Technology, Ecology, and Socialist Renewal[*]

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Recent global protests, as well as the World Social Forum, have called attention to the urgency of developing what we might call a "people's technology." A central focus of concern has been the biotech sector, but the issues posed by information technology lie not far behind. Both can be seen, at least in their current mode of development, as instruments for expanding and deepening the control exercised by capital, over the natural world and human society alike. An alternative political/economic agenda requires an alternative technological agenda, from several angles. These include: reducing costs, absorbing labor-power, overcoming alienation, and halting despoliation of the environment.

There is no conceptual difference between a people's technology and a socialist technology. My own preference is to use the two terms interchangeably, depending on the immediate context of the discussion. The "people's" dimension reminds us that our vision is one of democratic control, while the reference to socialism reminds us that you can't have democracy, especially in an area like technology, as long as a capitalist ruling class is calling the shots.

Marxism has had, from its beginnings, a defining interest in technological issues. What were, after all, the preeminent "forces of production" in Marx's time, if not the new technologies unleashed by the development of "modern industry"? And what better basis do we now have for the critique of first-epoch socialism than Braverman's admonition—well before the 1989 collapse, but echoed subsequently by Mészáros—to treat the Communist movement's long-unquestioned privileging of state power as a tragic detour from the task of embracing Marx's much broader assault on capitalist power-relations?

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[*] This article is based on a presentation at a symposium in honor of Richard Levins at the Harvard School of Public Health in June 2000.

And finally, what is it that drove this broader critique if not precisely Marx's analysis of the forces and relations of capitalist production?[1]

The problem, however, as Braverman and others have suggested, is that the scenario of technological transformation is too easily preempted by a fixation on state power. We grow up thinking that the major outside force in our lives is the government. In the actual history of workers' movements, therefore, it is hardly surprising that the protagonists came to view the winning of state power as a climactic step along the road to a better world. The more this step eluded them and the more ferociously it was blocked, the more daunting its eventual attainment was bound to appear. And when state power did finally come into the hands of revolutionists, in Soviet Russia, what could seem more vital to them, in the face of concerted counterrevolutionary attacks, than simply to hang onto it? It was in this setting, of course, that Lenin articulated what his successors would take for granted, namely that workers' control of industry—an integral component to any notion of a "people's technology"—could not possibly be on the ruling party's agenda.[2]

At the same time, as if all this were not enough of a setback, we find in the ongoing develoment of capitalism a continuous process whereby the broad applications of technology are devised at an ever greater remove from the general population. The achievements of technology become ever more astounding—whether for their sophistication (e.g., communications systems) or their perversity (weapons systems, factory fishing vessels, security systems)—while the tasks imposed at the lowest levels of the work-hierarchy become ever more mind-numbing. People's subjective sense of their technological competence thereupon shrinks even further, in a classic cycle of self-fulfilling prophecy.

What I want to argue is that the development of organized popular intelligence about technology is an essential component to the task of creating and maintaining a viable socialism. There are new reasons for thinking about this goal which have nothing to do with the fate of certain past regimes. These "new reasons" reflect not only recent developments in capitalism—which include heightened devastation (war), polarization, and technological displacement, as well as vastly accelerated ecological

[1] Harry Braverman, *Labor and Monopoly Capital: The Degradation of Work in the Twentieth Century* (New York: Monthly Review Press, 1974), pp. 8-24; István Mészáros, *Beyond Capital: Towards a Theory of Transition* (New York: Monthly Review Press, 1995), esp. pp. 615ff.
[2] V.I. Lenin, "On the Immediate Tasks of the Soviet Government" (April 1918), in *Selected Works.* 1-vol. ed. (New York: International Publishers, 1971), esp. p. 424.

breakdown—but also some insufficiently noted achievements that belong squarely in the socialist tradition. For socialism today, therefore, there are not just fresh challenges; there is also untapped potential. To illustrate this with regard to technology, I propose to sketch out certain preliminary considerations along the following lines: 1) the nature of the technological competence that needs to be diffused; 2) prior experience of situations in which popular technological competence has been encouraged; 3) the interplay of technological issues with social or class issues in formulating sound ecological policy; and 4) what a socialist technology might achieve and how it might function.

What kind of technological competence?

The popular technological competence that is now lacking can be sought in either of two directions: in the recovery of skills that are disappearing or in the acquisition of the latest new skills. Neither of these pursuits precludes the other, but they have decidedly different implications.

The "new" skills appear initially as the ones that are habitually emphasized, typically in the form of slogans like "a computer on every school-desk!" Whatever the scope of their diffusion, there remains the significant question of whether the recipients will evolve merely into users/consumers of the technology or whether they will also become its shapers. The outcome of this choice depends on the degree to which the technology is simply "handed down" to the recipients, who then receive it as isolated agents, or the degree to which, on the contrary, the technology is seized upon in an organized way and mastered as a potential power-resource. The adoption of this more purposeful approach could ultimately affect not only the use made of existing devices but also the directions taken in the invention of new ones—such as, for example, devices to reduce dependence on ecologically hazardous energy-sources.

The capacity to take such an approach depends in turn on a disposition to subordinate instrumental expertise to a larger vision. The vision in question need not initially refer to an alternative structure of economic power, although it could open the way to such a project. The starting point would more likely be some particular change in production- and consumption-patterns, of which one's own efforts are a part. While such changes are a routine component of capitalist "progress" (albeit with profit-driven parameters, as in the scenario of turning every adult into a motorist), the challenge in terms of a "people's technology" is to find them in the general population and grounded in basic needs. This is

where the resurrection of "endangered skills" comes in. The best illustration of such skills is the soil-conservation practices of peasant agriculture.[3] These combine the key traits of being on the one hand broadly diffused—part of the general culture—and, on the other, clearly shaped by a commitment to provide for future generations.

In countries such as India, the peasant sector has to some extent been drawn into a conscious struggle against the forces that would skim off the fruits of those skills while destroying the matrix in which they evolved. This struggle currently takes the form of protests against bio-engineered seeds.[4] By contrast, in those countries where the displacement of the peasantry occurred at an earlier time, the effort at retrieval must necessarily rely in part on what can be learned—more likely from an academic starting point—by individuals possessed of a strong social awareness but lacking roots in the culture that nurtured the original skills.

The task of recombining such expertise with the capacity to implement it in the interests of the people is, in a sense, the classic function of a revolutionary political organization. What is revolutionary, within the organization itself, is precisely its breaking down of the social barriers which would otherwise separate those who respectively embody these currently distinct kinds of skill.[5] Only if the organization can do this now will the society be able to do it later.

The issue is essentially one of demystifying expertise, and it involves adjustments from both directions. On the one hand, the highly trained people need to be extricated from the exclusive community of their peers; they should distance themselves as much as possible from the stereotypical experts of whom one can say (as does one of John le Carré's characters quoted by Howard Zinn) that they serve, in their bureaucratic "neutrality," as our jailers, our torturers, our executioners.[6] They need instead to internalize an ethic of responsiveness to the concerns of ordinary people, and this can only happen if their day-to-day existence includes situations in which appropriate—i.e., hierarchy-defying—interactions occur on a routine basis. This is likely to point again to a role for organizations: to generate

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[3] For my discussion of peasant agriculture, I am indebted especially to the chapter on "Agricultural Ecology" in Yrjö Haila and Richard Levins, *Humanity and Nature: Ecology, Science and Society* (London: Pluto Press, 1992).

[4] Vandana Shiva, *Biopiracy: The Plunder of Nature and Knowledge* (Boston: South End Press, 1997), pp. 124ff.

[5] Thus Richard Levins and Richard Lewontin call for "undermining the class barriers between full-time scientists and farmers and the mutual suspicion that accompanies it." *The Dialectical Biologist* (Cambridge, Mass.: Harvard University Press, 1985), p. 222.

[6] Howard Zinn, *Declarations of Independence: Cross-Examining American Ideology* (New York: HarperCollins, 1995), p. 6.

not just social situations but also specific projects requiring the collaboration of people of diverse skill-levels.

From the side of the general population, what has to be overcome is an odd though familiar amalgam of deference and disdain. In its place should arise a willingness to view the advanced training with which others may be endowed simply as an instrument they have acquired rather than as an attribute of "distinction." Otherwise, in the contorted rationalizations by which people sometimes reconcile themselves to apathy, they will view those who have what they lack as being in some way alien: privileged in their capacities but deficient in their humanity. This is the most dangerous of mindsets—the stuff of fascist appeals[7]—but in that very aspect it suggests the promise implicit in the alternative. People who can respect knowledge without being deferential to those who have it, are the ones who are capable of the kind of self-transformation that is integral to any remaking of society.

What people come to know, then, and what abilities they cultivate, are less important than the way the process comes about. Still, the revolutionary organizations must do more than just promote a culture of equality. They can introduce specific measures geared to spreading technological competence. So far as devices are concerned, they can demand that the "new" ones spawned by the existing order—notably, in the sphere of communications—be made equally accessible to all. More importantly, however, they can create settings, such as "short courses," in which people who have been trained but discarded by established institutions are given an opportunity to share their skills with others whose stake in the established order is even slimmer.[8] In a similar but less formal way, labor unions might play a role of bringing together workers from different parts of a single enterprise with the explicit purpose of having them come to grasp, as a result of their exchanges, the totality of the operation to which they have been lending their separate efforts.

All such processes, regardless of the specific skills of the people involved in them, constitute the nuclei for any eventual society-wide decisionmaking practice in matters of technology. The very range

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[7] Catherine McNicol Stock, *Rural Radicals: Righteous Rage in the American Grain* (Ithaca: Cornell University Press, 1996).

[8] The radical political potential of this type of education is implicit in Nick Dyer-Witheford, *Cyber-Marx: Cycles and Circuits of Struggle in High-Technology Capitalism* (Urbana: University of Illinois Press, 1999), esp. his discussion of "Communication Commons," pp. 201ff.

of experience reflected in the different mixes of participants assures—given a sufficiently grand underlying vision—that new and inspiring collective projects will emerge.

The possibility of collective initiative

One of the most persistent myths about capitalism is that it is the only framework that can foster technological innovation. This assumption deserves to be challenged from several angles. In the first place, innovation is not an end in itself. This fact, obvious enough on reflection, is largely buried in capitalism's public rhetoric; it needs to be loudly proclaimed. Not only is innovation not an intrinsic "good," but many innovations are decidedly harmful. The technology of destruction is only the most blatant example, as even supposedly beneficial innovations are often overshadowed by dubious side-effects, ranging from stress or disease at the individual level to resource-depletion and pollution at the level of the ecosphere.[9]

To acknowledge all this is to raise the question of the degree to which the innovation that occurs within a capitalist setting deserves to be inherently identified with capitalism. It is important not to lose sight of the long-term duality between the capitalist aspect and the human aspect of everything that goes on in capitalist society. This duality parallels and in part reflects the distinction drawn by Marx between use-value and exchange-value. Use-value, because it does not readily lend itself to quantitative measurement, was often slighted in political debate (even by socialists), but it has pursued a kind of suppressed existence which is coming back to our attention now that its classic embodiments—air, water, soil, species-diversity—are increasingly threatened.[10] With regard to innovation, the use-value dimension serves to remind us that there is an ongoing basis for creative activity that exists and flourishes *despite* capitalism and not because of it. This is important in terms of our recognition that while innovation is not necessarily good, it may well be good in some instances. What we can then suggest is

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[9] Levins telescopes this phenomenon in the following terms: "…pesticides increase pests; hospitals are foci of infection; antibiotics give rise to new pathogens; flood control increases flood damage; and economic development increases poverty." Richard Levins, "Ten Propositions on Science and Antis cience," in Andrew Ross, ed., *Science Wars* (Durham: Duke University Press, 1996), p. 181. The concept of such "revenge effects" is applied to a broad range of examples in Edward Tenner, *Why Things Bite Back: Technology and the Revenge of Unintended Consequences* (New York: Random House, 1996).

[10] Joel Kovel, *The Enemy of Nature: The End of Capitalism or the End of the World?* (London & New York: Zed Books, 2002), p. 40.

that the basis for distinguishing negative from positive innovations is precisely the degree to which they are—or are not—shaped by the priorities of capital.[11]

This hypothesis is of enormous importance for a socialist technology, because it reminds us that we owe historical advances in technology less to "entrepreneurs" than to artisans or professionals or skilled workers.[12] Whatever the role of private initiative, "Innovation appears now, not primarily as a single event, but rather *as a process* [, in which] interactive learning and collective entrepreneurship are fundamental."[13] Many of the most dramatic breakthroughs (especially in communications) have depended on "the role of the state [in] funding the research that is basic to the new technologies."[14] In the United States, these are of course largely military, and in their objectives they fully reflect the interests of capital. Still, their institutional setting offers certain clear advantages over direct private sponsorship. The biggest of these in practice has been superior funding. Under more enlightened conditions, however, other advantages of publicly sponsored projects come to mind, notably (1) the free exchange of ideas, unencumbered by fears of disclosing "trade secrets," and (2) the option of public accountability. These observations suggest a greater potential for non-capitalist innovation than is commonly assumed.

But the more radical notion of linking the merits of innovations with their specific socioeconomic grounding does not yet seem to have been broadly considered. The evidence I have found in its favor relates mainly to the sphere of agriculture, for which there appears to be a particularly striking contrast between, on the one hand, the ecologically sensitive innovations of peasant, communal, and organic producers and, on the other, the toxic impositions of the agro-industrial complex. Beyond this, Commoner has long emphasized the contrasts between (*a*) production based on such natural materials

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[11] The emphasis on *degree* is important in this formulation. No innovation under capitalism can escape the formative impact of capital, but any *useful* innovation reflects at the same time influences *other than* those of capital, whether in its conception, its elaboration, or its application. This simply restates the point that capital views innovation through the prism of profit-potential, whereas the criterion of usefulness refers to considerations independent of profit.

[12] The millennial evolution of agriculture is the characteristic though not the only example of this (Lynn White, Jr., *Medieval Technology and Social Change* [Oxford University Press, 1962]). On the role of artisans, see e.g. David Landes, *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present* (Cambridge University Press, 1969), p. 101.

[13] Bengt-Ake Lundvall, *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning* (1992): Introduction, reprinted in Ben R. Martin & Paul Nightingale, eds., *The Political Economy of Science, Technology and Innovation* (Northampton, Mass: Edward Elgar, 2000), p. 532.

as leather, rubber, and cotton and (*b*) the whole petrochemical sector.[15]   More generally, the promise of authentically socialist innovation would appear to lie above all in bringing to the fore the most urgent human needs and in finding new ways to utilize or apply already-known devices and procedures.

Capitalism's ideological appropriation of the mantle of innovation is conceptually similar to its appropriation of democracy, freedom, and individuality, but it seems to have received much less critical analysis. After all, we can readily point to examples of capitalist-sponsored repression, and also of the often legendary struggles against it—from the free-speech struggles of early U.S. labor history to the anti-dictatorial struggles of recent decades in such countries as Chile, Guatemala, South Africa, South Korea, and Indonesia. But whatever the harshness of capital's political arm, who can question capital's technological prowess? And wasn't it precisely in the technological arena that first-epoch socialism met its undoing? This is the assumption that concerns us here, for there has been no end to the citation of Chinese and Soviet leaders (most notably, Gorbachev) invoking capital's supposedly unanswerable technological claims.[16] Even from the standpoint of those—especially in Russia—who now bemoan the disappearance of their personal security, there appear to be few grounds for challenging capital's supremacy in the matter of economic initiative.

Our critique in this area needs to assimilate and propagate the insights of two largely separate traditions: that of environmentalism, and that of workers' self-management. From environmentalism, we draw not only a reference-point for judging capitalist innovations, but also a network of positive projects pointing toward innovation in hitherto neglected areas. Although environmentally-grounded innovations may in certain dimensions take the form of commodities—such as solar-powered calculators—which respond to market-demand, the more significant innovations are likely to have an organizational component entailing shifts and displacements for which the market cannot possibly be expected to give the appropriate signals. What market-player, for example, can signal the need for long-term replenishment of the soil? How can market-related behavior play any more than an incidental role in the

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[14] Ulrich Hilpert, "The State, Science and Techno-Industrial Innovation," in *idem*, ed., *State Policies and Techno-Industrial Innovation* (London & New York: Routledge, 1992), p. 7.

[15] Barry Commoner, *The Poverty of Power: Energy and the Economic Crisis* (New York, Bantam Books, 1977), p. 194.

[16] See Mikhail Gorbachev, *Perestroika: New Thinking for Our Country and the World* (Harper & Row, 1988), pp. 78-84; Manuel Castells, *End of Millennium* [vol. 3 of *The Information Age: Economy, Society and Culture*] (Oxford: Blackwell, 1998), pp. 5-9, 26-37.

hypothetical switchover from automobile-clogged conurbations to communities built around a mix of mass transit and non-motorized individual locomotion?[17]

Clearly both these projects—restoration of the soil and liberation of the cities—require an enormous fund of creative initiative. The technology involved will consist only to a subsidiary degree of any particular new devices. Far more important, without ceasing to be a dimension of technology, are the patterns defining the interaction of the various sites, devices, and agents that will make up the new system.[18] The requisite "initiative" for introducing such a system will far surpass any conceivable capitalist innovation, if for no other reason than that the latter does not need to consider as a dimension of its output the totality of the social/ecological nexus. This totality is precisely the guidepost for socialist innovation. While its contours may be present in the imaginations of any number of individuals, its translation into concrete projects, given the manifold repercussions of each component, can only be undertaken with the active participation of every affected sector (on the understanding that some of the human participants will speak for affected species or configurations of the natural environment).[19]

This is the point at which the environmental tradition intersects with the tradition of worker control. The point of convergence is the notion of democracy as a fount of practical initiative. The potential benefits of such an approach have often been suggested even within capitalist enterprises, albeit within narrow instrumental limits.[20] Under revolutionary conditions, initiative from below goes further and directly promotes concerns that transcend the horizon of particular economic units. This was one of the consistent patterns in the anarchist collectives that sprang up throughout Eastern Spain during the Civil War period (1936-39). It took shape not only in the consolidation of production units (overcoming wasteful proliferation), but also in arrangements for crossover labor-time between

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[17] In the words of architect Paolo Soleri, "The theory that soft capitalism or 'green capitalism' will eliminate waste is wrong…. More fuel-efficient automobiles will mean more of them, more roads and more sprawl." Soleri, "The Frugal City" [interview], *New Perspectives Quarterly*, vol. 17, no. 4 (Fall 2000), p. 5.

[18] Victor Wallis, "'Progress' or Progress? Defining a Socialist Technology," *Socialism and Democracy*, no. 27 (Spring-Summer 2000), pp. 52ff.

[19] See David M. Kotz, "Socialism and Innovation," *Science & Society* vol. 66, no. 1 (Spring 2002), esp. his discussion of the fact that "Major innovations typically have victims…" (p. 105).

[20] Juan G. Espinosa and Andrew S. Zimbalist, *Economic Democracy: Workers' Participation in Chilean Industry, 1970-1973* (New York: Academic Press, 1978), pp. 20-24.

agriculture and other sectors.[21] In the later experience of revolutionary Cuba, similarly, liberation from class constraints enabled people to perceive pro-environmental policies as being matters of universal benefit, thereby making possible "rational decisions about how to use nature."[22] In both the Spanish and the Cuban cases, whatever their institutional differences, the political setting facilitated certain indisputable advances in the use and conservation of resources.

Technological issues and class issues in ecological policy

The human impact on the environment reflects the sum-total of human productive activity. Ecological policy has to be understood, accordingly, not as the narrow province of bureaus explicitly concerned with things like species-protection or resource-preservation. To the contrary, it is the continuous outcome—whether intended or unintended—of the actions of every entity, be it public or "private," that affects by either its policy decisions or its practices the consumption of raw materials, the burning of fuel, or the disposal of waste. Obviously there are gradations of responsibility, and the question of scale is important. What is not important is the official rubric under which the outcomes are arrived at.

While all this may appear self-evident, it is remarkable how far removed it is from general public awareness. Insofar as people acknowledge some abstractly conceived "environmental crisis," there is almost reflex support, at least in the United States, for the most narrowly technological responses, along the lines of improved fuel-efficiency, or perhaps "alternative energy sources"—although with little attention to the level of commitment that a serious push in the latter direction would require. What is almost completely missing from public discourse is any scenario of selectively curbing those "end-uses" against whose aggregate the need for energy—whether efficient or ineffcent; clean or "dirty"—is reckoned.

This deficiency reflects a productivist bias which is integral to capitalism. Capitalist ideology has always tended to legitimize any economic pursuit for which a market-demand could be found (or generated). In this light, the ecologically grounded call for prioritizing some types of production over

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[21] Thus, as reported by Gaston Leval, "construction workers who were without work would go to help the land workers and when necessary the opposite would happen." Leval, *Collectives in the Spanish Revolution* (London: Freedom Press, 1975), p. 108

[22] Haila and Levins, *Humanity and Nature* (n. 3), p. 250.

others appears arbitrary and inadmissible—a problem that is only enhanced by the obvious difficulty of achieving consensus as to which productive activities ought to be favored. And yet how will it be possible, in the absence of such prioritization, to reduce energy-requirements in a way that does justice to the configuration of real needs?[23]

To deliberate, in a policy context, on human need is to return to the basic framework of socialist thinking. It is to definitively reject the conflation of need with the market-oriented concept of "demand." Once need is no longer calibrated in accordance with purchasing power, however, new criteria are required. Ecological concerns can here take their place side by side with long-recognized fundamental rights in the economic, educational, and cultural spheres.[24] These will then serve as the guidelines under which productive activities are sponsored. The application of such guidelines will require that any particular project be considered in relation to the totality of other commitments and of available resources, taking into account also, of course, the variety of possible ways in which such factors can be combined. In ecological parlance, this is known as a holistic approach. In political economy, it is known as planning.

Although planning is the most natural of human activities (being virtually a defining trait of our species), its practice by public authorities, on a society-wide basis and at the national level, still suffers from a stigma deriving from a single historical experience. Stalin's repressive approach, viewed through the lens of socialism's detractors, is thought by many, even now, to hold some sort of patent on the idea of large-scale planning. This assumption is a dangerous relic of Cold War demagogy. It could permanently obstruct ecological conversion. Partly for this very reason, but for other reasons as well, the methods it evokes can be no part of the process envisioned here. Repression emerges as a tactic only when the government has no hope of getting a majority behind its policies. Radical ecological measures, by contrast, presuppose majority support as a condition for becoming real options. This is because of the link between ecological soundness and the devolution of many aspects of implementation

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[23] For an attempt to formulate criteria for prioritization, see Victor Wallis, "Toward Ecological Socialism," *Capitalism, Nature, Socialism*, vol. 12, no. 1 (March 2001), pp. 135ff.

[24] See the Universal Declaration of Human Rights (1948).

to local, decentralized units, where it depends on the active involvement of the communities in question.[25]

Underlying this scenario is the objective interest of the majority in an ecological agenda. This interest must eventually translate into conscious support. How to accelerate that process is the permanent challenge to all Left activists. What works in their favor is the ultimately transparent correspondence between capital's economic greed and its environmental rapacity.[26] What works against them is the impression that there can be no other framework for keeping things running. Combatting this impression depends partly on showing that this framework is leading to ruin, but more importantly on showing that those who advocate a radical alternative are not lacking in practical sense.

Toward a socialist technology

Socialist technology, as already noted, is a matter not so much of particular devices, as of a certain approach to organizing production and consumption. The devices and the organizational forms are of course, under any system, dialectically intertwined. This interrelationship must now be understood, however, differently from the ways in which it was imagined by the revolutionists of the early 20th century. At that time the idea of socialism still included, in the minds of its proponents, the goal of surpassing capitalism in a narrowly instrumental sense: more grandiose projects, increased mechanization, reduced toil, higher cultural levels, longer lives. The formulation entailed an odd mix of legitimate aspirations with a kind of crude quantification in their expression. The mindset underlying such an approach coincided with the one that prioritized seizing and holding state power, as opposed to transforming production relations. It was an undialectical, voluntaristic mindset, which as such manifested the continuing global hegemony of capital.

This overarching instrumentalist view of technology has by no means disappeared, but the grounds for overcoming it have become much more widely accepted over the past few decades. The very idea of *not pursuing* certain technological projects or—if they have already been

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[25] For a variety of present-day socialist perspectives on planning (rejecting both the "command" model and the "market" model), see the special issue of *Science & Society* (Spring 2002), *Building Socialism Theoretically: Alternatives to Capitalism and the Invisible Hand.*

[26] This is eloquently captured in Part I of Kovel, *The Enemy of Nature* (n. 10). On its centrality in Marx's thought, see John Bellamy Foster, *Marx's Ecology: Materialism and Nature* (New York: Monthly Review Press, 2000).

implemented—of *scrapping* them (e.g., nuclear power plants, genetically modified crops), has attained a breadth of appeal which extends well beyond that of the early-19ᵗʰ-century machine-wreckers. The present-day critique reflects widely disparate constituencies, ranging from those of traditional religion to advocates of the most advanced ecological thinking; but as an epoch-defining prod to this new impulse, nothing can surpass the mid-20ᵗʰ-century development of the "ultimate weapon." This milestone gave unprecedented grounding to the contention—still not widely explored—that the merits of a system of social relations might lie precisely in its capacity to *restrain* certain technological innovations or, in more general terms, to subordinate narrowly instrumentalist projections to human and ecological priorities.

The need for restraint fits uneasily, at first glance, with the impulse to liberation, but this reflects only a one-sided view of liberation. Ecological thought reaffirms a truth long recognized in the sphere of artistic communication, namely, that the fullest range of expression corresponds to the most complete assimilation of the cumulative sensitivities of one's community. The sensitivities reflect both experience and language, conscious or unconscious; the community is in part parochial and in part universal. What appear as defining traits or as limits, however, are precisely the constitutive elements of a freedom which, without them, would remain empty.[27]

A socialist technology is one that evolves in a manner consistent with this model. It cannot dispense with a certain type of expertise, but the expertise must be one of breadth. Nourished at every stage by interaction across hitherto inviolate social boundaries, it will no longer be tied to a fixed stratum of "credentialed" authorities. Under such conditions, those who formulate alternative scenarios would be in day-to-day contact with a range of people who, by virtue of their own positions in society, could directly articulate typical needs, while at the same time, through their very interactions, doing so in an informed and qualified way.[28] The point of this arrangement would be to move as far as possible beyond the market-grounded model, in which a multiplicity of isolated personal choices, allegedly embodying "consumer sovereignty," leaves an open field to capital at the macro level.

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[27] On this point, one of Hegel's formulations is suggestive: "It is the will whose potentialities have become fully explicit which is truly infinite, because its object is itself and so is not in its eyes an 'other' or a barrier;…" *Philosophy of Right* (1821), ξ22, tr. T.M. Knox (Oxford: Clarendon Press, 1942), p. 30.

[28] Levins: "The optimal condition for science is with one foot in the university and one in the communities in struggle…" *Science Wars* (n. 9) p. 191.

Haila and Levins describe agriculture as evolving "from labor intensive to capital intensive to [potentially] thought and knowledge intensive."[29] The sequence can well apply to technology in general, with the understanding (which they also make clear) that the application of thought and knowledge must be, in effect, socially intensive. Capitalist technology, for all its ingenuity, could never match such an approach for adapting production to need. Such adaptation, indeed, is not even within its purview. The perpetual feverish overhauling that marks capitalist technology is thus an illusory achievement. Far from reflecting a liberation from fetters (as some suggested following the Soviet collapse), it is itself a fetter insofar as it feeds into the systematic postponement of the much higher stage that technology could attain if it were to be reinserted, under present-day conditions of humanity and nature, into the social matrix from which capitalism artificially wrenched it.

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[29] *Humanity and Nature* (n. 3), p. 163; also, Levins's call for "knowledge-intensive low input practices … in which the agricultural enterprise is a planned mosaic of fields in which each has its own product but also contributes to the productivity of the other fields" ("Rearming the Revolution: The Tasks of Theory for Hard Times," *Socialism and Democracy*, no. 23/24 [1998], p. 64).