

Social Construction of an 'Attack on Science'

Brian Martin

Paul R. Gross and Norman Levitt, *Higher Superstition: The Academic Left and Its Quarrels with Science* (Baltimore, MD: Johns Hopkins University Press, 1994), 315pp., \$25.95. ISBN 0-8018-4766-4.

Higher Superstition is ostensibly a critique of the constructivist analysis of science, attempting to show logical flaws, sloppy scholarship and sometimes just a poor understanding of science in key works. The book provides a few reminders that analysts of science should have an adequate understanding of scientific theories. But most well-read constructivists will find little here to undermine their views, since Gross and Levitt's basic approach is to attack constructivists for not being positivists, adding the spice of a one-sided commentary on intellectuals. For science studies scholars, the interest in the book lies not in the content but the way the argument is constructed, noting its resonance in wider circles.¹ For those who are used to studying the political uses of science, *Higher Superstition* provides an object lesson in the political uses of (a critique of) science studies. Gross and Levitt's attack on what they consider to be 'critics of science' can be understood as a sophisticated form of 'antiantiscience'. Attacks on 'antiscience' have popped up now and again for decades.² Before looking in detail at Gross and Levitt's book, it is worth spelling out the standard techniques used in 'antiantiscience'.

First, science is presented as a unitary object, usually identified with scientific knowledge. It is portrayed as neutral and objective. Second, science is claimed to be under attack by 'antiscience', which is composed essentially of ideologues who are threats to the

neutrality and objectivity that are fundamental to science. Third, a highly selective attack is made on the arguments of 'antiscience'. The net effect of antiantiscience is to affirm science as defined by scientific élites and to marginalize — usually by ignoring — the political critique of science. Most earlier works in the genre of antiantiscience have not gone into specifics, sometimes not even naming the alleged exponents of 'antiscience'. Gross and Levitt's treatment is far more detailed and well researched, as befits the work of scientists who are concerned with logic and evidence. Nevertheless, it fits the model of antiantiscience and can usefully be analyzed in this fashion.

Science as Unitary

Gross and Levitt treat 'science' as a single object, and assume that there are two options: supporting it or opposing it. They do not spell out or justify this perspective, but it is apparent in the way they refer to science. For example, they refer to 'critics of science' rather than 'critics of some aspects of science'. Going further, they routinely equate critique of scientific knowledge with hostility to science,³ a jump that is logically unsupportable and empirically dubious. Yet this equation makes sense given the authors' treatment of science as unitary.

Gross and Levitt's 'science' is essentially the existing body of knowledge in the natural sciences, perhaps accompanied by a bit of scientific method. Social sciences are excluded, a crucial demarcation.⁴ Also excluded are the funding of scientific research, the organization of the scientific community and the applications of science. Thus they narrow the focus to epistemology, leaving out most of the social dynamics of science. This of course makes it easier to defend 'science', since critiques of knowledge are much more vulnerable to criticism when they are uncoupled from critiques of associated social structures and practices.

On a few occasions, Gross and Levitt mention that some groups dislike particular uses of science, such as military applications (2, 33, 224–25). But for the most part they ignore the most common public criticisms of science — namely, those relating to its link with harmful and oppressive practices such as war, repression, social control, environmental damage and exploitation of animals. In their brief overview of the history of science and science's links

with projects of social improvement (16–23), they cover the period from the 1600s through the 1800s, when science sometimes came into conflict with traditional power structures such as the church. Their survey suddenly stops before what can be called the 'incorporation of science', when science was professionalized and oriented to the goals of the military, the state and capitalism.⁵ Gross and Levitt apparently believe that science remains an emancipatory project, as when they mention 'the long history of progressive Western thought in which science has been linked, by and large, with the efforts of human liberation' (45). Through their presentation of science as unitary and as identical to a disembodied system of knowledge that is the best available approximation of reality,⁶ they have made it possible for themselves to ignore the bulk of criticisms relating to science. In short, they are subscribers to the 'use–abuse' model of science, with a glorification of natural science as the epitome of rational inquiry.

It is no news to readers of *Social Studies of Science* that most social analysis of science proceeds on the basis that different parts and aspects of science are open to scrutiny from a variety of perspectives, and that scientific knowledge must be understood in its social context. Gross and Levitt's way of understanding science is fundamentally at variance with most of the work they criticize. In other words, they presume a certain picture of science and then criticize works that fail to conform to it.

The Construction of the 'Academic Left'

In order to undertake the project of antiantiscience, it is necessary to construct 'antiscience'. However, it is difficult to find authors who reject all science, who reject rationality or otherwise can be portrayed as suitable foils. Gross and Levitt have done an energetic job of finding critiques that appear to fit their model. They look especially at constructivist, postmodern, feminist and environmental critiques. To meld these together they use the expression 'academic left'. The authors admit that the critiques they call the 'academic left' go in different directions (5, 10–11). Indeed, they repeatedly come back to the limitations of the term and apologize for it.⁷ They even mention that 'perspectivist left' might be better (40). But they proceed to use 'academic left' anyway.⁸

Aside from gathering together groups with different agendas and perspectives, the term 'academic left' is misleading in a more fundamental way: it unnecessarily links the 'left' and critiques of scientific knowledge. There are plenty of scholars, including academics, who would consider themselves to be on the left and who have nothing to do with the critique of scientific knowledge. In many cases, they can be vehemently defensive of rationality and scientific method.⁹ Many Marxists in particular are uncritical of natural science, seeking to validate Marxism itself as scientific. In this context, to include Marxism in an 'academic left' that is critical of scientific method, rather than only critical of the 'distortion' of science under capitalism, requires some contortion. One of the key purposes of *Radical Science Journal* was to 'develop a Marxist critique of scientism in the Left'. The traditional left can be defined in terms of its critique of capitalism and support for the working class and other oppressed groups. Adding in the critique of patriarchy and support for women is a reasonable extension — though one that was and is far from easy for much of the male left.¹⁰ To consider a critique of the domination of nature as intrinsically part of the 'left' is contentious; the divergence between green and social democratic parties is indicative of frictions.¹¹ Postmodernism is even less easy to classify as left.

Gross and Levitt do not provide any sociological justification for their construction of the 'academic left' — they define it in terms of ideology (10–11) or moralism (220). Even if there is some common ideological or moralistic thread in the various critiques, this hardly justifies grouping together the people who make the critiques. It would make just as much sense to group together critics of Christian creationists — including atheists, Buddhists, liberal Christian theologians and Darwinists — and call them the 'religious left'. By adopting the term 'academic left', Gross and Levitt are able to castigate the left generally for the alleged sins of critics of scientific knowledge. Sometimes they leave out the 'academic' and refer just to the 'left' (25, 27, 242, 243), suggesting that they may think of more than just the critique of scientific knowledge when they refer to the 'academic left'.

Although Gross and Levitt try to distance themselves from the extreme right (8) — sometimes by colourful portrayals of positions which they disavow (36) — in practice they are often critical of (and indeed hostile to) 'left' positions. They appear to have only a superficial understanding of environmentalism, feminism and the

like, making many gross generalizations about them. For example, they dismiss the antinuclear-power movement by making fun of the thinking behind the bumper-sticker 'Split wood, not atoms' (160). Their comparison of wood and nuclear power neatly ignores the mainstream antinuclear critique, which is founded on options including energy efficiency, an integrated programme of renewable energy sources, and social changes such as eliminating planned obsolescence. What is amazing is that they seem to think it adequate to base a critique of the antinuclear-power movement on rebuttal of a bumper-sticker slogan. The political analysis inherent in the movements is not discussed. The authors seem to have adopted a type of essentialism in their critique of the supposed core of various movements — namely, that the essence of the movements is to be found in particular ideologies.

Gross and Levitt's potted version of the history and sociology of the US left intelligentsia (27–41) concentrates on the political activities of socialists. They do little to justify their inclusion of feminists, environmentalists or postmodernists in the left. They seem unaware of the dynamism of US grassroots (nonacademic) feminist, environmentalist, solidarity, peace, antiracist, nonviolent and other radical groups, perhaps because they look for evidence only in formal political institutions. They entirely ignore the sociological literature on the attitudes of academics, which shows among other things that mainstream political attitudes are by far the most common among US academics.¹² It also ignores the unusual situation of the US left compared to the left in other industrialized countries. More generally, they greatly exaggerate the power and status of their 'academic left'. There is, after all, a long history of attacks on left academics, which has continued long after the end of the so-called McCarthy era.¹³

Selective Attack

Having constructed two artificial entities, a unitary 'science' and a unitary 'academic left', each reduced to epistemological essences, Gross and Levitt proceed to attack. They pick out figures in each of several areas — science studies, postmodernism, feminism, environmentalism, AIDS activism — and criticize their critiques of science. Some of these authors have a poor understanding of science at the technical level, and this is the area where Gross and

Levitt find most to expose. There is occasionally something to be learned from their dissection of blunders and alleged blunders made in some critiques of science. It is certainly a warning to 'check out the facts' before making grandiose statements about a technical area such as quantum mechanics or chaos theory. But Gross and Levitt's critique is more misleading than revealing.

To begin, their critiques are undertaken in a vacuum. They find it sufficient to pick out some scholar (prominent or otherwise), pick a few works and then analyze particular parts of those works. There is little feeling for the overall body of work in the field, nor for how the scholars chosen are placed within it. Yet on the basis of a few isolated critiques, they feel quite ready to make generalizations about work in the field. Often these generalizations overshadow their actual critiques.

In their chapter on social studies of science, Gross and Levitt begin with a critique of the work of Stanley Aronowitz, which would be known to few in the field. Next, they make some criticisms of Bruno Latour's work, which of course is well known within science studies. But they seem ignorant of the critiques of Latourian approaches that have considerable prominence in the field.¹⁴ Finally, they tackle Steven Shapin and Simon Schaffer's celebrated *Leviathan and the Air Pump*. Setting aside the misunderstandings and weaknesses in their criticisms of these works, only an outsider could imagine that a critique of selected aspects of the work of Aronowitz, Latour, Shapin and Schaffer would provide an adequate basis for generalization about constructivism in science studies, not to mention the claim that most practitioners 'are committed to a leftist political position' (47).

In their chapter on gender, Gross and Levitt offer critiques of a preprint of an article on mathematics pedagogy, a chapter by the Biology and Gender Study Group, articles in an issue of the popular science magazine *Discover*, Sandra Harding's *The Science Question in Feminism* (focusing on two sentences from the book), an interview with Donna Haraway, and chapters by Harding, Evelyn Fox Keller and Helen Longino. These are said to be 'characteristic products of feminist science criticism' (113), but no detailed justification for the choice of these writings is given. If there is indeed a 'feminist-critique-of-science mafia' (100), Gross and Levitt have failed to demonstrate it.

In their chapter on 'ecoradicalism', they concentrate on the work of Jeremy Rifkin, dissecting two sentences from one of his

books, while making briefer critiques of works by Carolyn Merchant and Dave Foreman. They claim that the views of Rifkin are typical of the academic left, giving as evidence statements by Steven Best and Stanley Aronowitz. Gross and Levitt say that 'a host of other would-be critics of modern science' share 'Rifkin's ideological enthusiasms' (171), but these critics remain nameless. In passing, philosopher Val Plumwood is incorrectly categorized among those who 'scorn the canons of logic, evidence, objectivity, and coherence' (175), citing just one sentence from one article by her (176), ignoring the rest of the article,¹⁵ and her vast output of relevant scholarly work. It is easy to conclude that the number of academics who subscribe to Gross and Levitt's model of 'ecoradicalism' is far less than they assert. As for postmodernism and Aids activism, their case that there is a substantial group of left-wing academics in these areas who mount an 'attack on science' is thin indeed.

Gross and Levitt's assumption that science is unitary leads them to a familiar misinterpretation of constructivism, namely that the choice is between science as objective knowledge and scientific knowledge as dictated by social interests (46). They seem to lack the idea that scientific knowledge can be socially shaped or conditioned and yet be a powerful and effective tool for specific purposes — in other words, that scientific knowledge can be valuable even if it is not objective in some ultimate sense. For them there are two options only: determination by nature and determination by society.¹⁶ From their comments on undertaking constructivist analyses of constructivism (70, 136), it appears that they are unaware of science studies work on reflexivity.

Gross and Levitt target scholars who allegedly misunderstand science, are (therefore) 'antiscience' and who are said to be members of the 'academic left'. Nowhere do they criticize scholars on the 'academic right' who misunderstand science. Nor do they presume that such scholars are 'antiscience'. In many cases, they seem unaware of critiques within the field of the sloppiness with science that they are so quick to criticize. For example, they make no mention of Sal Restivo's penetrating analysis of Fritjof Capra's thesis of a parallelism between quantum physics and Eastern mysticism. This is a pity, since it would have been edifying to see how Gross and Levitt dealt with Restivo's sophisticated social analysis of mathematics.¹⁷

It would be misguided to defend every statement by every

scholar who is criticized in *Higher Superstition*. Specialists may or may not agree over detailed points of contention. Independent of the adjudication of such disputes, the key point is that Gross and Levitt have not sustained their overall case — namely, their generalization from alleged inaccuracies and misunderstandings at the detailed level to an indictment of entire fields of study. They seem to proceed as if a single flaw in fact or logic undermines the entire edifice, rather like detecting a mistake in a mathematical proof. The humanities and social sciences do not operate like this. Furthermore, science studies scholars would argue, neither as a rule does natural science. Because of the diversity of views within the fields surveyed in *Higher Superstition*, it is likely that most readers will find themselves in sympathy with at least some of the authors' assessments. Science studies critics of actor-network theory may find common ground with some of Gross and Levitt's critique of Latour; critics of certain postmodernist tendencies may resonate with Gross and Levitt's complaints; and so on.¹⁸ But this need not entail agreement with their wider assumptions and arguments about science and the 'academic left'.

Gross and Levitt explicitly restrict most of their attention to US scholars (25). This is unfortunate, since much of the most important work in a number of fields has come from outside the US, not least in science studies. While (as US scholars themselves) Gross and Levitt have plenty of company in their neglect of non-US sources, it is hardly a prescription for gaining a balanced view of the fields they survey. Perhaps it is their US bias that leads them to neglect the sociology of scientific knowledge. It is amusing to read their argument against constructivism on the grounds that constructivist analysis follows the method of empirical science (48). Bloor's classic exposition of the strong programme in the sociology of scientific knowledge, widely recognized and sometimes criticized for its mimicking of traditional scientific method, is nowhere mentioned.¹⁹

Gross and Levitt castigate 'critics of science' who haven't studied science directly but they don't mention scientists who criticize social science without studying it. There are certainly plenty in the latter category. Perhaps this apparent double standard is an extension of their positivism: their own behaviour needs no explanation or justification since it is correct, whereas the misguided behaviour of others must be explained through social

categories. This sociology of error is at work in their psychological explanations for adherence to the belief systems of the 'academic left' (27, 73, 220–33).²⁰ As a sample of Gross and Levitt's approach to social analysis, consider their statement: 'The overwhelming majority of active scientists neither practice nor condone discrimination' (111). This and associated claims about sexual discrimination in science are made not only without any supporting evidence,²¹ but without any mention of structural discrimination (such as the two-person career) or sexual harassment.²² In other words, they feel free to make generalizations about society without bothering to provide evidence, argument, surveys of the literature, and the like. It is easy to gain the impression that their many statements about both scientists collectively and about the 'academic left' are based largely on their personal experiences plus a few selected references, thus ignoring standard social science practice in making sociological generalizations. They criticize others for not consulting scientists about their critiques, which is reasonable enough. But, at least according to their acknowledgements, they seem not to have consulted the social scientists whom they have criticized.

The most striking feature of their attack is its emotive nature. The book opens with a discourse on 'muddleheadedness' (1) and deploys terms such as 'unalloyed twaddle' (43), 'fatuous' (254) and, most frequently, 'nonsense'. To me this suggests a condescending attitude towards humanities and social science. In my experience over the past 25 years, quite a number of scientists hold humanities and social science in contempt, an observation contrary to Gross and Levitt's claim that natural scientists — 'at least those with a sense of fair play' — are 'usually diffident' in relation to historians and sociologists of science (42). Certainly the authors are not diffident themselves. A suggestion of contempt for humanities and social science comes through at various times in *Higher Superstition*. For example, in a fantasy of 'oneupmanship' they imagine that, if necessary, scientists could do all right teaching humanities but not vice versa (243). The book's title is a nice summary of the themes discussed so far: the categories 'academic left' and 'science' are found in the subtitle, while 'higher superstition' signals the authors' attitude towards their subject. A title such as 'Critique of the Perspectivist Analysis of Science' would not have quite the same impact.

Political Critique Marginalized

By concentrating on epistemological critiques of science, Gross and Levitt are able to ignore the more overtly political critiques of science, which are nowhere mentioned.²³ Many of the political critiques do not rely on an epistemological critique, concentrating instead on the funding of science, the organization of the scientific community, decision-making, and so on. In effect, Gross and Levitt marginalize political critiques by attacking selected epistemological criticism and identifying them with any criticism of science. The practical concern of many social activists, including a significant number of critics who are established scientists, is that scientific expertise is mobilized by vested interests to serve what they consider to be the wrong ends.²⁴ Gross and Levitt's focus on 'higher superstition' serves to divert attention from this. Simply responding at the level of epistemology and of scholarship perpetuates this diversion. *Higher Superstition*, more than a piece of scholarly critique, serves as a political intervention, as a form of boundary-work,²⁵ as a means for bolstering 'science' against funding cutbacks and loss of public credibility. By reasserting the view that 'science' is unitary and under attack, it serves those who want money for scientific research with little scrutiny from outside the scientific community. Deconstructionism in the social sciences should not worry scientists. The real danger is a material deconstruction of the privileges of a protected sector.

• NOTES

1. See, for example, Wray Herbert, 'The PC Assault on Science', *US News & World Report* (20 February 1995), 64–65.

2. Eric Ashby, 'Science and Antiscience', in Paul Halmos (ed.), *The Sociology of Science* (Keele, Staffs: University of Keele, 1972), 209–26; John Maddox, 'Defending Science Against Anti-Science', *Nature*, Vol. 368 (17 March 1994), 185; John Passmore, *Science and its Critics* (London: Duckworth, 1978).

3. For reasonably clear articulations of this equation, see pp. 2–3, 8, 14, 23, 27, 108, 148, 220, 223, 237, 238 and 252–53.

4. This point is well made in Tom Gieryn, 'Policing STS: A Boundary-Work Souvenir from the Smithsonian Exhibition "Science in American Life"', *Science, Technology, & Human Values* (1995, forthcoming).

5. Gross and Levitt refer to the incorporation of science in a revealing passage:

'Science is, after all, well integrated into the technological, industrial, and military machinery of the capitalist system; in turn it relies on that system for the material basis of its continuing progress, at least in those fields where a substantial investment of money is necessary for fruitful research. For working scientists in the belly of the beast, of course, the situation seems far more subtle than that. In fact, from a variety of perspectives, scientists and intellectuals in general might honestly (and correctly) view the present culture as a historical paragon, to the degree that it fosters and encourages autonomy of thought and freedom of ideas' (47). This conclusion can best be understood in terms of an assumption that the essence of science is scientific knowledge, itself a reflection of nature.

6. Gross and Levitt give some nice summary statements of the positivist position, such as that scientific practice is 'driven for the most part by the internal logic of the subject and the unyielding contours of reality' (81) and 'Science is, above all else, a reality-driven enterprise' (234).

7. Gross and Levitt use the term 'academic left' 'with great misgiving' (2); it is a 'troubling term' (3); they apologize if the term causes confusion (9); it is 'not felicitous' (37).

8. Occasionally they use the expression 'postmodern left' instead (175, 250).

9. See, for example, contributions to *Z Papers*, Vol. 1, No. 4 (October–December 1992).

10. Lydia Sargent (ed.), *Women and Revolution: A Discussion of the Unhappy Marriage of Marxism and Feminism* (Boston, MA: South End Press, 1980).

11. Many socialists were for a long time highly critical of environmentalism: a classic early statement is Hans Magnus Enzensberger, 'A Critique of Political Ecology', *New Left Review*, No. 84 (March–April 1974), 3–31. Even today, many radical environmentalists are unsympathetic with state-oriented varieties of socialism. Gross and Levitt focus on 'ecoradicals' who are opposed to modern technology; the distance of this group from any reasonable grouping of the 'left' is enormous.

12. See, for example, Everett Carll Ladd, Jr and Seymour Martin Lipset, *The Divided Academy: Professors and Politics* (New York: McGraw-Hill, 1975).

13. Among many other sources, see Robert Justin Goldstein, *Political Repression in Modern America from 1870 to the Present* (Cambridge, MA: Schenkman, 1978); Bertell Ollman, *Class Struggle is the Name of the Game: True Confessions of a Marxist Businessman* (New York: William Morrow, 1983); Michael Parenti, 'Repression in Academia: A Report from the Field', *Politics and Society*, Vol. 1 (August 1971), 52–37.

14. Olga Amsterdamska, 'Surely You Are Joking, Monsieur Latour!', *Science, Technology, & Human Values*, Vol. 15 (1990), 495–504; Stewart Russell, 'The Social Construction of Artefacts: A Response to Pinch and Bijker', *Social Studies of Science*, Vol. 16 (1986), 331–46; Pam Scott, 'Levers and Counterweights: A Laboratory That Failed to Raise the World', *ibid.*, Vol. 21 (1991), 7–35; Steven Shapin, 'Following Scientists Around', *ibid.*, Vol. 18 (1988), 533–50.

15. Another sentence from the same article is quoted on p. 286.

16. It is with this framework that Gross and Levitt clinch their rebuttal of constructivism with the familiar claim that 'science works' (49, emphasis in the original; see also 112, 141).

17. Sal Restivo, *The Social Relations of Physics, Mysticism and Mathematics* (Dordrecht: D. Reidel, 1983).

18. In my own case, I cannot help but agree, among other points, with aspects of Gross and Levitt's criticisms of exaggeration of environmental dangers within the environmental movement. For an environmentalist critique of environmental doomsdayism, see Alan Roberts, *The Self-Managing Environment* (London: Allison & Busby, 1979), Chapter 1.

19. David Bloor, *Knowledge and Social Imagery* (London: Routledge & Kegan Paul, 1976). Bloor is mentioned in passing — 'a sociologist identified with the Edinburgh School of unyielding cultural constructivists' (52) — but only through the work of Stanley Aronowitz, whose method, according to Gross and Levitt, is to present the views of philosophers of science 'briefly and cryptically' (51). Indeed.

20. Gross and Levitt: 'One can attribute the popularity of relativism, for instance, as much to the traces of omnivorous credulity that linger from the sixties as to the dialectical skills of influential thinkers' (223). They do not make any effort to use psychological insights to help understand the operation of science: see, for example, Michael J. Mahoney, *Scientist as Subject: The Psychological Imperative* (Cambridge, MA: Ballinger, 1976); Mahoney, 'Psychology of the Scientists: An Evaluative Overview', *Social Studies of Science*, Vol. 9 (1979), 349–75; Ian I. Mitroff, *The Subjective Side of Science: A Philosophical Inquiry into the Psychology of the Apollo Moon Scientists* (Amsterdam: Elsevier, 1974). They assume that 'ideological commitments' undermine the work of those undertaking a critique of science, but make no similar observation concerning the commitments of natural scientists.

21. Gross and Levitt: 'as seems to have been forgotten in the current rise of antifoundationalism, assertion is not evidence' (112).

22. Billie Wright Dziech and Linda Weiner, *The Lecherous Professor: Sexual Harassment on Campus* (Boston, MA: Beacon Press, 1984); Martha R. Fowlkes, *Behind Every Successful Man: Wives of Medicine and Academe* (New York: Columbia University Press, 1980); Michele A. Paludi (ed.), *Ivory Power: Sexual Harassment on Campus* (Albany, NY: State University of New York Press, 1990); Diana E.H. Russell, *Sexual Exploitation: Rape, Child Sexual Abuse, and Workplace Harassment* (Beverly Hills, CA: Sage, 1984).

23. See the journals *Radical Science Journal*, *Science for People*, *Science for the People* and Rita Arditti, Pat Brennan and Steve Cavrak (eds), *Science and Liberation* (Boston, MA: South End Press, 1980), Hilary Rose and Steven Rose (eds), *The Political Economy of Science: Ideology of the Natural Sciences* (London: Macmillan, 1976); Rose and Rose (eds), *The Radicalisation of Science: Ideology of the Natural Sciences* (London: Macmillan, 1976). Political critiques of science are also commonly ignored in science studies, as I have argued in Brian Martin, 'The Critique of Science Becomes Academic', *Science, Technology, & Human Values*, Vol. 18 (1993), 247–59.

24. Gross and Levitt accept that the focus of scientific research and the direction of scientific advance can be affected by social factors (43–44, 234). Yet this 'weak cultural constructivism' is adequate grounding for nearly all the challenges to prevailing science and technology by feminists, environmentalists and other social activists.

25. Thomas F. Gieryn, 'Boundaries of Science', in Sheila Jasanoff, Gerald E. Markle, James C. Petersen and Trevor Pinch (eds), *Handbook of Science and Technology Studies* (Thousand Oaks, CA: Sage, 1995), 393–443.

Brian Martin has been involved with the critique of science since the 1970s, looking especially at suppression of intellectual dissent, scientific controversies, the role of experts and nonviolent alternatives to military defence.

Author's address: Department of Science and Technology Studies, University of Wollongong, Wollongong, New South Wales 2522, Australia; fax: +61 42 213452; e-mail: b.martin@uow.edu.au

Reviews (continued)

How Things Change: The History of Sociotechnical Structures

Geoffrey C. Bowker

Alain Gras (with the participation of Sophie Delpech), *Grandeur et Dépendance: Sociologies des macro-systèmes technique* (Paris: PUF, 1993), 291pp., 189FF. ISBN 2-13-045011-3.

Alain Gras, Caroline Moricot, Sophie L. Poirot-Delpech and Victor Scardigli, *Face à l'automate: le pilote, le contrôleur et l'ingénieur* (Paris: Publications de la Sorbonne, 1994), 310pp., 180FF. ISBN 2-85944-257.

There are several ways in which two people can use the same words but each take away a different version of what has been talked about. A classic form is the double-entendre. Here an attempt is made to construct as long a sequence of phrases as possible that make sense within two entirely different contexts. It adds to the piquancy if a section of the audience takes the conversation at its surface level. A second form emerges from the shared text. Two major audiences for *The Economist* magazine in the 1970s were Marxists and stockbrokers. Each agreed, *contra*