Shop Class as Soulcraft

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Thinking as Doing

It is by having hands that man is the most intelligent of animals.

—ANAXAGORAS[1]

The nearest kind of association is not mere perceptual cognition, but, rather, a handling, using, and taking care of things which has its own kind of "knowledge."

—MARTIN HEIDEGGER[2]

Experienced firefighters know when to flee a burning building; it is not uncommon for them to leave moments before one collapses. When asked how they knew exactly when to leave, they fall back on ideas like "a sixth sense." The fact that the firefighters' intuitions strike us, and even themselves, as somehow otherworldly is a good indication that our understanding of how our minds grasp the world must be incomplete.

The current educational regime is based on a certain view about what kind of knowledge is important: "knowing that," as opposed to "knowing how." This corresponds roughly to universal knowledge versus the kind that comes from individual experience. If you know *that* something is the case, then this

proposition can be stated from anywhere. In fact, such knowledge aspires to a view from nowhere. That is, it aspires to a view that gets at the true nature of things because it isn't conditioned by the circumstances of the viewer. It can be transmitted through speech or writing without loss of meaning, and expounded by a generic self that need not have any prerequisite experiences. Occupations based on universal, propositional knowledge are more prestigious, but they are also the kind that face competition from the whole world as book learning becomes more widely disseminated in the global economy. Practical know-how, on the other hand, is always tied to the experience of a particular person. It can't be downloaded, it can only be lived.

To parody the pretensions of theoretical knowledge, the ancient comedian Aristophanes coined a new word, *phrontisterion*. The literal translation is "think tank." In his play *Clouds* he has a distracted Socrates swing into view while suspended from a crane in a wicker basket, his gaze skyward. A supplicant has come, wishing to gain admission to Socrates' think tank. He calls out to Socrates from below. Socrates peers over the edge of his basket and responds.

Socrates: "Why dost thou call me, thou transient mortal?"

The would-be student: "First tell me: What the hell are you doing up there?"

Socrates: "I traverse the air and contemplate the sun."

The would-be student wonders why Socrates does these things from his contrived perch. "Why not do it from the ground, if at all?"

Socrates: "I could never have made correct discoveries about meteorological matters if I hadn't suspended my mind and infused the minute particles of my thought into the air, which it resembles. If I had been on the ground and merely gaped at the upper regions from below, I would never have made my discoveries. For the earth sucks the thought-juice down."[3]

We take a very partial view of knowledge when we regard it as the sort of thing that can be gotten while suspended aloft in a basket. This is to separate knowing from doing, treating students like disembodied brains in jars, the better to become philosophers in baskets—these ridiculous images are merely exaggerations of the conception of knowledge that enjoys the greatest prestige.

To regard universal knowledge as the whole of knowledge is to take no account of embodiment and purposiveness, those features of actual thinkers who are always in particular *situations*. The situated or worldly character of an embodied being has implications for the way we come to know the world, and the expert knowledge of the firefighter may be regarded as a heightened version of our everyday cognition. We do not usually encounter things in a disinterested way, for the simple reason that things that have no bearing on us do not engage our attention, of which we have a finite amount. ("Having a bearing on" must be taken generously; an attractive stranger who walks down the street as we sit at an outdoor café may engage our attention quite fully. As an object of desire, he or she bears on our world in the sense of opening up potential avenues of action, even if these are pursued only in the imagination.)

The things we know best are the ones we contend with in some realm of regular practice. Heidegger famously noted that

the way we come to know a hammer is not by *staring* at it, but by grabbing hold of it and using it. For him, this was a deep point about our apprehension of the world in general. The preoccupation with knowing things "as they are in themselves" he found to be wrongheaded, tied to a dichotomy between subject and object that isn't true to our experience. The way things actually "show up" for us is not as mere objects without context, but as equipment for action (like the hammer) or solicitations to action (like the beautiful stranger) within some worldly situation. One of the central questions of cognitive science, rooted in the prevailing epistemology, has been to figure out how the mind "represents" the world, since mind and world are conceived to be entirely distinct. For Heidegger, there is no problem of *re*-presenting the world, because the world *presents* itself originally as something we are already *in* and *of*. His insights into the situated character of our everyday cognition shed light on the kind of expert knowledge that is also inherently situated, like the firefighter's or the mechanic's.

If thinking is bound up with action, then the task of getting an adequate *grasp* on the world, intellectually, depends on our doing stuff in it. And in fact this is the case: to really know shoelaces, you have to tie shoes. Otherwise you might make the error my father did, attributing the properties of mathematical strings to shoelaces, and airily suppose that a double knot can be untied in one stroke, regardless of the particular material the shoelace is made of.[4] The economists Alan Blinder and Frank Levy have shown us the likely consequences, in an increasingly global labor market, of the fact that some jobs are inherently situated, and cannot be reduced to rule following. And I know from experience that the habits of mind of the mathematical physicist are ill suited to the realities of an old car. Let us consider more fully how it is that practical know-how is neither fully formalizable nor essentially rulelike.

Of Ohm's Law and Muddy Boots

One of the nuggets my dad offered me as I was trying to figure out why I was getting no spark at the spark plug, in my 1963 Volkswagen, was Ohm's law: V=IR, where V stands for voltage, I for current, and R for resistance. The equation states that these things stand in a definite relationship to one another. But in an old car, the idea of resistance as something simple and unitary, as the letter *R*, can get in the way of the kind of perception required to notice the actual sources of resistance, and the varied circumstances they are tied to. What mechanics say is that electrical connections need to be *tight*, *dry*, and *clean* of corrosion and dirt. They are constantly becoming loose from vibration, wet from the weather, corroded because that is the way of all flesh, and dirty because *the road is a dirty place.*

Ohm's law doesn't refer to any particular place, nor does it refer to the particular sources of corruption. Such as rain. During one of those rainy weeks when he keeps having to wipe the mud off his boots and peel a clammy shirt off his shoulders, an experienced mechanic facing an ignition problem in an older car is likely to reach for some WD-40 and spray it in the dis-

tributor, to displace moisture from the contact points. On the other hand, if his hair is full of sand that has been raining down in little micro-avalanches from the recesses of a truck up on the lift, he is likely to intuit that the driver has been off-roading in the local dunes, say, and reach instead for his compressed air to blow debris out of the distributor. I say "intuit" rather than "conclude" because he may not draw any explicit connections in his mind between muddy boots and remedy A, on the one hand, and sandy hair and remedy B, on the other. Rather, he is familiar with typical *situations*, and their typicality is something of which he has a *tacit* knowledge. This tacit knowledge seems to consist of recognizing patterns, and the causal patterns of the ignition problem are mirrored by patterns in his own bodily motions: periodically scratching the sand out of his scalp, or peeling a clammy shirt off his shoulders.

Ohm's law is something explicit and rulelike, and is true in the way that propositions are true. Its utter simplicity makes it beautiful; a mind in possession of this equation is charmed with a sense of its own competence. We feel we have access to something universal, and this affords a pleasure that is quasi-religious, perhaps. But this charm of competence can get in the way of noticing things; it can displace, or perhaps hamper the development of, a different kind of knowledge that may be difficult to bring to explicit awareness, but is superior as a practical matter. Its superiority lies in the fact that it begins with the typical rather than the universal, so it goes more rapidly and directly to particular causes, the kind that actually tend to cause ignition problems.

Appreciating the situated character of the kind of thinking we do at work is important, because the degradation of work is often based on efforts to replace the intuitive judgments of practitioners with rule following, and codify knowledge into abstract systems of symbols that then stand in for situated knowledge. Daniel Bell, the author of *The Coming of Post-Industrial Society*, calls this codification an "intellectual technology." Its significance lies in the fact that it opens up the possibility of a "social technology," that is, a division of labor, that may be brought to bear on, for example, the organization of a hospital, an international trade system, or a work group whose members are engaged in specialized tasks for a common objective. The crux of the idea of an intellectual technology is "the substitution of algorithms (problem-solving rules) for intuitive judgments. These algorithms may be embodied in an automatic machine or a computer program or a set of instructions based on some statistical or mathematical formula."[5]

Bell seems to regard the mechanization and centralization of thinking as progress, or at any rate as inevitable; it is the only proper response to the growing complexity of society. His readiness to do away with the intuitive judgments of expert practitioners rests on the idea that such judgments are inadequate to complex systems that may involve

> *the interaction of too many variables for the mind to hold in correct order simultaneously. . . . [I]ntuitive judgments respond to immediate cause-and-effect relationships which are characteristic of simpler systems, whereas in complex systems the actual causes may be deeply hidden or remote in time or, more often, may lie in the very structure (i.e. pat-*

tern) of the system itself, which is not immediately recognizable. For this reason, one has to use algorithms, rather than intuitive judgments, in making decisions.[6]

Such a cognitive theory, if sound, would justify the alienation of judgment from skilled professionals when things get too complex. But, in fact, it is often the case that when things get really hairy, you want an experienced human being in control. The preference for algorithms over intuitive judgments, when faced with causes that "lie in the very structure (i.e. pattern)" of a system, is precisely the wrong conclusion to draw if one gives due regard to the tacit dimension of knowledge.

The Tacit Knowledge of the Firefighter and the Chess Master

The basic idea of tacit knowledge is that we know more than we can say, and certainly more than we can specify in a formulaic way. Intuitive judgments of complex systems, especially those made by experts, such as an experienced firefighter, are sometimes richer than can be captured by any set of algorithms.

The psychologist Gary Klein has studied the decision making of firefighters and other experts who perform complex tasks in the real world. "In many dynamic, uncertain, and fast-paced environments, there is no single right way to make decisions," Klein says. "Experts learn to perceive things that are invisible to novices, such as the characteristics of a typical situation."[7]

The experienced mind can get good at integrating an ex-

traordinarily large number of variables and detecting a coherent pattern. It is the pattern that is attended to, not the individual variables. Our ability to make good judgments is holistic in character, and arises from repeated confrontations with real things: comprehensive entities that are grasped all at once, in a manner that may be incapable of explicit articulation.[8] This tacit dimension of knowledge puts limits on the reduction of jobs to rule following. It is not just the firefighter's *intervention* that is inherently in situ (as the economist Alan Blinder would point out). His knowledge, too, arises in particular places: places where there are fires.

Algorithms can be made to *simulate* the kind of tacit knowledge that experts possess, as when IBM's Deep Blue succeeded in playing chess at the highest level in 1997. Through brute computation of every possible move that adheres to the rules of chess (200 million board positions per second), the program was able to pick winning moves. To constrain the problem, the programmers made it their goal to beat one man in particular, Gary Kasparov, the reigning champion. Knowing his preferred opening moves and strategies made the problem tractable. But in beating Kasparov at his own game, Deep Blue was doing something very different than what a human chess player does. This is illustrated by an experiment in which an international chess master played speed chess with a limit of five seconds per move while also doing mental arithmetic. The arithmetic tied up his working memory and capacity for explicit analysis, yet he was still able to "more than hold his own" against "a slightly weaker, but master-level player."[9] Clearly, human chess players are doing something other than applying the rules of chess

and comparing downstream board configurations along different decision trees, like a computer.

There is further evidence to suggest that what an expert human chess player *does* do is recognize patterns, like a firefighter. In a famous experiment, chess players of varying levels of competence viewed chess boards projected on a screen for a few seconds each.[10] They then had to reproduce the configuration of pieces they had seen. When the projected configurations were ones that actually occur in the game of chess, grandmasters were able to correctly reproduce the positions of twenty to twenty-five pieces, very good players about fifteen pieces, and beginners five or six. But when the pictures flashed before them showed random configurations of pieces, not corresponding to patterns they would have actually come across in playing chess, then there was no difference in the players' ability to reproduce the positions from memory; players of all levels were able to reproduce the positions of only five or six pieces.[11] The expert is expert not because he has a better memory in general, but because the patterns of chess are the patterns of his experience.

The success of Deep Blue would seem not to shed much light on how expert chess players do what they do. It might well be objected, "*of course* it doesn't; it's a computer!" This objection strikes me as just the right response, but sometimes common sense needs to be defended by an elaborate argument. We are constantly tempted to regard ourselves in the distorting mirror of technology, and in fact the "computational theory of mind" prevails in cognitive psychology (though it is becoming quite

embattled).[12] An entire academic field has its origin in the idea that we *are* computers.[13] Further, the computer comes to represent an ideal, in light of which real thinking perversely begins to look deficient.[14] Thus, when the postindustrial visionary reasons from the fact that complex systems involve "the interaction of too many variables for the mind to hold in correct order simultaneously" to the conclusion that "one has to use algorithms, rather than intuitive judgments, in making decisions," he argues from the fact that the mind does not do what a computer does to an assertion about the incompetence of the mind. This seems to express an irrational prejudice against people. For, in fact, highly cultivated human minds can get to be pretty good at sussing out a burning building, playing chess, chasing down intermittent gremlins in a car's electrical system, and who knows what else.

The fact that a firefighter's knowledge is tacit rather than explicit, and therefore not capable of articulation, means that he is not able to give an account of himself to the larger society. He is not able to make a claim for the value of his mind in the terms that prevail, and may come to doubt it himself. But his own experience provides grounds for a radical critique of the view that theoretical knowledge is the only true knowledge.

Personal Knowledge versus Intellectual Technology

Tommy, my former shop mate, currently works at Pro Class Cycles, an independent shop on Richmond's south side that has been there since the mid-1980s. It is the place to go for used