The Social Shaping of Technology Continues

By Brian Martin

Donald MacKenzie, *Knowing Machines: Essays on Technical Change*. Cambridge, Mass.: MIT Press, 1996. Pp. 338. US$35 HB.

DONALD MACKENZIE is one of the most sophisticated and insightful analysts of technology working today. His book *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (MIT Press, 1990) was an outstanding history of technology, setting a high standard for others to follow. It is appropriate that MIT Press has published a collection of MacKenzie's recently published articles. The title *Knowing Machines* refers firstly to the understanding of machines and secondly to computers, which are the subject of half the chapters. These articles demonstrate the insights that can be obtained within the general approach called social shaping of technology, a phrase that has come into common use especially since the book with that title (Donald MacKenzie and Judy Wajcman, eds, *The Social Shaping of Technology*, Open University Press, 1985). It also shows some of the limitations of that approach, even in the most capable hands.

In his lucid introductory chapter, MacKenzie outlines the main arguments in the book. They are (1) to oppose technological determinism, (2) to show that technology is considered 'best' because it triumphs, not vice versa, (3) to undertake a symmetrical analysis, indifferent to the success or failure of technology, (4) to show the importance of the self-fulfilling prophecy in technological development and (5) to demonstrate the importance of knowledge for technology. These are all aspects of a constructivist approach to technology. MacKenzie is sympathetic to actor-network theory and quite willing to draw insights from it, but he does not adopt it fully, drawing back from treating non-humans as actors.

The book contains seven chapters based around technological case studies and two chapters that deal more centrally with theory. The first of the two theoretical chapters is "Marx and the Machine", first published in 1984 and the only chapter dating back to the 1980s. It is a well-informed assessment of Marx's views on technology and a critique of the secondary literature. It emphasises the importance of embedding technology in the wider economic process. The next chapter was first published in 1992 and shows quite a change in MacKenzie's orientation. While still interested in the link between technology and economics, his concern is now in neoclassical economics. He politely suggests to neoclassical economists that there may be some shortcomings in their approach and recommends the "alternative economics" of Herbert Simon and others based on "satisficing" rather than profit maximising. His points are well made but are quite cautious. There are many critiques of the foundations of neoclassical economics, from political economists, mathematicians, environmentalists, Gandhians and others, that far better deserve the label 'alternative economics'. MacKenzie's acceptance of the market model is highlighted when he castigates David Noble for saying that the goal of capitalist development is domination, claiming in rebuttal that "a firm or an industrial sector that pursued control at the expense of profit would, unless protected from competition, shrink or die" (p. 52). John Kenneth Galbraith and many others have argued that the monopoly sector of the capitalist economy is well insulated from the neoclassical-style market.

The remaining seven chapters deal with the laser gyro, supercomputers, formal proofs of the logic of computer programmes, accidental deaths related to computers, and the role of tacit knowledge in the construction of nuclear weapons. These studies are built on a detailed understanding of the technologies involved and, in several cases, extensive interviews with key participants. The chapters on computers confront 'hard' cases for the social shaping of technology. Supercomputers—computers built for the fastest possible rate of calculation—might seem to be shaped only by physical and economic constraints. MacKenzie delves into the role of the two US nuclear weapons labs on the development of supercomputing. He concludes that their heavy involvement certainly influenced the emphasis on floating-point arithmetic speed, but otherwise is hard to see. Another influence on supercomputers was the engineer Seymour Cray. MacKenzie and Boelie Elzen interpret Cray's charisma as a matter of forging a network. This was a socio-technical strategy, based on a particular technology and a network based on a small number of sales to familiar customers. Two chapters deal with a computer chip called VIPER which was developed in accordance with an attempted mathematical proof that it contained no errors. MacKenzie shows the role of social factors—such as the impact of personality and geography on creation of a community consensus—in this area that seems at first glance overwhelmingly formal and logical.

One of MacKenzie's important themes is the role of the self-fulfilling prophecy in technological development. For example, beliefs that the speed of computers would continue to increase at a regular rate provided

goals for computer companies, which in turn created the computers conforming to expectations. In the chapter "Computer-related accidental death," MacKenzie sifts through available data to determine how many people have died due to computer failures. This chapter is significant in several ways. Firstly, it is a study of the impact of technology on society rather than a study of the impact of society on technology. For a sophisticated constructivist, this is quite a shift. Secondly, MacKenzie's explanation for undertaking the study is couched in apologetic terms, perhaps reflecting the constructivist's reluctance to be seen doing empirical work. Thirdly, the terms of the study are narrow, for example leaving out deaths in the construction of computers and from computers used in weapons. The final chapter, co-authored by Graham Spinardi, deals with the role of tacit knowledge in the construction of nuclear weapons. They argue that nuclear weapons could be "uninvented" eventually, if the tacit knowledge of bomb designers is lost over a period of decades without nuclear testing. The authors interviewed dozens of nuclear weapons experts and mount a careful case, covering a range of considerations and arguments, from the Manhattan project to current techniques for building cheap and dirty bombs. The chapter adds a mass of detail and argumentation to ideas about the uninvention of nuclear weapons sketched in *Inventing Accuracy*.

Applying the social shaping approach to the prospects for eliminating nuclear weapons is certainly "socially relevant", but it also reveals shortcomings. The authors interviewed weapons designers but apparently consulted no one in the peace movement. The chapter would be of some use to peace activists through its technical detail, but it ignores peace movement literature on the bomb. The authors say that the "conventional wisdom ... is that knowledge of nuclear weapons cannot plausibly be lost—that nuclear weapons cannot be uninvented" (p. 217). This has never been the conventional wisdom in the peace movement, which has campaigned to eliminate nuclear weapons since they were invented, not to mention other sorts of weapons.

MacKenzie and Spinardi say that there are three elements to uninvention of nuclear weapons: tacit knowledge, controls over fissile materials to stop proliferation of nuclear weapons capabilities, and actor-network translation of interests, namely "displacement of goals, invention of new goals, the creation of new social groups, and the like" (p. 254). Regarding this third element, they recommend looking at actor-network theory to see what it might contribute. This ignores decades of research and practical experience by peace researchers and activists which, although it might not be couched in actor-network terminology, is perfectly relevant just the same. What is surprising is that MacKenzie has not thought that peace researchers and activists (which include quite a few experts on nuclear weapons) might

be a "relevant social group" so far as the abolition of nuclear weapons is concerned.

The social shaping of technology is a powerful approach, but using it does not guarantee that the most important questions are asked. In studying the influence of the military on computer architecture, for example, the main point is missed: the military uses computers on a massive scale for designing, building and operating weapons. The uses of computers for war are far more important than the influence of war on computers. MacKenzie is a rare scholar in gaining detailed technical knowledge, undertaking extensive interviews and deploying a sophisticated theoretical framework in a sensitive fashion. His ambitions are even greater, and include harnessing this scholarship to issues of moral and political relevance. My criticisms of his work in this regard would be superfluous for the many scholars who never attempt an engagement with important social issues.

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Reviewing Medical Movies

By Yvonne Luxford

Lisa Cartwright, *Screening the Body: Tracing Medicine's Visual Culture*. Minneapolis: University of Minnesota Press, 1995. Pp. xvii + 199. US$17.95 PB.

WITH her background in North American media and visual studies Lisa Cartwright brings together a fascinating view of the relationship between the histories of cinema and scientific and medical imaging. Unlike many studies exploring this linkage, which focus upon the representation of scientists and medical practitioners on the popular cinema screen, this book examines the use of cinematography, and other techniques of visual representation, as tools of analysis within the laboratories and hospitals of this century. Eclectically dipping into a vast array of material and