking had no such public standing, and no craftwork would earn Athenian women in the classical era the right to vote. The development of classical science contributed to the gendering of skill that produced the word *craftsman* as applying to men. This science contrasted the man's hand dexterity to the inner-organ strength of women as childbearers; it contrasted the stronger arm and leg muscles of men to those of women; it supposed that men's brains were more "muscular" than those of women.[7]

This gender distinction sowed the seed of a still-living plant: most domestic crafts and craftsmen seem different in character than labor now outside the home. We do not think of parenting, for instance, as a craft in the same sense that we think of plumbing or programming, even though becoming a good parent requires a high degree of learned skill.

The classical philosopher most sympathetic to the archaic ideal of Hephaestus was Plato, who also worried about its demise. He traced

skill back to the root word for "making," *poiein.* This is the parent word for *poetry,* and in the hymn, too, poets appear as just another kind of craftsman. All craftsmanship is quality-driven work; Plato formulated this aim as the *arete,* the standard of excellence, implicit in any act: the aspiration for quality will drive a craftsman to improve, to get better rather than get by. But in his own time Plato observed that although "craftsmen are all poets . . . they are not called poets, they have other names."[8] Plato worried that these different names and indeed different skills kept people in his day from understanding what they shared. In the five centuries between the hymn to Hephaestus and his own lifetime, something seemed to have slipped. The unity in archaic times between skill and community had weakened. Practical skills still sustained the ongoing life of the city but were not generally honored for doing so.

To understand the living presence of Hephaestus, I ask the reader to make a large mental jump. People who participate in "open source" computer software, particularly in the Linux operating system, are craftsmen who embody some of the elements first celebrated in the hymn to Hephaestus, but not others. The Linux technicians also represent as a group Plato's worry, though in a modern form; rather than scorned, this body of craftsmen seem an unusual, indeed marginal, sort of community.

The Linux system is a public craft. The underlying software kernel in Linux code is available to anyone, it can be employed and adapted by anyone; people donate time to improve it. Linux contrasts to the code used in Microsoft, its secrets until recently hoarded as the intellectual property of one company. In one current, popular Linux application, Wikipedia, the code kernel makes possible an encyclopedia to which any user can contribute.[9] When established in the 1990s, Linux sought to recover some of the adventure of the early days of computing in the

1970s. During these two decades, the software industry has morphed within its brief life into a few dominant firms, buying up or squeezing out smaller competitors. In the process, the monopolies seemed to churn out ever more mediocre work.

Technically, open-source software follows the standards of the Open Source Initiative, but the brute label "free software" doesn't quite capture how resources are used in Linux.[10] Eric Raymond usefully distinguishes between two types of free software: the "cathedral" model, in which a closed group of programmers develop the code and then make it available to anyone, and the "bazaar" model, in which anyone can participate via the Internet to produce code. Linux draws on craftsmen in an electronic bazaar. The kernel was developed by Linus Torvalds, who in the early 1990s acted on Raymond's belief that "given enough eyeballs, all bugs are shallow"—engineer-speak for saying that if enough people participate in the code-writing bazaar, the problems of writing good code can be solved more easily than in the cathedral, certainly more easily than in proprietary commercial software.[11]

This, then, is a community of craftsmen to whom the ancient appellation *demioergoi* can be applied. It is focused on achieving quality, on doing good work, which is the craftsman's primordial mark of identity. In the traditional world of the archaic potter or doctor, standards for good work were set by the community, as skills passed down from generation to generation. These heirs to Hephaestus have experienced, however, a communal conflict about the use of their skills.

The programming community is grappling with how to reconcile quality and open access. In the Wikipedia application, for instance, many of the entries are biased, scurrilous, or just plain wrong. A breakaway group now wants to apply editing standards, an impulse that runs smack up against the movement's desire to be an open community. The editor "elitists" don't dispute the technical proficiency of their adversaries; all the professional parties in this conflict feel passionately about maintaining quality. The conflict is equally strong in the generative

realm of Linux programming. Its members are grappling with a structural problem: how can quality of knowledge coexist with free and equal exchange in a community?[12]

We'd err to imagine that because traditional craft communities pass on skills from generation to generation, the skills they pass down have been rigidly fixed; not at all. Ancient pottery making, for instance, changed radically when the rotating stone disk holding a lump of clay came into use; new ways of drawing up the clay ensued. But the radical change appeared slowly. In Linux the process of skill evolution is speeded up; change occurs daily. Again, we might think that a good craftsman, be she a cook or a programmer, cares only about solving problems, about solutions that end a task, about closure. In this, we would not credit the work actually involved. In the Linux network, when people squash one "bug," they frequently see new possibilities open up for the use of the code. The code is constantly evolving, not a finished and fixed object. There is in Linux a nearly *instant* relation between problem solving and problem finding.

Still, the experimental rhythm of problem solving and problem finding makes the ancient potter and the modern programmer members of the same tribe. We would do better to contrast Linux programmers to a different modern tribe, those bureaucrats unwilling to make a move until all the goals, procedures, and desired results for a policy have been mapped in advance. This is a closed knowledge-system. In the history of handcrafts, closed knowledge-systems have tended toward short lifespans. The anthropologist André Leroi-Gourhan contrasts, for instance, the open, evolving, difficult, but long-lasting craft of metal knife-making in preclassical Greece to the craft of wooden knife-making—a more precise, economical, but static system of fabricating knives that was soon abandoned for the problems of metal.[13]

Linux is most deeply "Greek" in its impersonality. In Linux online workshops, it's impossible to deduce, for instance, whether "aristotle

@mit.edu" is a man or a woman; what matters is what "aristotle@mit .edu" contributes to the discussion. Archaic craftsmen experienced a kindred impersonality; the demioergoi were frequently addressed in public by the names of their profession. All craftsmanship, indeed, has something of this impersonal character. That the quality of work is impersonal can make the practice of craftsmanship seem unforgiving; that you might have a neurotic relation to your father won't excuse the fact that your mortise-and-tenon joint is loose. In one of the British-based Linux chat rooms to which I belong, the normal polite feints and indirections of British culture have disappeared. Gone are such locutions as "I would have thought that . . ."; in are "This problem is fucked-up." Looked at another way, this blunt impersonality turns people outward.

The Linux community might have served the mid-twentieth-century sociologist C. Wright Mills in his effort to define the character of the craftsman. Mills writes: "The laborer with a sense of craft becomes engaged in the work in and for itself; the satisfactions of working are their own reward; the details of daily labor are connected in the worker's mind to the end product; the worker can control his or her own actions at work; skill develops within the work process; work is connected to the freedom to experiment; finally, family, community, and politics are measured by the standards of inner satisfaction, coherence, and experiment in craft labor."[14]

If Mills's description seems impossibly idealistic, rather than reject it we might ask instead why craftsmanship of the Linux sort is so unusual. The question is a modern version of Plato's ancient worry; the Linux programmers are certainly grappling with fundamental issues like collaboration, the necessary relation of problem solving to problem finding, and the impersonal nature of standards, yet the community seems special if not marginal. Some cluster of social forces must be pushing these fundamental issues to the sidelines.

Weakened Motivation

Workers Demoralized by Command and by Competition

The modern world has two recipes for arousing the desire to work hard and well. One is the moral imperative to do work for the sake of the community. The other recipe invokes competition: it supposes that competing against others stimulates the desire to perform well, and in place of communal cohesion, it promises individual rewards. Both recipes have proved troubled. Neither has—in naked form—served the craftsman's aspiration for quality.

The problems with the moral imperative appeared to me personally and sharply on a visit my wife and I made to the communist empire in 1988, on the eve of its collapse. We'd received an invitation from the Russian Academy of Sciences to visit Moscow, a trip to be organized without the "support" of the foreign ministry and its resident spies; we were promised the freedom of the city. We toured Moscow churches previously locked, now overflowing, and the offices of an unauthorized newspaper where people smoked, talked, and at odd moments wrote. Almost as an afterthought, our hosts led us out to the Moscow suburbs, which I had never seen before.

These housing developments were built mostly in the decades after the Second World War. Laid out as enormous chessboards, the suburbs stretch to the horizon across flat land sparsely planted with birch and aspen. The architectural design of the suburban buildings was good, but the state had not been able to command good-quality work. The signs of poorly motivated workers appeared in the details of construction: in almost every building, concrete had been badly poured and sloppily reinforced, well-conceived, prefabricated windows had been set askew into the concrete shells, and little caulk had been applied to the seams joining window frames to concrete. In one new building we found the empty cartons of caulk for sealing the windows, but the contents had been sold, our guides said, on the black market. In a few apartment

towers workers had stuffed pieces of newspaper between the window frames and walls, then painted over the seams to give the appearance—lasting only a season or two—that the buildings had been sealed.

Poor craftsmanship was a barometer of other forms of material indifference. The housing we saw was meant for relatively privileged citizens, the Soviet scientific class. These families were allotted individual apartments rather than forced to live in communal space. Yet the negligence of construction was mirrored in the inhabitants' neglect of their surroundings: window boxes and balconies were bare of plants; walls had crusted over with crayon graffiti or spray-painted obscenities that nobody had bothered to clean up. When I asked about the dilapidated state of these buildings, our tour guides gave us a sweeping explanation. "People"—in general—don't care; they are demoralized.

This broad condemnation could not apply generally in the empire, since Soviet construction workers had long proved capable of making high-quality scientific and military buildings. Still, the guides seemed bent on proving the emptiness of the collective, moral recipe for craftsmanship. They led my wife and me from block to block with grim satisfaction, pointing out fraudulence and deception, taking almost a connoisseur's pleasure in contemplating the fake caulking that nature required mere winter to expose. When prodded, one of our guides coined "the ruins of Marxism" to explain the evidence both of demoralized workers and of inhabitants indifferent to their surroundings.

The young Karl Marx thought of himself as a secular Hephaestus whose writings would set the modern craftsman free. In the *Grundrisse,* he framed craftsmanship in the broadest possible terms as "form-giving activity."[15] He emphasized that self and social relations develop through making physical things, enabling the "all-round development of the individual."[16] Before Marx became an analyst of economic injustice, he was a Moses to workers, promising to realize the dignity of labor natural to people as part of a community. This utopian core of Marxism survived even as the older Marx hardened into a bitter, rigid

ideologue. As late as his essay "The Gotha Program," he returned to the view that communism would rekindle the spirit of craftsmanship.[17]

On the ground, Russia's command economy seems to explain the ruin of Marxism. Economists note the abysmally low productivity of Russian civil society throughout the 1970s and 1980s. The construction industry suffered particular problems of centralized command: its central bureaucracy was bad at estimating the materials needed for a project; the movement of materials across Russia's vast distances was slow and followed irrational paths; factories and construction crews seldom communicated directly. And authorities overreacted to initiative on building sites, fearing that local self-management might germinate general resistance to the state.

For these reasons, the moral imperative, "Do a good job for your country!" rang hollow. The problems on the ground are hardly unique to Russia's construction industry. The sociologist Darren Thiel has found equally demoralized workers at many British building sites. The construction industry in free-market Britain suffers from low productivity; its craft workers are treated badly or indifferently; onsite initiative is discouraged.[18]

The moral imperative is not, though, inherently empty. In the same decades that Russia was rotting, Japan was prospering under a command economy suffused with its own cultural imperatives to work well for the common good. Japan has been called "a nation of craftsmen," which is a little like calling England a nation of shopkeepers or observing that New Zealanders are good at raising sheep.[19] Still, in the past half-century the Japanese manifested a practical creativity that brought the country back to life after the Second World War. In the 1950s the Japanese mass-produced cheap, simple goods; by the early 1970s they produced cheap, high-quality automobiles, radios, and stereos, as well as superb steel and aluminum for special applications.

Working precisely to high standards provided the Japanese during these years a sense of mutual and self-respect. In part they needed the

collective goal because workers, particularly those in the middle ranks of organizations, spent long hours together laboring, seldom seeing their wives or children, in order to make ends meet. But the moral imperative worked because of how it was organized.

In the postwar years Japanese corporations embraced the nostrums of the business analyst W. Edwards Deming, who advocated, for the sake of "total quality control," that managers get their hands dirty on the shop floor and subordinates speak frankly to their superiors. When Deming spoke of "collective craftsmanship," he meant that the glue binding an institution is created by sharp mutual exchanges as much as by shared commitment. Caricatures of the Japanese frequently depict them as herd-loving conformists, a stereotype that hardly makes sense of how sharply critical Japanese at work in Toyota, Subaru, and Sony plants could be of one another's efforts.

Hierarchy governed the Japanese workplace, but the plain speaking of the Linux community was normal in these plants. Within the Japanese factories it was possible to speak truth to power, in that an adept manager could easily penetrate the codes of courtesy and deference in speech to get across the message that something was wrong or not good enough. In Soviet collectivism, by contrast, the ethical as well as the technical center was too far removed from life on the ground. Marx dealt with "the worker"; Deming and his Japanese followers dealt with the work.

Rather than become Japanese, this comparison asks us to think again about the triumphalism that greeted the collapse of the Soviet empire a generation ago, capitalism winning out as communism collapsed from within. A large part of the triumphalist story turned on contrasting the virtues of competition to the vices of collectivism—individual competition taken to be more likely to produce good work, competition to spur quality. Not only capitalists have subscribed to this view; in the "reform" of public services like health care, the effort has been to promote internal competition and markets to improve the

quality of services. We need to look more deeply at this triumphalist view, because it obscures both the roles competition and cooperation actually play in getting good work done and, more largely, the virtues of craftsmanship.

The making of the mobile telephone tells an illuminating story about the superiority of cooperation to competition in getting good work done.

The mobile phone is the result of the metamorphosis of two technologies, the radio and the telephone. Before these two technologies fused, telephone signals were broadcast by landline wires, radio signals emitted in the air. In the 1970s mobile phones of a sort existed in the military. These were large, clunky radios with dedicated bands for communication. Domestic versions of the mobile phone operated domestically in taxicabs, their range limited, their sound quality poor. The landline telephone's fixity was its defect, its virtue the clarity and security of transmission.

At the heart of this virtue lay the switching technology of the landline phone, elaborated, tested, and refined with care over several generations of use. It was this switching technology that had to change in order for the radio and telephone to amalgamate. The problem and its solution were clear enough. Much ambiguity lurked, however, in connecting the two.

The economists Richard Lester and Michael Piore have studied the firms that sought to create the switching technology, finding that cooperation and collaboration within certain companies allowed them to make headway on the switching technology problem, whereas internal competition at other corporations diminished engineers' efforts to improve the quality of the switches. Motorola, a success story, developed what it called a "technology shelf," created by a small group of engineers, on which were placed possible technical solutions that other

teams might use in the future; rather than trying to solve the problem outright, it developed tools whose immediate value was not clear. Nokia grappled with the problem in another collaborative way, creating an open-ended conversation among its engineers in which salespeople and designers were often included. The boundaries among business units in Nokia were deliberately ambiguous, because more than technical information was needed to get a feeling for the problem; lateral thinking was required. Lester and Piore describe the process of communication this entailed as "fluid, context-dependent, undetermined."[20]

By contrast, companies like Ericsson proceeded with more seeming clarity and discipline, dividing the problem into its parts. The birth of the new switch was intended to occur through "the exchange of information" among offices "rather than the cultivation of an interpretative community."[21] Rigidly organized, Ericsson fell away. It did eventually solve the switching technology problem, but with greater difficulty; different offices protected their turf. In any organization, individuals or teams that compete and are rewarded for doing better than others will hoard information. In technology firms, hoarding information particularly disables good work.

The corporations that succeeded through cooperation shared with the Linux community that experimental mark of technological craftsmanship, the intimate, fluid join between problem solving and problem finding. Within the framework of competition, by contrast, clear standards of achievement and closure are needed to measure performance and to dole out rewards.

Any musician would find the story of the mobile phone eminently clear: good chamber music and orchestral work can only improve, especially in rehearsal, in the same way. Listeners may sometimes imagine that working with a superstar conductor or soloist inspires orchestral players, the virtuoso setting a standard that lifts everyone's game, but this depends on how the star behaves. A soloist withdrawn from collegiality can actually diminish the will of orchestra players

to perform well. Engineers, like musicians, are intensely competitive creatures; the issue for both is what happens when a compensating cooperation vanishes: the work degrades. The triumphalist story, however, has tended to be blind to this necessary balance.

The evidence of demoralized Russian workers that my wife and I encountered in the Moscow suburbs can be found closer to home. When I returned from this final trip to the empire, I began studying the demioergoi of the new American economy: middle-level workers whose skills should have earned them a secure place in the "new economy" in formation since the 1990s.[22] The label refers to labor in the high-technology, finance, and human services sectors, supported by global investors, conducted in institutions that are more flexible, responsive, and focused on the short-term than in the rigid bureaucratic cages of the past. My students and I focused on people who write computer code, do accounting in backoffices, or arrange shipments to local stores in a retail chain—all competent but without sexy job titles or showy incomes.

The world that their fathers and grandfathers knew was in a way protected from the rigors of competition. Skilled middle-class workers found a place, in twentieth-century corporations, in relatively stable bureaucracies that moved employees along a career path from young adulthood to retirement. The forebears of the people we interviewed worked hard for their achievements; they knew fairly well what would happen to them if they didn't.

It's no longer news that this middle-class world has cracked. The corporate system that once organized careers is now a maze of fragmented jobs. In principle, many new economy firms subscribe to the doctrines of teamwork and cooperation, but unlike the actual practices of Nokia and Motorola, these principles are often a charade. We found that people made a show of friendliness and cooperation under the watchful eyes of boss-minders rather than, as in good Japanese firms, challenging and disputing their superiors. We found, as have other

researchers, that people seldom identified as friends the people with whom they worked in teams. Some of the people we interviewed were energized by this individualized competition, but more were depressed by it—and for a particular reason. The structure of rewards didn't work well for them.

The new economy has broken two traditional forms of rewarding work. Prosperous companies are intended, traditionally, to reward employees who work hard, at all levels. In these new economy firms, however, the wealth share of middle-level employees has stagnated over the past generation, even as the wealth of those at the top has ballooned. One measure is that in 1974 the chief executive officer of a large American corporation earned about thirty times as much as a median-level employee, whereas in 2004 the CEO earned 350 to 400 times as much. In these thirty years, real-dollar earnings at the median point have risen only 4 percent.

Sheer service to a company was, in an earlier generation, another reward for work, set in bureaucratic stone through automatic seniority increases in pay. In the new economy, such rewards for service have diminished or disappeared; companies now have a short-term focus, preferring younger, fresher workers to older, supposedly more ingrown employees—which means for the worker that, as his or her experience accumulates, it loses institutional value. The technicians whom I first began interviewing in Silicon Valley thought they could see themselves through this problem of experience by developing their skills, creating an inner armory that they could transport from company to company.

But craft does not protect them. In today's globalized marketplace, middle-level skilled workers risk the prospect of losing employment to a peer in India or China who has the same skills but works for lower pay; job loss is no longer merely a working-class problem. Again, many firms tend not to make long-term investments in an employee's skills, preferring to make new hires of people who already have the new skills needed rather than to engage in the more expensive process of retraining.

There are wrinkles in this gloomy picture. The sociologist Christopher Jencks has shown that economic "returns to skill" are robust at the upper reaches of the skills ladder but weaker lower down; crack systems designers are handsomely rewarded today, but low-level programmers often do no better and sometimes worse than people with manual service skills like plumbers and plasterers. Again, Alan Blinder argues, although many higher-skilled technical jobs in the West are being sent offshore to places in Asia and the Middle East, there are unexportable jobs that require face-to-face contact. If you live in New York, you can work with an accountant in Bombay, but you cannot usefully deal with a divorce lawyer there.[23]

Still, the trials of the craftsmen of the new economy are a caution against triumphalism. The growth of the new economy has driven many of these workers in America and Britain inside themselves. Those firms that show little loyalty to their employees elicit little commitment in return—Internet companies that ran into trouble in the early 2000s learned a bitter lesson, their employees jumping ship rather than making efforts to help the imperiled companies survive. Skeptical of institutions, new economy workers have lower rates of voting and political participation than technical workers two generations ago; although many are joiners of voluntary organizations, few are active participants. The political scientist Robert Putnam has explained this diminished "social capital," in his celebrated book *Bowling Alone,* as the result of television culture and the consumerist ethic; in our study, we found that withdrawal from institutions was tied more directly to people's experiences at work.[24]

If the work people do in new economy jobs is skilled and high pressure, requiring long hours, still it is dissociated labor: we found few among the technicians who believed that they would be rewarded for doing a good job for its own sake. The modern craftsman may hew inside him- or herself to this ideal, but given the structuring of rewards, that effort will be invisible.

From the social point of view, in sum, demoralization has many sides. It can occur when a collective goal for good work becomes hollow and empty; equally, sheer competition can disable good work and depress workers. Neither corporatism nor capitalism as crude labels get at the institutional issue. The forms of collective communication in Japanese auto plants and the practices of cooperation in firms like Nokia and Motorola have made them profitable. In other realms of the new economy, however, competition has disabled and disheartened workers, and the craftsman's ethos of doing good work for its own sake is unrewarded or invisible.

Fractured Skills
Hand and Head Divided

The modern era is often described as a skills economy, but what exactly is a skill? The generic answer is that skill is a trained practice. In this, skill contrasts to the *coup de foudre,* the sudden inspiration. The lure of inspiration lies in part in the conviction that raw talent can take the place of training. Musical prodigies are often cited to support this conviction—and wrongly so. An infant musical prodigy like Wolfgang Amadeus Mozart did indeed harbor the capacity to remember large swatches of notes, but from ages five to seven Mozart learned how to train his great innate musical memory when he improvised at the keyboard. He evolved methods for seeming to produce music spontaneously. The music he later wrote down again seems spontaneous because he wrote directly on the page with relatively few corrections, but Mozart's letters show that he went over his scores again and again in his mind before setting them in ink.

We should be suspicious of claims for innate, untrained talent. "I could write a good novel if only I had the time" or "if only I could pull myself together" is usually a narcissist's fantasy. Going over an action

again and again, by contrast, enables self-criticism. Modern education fears repetitive learning as mind-numbing. Afraid of boring children, avid to present ever-different stimulation, the enlightened teacher may avoid routine—but thus deprives children of the experience of studying their own ingrained practice and modulating it from within.

Skill development depends on how repetition is organized. This is why in music, as in sports, the length of a practice session must be carefully judged: the number of times one repeats a piece can be no more than the individual's attention span at a given stage. As skill expands, the capacity to sustain repetition increases. In music this is the so-called Isaac Stern rule, the great violinist declaring that the better your technique, the longer you can rehearse without becoming bored. There are "Eureka!" moments that turn the lock in a practice that has jammed, but they are embedded in routine.

As a person develops skill, the contents of what he or she repeats change. This seems obvious: in sports, repeating a tennis serve again and again, the player learns to aim the ball different ways; in music, the child Mozart, aged six and seven, was fascinated by the Neapolitan-sixth chord progression, in fundamental position (the movement, say, from a C-major chord to an A-flat major chord). A few years after working with it, he became adept in inverting the shift to other positions. But the matter is also not obvious. When practice is organized as a means to a fixed end, then the problems of the closed system reappear; the person in training will meet a fixed target but won't progress further. The open relation between problem solving and problem finding, as in Linux work, builds and expands skills, but this can't be a one-off event. Skill opens up in this way only because the rhythm of solving and opening up occurs again and again.

These precepts about building skill through practice encounter a great obstacle in modern society. By this I refer to a way in which machines can be misused. The "mechanical" equates in ordinary language with repetition of a static sort. Thanks to the revolution in micro-

computing, however, modern machinery is not static; through feedback loops machines can learn from their experience. Yet machinery is misused when it deprives people themselves from learning through repetition. The smart machine can separate human mental understanding from repetitive, instructive, hands-on learning. When this occurs, conceptual human powers suffer.

Since the Industrial Revolution of the eighteenth century, the machine has seemed to threaten the work of artisan-craftsmen. The threat appeared physical; industrial machines never tired, they did the same work hour after hour without complaining. The modern machine's threat to developing skill has a different character.

An example of this misuse occurs in CAD (computer-assisted design), the software program that allows engineers to design physical objects and architects to generate images of buildings on-screen. The technology traces back to the work of Ivan Sutherland, an engineer at the Massachusetts Institute of Technology who in 1963 figured out how a user could interact graphically with a computer. The modern material world could not exist without the marvels of CAD. It enables instant modeling of products from screws to automobiles, specifies precisely their engineering, and commands their actual production.[25] In architectural work, however, this necessary technology also poses dangers of misuse.

In architectural work, the designer establishes on screen a series of points; the algorithms of the program connect the points as a line, in two or three dimensions. Computer-assisted design has become nearly universal in architectural offices because it is swift and precise. Among its virtues is the ability to rotate images so that the designer can see the house or office building from many points of view. Unlike a physical model, the screen model can be quickly lengthened, shrunk, or broken into parts. Sophisticated applications of CAD model the effects on a

structure of the changing play of light, wind, or seasonal temperature change. Traditionally, architects have analyzed solid buildings in two ways, through plan and section. Computer-assisted design permits many other forms of analysis, such as taking a mental journey, on-screen, through the building's airflows.

How could such a useful tool possibly be abused? When CAD first entered architectural teaching, replacing drawing by hand, a young architect at MIT observed that "when you draw a site, when you put in the counter lines and the trees, it becomes ingrained in your mind. You come to know the site in a way that is not possible with the computer. . . . You get to know a terrain by tracing and retracing it, not by letting the computer 'regenerate' it for you."[26] This is not nostalgia: her observation addresses what gets lost mentally when screen work replaces physical drawing. As in other visual practices, architectural sketches are often pictures of possibility; in the process of crystallizing and refining them by hand, the designer proceeds just as a tennis player or musician does, gets deeply involved in it, matures thinking about it. The site, as this architect observes, "becomes ingrained in the mind."

The architect Renzo Piano explains his own working procedure thus: "You start by sketching, then you do a drawing, then you make a model, and then you go to reality—you go to the site—and then you go back to drawing. You build up a kind of circularity between drawing and making and then back again."[27] About repetition and practice Piano observes, "This is very typical of the craftsman's approach. You think and you do at the same time. You draw and you make. Drawing . . . is revisited. You do it, you redo it, and you redo it again."[28] This attaching, circular metamorphosis can be aborted by CAD. Once points are plotted on-screen, the algorithms do the drawing; misuse occurs if the process is a closed system, a static means-end—the "circularity" of which Piano speaks disappears. The physicist Victor Weisskopf once said to his MIT students who worked exclusively with computerized

experiments, "When you show me that result, the computer understands the answer, but I don't think you understand the answer."[29]

Computer-assisted design poses particular dangers for thinking about buildings. Because of the machine's capacities for instant erasure and refiguring, the architect Elliot Felix observes, "each action is less consequent than it would be [on] paper . . . each will be less carefully considered."[30] Returning to physical drawing can overcome this danger; harder to counter is an issue about the materials of which the building is made. Flat computer screens cannot render well the textures of different materials or assist in choosing their colors, though the CAD programs can calculate to a marvel the precise amount of brick or steel a building might require. Drawing in bricks by hand, tedious though the process is, prompts the designer to think about their materiality, to engage with their solidity as against the blank, unmarked space on paper of a window. Computer-assisted design also impedes the designer in thinking about scale, as opposed to sheer size. Scale involves judgments of proportion; the sense of proportion on-screen appears to the designer as the relation of clusters of pixels. The object on-screen can indeed be manipulated so that it is presented, for instance, from the vantage point of someone on the ground, but in this regard CAD is frequently misused: what appears on-screen is impossibly coherent, framed in a unified way that physical sight never is.

Troubles with materiality have a long pedigree in architecture. Few large-scale building projects before the industrial era had detailed working drawings of the precise sort CAD can produce today; Pope Sixtus V remade the Piazza del Popolo in Rome at the end of the sixteenth century by describing in conversation the buildings and public space he envisioned, a verbal instruction that left much room for the mason, glazier, and engineer to work freely and adaptively on the ground. Blueprints—inked designs in which erasure is possible but messy—acquired legal force by the late nineteenth century, making

these images on paper equivalent to a lawyer's contract. The blueprint signaled, moreover, one decisive disconnection between head and hand in design: the idea of a thing made complete in conception before it is constructed.

A striking example of the problems that can ensue from mentalized design appear in Georgia's Peachtree Center, perched on the edge of Atlanta. Here is to be found a small forest of concrete office towers, parking garages, shops, and hotels, edged by highways. As of 2004, the complex covered about 5.8 million square feet, which makes this one of the largest "megaprojects" in the region. The Peachtree Center could not have been made by a group of architects working by hand—it is simply too vast and complex. The planning analyst Bent Flyvbjerg explains a further economic reason why CAD is necessary for projects of this scope: small errors have large knock-on effects.[31]

Some aspects of the design are excellent. The buildings are laid out in a grid plan of streets forming fourteen blocks rather than as a mall; the complex pays allegiance to the street and is meant to be pedestrian friendly. The architecture of the three large hotels is by John Portman, a flamboyant designer who favors such dramatic touches as glass elevators running up and down forty stories of interior atriums. Elsewhere, the three trade marts and office towers are more conventional concrete-and-steel boxes, some faced outside with the Renaissance or Baroque detailing that has become the stamp of postmodern design. The project as a whole reaches for character rather than anonymity. Still, pregnant failures of this computer-driven project are evident on the ground—three failures that menace computer-assisted design more largely as a disembodied design practice.

The first is the disconnect between simulation and reality. In plan, the Peachtree Center populates the streets with well-designed sidewalk cafés. Yet the plan has not actually engaged with the intense Georgia heat: the outdoor seats of the cafés are in fact empty from late morning to late afternoon much of the year. Simulation is an imperfect

substitute for accounting the *sensation* of light, wind, and heat on site. The designers would perhaps have done better to sit unprotected in the midday Georgia sun for an hour before going to work each day; physical discomfort would have made them see better. The large issue here is that simulation can be a poor substitute for tactile experience.

Hands-off design also disables a certain kind of relational understanding. Portman's hotel, for instance, emphasizes the idea of coherence, with its inner drama of all-glass elevators running up a forty-story atrium; the hotel's rooms look outward over parking lots. On-screen, the parking-lot issue can be put out of mind by rotating the image so that the sea of cars disappears; on foot, it cannot be disposed of in this way. To be sure, this is not the computer's inherent fault. Portman's designers could perfectly well have put in an image of all the cars and then viewed the sea, on-screen, from the hotel rooms, but then they'd have had a fundamental problem with the design. Whereas Linux is set up to discover problems, CAD is often used to hide them. The difference accounts for some of CAD's commercial popularity; it can be used to repress difficulty.

Finally, CAD's precisions bring out a problem long inherent in blueprint design, that of overdetermination. The various planners involved in the Peachtree Center rightly point with pride to its mixed-use buildings, but these mixtures have been calculated down to the square foot; the calculations draw a false inference about how well the finished object will function. Overdetermined design rules out the crinkled fabric of buildings that allow little start-up businesses, and so communities, to grow and vibrate. This texture results from underdetermined structures that permit uses to abort, swerve, and evolve. There is thus missing the informal and so easy, sociable street life of Atlanta's older neighborhoods. A positive embrace of the incomplete is necessarily absent in the blueprint; forms are resolved in advance of their use. If CAD does not cause this problem, the program sharpens it: the algorithms draw nearly instantly a totalized picture.

The tactile, the relational, and the incomplete are physical experiences that occur in the act of drawing. Drawing stands for a larger range of experiences, such as the way of writing that embraces editing and rewriting, or of playing music to explore again and again the puzzling qualities of a particular chord. The difficult and the incomplete should be positive events in our understanding; they should stimulate us as simulation and facile manipulation of complete objects cannot. The issue—I want to stress—is more complicated than hand *versus* machine. Modern computer programs can indeed learn from their experience in an expanding fashion, because algorithms are rewritten through data feedback. The problem, as Victor Weisskopf says, is that people may let the machines do this learning, the person serving as a passive witness to and consumer of expanding competence, not participating in it. This is why Renzo Piano, the designer of very complicated objects, returns in a circular fashion to drawing them roughly by hand. Abuses of CAD illustrate how, when the head and the hand are separate, it is the head that suffers.

Computer-assisted design might serve as an emblem of a large challenge faced by modern society: how to think like craftsmen in making good use of technology. "Embodied knowledge" is a currently fashionable phrase in the social sciences, but "thinking like a craftsman" is more than a state of mind; it has a sharp social edge.

Immured in the Peachtree Center for a weekend of discussions on "Community Values and National Goals," I was particularly interested in its parking garages. A standardized bumper had been installed at the end of each car stall. It looked sleek, but the lower edge of each bumper was sharp metal, liable to scratch cars or calves. Some bumpers, though, had been turned back, on site, for safety. The irregularity of the turning showed that the job had been done manually, the steel smoothed and rounded wherever it might be unsafe to touch; the craftsman had thought for the architect. The lighting in these aboveground car-houses turned out to be uneven in intensity, dan-

gerous shadows suddenly appearing within the building. Painters had added odd-shaped white strip lines to guide drivers in and out of irregular pools of light, showing signs of improvising rather than following the plan. The craftsmen had done further, deeper thinking about light than the designers.

These steel grinders and painters had evidently not sat in on design sessions at the start, using their experience to indicate problematic spots in the designs plotted on-screen. Bearers of embodied knowledge but mere manual laborers, they were not accorded that privilege. This is the sharp edge in the problem of skill; the head and the hand are not simply separated intellectually but socially.

Conflicting Standards

Correct versus Practical

What do we mean by good-quality work? One answer is how something should be done, the other is getting it to work. This is a difference between correctness and functionality. Ideally, there should be no conflict; in the real world, there is. Often we subscribe to a standard of correctness that is rarely if ever reached. We might alternatively work according to the standard of what is possible, just good enough—but this can also be a recipe for frustration. The desire to do good work is seldom satisfied by just getting by.

Thus, following the absolute measure of quality, the writer will obsess about every comma until the rhythm of a sentence comes out right, and the woodworker will shave a mortise-and-tenon joint until the two pieces are completely rigid, needing no screws. Following the measure of functionality, the writer will deliver on time, no matter that every comma is in place, the point of writing being to be read. The functionally minded carpenter will curb worry about each detail, knowing that small defects can be corrected by hidden screws. Again, the point is to finish so that the piece can be used. To the absolutist in every

craftsman, each imperfection is a failure; to the practitioner, obsession with perfection seems a prescription for failure.

A philosophical nicety is necessary to bring out this conflict. *Practice* and *practical* share a root in language. It might seem that the more people train and practice in developing a skill, the more practical minded they will become, focusing on the possible and the particular. In fact, the long experience of practice can lead in the opposite direction. Another variant of the "Isaac Stern rule" is: the better your technique, the more impossible your standards. (Depending on his mood, Isaac Stern worked many, many variations of the "Isaac Stern rule" on the virtue of repeated practice.) Linux can operate in a similar fashion. The people most skilled in using it are usually the ones thinking about the program's ideal and endless possibilities.

The conflict between getting something right and getting it done has today an institutional setting, one I shall illustrate in the provision of medical care. Many elderly readers will, like me, know only too well its outline.

In the past decade Britain's National Health Service (NHS) has had new measures for determining how well doctors and nurses do their jobs—how many patients are seen, how quickly patients have access to care, how efficiently they are referred to specialists. These are numeric measures of the right way to provide care, but measures meant to serve patient interests humanely. It would be easier, for instance, if referral to specialists was left to the doctor's convenience. However, doctors as well as nurses, nurses' aides, and cleaning staff believe that these "reforms" have diminished the quality of care, using the guideline of what's practicable on the ground. Their sentiments are hardly unusual. Researchers in western Europe widely report that practitioners believe that their craft skills in dealing with patients are being frustrated by the push for institutional standards.

The National Health Service has a special context quite unlike American-style "managed-care" or other market-driven mechanisms. In the wake of the Second World War, the creation of the NHS was a source of national pride. The NHS recruited the best people, and they were committed; few departed for better-paying jobs in America. Britain has spent a third less of its gross domestic product on health than the United States, yet its infant mortality rate is lower, and its elderly live longer. The British system is "free" health care, paid for through taxes. The British people have indicated that they are happy to pay these taxes, or even contribute more, if only the service can improve.

In time, like all systems, the NHS has worn down. The hospitals physically aged, equipment needing replacement remained in use, waiting times for service lengthened, and not enough nurses were in training. To solve these ills, Britain's politicians turned a decade ago to a different model of quality, one established by Henry Ford in the American auto industry early in the twentieth century. "Fordism" takes the division of labor to an extreme: each worker does one task, measured as precisely as possible by time-and-motion studies; output is measured in terms of targets that are, again, entirely quantitative. Applied to health care, Fordism monitors the time doctors and nurses spend with each patient; a medical treatment system based on dealing with auto parts, it tends to treat cancerous livers or broken backs rather than patients in the round.[32] A particular wrinkle in British health care is the number of times the health service has been "reformed" along Fordist lines in the past decade: four major reorganizations reverse or depart from previous changes.

Fordism has acquired a bad name in private industry for reasons that Adam Smith first laid out in *The Wealth of Nations* in the eighteenth century. The division of labor focuses on parts rather than wholes; to the vivacity of merchants, Smith contrasted the dulled wits of factory laborers doing just one small thing, hour after hour, day after day. Smith believed, though, that this system would be more efficient

than work done by hand in the preindustrial way. Henry Ford justified his procedures by arguing that strictly machine-built autos were of better quality than those cars that were in his time assembled in small workshops. The advent of microelectronics in manufacturing has provided further support for this way of making things: microsensors do a much more rigorous, steady job of monitoring problems than human eyes or hands. In sum, by the absolute measure of quality in the thing itself, the machine is a better craftsman than a person.

Medical reform finds its place in this long debate about the nature and value of craftsmanship in a mechanical, quantitative society. In the NHS, the Fordist reformers can claim quality has indeed improved: in particular, cancers and heart diseases are better treated. Moreover, frustrated though they are, British doctors and nurses have not lost the will to do good work; theirs is not the story of the Soviet construction workers. Though fatigued by constant reform and angry at the system of targets, these health care providers have not become indifferent to doing high-quality work; Julian Legrand, an insightful analyst of the NHS, remarks on the fact that although staff are nostalgic for the old days of loose practice, if they were magically transported back two generations, they would be appalled by what they saw.[33]

Putting nostalgia aside, what is there about medical "craft" that is demeaned by these changes? Studies of nurses provide one answer.[34] In the "old" NHS, nurses listened to elderly patients' stories about their children as well as to complaints about aches and pains; in the hospital wards, nurses often stepped in when a patient crisis erupted, even if they were legally not qualified to do so. Obviously, a sick patient cannot be repaired like an automobile, but behind this stands a deeper point about the practice standard. To do good work means to be curious about, to investigate, and to learn from ambiguity. As with Linux programmers, nursing craft negotiates a liminal zone between problem solving and problem finding; listening to old men's chatter, the nurse

can glean clues about their ailments that might escape a diagnostic checklist.

This liminal zone of investigation is important to doctors in another way. In the Fordist model of medicine, there must be a specific illness to treat; the evaluation of a doctor's performance will then be made by counting the time required to treat as many livers as possible and the number of livers that get well. Because bodily reality doesn't fit well inside this classifying model, and because good treatment has to admit experiment, a not insignificant number of doctors create paper fictions to buy themselves time from the bureaucratic monitors. Doctors in the NHS often assign a patient a disease in order to justify the time spent on exploring a puzzling body.

The absolutists working on standards for the system can claim that they've raised the quality of care. Nurses and doctors in practice argue against this numeric claim. Rather than fuzzy sentimentalism, they invoke the need for curiosity and experiment and would subscribe, I think, to Immanuel Kant's image of "the twisted timber of humanity" as applying to both patients and themselves.

This conflict came to a head on June 26, 2006, at the annual meeting of the British Medical Association in Belfast. The association's president, Dr. James Johnson, observed that the government's "favored method of raising quality and keeping prices down is to do what they do in supermarkets and offer choice and competition." To his colleagues he said, "You tell me that the breakneck pace and incoherent planning behind systems reform are seriously destabilising the NHS. The message I am getting from the medical profession is that the NHS is in danger and that doctors have been marginalised." To the government, Johnson appealed, "Work with the profession. We are not the enemy. We will help you find the solution."[35] When government officials then took the stage, however, an icy, polite silence greeted their speeches.

British doctors and nurses are today suffering from reform fatigue,

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.

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.

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.