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Marxism and the critique of social rationality: from surplus value to the politics of technology

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The most effective way to silence criticism is a justification on the very terms of the likely critique. When an action is rationally justified, how can reason deny its legitimacy? This paper concerns critical strategies that have been employed for addressing the resistance of rationality to rational critique, particularly with respect to technology. Foucault addressed this problem in his theory of power/knowledge. This paper explores Marx's anticipation of that approach in his critique of the 'social rationality' of the market and technology. Marx got around the silencing effect of social rationality with something very much like the concept of underdetermination in his discussion of the length of the working day. There are hints of a critique of technology in his writings as well. In the 1960s and 1970s, neo-Marxists and post-structuralists demanded radical changes in the technological rationality of advanced societies. Soon technical controversies spread, primarily through the influence of the environmental movement. The concept of underdetermination was finally formulated clearly in contemporary science and technology studies, but without explicit political purpose. Nevertheless, this revision of the academic understanding of technology contributes to weakening technocratic rationales for public policy. A new era of technical politics has begun.

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The trajectory to which my title refers suggests my intention of linking Marx's writings to current technical issues. I am primarily interested in the methodological implications of Marx's contribution rather than the details of his thought. I will also engage contemporary constructivist technology studies along the way.

Why Marx? The question is reasonable in the current intellectual context in which Marx's economic thought is generally dismissed as outdated and his historical significance diminished by the fall of the Soviet Union. But Marx's engagement with technology has had a continuing influence, in fact, several different influences that are not about to go away.

Marx wrote his major works at a time when the industrial revolution in England promised to transform the world. The central role of technical development in human history was suddenly visible. How Marx conceived that role is in dispute, but one line of

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interpretation feeds directly into the concerns of this paper (MacKenzie, 1996, ch. 2). According to that view Marx conceived of technology as contingent on social relations. Technology would thus have to be understood in social terms rather than as determining for society. This view has implications for any ontological account of technology since such accounts will depend on a broader social ontology. I will not enter into that ontological discussion directly here, but will instead focus on one of its implications: *the relation between technology and knowledge conceived as intrinsically social phenomena*.

This approach changes our understanding of both technology and knowledge and opens up the question of politics in a new way. The standard view holds that while the goals technology serves are socially determined, its design depends on the state of scientific and technical knowledge. Advancing knowledge, in a sense, drags technology along in its wake. But Marx appears to have reversed this equation in arguing that the design of industrial technology reflected the requirements of capitalist production. Knowledge still played a role in design, but not a determining one. Rather, the manufacturing division of labour introduced by capitalism oriented machine design. The analysis and breakdown of workers' tasks into simple fragmented gestures prepared the transfer of work to machines. Marx anticipated that a radically different division of labour and technology would emerge under socialism. These considerations on technological development imply that the knowledge required for production evolves under the impact of the prevailing economic system, which itself depends ultimately on class power. I will return to this argument later in this paper.

Contemporary technology studies emerged not out of Marxist analysis but out of an earlier development of anti-positivist science studies. Epistemological relativism triumphed in the wake of Kuhn's famous book on scientific revolutions as science came to be studied as a fundamentally social phenomenon. The rejection of positivism in science studies prepared the way for a break with determinism in technology studies. Technology too, it turned out, was a social phenomenon and not an instrumental application of universal knowledge. Constructivism aimed to liberate us from the last myth, the myth of pure rationality, with the unstated purpose of combating the authoritarianism of the experts.

Constructivism had the good fortune to emerge at a moment of growing concern with environmental issues and the rise of the internet. As public understanding of technology grew more sophisticated, scholarly study of technology found an unusually wide audience. However, the revival of religious fundamentalism has called forth a defence of traditional rationalism. The Enlightenment struggle against superstition and intolerance is not over and the weapons of Enlightenment are still needed, among them the unwavering appeal to scientific truth. The scholarly debate headed toward deadlock as the political context of discussion contaminated the intellectual space with a toxic dose of reality.

I do not intend to address the philosophical issue of relativism versus rationalism in this paper. I do not believe it is necessary to resolve such vast questions to develop a powerful critique of rationality as it is realised in social institutions such as markets and technologies. I will argue that some aspects of Marx's method point the way to an alternative to the epistemological emphasis of current debates. Widening the context of discussion to include Marx may help us free technology studies from the heavy philosophical burden it inherits from its origins in science studies. Marx allows us to maintain a critical stance in the framework of a *social* concept of rationality. Anticipating my conclusion, I argue here that technology is both rational and underdetermined, and that it co-constructs its society. Technology is therefore political in the sense that its developmental path is more or less

subject to debate and choice. The outcome has consequences for the interests and the way of life of the various classes and groups that make up society.

I would like to begin by contrasting Marx with Foucault. Foucault's thought is probably the most influential alternative to Marx on the left today. His theory is explicitly presented as such an alternative. 'Power/knowledge' is the key term in Foucault's critique of rational domination, which he contrasts with the Marxist idea of class power. Marxism, he argues, still conceives of power as 'sovereign', that is to say, as repressive. The Enlightenment notion that truth is above politics goes along with this. These are, Foucault claims, outdated conceptions of both power and knowledge.

In modern societies knowledge is conjoined with power and together they are productive of individual subjectivity and the social order. Disciplines such as criminology and psychiatry arise along with the institutions of confinement that place their human objects at their disposal. They reshape these objects through disciplinary procedures and so create a modern society.

According to Foucault, power/knowledge is a web of social forces and tensions in which everyone is caught as both subject and object. This web is constructed around techniques, some of them materialised in architecture or other devices, others embodied in standardised behaviours. These do not so much coerce and suppress the individuals as guide them toward the most productive use of their bodies. On this account, technology is just one among many similar mechanisms of social control, all based on pretensions to neutral knowledge, all having asymmetrical effects on social power.

This explains why the social imperatives of modernity are experienced as technical constraints rather than as political coercion. Surveillance, disciplinary power, normalisation, all make modern life possible. They 'condense' technical and social functions at the level of everyday behaviour, even before that functional duality is transferred to the design of institutions and devices. Eventually these constraints are embodied in structures that determine individual's action more effectively than rules and commands by determining their reflexes, skills and attitudes. The Panopticon is Foucault's one developed example of the place of artifacts in his theory. Of it he writes:

> The exercise of power is not added on from the outside, like a rigid, heavy constraint, to the functions it invests, but is so subtly present in them as to increase their efficiency by itself increasing its own points of contact. The panoptic mechanism is not simply a hinge, a point of exchange between a mechanism of power and a function; it is a way of making power relations function in a function, and of making a function function through those power relations (Foucault, 1977, p. 206–7).

Foucault claimed that a power based on knowledge and embedded in social techniques and technology cannot be overthrown by a political revolution. The state in its modern form exists through the effects of power/knowledge and a change of policies and personnel would leave these effects intact. What is possible is both less and more than such a change, however revolutionary. Foucault argued for 'the subversive recodification of power relations' underlying the structure and methods of the sciences in order to integrate the subjugated knowledge possessed by those on the bottom of the hierarchy (Foucault, 1980, p. 123). The aim is not to abolish power but to find a way 'which would allow these games of power to be played with a minimum of domination' (Foucault, 1988, p. 18; Feenberg, 2002, ch. 3).

Foucault's theory is enormously suggestive. It is significant that he focuses on rational forms of domination not by attacking science as such but by deconstructing those sciences

in which human beings are both object and subject. These social, political, medical, and administrative sciences are deeply embedded in the power relations of modern societies. Undermining their claims to purity both provides a guiding thread for understanding modernity and theoretical support for new forms of political resistance on the terrain of knowledge. All this is certainly an advance over Marx. But Foucault does not have an effective critique of Marx's views as a whole. Although some of Marx and Marxists' discussions of class and the state conform with Foucault's notion of sovereignty, Marx was actually the first to develop a powerful critique of social rationality. For Marx rational social arrangements are just as biased by the effects of power as they are for Foucault.

In support of this claim I must first explain what I mean by a 'rational' social subsystem, and then revise the notion of bias accordingly. Let me begin then with the concept of 'social rationality', which I have introduced to identify the peculiar character of many modern institutions (Feenberg, 2008).

It is obvious that no institution can be rational in exactly the same way as science and mathematics. Institutions are not held together by logical relations but by causal and symbolic forces that lack the rigour of experiment and equation. Nevertheless, procedures that bear a certain resemblance to those of science and mathematics operate in modern societies with tremendous effects on the whole social system. Social rationality in this sense depends on three such principles consciously applied by organisations and institutionalised in systems. These are: exchange of equivalents, classification and application of rules, and optimisation of effort and calculation of results.

Each of these principles looks 'rational' as we ordinarily understand the term. The market, like calculation, is an exchange of equivalents. Bureaucracies resemble science in classifying objects and treating them uniformly under rules of some sort. And like science they measures their objects ever more carefully. Business, like technology, is based on optimising strategies. Social life in our time thus appears to mirror scientific and technical procedures. This has consequences for the critique of social bias.

We normally identify bias where prejudices, emotions and pseudo-facts of one sort or another influence judgements that ought to be based on objective standards. I call this 'substantive bias' because it rests on a content of belief such as, for example, the idea that some races possess inferior intelligence. This concept of bias is an inheritance of the Enlightenment, which aimed its critique at narrative legitimations of feudal and religious institutions. By contrast, the Enlightenment appealed to rational foundations, facts and theories unbiased by prejudice. There is no doubt that Enlightenment critique played, and still plays, an important role in emancipatory politics. However it has a significant limitation since it implies the neutrality and universality of systems such as technology, bureaucracy and markets that claim a rational foundation.

The critique of a rational system such as the market requires a different concept of bias. To explain that concept I need to distinguish it from romantic critique, which attributes substantive bias to rational systems and thereby denies the rationality of rationality as such. A similar critique is found in some postmodernist, feminist and STS (Science, Technology and Society) theory. But whenever rationality is reduced to a non-rational origin such as Western or patriarchal ideology, or mere power relations, its special characteristics qua rational are overlooked.[1] This was not Marx's approach. He encountered it on the left in his day, for example in Proudhon, who titled his most famous book *Property Is Theft*. But if

[1] The risk of regression to which such approaches are exposed is very real: Christian fundamentalists have been able to appeal to science studies in defence of their right to teach 'intelligent design' in schools.

property really is theft, the coherence and survival of capitalism are incomprehensible. No social order can be based on simple plunder, certainly not one as complex and fragile as the capitalist system.

Marx's distinctive approach involved a very different style of critique based on the discovery of what I call 'formal bias', by which I mean a critique of the discriminatory effects of a rational order. Formal bias hides in aspects of rational systems that only become visible when the systems are situated in their context. It is not a matter of prejudice and need not be defended with appeals to pseudo-facts or narrative myths because in this case the system itself objectifies the discriminatory principle. Criticism is silenced because the defender of the system can demonstrate its fairness on the terms of substantive critique. For example, a culturally biased test may discriminate effectively between populations, but those who design, administer and grade the test need not themselves be prejudiced for it to achieve a biased outcome.

Marx acknowledged the rational coherence of the market economy. But already in 1844 he cites 'a contemporary economic fact. The worker becomes poorer the more wealth he produces' (Marx, 1963, p. 121). This fact suggests the hidden bias of the market, which Marx sets out to explain as a consequence of the rational structure of capitalism. It is a difficult challenge. Habermas has succinctly summarised the problem Marx faced:

> The institution of the market promises that exchange relations will be and are just owing to equivalence . . . The principle of reciprocity is now the organizing principle of the sphere of production and reproduction in itself (Habermas, 1970, p. 97).

In this passage Habermas explains the astonishing coincidence of mathematical equivalence and moral reciprocity in market relations. It is this equivalence that legitimates the market and makes it seem both natural and good.

Marx overcame this legitimating strategy in his theory of surplus value. I recall his argument here not to revive Marxist economics but as an example of a methodological innovation that has continuing validity and usefulness. In the ideal model of the capitalist economy that Marx derives from his bourgeois predecessors goods are paid for on the average at their value and their value consists in the labour required to produce them. Labour power itself is a good and the labour required to produce it is measured by the cost of food and other necessities. But because the capitalist owns the factory he has the power to set the length of the working day independent of the value of the labour performed within its compass. During the long working day workers produce goods worth more than the cost of their wages and so they enrich the capitalist to whom their product belongs. Meanwhile, the workers themselves remain at a mere subsistence level sufficient to reproduce their labour power.

Marx makes no reference to prejudices or pseudo-facts in this critique of capitalism. Surplus value is produced by the rational workings of the system itself. Property is not theft because labour is paid at its value. This is why Marx objected to early union demands for a fair wage. The problem is not with a specific rate of wages but with the structure of the market, which leaves the length of the working day to the discretion of the capitalist. However, Marx's argument does effectively refute the normativity the market acquires when it is viewed as a pure exchange of equivalents, outside the context in which it actually functions as a mechanism of exploitation.

I want to turn now to the relation between Marx's conception of formal bias and his critique of technology. Marx was not a rigorous technological determinist despite having written some famous passages in which he says that the 'forces of production' determine

the relations of production and all of social life. The bulk of his concrete discussions of technology concern the harm caused by industrial work. These passages seem to imply a critique of technology as such. But Marx rejected any such imputation and blamed the problems on the capitalist employment of machinery. But there are also a few passages in which technology is criticised for its specifically capitalist character. He writes, for example, that science 'is the most powerful weapon for repressing strikes, those periodical revolts of the working class against the autocracy of capital' (Marx, 1906 reprint, p. 475). And further 'it would be possible to write quite a history of inventions, made since 1830, for the sole purpose of supplying capital with weapons against the revolts of the working class' (Marx, 1906 reprint, pp. 47–8). These passages suggest the contingency of science and technology on the interests of the capitalist class. Power/knowledge *avant la lettre* appears to be at work in Marx (Feenberg, 2002, ch. 2).

The industrial revolution is the first time in history that basic economic production concerns members of the upper classes. Capitalists possess literate skills and access to scientific knowledge. At the same time they are in touch with the crafts in which lower-class people are engaged. Their familiarity with these two worlds of knowledge was one factor enabling them to restructure the labour process in order to eliminate costly craft labour. As Andrew Ure wrote in 1835:

> By the infirmity of human nature it happens, that the more skillful the workman, the more self-willed and intractable he is apt to become, and, of course, the less fit a component of a mechanical system, in which, by occasional irregularities, he may do great damage to the whole. The grand object therefore of the modern manufacturer is, through the union of capital and science, to reduce the task of his work-people to the exercise of vigilance and dexterity (Ure, 1835, p. 18).

Competition drives the process of deskilling, but it would not be an effective economic strategy in the absence of the specific social relations of capitalism. The capitalist labour process is controlled in great detail from above and this is historically unprecedented, at least so far as central economic institutions are concerned. Control from above situates the capitalist in a new post in the division of labour. He is needed as the unifier and leader of the work group, not just politically or economically, but technically. Once labour becomes wage labour and its tasks are parcelled out, production units no longer have a quasi natural character, rooted in community and family and supported by craft guilds and their traditions. The workers have no interest in production in both senses of the word, and even understanding the work plan becomes more and more difficult for those who implement it. Without the capitalist's exercise of 'power/knowledge' workers might resist the long workday by slowing their pace and coordination might break down.

But Marx's analysis goes further, explaining how, in Foucault's words, power relations come to 'function in a function'. Marx shows how deskilling leads to mechanisation. Once craft work is broken down into its simplest elements, and each element assigned to a specific worker in a new division of labour, the potential role of machines in performing it becomes evident. Much of the capitalists' role can be objectified in such machinery. Thus, a social demand, in this case of capital, presides over the Industrial Revolution and orients much innovation throughout the nineteenth and twentieth centuries.

Deskilling is such a general feature of invention over the last few centuries that it appears to be essential to progressive economic development. But in fact the history of capitalist enterprise shows just how contingent it is on peculiar social conditions and class conflicts, just as Marx supposed. What makes this difficult to perceive is the technically rational form

taken on by these contingent developments. As a result old ideas about progress shared by Marxists and liberals alike prevailed until the 1970s when Harry Braverman's pathbreaking book *Labor in Monopoly Capitalism* (1974) renewed Marx's social critique on the basis of the concept of deskilling.

David Noble followed with influential studies of the role of deskilling in American industrialisation. Noble's famous example of the automation of the machine tool industry has had a wide influence. He explained that machine tools can be automated in two different ways. At first an analogue record/playback system was introduced by General Electric but it found no buyers because it still relied on craft workers to record a programme. Management held out for digital systems that would translate directly from engineering drawings to machine movements, completely cutting craftsmen out of the loop. Noble's argument exemplifies the workings of what constructivists call under-determination. Management's choice between these systems was ultimately decided by its ideological hostility to craft labour, which was supported by a long tradition of management science, and not by neutral technical or economic reasons (Noble, 1984). Such influential revisions helped liberate Marxists from a naïve view of technological advance as a universal achievement.

According to the new approach, forces and relations of production co-construct each other. This term, 'co-construction', belongs to recent constructivist technology studies, which have rediscovered the Marxian idea of the interdependence of the social and the technical.[1] Contemporary technology studies thus offer concepts useful for analysing these developments and what they hide. In this field technology is conceived not as a pure product of inventive genius or as an application of science but as a 'construction' of social actors. The technical underdetermination of artifacts leaves room for social choice between different designs that have overlapping functions but better serve one or another social interest. This means that context is not merely external to technology, but actually penetrates its rationality, carrying social requirements into the very workings of gears and levers, electric circuits and combustion chambers.

These concepts were introduced in an influential article by Trevor Pinch and Wiebe Bijker that made the connection between constructivism in science studies and a parallel approach to technology. They illustrated their argument with the history of the bicycle. As in Noble's example of machine tools, so in this case two main designs were in competition at first. One of these designs looked a lot like bicycles today. It was relatively safe to ride but slow, useful only as a means of transportation. The other had a high front wheel and was faster but less stable. It appealed to young sportsmen who liked to race. The different designs thus corresponded to the requirements of the different social actors. The triumph of the low wheelers resulted from the introduction of air filled tires to reduce vibration. When these were tried out in bicycle races, the low wheelers proved fast as well as stable and soon became the preferred design. 'Closure' was achieved, but the outcome was contingent and not the result of 'progress' in the sense in which that term is understood in a deterministic context. Pinch and Bijker comment: '[T]he different interpretations by social groups of the content of artifacts lead by means of different chains of problems and solutions to different further developments' (Pinch and Bijker, 1987, p. 42; see also Arthur, 1989).

Pinch and Bijker's key point is the influence of the social on 'the content of the artifact itself' and not merely on such external factors as use or pace of development (Pinch and

[1] Some of the writers in this field acknowledge the interest of Noble's application of the Marxist approach (MacKenzie, 1996; Pinch and Bijker, 1987).

Bijker, 1987, p. 42). This appears to parallel a similar constructivist relativism in science studies but the parallel is partially misleading. Facts and artifacts are very different. The 'hardening' of natural scientific facts by experiment and replication yields a 'content' that is far more compelling than a successful technological design. Of course the elements of engineering are often firmly established by scientific methods and long empirical experience, but they are a far cry from a finished artifact. They must be combined in contingent combinations and it is in the course of this process that the 'interpretive flexibility' of technology becomes evident. The underdetermination of the outcome is radical and obvious to technologists. Its demonstration requires no subtle epistemological arguments. Foucault's caution in restricting his study to sciences such as psychiatry and criminology reflected an appreciation of their similarly 'soft' status.

As the deskilling contest clearly shows, the social construction of technical artifacts is an intervention into the lives of their users. The 'scripts' inscribed in the artifacts govern their usage and hence a large part of social behaviour, in some cases even users' way of life. Users are configured by artifacts but in turn influence their design. Interactions played out in the course of the diffusion of technologies shape both human beings and the technologies themselves (Akrich, 1992; Oudshoorn and Pinch, 2003; Woolgar, 1991). I have studied several cases in which these complex relations between users and designers played a key role. In my study of the French Minitel I showed how the very meaning of the system was transformed by hackers who turned an information network designed to rationalise French society into a communication network for the exchange of instant messages between users seeking dates (Feenberg, 1995, ch. 7). The original programme designed to 'configure' the users as more efficient members of an 'information society' was subverted as the users resignified the system as a place of human encounter.

This very brief sketch of constructivist technology studies does not do justice to the rich body of research in the field but it gives a hint of its relevance to issues of great social and political consequence. The central achievement of these theories is the liberation of technology studies from deterministic models and the introduction of a hermeneutic perspective. The new question of technology is not about efficiency but about meaning.

Or rather, it encompasses both in what I call a 'double aspect' theory of technology (Feenberg, 1992, p. 311). The nature of technology is not reducible to one or the other of its aspects, either the system of causal relations in which it is involved or the context of meaning it institutes. The two aspects are equiprimordial, distinguished only analytically in the proper understanding of any particular technology. Any adequate ontology of technology must start out from this original duality.[1]

From this standpoint, the history of deskilling as Marxists analyse it is a hermeneutic contest between two different visions of work and the worker, one promoted by capital and the other by workers. Deskilling involves the realisation of the capitalist interpretation of work in the technical specifications of factory equipment. A new type of society is built around this transformation.

I have introduced the term 'technical code' to refer to the general rules for translating such meanings between the language of social actors and the technical languages of the day. We are surrounded by such technical codes. Environmentalist concern with climate change is translated into the specifications of engines and building codes. To automotive engineers, safety literally means seatbelts, airbags, electronic skid control, and so on. In

[1] I have sketched such an ontology in the 'instrumentalisation theory' explained in Feenberg, 2002, chapter 7.

Bruno Latour's vocabulary, each language is employed to mobilise different networks; ordinary language mobilises human actors, including the general population and its political leaders. Among those so mobilised are technical experts whose technical discourse mobilises the non-human actors required to carry out programmes such as fighting climate change or building safer cars. Deskilling is a technical code expressed on the one hand in discursive form as an ideological preference for the replacement of skilled labour by machinery, and expressed on the other hand in technical specifications that determine machines with precisely this function. The technical code of capitalism translates the requirements of control from above into technology (Feenberg, 1999, pp. 87–9).

Marx hints at the possibility of a socialist technical code that would liberate intelligence and skill. In the *Grundrisse*, for example, he writes that labour under socialism must be 'of a scientific and at the same time general character, not merely human exertion as a specifically harnessed natural force, but exertion as subject, which appears in the production process not in a merely natural, spontaneous form, but as an activity regulating all the forces of nature' (Marx, 1973, p. 612). This conception of socialist labour explains why, in 'The Critique of the Gotha program', Marx anticipates a day when work will be 'life's prime want' (Marx and Engels, 1972, p. 388; Feenberg, 2002, ch. 6).

This implies a very different evolution of technology under socialism. Presumably the 'assembled producers', as Marx called the empowered workers, would make different technical choices from the capitalists. A different technical code would be imposed by workers, who would appear as actors in the technical domain. Although Marx left all this rather vague, later Marxists have developed the point.

I want now to address the development of the politics of technology critique in recent times. I have tried to show that Marx anticipated Foucault's essential point, namely that a critique of modern civilisation must include rationality in its purview. The structure of wage labour and technology requires just such a critique. But these systems are no longer confined to capitalist enterprise as they were in Marx's day. In the twentieth century they spread to state institutions and eventually to communist societies. From this it becomes clear that the workers' movement was simply the initial instance of a more general technical politics. The first place in which technology was widely deployed was the factory and so it was there that technical resistances first manifested themselves. Once technology spreads over the whole surface of society, a much wider range of technical struggles emerge, as is clear from the contemporary politics of the environment, medicine and computerisation.[1]

The multiplication of scenes of struggle shows that the bias of technological rationality is due not to ownership but to what I call the 'operational autonomy' of the capitalist and his administrative successors. By operational autonomy I mean the freedom of the owner or manager to make independent decisions regardless of the views or interests of subordinate actors and the surrounding community. Operational autonomy positions management in a technical relation to the world, safe from the consequences of its own actions. It is able to reproduce the conditions of its own supremacy at each iteration of the technologies it chooses and commands. Technocracy is an extension of such a system to society as a whole in response to the spread of technology and management to every sector of social life. A self-perpetuating dynamic emerges. We could employ Thomas

[1] I have offered examples of such struggles in several of my books: medicine (Feenberg, 1995, ch. 5), computerisation (Feenberg, 1995, ch. 7), educational technology (Feenberg, 2002, ch. 5) and environmentalism (Feenberg, 1999, ch. 3).

Hughes' term and call this a kind of 'momentum' acquired by modern organisations as they expand and develop.

Unfortunately, the socialist movement remained fixated on ownership and expected miracles from nationalisations without democratisation of technical relations. The neutrality of technology became doctrine among Marxists as it was among capitalists and direct transfers of the most oppressive Western technological designs formed the underpinnings of industrialisation in the Soviet Union. The failure to place the problem of operational autonomy at the centre of the theory of transition led to a catastrophic centralisation of power in Russia, China and other communist countries. By the 1970s this approach was discredited among most Marxist theorists in the West. Labour process theory and various forms of neo-Marxism restored a more sophisticated understanding of Marxian social theory that converged in certain respects with Foucault's non-Marxist critique of rationality.

Revisionist Marxism in the 1960s and 1970s developed a radical critique of modern civilisation as a whole. The most famous representative of this trend was Herbert Marcuse. He worked out the complex of critical ideas that have by now become clichés: the stabilisation of the 'one-dimensional' system through media propaganda, technocratic ideology, privatisation, consumerism and the displacement of surplus aggression onto racial or foreign scapegoats.

In addition, Marcuse challenged blind faith in 'progress' with a radical critique of technological rationality. In the dominant ideology technology was represented as a pure application of knowledge of nature, above political and social differences. The rational character of technology served as its alibi, freeing it from responsibility and placing it beyond controversy. Marcuse contested this image of neutral, value-free technology. He argued that its 'neutrality' destined it to serve the most powerful forces in society. In this respect modern technology differs from traditional crafts, bound to the service of specific culturally secured values. The liberation of technology from culture makes it available for any use whatsoever. In practice the privileged designs and usages are those of the dominant actors. This aspect of Marcuse's argument leads in my own work to the concept of formal bias.

Marcuse was less concerned with the problem of authority that preoccupied Foucault than with the intrinsic limitations of scientific-technical rationality as it has developed in modern societies. His argument reprised certain themes of the romantic critique of reason, such as its suspicion of quantification, albeit in a political form. Marcuse contrasted a science and technology of domination with an alternative realisation of rationality respectful of the developmental potential of nature and human beings. Such an alternative, Marcuse argued, would be rooted in the imaginative understanding of the world and the sense of beauty (Feenberg, 2005, ch. 5).

Marcuse's argument culminates in a positive alternative, the reconstruction of technological rationality around a life-affirming ethos. He argued for:

> rupture with the continuum of domination, the qualitative difference of socialism as a new form of way of life, not only rational development of the productive forces, but also the redirection of progress toward ending of the competitive struggle for existence, not only abolition of poverty and toil, but also reconstruction of the social and natural environment as a peaceful, beautiful universe: total transvaluation of values, transformation of needs and goals. This would mean not to regress in the technical progress, but to reconstruct the technical apparatus in accordance with the needs of free men, guided by their own consciousness and sensibility, by their autonomy (Marcuse, 1970, p. 280).

Marcuse's ecstatic projection sounds shockingly utopian today, but it provides a vision of a very different technological future, and some sort of vision is needed if we are ever to see the fundamental changes required by an adequate response to the environmental crisis. Marcuse's influence reached a highpoint in the 1970s when the counter-culture promised a radical break with the American way of life. The activists of this time called for the pursuit of happiness in other than commodity forms. Marcuse's formulation of the critique of consumerism is significant for rejecting appeals to individual self-denial and instead emphasising the necessity of restructuring of the technological base of the system. He argued that the civilisational project that shapes modern technology can be replaced by another way of life based on a technology that respects nature. The disappearance of the counter-culture has not refuted this message, which is reiterated today more moderately by the environmental movement. 'Demythologised' for contemporary purposes, Marcuse's argument can be rephrased in terms of the underdetermination of technology, which opens the possibility of alternative modernities.

This historical background explains the decline of the positivist rationalism and technocratic determinism that achieved intellectual hegemony in the English speaking world after the World War II. The dramatic emergence of the New Left and its counter-culture, followed by the long slow rise of environmentalism, eroded the hegemonic certainties of the post-war period. The possibility of alternatives, repeatedly illustrated by successful environmental regulation, sapped the authority of technocratic experts who claimed to know the one best way to do things. Rationality was no longer one but multiple, at least in its socially concrete realisations, and so subject to politics rather than over-ruling it in the name of a superior unifying truth.

The changed situation of rationality explains the credibility of the new social studies of technology that emerged to prominence in the 1980s. By the end of the century academic study of technology had abandoned determinism and instrumentalism in favour of various constructivist alternatives. This depoliticised version of a critique of technology introduced important methodological innovations as we have seen. But constructivist social science was remarkably inhibited when it came to studying itself. If it had violated this taboo it would have discovered the background discussed here earlier and especially the importance of social struggles over technology in giving its theoretical innovations significance beyond a specialised audience.

This inhibition no doubt explains the shock of the so-called 'science wars', in which a rearguard defence of typical positivistic and technocratic theses confronted constructivists, many of whom were convinced, like the scientists they studied, that they were not responsible for the politics of their research (Gross and Levitt, 1994). The stakes were raised when attacks came from the left, the natural home of most constructivist scholars. For example, Meera Nanda argues that post-modernism and constructivism are operationalised by Hindu nationalists. She writes,

> Neo-Hinduism and Hindutva are *reactionary modernist* movements, intent on harnessing a mindless and even dangerous technological modernisation for the advancement of a traditionalist, deeply anti-secular and illiberal social agenda. Nevertheless, they share a postmodernist philosophy of science that celebrates the kind of contradictory mish-mash of science, spirituality, mysticism and pure superstition that passes as 'Vedic science' (Nanda, 2004; see also Nanda, 1996).

It had evidently not occurred to constructivists that while their theory might undermine technocracy it was worse than useless against fundamentalism. The problem was made

insoluble by the identification of science and technology in a supposedly unified 'technoscience'. Unless science and technology are distinguished there is no way to avoid the contradiction between a progressive, democratic argument against the subjective bias of fundamentalism and the parallel argument against the formal bias of technocracy.[1] To make matters worse, the STS community was at first reluctant to make its anti-technocratic argument explicit. What Wiebe Bijker once called the 'academic detour' had led far from the main political road as feminist critics noted (Wajcman, 2004, p. 126). It took a while to find the way back, but eventually students of technology such as Bruno Latour and Bijker himself engaged more openly with the core political issue—the relation of technology to democracy (Bijker, 1996; Latour, 1999).[2] The theme of democratisation of technology, an obvious political implication of the thesis of underdetermination, thus began to receive the attention it deserves. If this theme is pursued, the encounter of technology studies and political theory may bring about a major reconfiguration of the social sciences.

As Latour has argued, the exclusion of technology from the social scientific concept of society is untenable. But once technology enters the picture, the issue of rationality appears in a new guise. It was Weber who introduced the concept of rationalisation to explain many of the processes Marx had earlier identified as central to modernity. But whereas in Marx such processes were conceived as potentially multiple—capitalist or socialist—Weber argued that they were the same for all modern societies. Now, with the new focus on technology, we have a basis for questioning Weber's simplification. Because of the underdetermination of technology, rationalisation must reproduce the multiplicity of the social. There is no single homogeneous outcome to technological development and so none to social development either. The future, which seemed closed by the certainties of social science, opens up anew. The question of democratisation concerns the form in which social influences on development will be exercised and institutionalised in the rationalised domains (Callon *et al.*, 2009). This question will be under discussion for some time to come.

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[1] Of course the distinction is not always sharp but like many other fuzzy distinctions it is nonetheless real and consequential (see Feenberg, 2002, pp. 171–4).

[2] I have attempted to develop a quasi-constructivist political theory of technology (Feenberg, 1999, part II).

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