S|S|S

DISCUSSION PAPER

ABSTRACT Might a *rapprochement* be desirable and possible between the more academic and the more activist wings of STS? What can each learn from the other? A promising trajectory for this purpose may be to reinterpret and extend research in the constructivist tradition, building on recent work that appears to constitute the beginnings of a *re*constructivist scholarly tradition.

Some of the necessary work would be explicitly prescriptive: given that technology and society are mutually and reciprocally constructing, how should technologies be constructed, which social groups deserve inclusion in which processes, and how should closure be reached? But other issues might be taken up by scholars motivated exclusively by curiosity, or by the intention of building a subfield: what factors slow or prevent the emergence of entire subfields of technoscientific endeavour, as arguably has occurred with 'green chemistry', 'alternative health', and alternatives to weaponry-oriented national defence?

Our intention is not to prescribe, but to help catalyse a next round of friendly discussion in STS about these and related matters, encouraging greater reflexivity of the field as a whole.

Keywords democracy, lay audiences, non-decisions, reflexivity, reward system, thoughtful partisanship, undone science

Science Studies and Activism:

Possibilities and Problems for Reconstructivist Agendas

Edward Woodhouse, David Hess, Steve Breyman and Brian Martin

There is a long history in STS of politically engaged scholarship, as indicated by the Carson Prize and by networks of scholars and students with activist leanings (for example, the Dutch science shops). A growing number in STS have been finding ways to express their social values or policy concerns while working in accord with the conceptual developments of the laboratory, controversy, actor-network and other science studies of the 1970s and 1980s. Such work might be termed 'reconstructivist', in the sense that research assumes that technoscience is contingent and socially negotiated – and goes on to tackle the problems of how to *re*construct

technoscience to promote a more democratic, environmentally sustainable, socially just, or otherwise preferable civilization.[1] European scholarship on 'constructive technology assessment' is an example of this trend.[2] This sort of research rarely, if ever, is 'anti-science' or 'anti-technology', of course, but works on the difficult issue of selecting which scientific research programmes, technology designs, and related social processes deserve greater or lesser public support or intellectual attention.

If we are right in thinking that there is a trend toward work that is more openly normative, prescriptive, or activist, then it may be even more important than heretofore to inquire into how such scholarship can be conducted so as to combine the goals of practical utility and scholarly excellence.[3] In earlier writings, we each have grappled with aspects of the challenge, and this essay emerges from a series of discussions among the authors aimed at developing common ground.[4] Recognizing that many others likewise have been thinking about the topic, we intend the analysis and recommendations here to be an invitation to ongoing conversation rather than a programmatic statement.[5] Moreover, rather than contributing to an ongoing divide in the field between research that aims to be politically neutral and research that is more politically engaged, we instead suggest how scholars who define themselves as advocates can interact productively with scholars motivated more by intellectual curiosity, by (inter)disciplinary priorities, and by other equally legitimate purposes.[6] How can many different types of scholars collaboratively extend the field to focus systematically on barriers and prospects for constructing technologies 'better'?

One way to express the rationale for a new emphasis in STS is Patrick Hamlett's observation that it is a rather 'small step from asserting that technologies are socially constructed (or that technology and society are mutually and reciprocally constructed) to asking more normative questions:

> How *should* technologies be constructed?
> *Which* 'relevant social groups' ought to be included in the process?
> *Are there morally preferable ways for the creation of technological frames?*
> *How* should *interpretive flexibility come to closure?*
> *When and how* should *closure be re-opened?*'[7]

Because all inquiries and knowledge claims occur in social contexts by persons with cognitive, emotional, interpersonal, and other commitments, biases, and ideologies, all research can, of course, be said to have a normative component.[8] But we use the term more specifically to denote scholars' relatively deliberate efforts to structure inquiry, description, and explanation to serve social purposes. Normative research in this sense takes a number of forms, but often is critical in documenting and condemning perceived failures, or prescriptive in proposing alternatives.

By the term 'activism', we refer to a range of methods used by groups with relatively little institutional power attempting to influence opinion,

policy or practice toward democratic and other normative ends described below.[9] Although we certainly value efforts to understand the power and growth of political forces working contrary to the aims of democratic political theory, we assume that STS scholars are not likely to be advocating such causes. In any case, our interest in 'activism' is restricted to intellectual and practical activities in keeping with democratic theory and practice.[10]

Defining reconstructivist STS is a task that belongs partly to subsequent inquiries, discussions and negotiations among relevant scholars. Roughly and provisionally, however, we use the term to denote a wide domain of scholarship that is normative in orientation and activist in sympathies. Our own ideological commitments include improving/extending democracy, environmental sustainability, and social justice, with particular attention to how these concerns play out across divisions of race, class, gender, sexuality, ethnicity, and nation-states. But there obviously will be conflicts among these 'goods', and various scholars presumably will emphasize different goals; so reconstructivism probably should be defined not by any particular agenda, but by the more general intention of conducting forefront scholarship aimed in part at helping to inform and deepen public inquiries, deliberations and negotiations concerning the democratic shaping and reshaping of technologies.

We begin the analysis by reviewing some of the ways STS scholars have articulated their research with their normative commitments. We then turn to the issue of research agendas, and examine how the choice of problems to study influences the likely uses of the resulting research; even where there is no overt partisanship, we argue that the choice of topic or approach can make the work more relevant to activists. Next we look at the challenge facing would-be activist scholars in setting research priorities, illustrated by the issue of how to study non-decisions as well as active controversies, including 'undone science' – scientific research areas of social relevance that are understudied, often because there is no group with both money and interest in them. We purposely leave until later in the paper several more theoretical issues, including the possibility of extending the practice of reflexivity from a task for individual researchers to one for the field as a social entity.[11]

Thoughtful Partisanship in STS

The sociology of scientific knowledge, actor-network theory, and other schools of thought we collectively refer to as 'constructivist', have made crucial contributions to the development of STS as a discipline, and have helped activist and avowedly neutral scholars alike to think in conceptually deeper ways. Concepts such as 'interpretive flexibility', 'closure', 'enrollment', 'reflexivity', 'interests', 'obligatory points of passage', 'sociotechnical networks', 'boundary objects', 'modalities' and 'capturing' can be as helpful for normatively oriented, activist scholarship as for more purely intellectual purposes. Yet too rarely is there extended and professionally

sophisticated discussion within STS of the variety of ways in which these and other concepts can be brought to bear by activist scholars seeking to conduct forefront scholarship. We see a continuum of approaches potentially combining constructivist concepts with activist intentions, and we assume it would be helpful to discuss the available alternatives with research students so they can make thoughtful and informed choices as they pursue dissertations and other research.

At one end of the spectrum is a subtly normative approach in the sociology of scientific knowledge tradition that explores technoscientific controversies and policy-making so as to demystify the rhetoric of 'good science'. An example is Gary Edmond and David Mercer's study of the Bendectin mass toxic tort litigation, which not only debunks standard accounts of the controversy based on naïve conceptions of 'good science', but goes on to explain: 'The primacy of epidemiology was the achievement of lawyers, scientists and judges interacting in a law–science lifeworld' – and so would be any alternative legal standard. This simple insight, unavoidable for any STS scholar incorporating constructivist concepts, is so powerful that the authors need not support, oppose, or prescribe anything to have a political effect (if their ideas become known), because their way of thinking about the matter . . .

> . . . undermines the basis for many proposed solutions to the 'problems' surrounding toxic tort litigation, and law–science interactions more generally . . . [including p]roposals such as delimiting the rôle of juries, greater judicial surveillance of science via stricter rules for the admissibility of scientific evidence, neutral experts and expert panels . . .[12]

A second approach on the non-radical end of the activist spectrum allows an author to offer policy recommendations that fit within mainstream practices, practices that would be approved by just about any thoughtful person who believes in fair play. Thus, Steven Yearley concluded on the basis of his research on computer modelling that . . .

> . . . to build robust and legitimate models, public bodies will need to devise methods of consultation and participation not only when the model is running but also in setting out the objectives and parameters of the model in its earliest stages.[13]

Given the extent to which experts presently dominate computer modelling (and many other aspects of technoscience), recommendations such as this one are by no means tepid and useless, even if they are not (or should not be) terribly controversial. There is considerable opportunity, we believe, for science studies scholars who mostly pursue their own academic-disciplinary inquiries to move temporarily to this type of normative stance, as when their research reveals a situation where conventional expectations are egregiously violated (for instance, providing at least minimal consultation for affected stakeholders).

Is prescription of this sort a prerequisite for 'useful' research? Must a scholar believe that he or she has the answer in order to function as a

change agent? Clearly not.[14] In the introduction to their co-edited book, *Cyborgs and Citadels*, Gary Downey and Joseph Dumit argue that an intervener is not the leader and definer of a movement for change, but rather a catalyst for a *process*: s/he can bring together multiple constituencies that, once catalysed, move in their own self-organizing dynamics that change the researcher as well.[15] Reflecting on political experience, even in university committees, we all know that myriad participants interact – and we know that policy normally *evolves* through this interaction, rather than being conceptualized primarily by one or more masterminds who show the way via analysis.[16]

A related version of the modest scholar-activist is found in participatory action research (PAR), which aims to produce rigorous analysis arising *from* the projects of citizens and activists.[17] Intending to enrich the general fund of science as well as popular wisdom, an ongoing question for action research is how to link researchers' pursuit and accumulation of knowledge with grassroots action for social change. PAR shows promise as a method to connect grassroots struggles and the resources of STS scholars, but it is relatively rare in STS scholarship. One example from our work is Steve Breyman's analysis of his campus greening and Green City projects; another is Brian Martin's documentation and intervention opposing suppression of dissent in science.[18]

Other examples of scholarly work that are openly partisan and clearly intended to support or stimulate social action include Sharon Beder's research on the Sydney sewage system, which included revelations about pollution cover-ups, aimed to challenge the sewage engineering establishment, and in practice helped to catalyse a major environmental mobilization.[19] Todd Cherkasky studied the introduction of new technology in the bread-making industry with the explicit aim of supporting trade unions in developing strategies to protect workers' jobs and enhance the quality of working life.[20] David Noble's studies of the introduction of technology in the workplace were designed to reveal the powerful and damaging impact of capitalism on working life, and to support mobilization by workers.[21] Richard Sclove analysed the connections between democracy and technology with the aim of encouraging greater citizen participation in technological decision-making.[22]

Why Partisanship?

Avowed partisanship may strike some intellectuals as posing a danger to good scholarship. Because even some activist scholars do not have a fully worked out rationale for their actions, one of the tasks of a reconstructivist STS, in our eyes, is to take seriously as a matter of professional methodology the issue of whether and how partisanship makes sense as an intellectual strategy in the service of usable knowledge. We can give only an introduction to the matter here.[23]

Because the intelligence of democracy requires a relatively level playing field for negotiations among diverse interests, and because contemporary

negotiations typically are skewed by unequal access to finances, expertise and other political resources, scholars who seek to improve social outcomes have a better chance of achieving their goal by taking one particular stance: to counteract existing biases. That normally will require a shift not merely from the university into the community, but a shift toward serving those social interests now relatively disadvantaged in social negotiation. Many environmental scientists, for example, have implicitly or explicitly done this in challenging agribusiness interests regarding pesticides.[24] Some epidemiologists likewise have done *pro bono* work for communities affected by cancer clusters in the Northeast, and in Louisiana's cancer alley.[25]

More generally, David Dickson argues that:

> The substance of a truly democratic strategy for science and science policy would be ... to confront the growing control of private interests over all spheres of social life ... [which] means changing the conditions of access to the fruits of politically funded research so that those social groups that lack the economic or political power currently required to exploit such research are placed in position to do so.[26]

But would such deliberate tilting be justifiable as an across-the-board strategy? Consider this reasoning: most professional experts outside universities now earn a living working for corporate executives – or for government officials who tend to ally with business – who not infrequently wish to deploy expertise for tasks partially in conflict with some goals of workers, consumers, or those who seek to preserve the environment. It is commonplace to read that:

> Expertise has joined money as a major obstruction to democratic decision making, and professionals have gained the high moral ground in claiming legitimate authority.[27]

Frank Fischer refers to the interpenetration of technical expertise and political-economic authority as 'technocorporatism',[28] an alliance made easier by the fact that many engineers and other technical professionals tend to be 'skeptical and even hostile toward politicians and political institutions'.[29]

Government scientists sometimes challenge business-funded expertise, of course, and businesses must serve customers well enough to make a profit; but a wide array of social science literature suggests that problems and perspectives of have-nots are under-represented among experts' agendas.[30] Hence, the concerns, ideas, and expertise of non-élites are less often brought to bear on social problem-solving, and significant angles may be neglected or under-emphasized, thereby reducing the overall intelligence of political negotiation and economic action. Hazardous waste facilities have been sited in a racist pattern, for example, partly because few experts took it upon themselves explicitly to oppose such an outcome.[31] Partisan analysis on behalf of have-nots therefore could serve to reduce the imbalance in allocation of expertise, whereas adding yet another expert on the side of already over-represented mainstream power-holders will rarely catch important and otherwise neglected angles on a problem.

Does this imply that more STS scholars than at present usefully could adopt an approach toward the radical end of the activist continuum in at least some of their work? So it seems to us; but, to reiterate, we recognize that our approach to scholarship is one among many legitimate alternatives, and we recognize as well that there is no neat dividing line where disciplinary- or curiosity-driven research leaves off and normative-activist research begins. We acknowledge, furthermore, that different costs and benefits accompany various approaches, and we seek mainly to urge members of the field to take seriously the task of deciding when and how to engage in thoughtfully partisan scholarship.[32]

Research Agendas

Closely connected with the choice regarding partisanship is one of the basic questions every scholar faces – 'What topic deserves my attention?' This applies especially to activist-oriented scholars, because the agenda from an activist viewpoint ought not to look the same as it does from the mainstream of the field. For example, military technology obviously could be a fertile ground for STS research, yet aside from Donald MacKenzie's longstanding interest in the subject, and the more recent thinking of a few others,[33] STS research has never been strong on weaponry technologies, or on the military as a technological organization.[34] Much of the best research on weaponry technology has come from political scientists and sociologists who do not self-define as 'STS', such as Chris Demchak's study of how the modern battle tank introduced unanticipated organizational change into the military, leading to unanticipated and undesired changes in strategy and tactics.[35] In the post-Cold War era, the silence on military matters among STS scholars is deafening, despite the fact that the US military is 'now the busiest army in the world, with operations up more than 300% since the end of the Cold War'.[36]

Another area of understudied research involves science and technology problems related to excluded groups. Whereas there is a substantial and growing literature on gender and feminist STS, catalysed in part by the development of Women's Studies, there is much less STS work on hetero-sexism and racism, although recent 4S Meetings have had more panels in those areas, due in part to cognizance being taken of Critical Race Studies.[37] Likewise, Wesley Shrum points out that research in less-developed countries continues to be neglected by mainstream science and technology studies: 'In the past ten years', he calculates, 'only three of 366 published articles in *Social Studies of Science* and in *Science, Technology, & Human Values* have dealt with agriculture in LDCs'.[38]

Opinions obviously will differ regarding the amount of attention various topics deserve, and the above examples are intended merely to suggest a *prima facie* case for mounting a sustained conversation among activist-oriented STS scholars concerning research priorities. Other scholars may benefit as well: whereas it may be defensible not to worry about such issues if one's conception of scholarship is to pursue whatever is

congenial, even non-activist scholars who want to pursue research 'important to the field' probably need to participate in agenda-setting sessions, so as to have some basis for deciding what is especially worthwhile. Such a tack seems even more important for those of us interested in learning how better to identify projects useful for activist purposes. At present, most of us investigate our choice of research direction with radically less sophistication and care than that with which we carry out the project.

Non-Decisions And Undone Science

Consider one line of inquiry for which more deliberate agenda-setting might be especially important. As well as focusing on how facts are constructed, controversies resolved, networks built, boundaries negotiated, and publics (mis)understood, would it also make sense for STS scholars to analyse roads not considered, projects not begun, methods ignored or dismissed out of hand, and technologies not explored systematically?[39] Who is silenced or suppressed, directly and indirectly, by specific means as well as by structural factors? Such an approach would require focusing on non-decisions as well as decisions, on inaction as well as action, and on inadequate or non-existent funding as well as on adequate or excessive funding.[40]

No one well understands what such an agenda would look like, and we raise the point more in the spirit of kicking off inquiry and debate than of championing any particular direction. But one category worth considering for higher priority might be termed 'the problem of undone science' – the possibility of systematic distortion of a field's (or even a society's) total research portfolio. Failure to do needed work might be caused by cultural blinders, by exclusion of key stakeholders from science policy processes, or by the dynamics of momentum and lock-in.[41] Analysis of such problems obviously would draw on the insights of knowledge-making as a socially shaped process, but also would move to another level of analysis: whereas social constructivist accounts usually focus on the micro processes whereby individual observations are transformed into generally accepted knowledge, the problem of undone science also would consider the processes by which research fields and topics are selected.[42]

Of course, no one has a felicific calculus for the 'correct' balance of goals that ought to guide R&D endeavours, so it never would be possible to argue conclusively in alleging 'imbalance'.[43] Activist-oriented scholars nevertheless can proceed plausibly to analyse situations where they believe commercial concerns are getting disproportionate weight, or where historically privileged groups appear still to be receiving unwarranted treatment – as in international trade regimes tilted toward affluent nations, or in product innovation attentive more to the wants of the rich than to the needs of the poor. Choosing to embark on research of this sort obviously requires partisan judgements that are bound to be highly contestable, but even standard, curiosity-driven academic research agendas tend to be set

more on the basis of personal judgement than on well-established, power-ful methods of the sort that sometimes characterize the conduct of re-search. If potentially flawed judgements thus are required to embark on any sort of STS research, activist-oriented researchers may be in no worse position than is any other type of scholar.

In some respects, the activist actually may have it easier, because patterns in the world sometimes stand out so starkly as to be a *more* reliable guide than is ratiocination or discipline-oriented cue-taking. Thus, as Daniel Sarewitz puts it, one of the most important questions facing science policy-makers is 'the preposterous mismatch between the R&D agenda of the North and the development priorities of the South'.[44] Whereas aca-demic science studies scholarship might have a hard time 'seeing' this phenomenon from a position within high-tech scientific laboratories and networks, an activist scholar could hardly fail to notice the 'preposterous mismatch' Sarewitz discusses. Raising such issues credibly, even where there are plausible alternative interpretations more favourable to the *status quo*, can help deepen thinking and debate on basic research and other aspects of innovation. Consider three examples of undone science.

Green Chemistry How might historians, philosophers, sociologists, and others who study chemistry and chemical engineering, modify their schol-arly foci if they adopted activist-oriented postures? One possibility is that they would begin to interrogate chemists and chemical engineers about how their endeavours could have been approached differently (or hence-forth could be approached differently). Not far down this line of investiga-tion it would become apparent that what we think of as 'chemistry' actually is one variant within a family of chemistries: 20th-century 'brown' chem-istry appears to have been shaped more by economic and other practical contextual forces than from anything inherent in the structure of matter. An increasing number of chemical researchers are now saying that it is scientifically and technically possible to reconstruct a 'greener' chemistry and chemical engineering.[45]

One aspect involves modifying industrial processes to replace hazard-ous solvents (such as toluene) with innocuous ones (such as water and ethyl lactate). Alternative synthesis pathways often are available, such as a recent reconfiguration of the Ibuprofen (Advil[TM]) production process to avoid creating formaldehyde and cyanide as production intermediates. Envisioning and creating safer final products is a third major component of the possible endeavour, as in switching from PERC-based dry cleaning to supercritical carbon dioxide.[46]

The greening of the chemical industry is proceeding more slowly than is technically and financially feasible, in part because virtually no one outside a tiny green chemistry community knows about the potentials. Chemical R&D agendas have left important questions under-attended, in part because of the structure of the agenda-setting process and because social researchers have failed to call attention to imbalances, omissions, and partisan biasing of research.[47] Fewer historians of technology focus on

chemistry than on other sciences, for example, and virtually no social scientists cover mid- and late-20th-century chemistry.

Alternative Health Thanks in part to predominance of industry funding, research on the health risks posed by organic chemicals is surprisingly sparse, particularly research examining interactions among environmental pollutants, diet, human hormones, and hormone-mimicking chemicals. For treatment, patients often learn the disheartening news that conventional therapies offer high toxicities (especially radiation therapy and chemotherapy) and only moderate chances of long-term (10-year) survival for many cancers. Yet complementary and alternative medicine (CAM) receives no more than token funding, so understanding is limited regarding such treatment methods as high-dose supplements, botanicals, off-book uses of conventional drugs, and mind-body therapies.

Basic research for chronic disease treatment arguably should be oriented more toward interactions that include environment and lifestyle, and toward reversibility of gene expression. This set of research priorities would lead to the development of research fields that have been systematically underfunded and unconnected, in part because industrial interests favour, on both the aetiology and treatment sides, an approach to cancer as nonreversible genetic damage. For example, no one presently has adequate data showing whether diets high in organic vegetables and whole grains enhance ongoing detoxification processes, as well as tumour control and debulking – but a great many people *need* to know, and we suggest that part of the job of activist-oriented scholarship is to analyse and publicize about such disjunctures between knowledge needed and knowledge supplied.[48]

Nonviolent Action Military funding and incentives have long played a large rôle in providing direction for R&D in fields such as microelectronics, oceanography, aeronautics and psychology. While there has been some study of the rôle of the military in driving science and technology, arguably this has not been commensurate with the importance of this area. Our concern here, though, is with R&D that is not being done due to the standard assumption that 'defence' means 'military defence'.

Possible directions for STS analysts looking at alternatives to military defence include arms control and monitoring, diplomacy, conflict resolution, and various methods of challenging the driving forces underlying militarism and war, including the rôle of the state system, military industries and patriarchy. One little-known alternative to military defence, called 'nonviolent defence', 'social defence' or 'civilian-based defence', is based on nonviolent action, including non-cooperation, rallies, strikes, boycotts and sit-ins.[49] Appropriate science and technology also would be advantageous, including networked communication systems that could not easily be shut down by a state aggressor or by terrorists. Similarly, resilient agricultural, energy, transport and medical systems would require substantial new research and experimentation.[50] The option of nonviolent defence thus gives rise to quite a different agenda for R&D in terms of the

fields emphasized, topics analysed, and even the research methods utilized. That this idea may seem quaint or offbeat conceivably indicates how thoroughly the dominant approach to defence has colonized the thinking, not just of government officials and military officers, but even that of otherwise thoughtful intellectuals.

Extending Reflexivity

Thinking more clearly about undone science is one aspect of the larger challenge of extending reflexivity. Some constructivists, particularly Steve Woolgar, have done a commendable job of calling the field's attention to the problem of how we think about our own predicaments as scholars attempting to understand the world around us.[51] If scientists and technologists think and act in socially constructed ways, and if STS scholars likewise behave largely in accord with the norms and other social influences through which we are socialized and cued, then how can we position ourselves so as to take this reality into account without being paralysed? In developing approaches to activist-oriented scholarship, it would be foolish to throw away the insights purchased through this tradition of thought. We suggest that the reflexivist project actually be extended and given greater attention in STS, but in so doing some of its original motivations and approaches may need to be re-examined.

The move that we suggest, a move that seems already to be underway, is to devote more sustained and more professional energy to asking ourselves and each other: for whom should we work? If knowledge is socially constructed, and if knowledge is a resource used differently by various partisans in various social settings, does it still make sense to rely on the traditional notion that 'new knowledge' – in the STS case, knowledge about the nature and dynamics of science and technology – is an unproblematic good serving everyone more or less equally? Moreover, inasmuch as there always are more research questions than time to study them, it seems hard to miss the possibility of extending the individual-level reflexivity of the 1980s to the field more generally: what social forces are setting our collective agendas; is the agenda-setting process a laudable one; and what plausible reconstructions of it might be worth examining?[52]

A criticism worth considering is the possibility that STS as a field of inquiry has tended to reproduce the hierarchies of scientific research fields, which in turn reflect the funding priorities of a political economy of science heavily weighted toward research supported by military and industrial sources. The hot areas of science and technology research tend to become the hot areas of social analysis: information technology, molecular biology and genomics, high-tech medicine, physics and applied physical sciences. Is this merely good sense, or does it mean that STS becomes too much a reflection, rather than an independent field? Among other concerns is the possibility discussed above, that STS scholars will fail to investigate fundamental questions about undone science. Another worry is the considerable time lag between initiation of social science scholarship and its slow

diffusion via university training into a new generation's usable knowledge; a rapidly shifting research agenda focused on near-term hot topics may fail to provide scholarship needed for the medium-term future.[53]

Because funding costs are often relatively low in the social sciences and humanities, there is a real possibility that much of the research can be self-funded or funded through diverse sources that reduce direct control of the sort exerted by industry and the military in the natural sciences. However, because of the non-technical nature of the field, controversies over content tend to be more readily open to direct political intervention from outside sources. Thus, administrators may select against departments and re-searchers who directly confront university dependence on corporate pa-tronage, especially if the critics use, for example, Marxist or feminist frameworks of analysis. Such frameworks become labelled as 'political', as if other ones are not (for example, functionalism or its structural successor in the academy, apolitical versions of postmodernism).

The ambiguous position of STS departments and academics in tech-nological universities, or even in schools of engineering, means that the field as a whole is subjected to pressures that may tend to select for members who do not confront the cosy relationships between off-campus military-industrial sponsors and on-campus engineering and science labo-ratories. The question of reflexivity in STS is therefore a broad and deep one, and, as Brian Wynne has clarified, there is no inherent reason why reflexivity should be limited to the somewhat internalist formulation that preoccupied early SSK discussions.[54] It is equally or more important to think reflexively about relations among STS, the technoscientists we study, and the rest of society. Our sense is that STS is moving into a period where diverse and multivalent reflexive analyses can include a more institutionally and politically located reflexivity.

Making More of a Place for Reconstructive STS

We have no doubt that thoughtful partisanship and social activism can co-exist peacefully and even fruitfully with more purely intellectual scholar-ship within STS. Yet this has not always been the experience, and to many it has sometimes seemed that there are 'two subcultures' of the STS interdiscipline.[55] Steve Fuller spoke of the divide between the High Church (a discipline-centred, scholarly STS) and the Low Church (an activist-oriented STS rooted in the social movements of the 1960s).[56] Brian Martin lamented the 'academization' of the critique of science, as the new approaches pushed politicized analysis characteristic of early critique to the margins.[57] Bruno Latour feared division into 'an applied but soft branch – STS – and a basic but isolated one – science studies'.[58] Langdon Winner suggested we converse amongst ourselves, not only about re-search agendas but also 'about which ends, principles, and conditions deserve . . . our commitment'.[59] And Brian Martin argued for a return to the days when STS scholars worked on projects with, alongside, and

relevant to social movements, and to for them intervene as 'open partisans' in scientific controversies.[60]

Soon, however, probing began of possibilities for middle paths. David Hess suggested dialogue between the camps;[61] Dick Pels recommended weakly asymmetrical third positions that would be situated, partial and committed in a knowledge-political sense;[62] Evelleen Richards called for contextualized and policy-relevant SSK analyses;[63] Sheila Jasanoff suggested a reconceptualized symmetry principle and a move from SSK's restrictive controversy framework to one that explains the 'co-production' of science and society;[64] and Sandra Harding and Donna Haraway drew on constructivist concepts but reoriented them to postcolonial, feminist and antiracist scholarship.[65] Although divisions remain, and some thoughtful scholars continue to view partisan research as a meritorious 'futile gesture',[66] we are optimistic about the potential melding of constructivist insights with activist-reconstructivist agendas.

We advocate this inclusive position partly because of the costs of infighting within the small STS community, but even more because it has become apparent that explicit partisanship is not a prerequisite for STS scholarship to be relevant to activists, as shown by the examples given earlier. Indeed, whereas it once seemed at least halfway plausible that 'the only policy advice [a constructivist] can give is to improve one's use of the rhetoric of science and technology to persuade others of one's point of view and to build cohesive social networks',[67] it has become clear that creative constructivists of diverse ideologies actually can illuminate socially important scientific and technological issues using many different methodologies. We are, of course, among those who will prefer directly to challenge problematic technologies, provide analytic assistance and credibility on behalf of often forgotten voices, and articulate alternatives. There always is a risk that such advocacy may be done poorly, of course, just as any kind of analysis may be done poorly. But even many economists, practising that most 'scientific' of social sciences, sometimes function as advocates (especially of efficient allocation of scarce resources). So it is reasonable to suppose that sufficiently skilled and otherwise 'appropriate' advocacy may fit into STS, along with less avowedly partisan approaches that begin with symmetry and impartiality as methodological heuristics.

Who Is the Audience?

Activist researchers also face the difficult question of audience: write for one's disciplinary peers, for activist colleagues, or for a more general public? As Steven Epstein has demonstrated, larger social movements tend to undergo an 'expertification' process such that some activists and staff members become sufficiently knowledgeable that they become able to absorb scholarly research and put it to use as part of the movement's activities.[68] However, scholarship written too much for a lay public or for non-expert segments of a social movement will tend to be ignored in

scholarly circles. For example, Margaret Wooddell and David Hess's collections of interviews with women cancer patients, and Hess's interviews with men and women cancer activists, were written for patients and clinicians in the complementary and alternative cancer therapy movement.[69] Although that work has circulated in various activist workshops and grassroots networks circles, alternative provider offices and movement organizations, and although it has received press coverage as well as interest from government officials, the work has been virtually ignored in STS circles. Scholars thus sometimes (or often) face a trade-off between being rewarded by academic peers and contributing to a better world.

One way of meeting both types of audiences is to publish for one's peers and then translate the ideas for a more general public or for activist audiences. For example, *New Scientist* and *Technology Review* regularly cover STS issues, although both these high-circulation magazines in recent years appear to have become less receptive to critical social analysis of science and technology. Other publications open to STS perspectives include *IEEE Technology and Society Magazine* and equivalent journals designed for social commentary, general interest magazines such as *The Atlantic* (which recently featured an article by two science policy scholars criticizing climate warming research),[70] newsletters of activist organizations, and web sites.

Regrettably, graduate training does little to prepare students for writing for popular audiences. Nor do 4S and EASST conferences do much to assist members of the field in deciding whether it makes sense to aim for occasional publications of such a nature. We believe that learning to convey complex ideas in a simpler way can actually be a great asset for clearer and more rigorous scholarly thought, and that there would be unexpected payoffs within academe if a larger fraction of us honed our aptitudes by tackling 'popularization'.[71]

It is axiomatic that established scholars are able to get away with popular publication more readily than are junior scholars, yet few scholars suddenly make that choice as they mature.[72] It apparently takes a considerable jolt to jump into activist scholarship at a later stage in a career. It does occur, though, for example after being personally affected – such as by a medical tragedy in the family – or through involvement in a social movement that offers an alternative set of 'peers' and rewards.

The reward system of the academy, of course, tends to create a predicament for those interested in activism-scholarship. Most assured of scholarly prestige and associated reward are those toiling successfully at the relatively conservative end of the activist spectrum: scholarly books with relevance to a disciplinary problem, with little normative language and prescription, and mostly inaccessible to a broader public. An alternative path to advancement is entrepreneurial success, especially through bringing in large grants, which are likely to reflect areas of high industrial and national priority (though there obviously are exceptions). One therefore can predict that those pursuing reconstructivist STS will undergo pressures to migrate toward the range of positions that we describe as 'subtly'

or 'weakly' normative. Only an altered reward system would allow a more strongly normative strand of STS to flourish, and we suggest that those who care about an STS field most capable of serving human needs would do well to stimulate whatever reconsideration of their department's (and field's) reward systems may be feasible.[73]

Conclusion

Because there is no uniquely correct position from which to study, advise, or intervene, reflexivity and other lessons of constructivism remain important for STS work. Activist-oriented researchers need to admit their own partiality and fallibility, and devise ways of proceeding in a world more multifaceted than those committed to social causes sometimes have acknowledged.

Doing better at this can be promoted if STS scholars, of all stripes, recognize 'activist-oriented STS' as a kind of research that is oriented toward a different audience than either other scholars or policy-makers, the two classical audiences of STS research. Table 1 spells out differences between STS oriented to three constituencies: to scholars, to policy-makers, and to activists (acknowledging that these categories are not rigid or mutually exclusive). We suggest that while activist-oriented STS can take the form of scholarly articles or policy briefs, it is also opening up emergent types of publication, such as cross-over books (books aimed for both scholarly readers and a general public) and electronic media (websites, videos, and so on). To what extent ought the reward system of the field be altered to count such work as equivalent to scholarship for the purposes of hiring, promotion, and tenure?[74]

Like any classification system, this one is intended merely as a heuristic basis for future discussions and interventions into our own research practices. Scholar-oriented STS can turn out to be useful to policy-makers

TABLE 1
Features of STS Oriented to Three Types of Constituencies

	Scholar-oriented STS	Policy-maker-oriented STS	Activist-oriented STS
Researcher's primary commitment	scholarship	government and expert-adviser system	social change, often at the grassroots
Key criterion for choice of topic and method	intellectual importance	government officials' priorities	social and environmental problems
Primary audience	scholars	policy-makers	activists, publics
Typical style *Typical communication channels*	academic scholarly journals, books, and conferences	bureaucratic reports, policy briefings	accessible cross-over books, electronic media

or activists or both, as some of our examples have suggested; and some activist-oriented STS may turn out to be more significant for scholars than for activists. There are spin-offs and unexpected consequences in different directions, analogously to the way that artefacts may be shaped by certain interests but end up primarily serving other ones.[75]

We have described what seems to us a promising new phase of STS scholarship. Constructivist insights and concepts have now been thoroughly incorporated into the field, and there has been considerable shrinking of what once seemed a very substantial gap between those doing 'committed' scholarship and those doing avowedly 'neutral' or relatively nonpartisan scholarship. To make the most of the new opportunities, we propose, the field needs more explicit and sustained inquiry of at least four kinds:

- General discussion of the range of approaches for incorporating normative, activist, or reconstructive intentions into one's own research;
- Inquiry into topics now given inadequate attention, and a more sustained and professionally sophisticated process for agenda-setting;
- More active participation in positive efforts to shape technoscientific activities in progressive directions (illustrated here by the green chemistry, alternative medicine and nonviolent defence cases); and
- Reflexive analysis of conceptual foundations, publication practices, and the reward system of STS, with the goal of making more room for normative, activist, reconstructive work – whether or not such work conforms to our particular slant on thoughtful partisanship.

Most generally, the point of rapprochement between activist-oriented STS research and the rest of social science is that a wiser technoscience surely depends in no small part on arranging a conducive political-economic framework within which technoscientific activity is constrained and evoked. Not many aspects of social thought fail to bear on that reconstructivist enterprise.

Notes

1. Wiebe Bijker, 'The Need for Critical Intellectuals: A Space for STS?', Presidential Plenary, Annual Meeting of the Society for Social Studies of Science [4S] (Cambridge, MA, 1 November 2001).
2. Arie Rip and Thomas J. Misa (eds), *Managing Technology in Society: The Approach of Constructive Technology Assessment* (London: Pinter Publishers, 1995).

3. We use these terms to designate the general field in which individual scholars select different positions.

4. Steve Breyman, 'Social Studies of Science & Activism: STS as a Campus Greening Movement', *Philosophy & Social Action*, Vol. 23, No. 1 (January–March 1997), 5–18; Susan E. Cozzens and Edward J. Woodhouse, 'Science, Government, and the Politics of Knowledge', in Sheila Jasanoff, Gerald E. Markle, James C. Petersen and Trevor Pinch (eds), *Handbook of Science and Technology Studies* (Thousand Oaks, CA, London & New Delhi: 4S/Sage Publications, 1995), 533–53; David J. Hess, 'If You're Thinking of Living in STS . . . A Guide for the Perplexed', in Gary Lee Downey and Joseph Dumit (eds), *Cyborgs and Citadels: Anthropological Interventions in Emerging Sciences and Technologies* (Santa Fe, NM: SAR Press, 1997), 143–64; Brian Martin, 'The Critique of Science Becomes Academic', *Science, Technology, & Human Values*, Vol. 18, No. 2 (Spring 1993), 247–59; E.J. Woodhouse, 'The Turn toward Society?: Social *Re*construction of Science', *Science, Technology, & Human Values*, Vol. 16, No. 3 (Summer 1991), 390–404.

5. Steve Fuller, *The Governance of Science: Ideology and the Future of the Open Society* (Buckingham, UK & Philadelphia, PA: Open University Press, 2000); Sandra G. Harding, *Is Science Multicultural? Postcolonialisms, Feminisms, and Epistemologies* (Bloomington: Indiana University Press, 1998); Downey & Dumit (eds), op. cit. note 4.

6. One of the best collections of articles bearing on our topic was the Special Issue of this journal, edited by Malcolm Ashmore and Evelleen Richards, on 'The Politics of SSK: Neutrality, Commitment and Beyond', *Social Studies of Science*, Vol. 26, No. 2 (May 1996), 219–468. That issue included, among other articles not elsewhere cited in these endnotes: Evelleen Richards and Malcolm Ashmore, 'More Sauce Please! The Politics of SSK: Neutrality, Commitment and Beyond' (Editors' Introduction), 219–28; H.M. Collins, 'In Praise of Futile Gestures: How Scientific is the Sociology of Scientific Knowledge?', 229–44; Malcolm Ashmore, 'Ending Up On the Wrong Side: Must the Two Forms of Radicalism Always Be at War?', 305–22; Vicky Singleton, 'Feminism, Sociology of Scientific Knowledge and Postmodernism: Politics, Theory and Me', 445–68. Also see, among many other thoughtful commentators: H.M. Collins, 'Captives and Victims: Comment on Scott, Richards, and Martin', *Science, Technology, & Human Values*, Vol. 16, No. 2 (Spring 1991), 249–51; Hans Radder, 'Normative Reflexions on Constructivist Approaches to Science and Technology', *Social Studies of Science*, Vol. 22, No. 1 (February 1992), 141–73; Ronald N. Giere, 'Science and Technology Studies: Prospects for an Enlightened Postmodern Synthesis', *Science, Technology, & Human Values*, Vol. 18, No. 1 (Winter 1993), 102–12; W.E. Bijker, 'Do Not Despair: There is Life after Constructivism', ibid., 113–38; Langdon Winner, 'On Opening the Black Box and Finding it Empty: Social Constructivism and the Philosophy of Technology', ibid., No. 3 (Summer 1993), 362–78; Hans Radder, 'The Politics of STS', and 'Second Thoughts on the Politics of STS: A Response to the Replies by Singleton and Wynne', *Social Studies of Science*, Vol. 28, No. 2 (April 1998), 325–31, 344–48; Vicky Singleton, 'The Politic(ian)s of SSK: A Reply to Radder', ibid., 332–38; Brian Wynne, 'Reply to Radder', ibid., 338–44.

7. Patrick W. Hamlett, 'Technology Theory and Deliberative Democracy', *Science, Technology, & Human Values* (forthcoming, 2002), manuscript page 3.

8. Even what we call 'curiosity' is of course structured (in ways only dimly understood) by social contexts and relations.

9. Activism thus assumes some intervention in the public domain that goes beyond institutionally sanctioned and commonplace activities such as private discussions, everyday workplace behaviour, voting or lobbying. It is also possible to include as activism a range of other social action beyond 'business as usual', including running for office, canvassing for political candidates, and organizing campaigns within organizations. Aligned with activist groups are those who provide legal and other advice, raise funds, and engage in other support activities.

10. Political participants obviously work for a wide variety of ends, but our interest is exclusively with forms of advocacy and activism that are in keeping with democratic

political theory. Even within this sphere, there is, of course, substantial room for dispute, and while we personally tend to prefer liberal activism urging, say, minimum safety standards, we would hardly deny conservative activists in or out of STS the legitimate right to work for preserving consumers' freedom of choice, even at the expense of modestly higher overall risk. What is not part of our understanding of democratic theory is activism that works against the norms of political equality, sustained deliberation, and other behaviours required for the potential intelligence of democracy to be actualized. Hence, we might not include in our definition political action in support of racism, or political action on behalf of the already privileged. These are dicey distinctions to implement, of course, and it would be absurd not to acknowledge that some STS scholars will consider it unwise or infeasible to distinguish among social causes in these ways. Not every good thing goes together neatly, moreover, and there may be conflicts among equality, social justice, enhanced participation, health, sustainability, justice and nonviolence. Some left-wing commentators have castigated the environmental movement for defending those with privilege, for example. Consequently, while we have our own personal preferences concerning activist goals, we seek not to decree but to contribute to a many-sided dialogue about appropriate inquiry and advocacy concerning a wiser, fairer technological civilization.

11. While we mention some justifications for activist-oriented STS, our principal aim is to describe some common varieties of activist-oriented STS scholarship, and to position this sort of scholarship theoretically. We do not address the issue of the actual impact of activist-oriented STS. The difficulty STS faces in making an impact is discussed thoughtfully by David Edge, 'Reinventing the Wheel', in Jasanoff et al. (eds), op. cit. note 4, 3–23.

12. Gary Edmond and David Mercer, 'Litigation Life: Law-Science Knowledge Construction in (Bendectin) Mass Toxic Tort Litigation', *Social Studies of Science*, Vol. 30, No. 2 (April 2000), 265–316, at 303–04. Likewise, see Shana M. Solomon and Edward J. Hackett, 'Setting Boundaries Between Science and Law: Lessons from *Daubert v. Merrell Dow Pharmaceuticals, Inc.*', *Science, Technology, & Human Values*, Vol. 21, No. 2 (Spring 1996), 131–56.

13. Steven Yearley, 'Computer Models and the Public's Understanding of Science', *Social Studies of Science*, Vol. 29, No. 6 (December 1999), 845–66, at 863; see also Michael Bloor, 'The South Wales Miners Federation, Miners' Lung and the Instrumental Use of Expertise, 1900–50', *ibid.*, Vol. 30, No. 1 (February 2000), 125–40.

14. Orlando Fals Borda, *Knowledge and People's Power: Lessons with Peasants in Nicaragua, Mexico and Columbia* (New Delhi: Indian Social Institute, 1988); Juliet Merrifield, *Putting the Scientists in Their Place: Participatory Research in Environmental and Occupational Health* (New Market, TN: Highlander Center, 1989); Peter Reason and John Rowan (eds), *Human Inquiry: A Sourcebook of New Paradigm Research* (New York: Wiley, 1981).

15. Gary Lee Downey and Joseph Dumit, 'Locating and Intervening: An Introduction', in Downey & Dumit (eds), op. cit. note 4, 5–29, at 24–28.

16. On interaction as a substitute for policy analysis, see Charles E. Lindblom and Edward J. Woodhouse, *The Policy-Making Process* (Englewood Cliffs, NJ: Prentice Hall, 3rd edn, 1993).

17. William Foote Whyte (ed.), *Participatory Action Research* (Newbury Park, CA: Sage, 1991).

18. Breyman, op. cit. note 5; Brian Martin, < *www.uow.edu.au/arts/sts/bmartin/dissent/* > .

19. Sharon Beder, *Toxic Fish and Sewer Surfing: How Deceit and Collusion Are Destroying our Great Beaches* (Sydney: Allen & Unwin, 1989); S. Beder, 'Controversy and Closure: Sydney's Beaches in Crisis', *Social Studies of Science*, Vol. 21, No. 2 (May 1991), 223–56; S. Beder, 'Sewerage Treatment and the Engineering Establishment', in Brian Martin (ed.), *Confronting the Experts* (Albany: State University of New York Press, 1996), 13–43.

20. Todd Cherkasky, *Design Style: Changing Dominant Design Practice* (unpublished PhD dissertation, Department of Science and Technology Studies, Rensselaer Polytechnic Institute, 1999).

21. David F. Noble, *America by Design: Science, Technology and the Rise of Corporate Capitalism* (New York: Knopf, 1977); D.F. Noble, *Forces of Production: A Social History of Industrial Automation* (New York: Knopf, 1984).

22. Richard E. Sclove, *Democracy and Technology* (New York: Guilford Press, 1995).

23. This section is drawn primarily from Lindblom & Woodhouse (1993), op. cit. note 16. The ideas derive in part from Robert A. Dahl and Charles E. Lindblom, *Politics, Economics, and Welfare* (New York: Harper & Brothers, 1953); C.E. Lindblom, *The Intelligence of Democracy* (New York: The Free Press, 1965); C.E. Lindblom and David K. Cohen, *Usable Knowledge: Social Science and Social Problem Solving* (New Haven, CT: Yale University Press, 1979); C.E. Lindblom, *Inquiry and Change: The Troubled Attempt to Understand and Shape Society* (New Haven, CT: Yale University Press, 1990).

24. David Pimentel and Susan Pimentel, 'Ecological Aspects of Agricultural Policy', *Natural Resources Journal*, Vol. 20 (1980), 555–85; David Pimentel, *Techniques for Reducing Pesticide Use: Environmental and Economic Benefits* (New York: Wiley, 1997).

25. Institute for Environmental Issues and Policy Assessment of Southern University, *River Sentinel 95: People Who Can be Harmed by Toxic Releases* (Baton Rouge, LA, 1995); Philip Brown, 'When the Public Knows Better: Popular Epidemiology Challenges the System', *Environment*, Vol. 35 (October 1993), 16–20, 32–41. See also Barbara Allen, *Uneasy Alchemy: Dissonance, Resistance, Justice, and Change in Louisiana's Industrial Corridor* (unpublished PhD dissertation, Department of Science and Technology Studies, Rensselaer Polytechnic Institute, 1999).

26. David Dickson, *The New Politics of Science* (Chicago, IL: The University of Chicago Press, 1988), 326–27.

27. Charles Derber, William A. Schwartz and Yale Magrass, *Power in the Highest Degree: Professionals and the Rise of the New Mandarin Order* (New York: Oxford University Press, 1990), 206.

28. Frank Fischer, *Technocracy and the Politics of Expertise* (Newbury Park, CA: Sage, 1990), esp. 181–97. Also see F. Fischer, 'Citizen Participation and the Democratization of Policy Expertise: From Theoretical Inquiry to Practical Cases', *Policy Sciences*, Vol. 26 (1993), 165–87; F. Fischer, *Citizens, Experts, and the Environment: The Politics of Local Knowledge* (Durham, NC: Duke University Press, 2000).

29. Robert D. Putnam, *Elite Transformation in Industrial Societies: An Empirical Assessment of the Theory of Technocracy* (Beverly Hills, CA: Sage, 1977), 385.

30. On experts' orientation to powerful groups, see: Joel Primack and Frank von Hippel, *Advice and Dissent* (New York: Basic Books, 1974); David Elliott and Ruth Elliott, *The Control of Technology* (London: Wykeham, 1976); Christine Mironesco, ' "Expert" and "Political" Elements in Official Scientific Advice on Swiss Nuclear Power', in Anthony Barker and B. Guy Peters (eds), *The Politics of Expert Advice: Creating, Using and Manipulating Scientific Knowledge for Public Policy* (Pittsburgh, PA: University of Pittsburgh Press, 1993), 49–59; E.J. Woodhouse and Dean Nieusma, 'When Expert Advice Works, and When It Does Not', *IEEE Technology and Society Magazine*, Vol. 16 (Spring 1997), 23–30; Jeff Schmidt, *Disciplined Minds* (Lanham, MD: Rowman & Littlefield, 2000).

31. Robert D. Bullard, *Dumping in Dixie: Race, Class, and Environmental Quality* (Boulder, CO: Westview, 1990).

32. See Lindblom & Cohen, op. cit. note 23.

33. Donald MacKenzie, 'Science and Technology Studies and the Question of the Military', *Social Studies of Science*, Vol. 16, No. 2 (May 1986), 361–71; D. MacKenzie, *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge, MA: MIT Press, 1990); D. MacKenzie and Graham Spinardi, 'Tacit Knowledge and the Uninvention of Nuclear Weapons', in D. MacKenzie, *Knowing Machines: Essays on Technical Change* (Cambridge, MA: MIT Press, 1996), 215–60; Chris Hables Gray, *Postmodern War: The New Politics of Conflict* (London: Routledge, 1997).

34. Hugh Gusterson, *Nuclear Rites: A Weapons Laboratory at the End of the Cold War* (Berkeley: University of California Press, 1996); Patrick W. Hamlett (ed.), 'Special Section: Technology and the Arms Race', *Science, Technology, & Human Values*, Vol. 15, No. 4 (Autumn 1990), 379–473.

35. Chris C. Demchak, *Military Organizations, Complex Machines: Modernization in the U.S. Armed Services* (Ithaca, NY: Cornell University Press, 1991).

36. Sign posted in the Visitor Center, National Space Center and Rocket Park (Huntsville, AL, March 2001).

37. Londa Schiebinger, *Has Feminism Changed Science?* (Cambridge, MA: Harvard University Press, 1999); Wendy Faulkner, 'The Power *and* the Pleasure? A Research Agenda for "Making Gender Stick" to Engineers', *Science, Technology, & Human Values*, Vol. 25, No. 1 (Winter 2000), 87–119; Robert D. Bullard, 'Overcoming Racism in Environmental Decision Making', *Environment*, Vol. 36 (May 1994), 10–20, 39–44; R.D. Bullard and Glenn S. Johnson, *Just Transportation: Dismantling Race and Class Barriers to Mobility* (Stony Creek, CT: New Society Publishers, 1997); Harding, op. cit. note 5.

38. Wesley Shrum, 'Science and Story in Development: The Emergence of Non-Governmental Organizations in Agricultural Research', *Social Studies of Science*, Vol. 30, No. 1 (February 2000), 95–124, at 119 (note 1).

39. There is some excellent work in the field on roads not taken – for example, Evelleen Richards, *Vitamin C and Cancer: Medicine or Politics?* (London: Macmillan, 1991) – but less on roads not openly advocated or seriously considered. The non-decision-making literature highlights the importance of the latter sorts of paths, which are less visible since there is seldom any controversy to observe. Fitting in here are some of the options discussed by Ruth Schwartz Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic Books, 1983). See also Sara Delamont, 'Three Blind Spots? A Comment on the Sociology of Science by a Puzzled Outsider', *Social Studies of Science*, Vol. 17, No. 1 (February 1987), 163–70.

40. See Cozzens & Woodhouse, op. cit. note 4. On non-decisionmaking, see Peter Bachrach and Morton S. Baratz, 'Two Faces of Power', *American Political Science Review*, Vol. 56 (1962), 947–52; P. Bachrach and M.S. Baratz, 'Decisions and Nondecisions: An Analytical Framework', *ibid.*, Vol. 57 (1963), 632–42; P. Bachrach and M.S. Baratz, *Power and Poverty: Theory and Practice* (New York: Oxford University Press, 1970); Matthew A. Crenson, *The Un-Politics of Air Pollution: A Study of Non-Decisionmaking in the Cities* (Baltimore, MD: Johns Hopkins University Press, 1971); Steven Lukes, *Power: A Radical View* (London: Macmillan, 1974).

41. David J. Hess, *Selecting Technology, Science, and Medicine*, Alternative Pathways in Globalization, Vol. 1 (<*www.home.earthlink.net/~davidhesshomepage*>, 2001).

42. Note that in the previous section, we discussed important areas of technoscience that are relatively neglected by STS scholars. Here we focus on areas of technoscience that are relatively neglected by technoscientists. These areas may or may not be neglected as well by STS scholars.

43. See Lindblom & Cohen, op. cit. note 23, esp. 'Alternatives to Authoritativeness', 72–85.

44. Daniel Sarewitz, *Frontiers of Illusion: Science, Technology, and the Politics of Progress* (Philadelphia, PA: Temple University Press, 1996), 195.

45. Terrence J. Collins, 'Introducing Green Chemistry In Teaching And Research', *Journal of Chemical Education*, Vol. 72, No. 11 (1995), 965–66; Paul T. Anastas and Carol A. Farris (eds), *Benign by Design: Alternative Synthetic Design for Pollution Prevention* (Washington, DC: American Chemical Society, 1994); P.T. Anastas and Tracy C. Williamson (eds), *Green Chemistry: Designing Chemistry for the Environment* (Washington, DC: American Chemical Society, 1996); E.J. Woodhouse and Steve Breyman, 'Green Chemistry as an Expert Social Movement?' (unpublished paper delivered at the 4S/EASST Meeting, Vienna, 30 September 2000).

46. *The Presidential Green Chemistry Challenge Awards Program: Summary of 1996 Award Entries and Recipients* (US Environmental Protection Agency, Office of Pollution Prevention and Toxics, July 1996, EPA744–K–96–001).

47. E.J. Woodhouse, 'Change of State?: The Greening of Chemistry and Chemical Engineering', in Monica J. Casper (ed.), *Chemical States: Transforming Bodies, Environments, and Nations* (New York: Routledge, forthcoming 2002); David H. Guston, E.J. Woodhouse and Daniel Sarewitz, 'A Science and Technology Policy Focus for the Bush Administration', *Issues in Science and Technology*, Vol. 17, No. 3 (Spring 2001), 29–32.

48. Margaret J. Wooddell and David J. Hess, *Women Confront Cancer: Making Medical History by Choosing Alternative Therapies* (New York: New York University Press, 1998); D.J. Hess, *Evaluating Alternative Cancer Therapies: A Guide to the Science and Politics of an Emerging Medical Field* (New Brunswick, NJ: Rutgers University Press, 1999).

49. Anders Boserup and Andrew Mack, *War Without Weapons: Non-violence in National Defence* (London: Frances Pinter, 1974); Robert J. Burrowes, *The Strategy of Nonviolent Defense: A Gandhian Approach* (Albany: State University of New York Press, 1996); Gustaaf Geeraerts (ed.), *Possibilities of Civilian Defence in Western Europe* (Amsterdam: Swets & Zeitlinger, 1977); Adam Roberts (ed.), *The Strategy of Civilian Defence: Non-violent Resistance to Aggression* (London: Faber & Faber, 1967); Gene Sharp, with the assistance of Bruce Jenkins, *Civilian-Based Defense: A Post-Military Weapons System* (Princeton, NJ: Princeton University Press, 1990).

50. Brian Martin, *Technology for Nonviolent Struggle* (London: War Resisters' International, 2001); B. Martin, 'Science, Technology and Nonviolent Action: The Case for a Utopian Dimension in the Social Analysis of Science and Technology', *Social Studies of Science*, Vol. 27, No. 3 (June 1997), 439–63.

51. Among many other contributions, see Steve Woolgar, 'Interests and Explanation in the Social Study of Science', *Social Studies of Science*, Vol. 11, No. 3 (August 1981), 365–94; S. Woolgar, 'Laboratory Studies: A Comment on the State of the Art', *ibid.*, Vol. 12, No. 4 (November 1982), 481–98; Michael Mulkay, Trevor Pinch and Malcolm Ashmore, 'Colonizing the Mind: Dilemmas in the Application of Social Science', *ibid.*, Vol. 17, No. 2 (May 1987), 231–56.

52. On the extension of reflexivity to the field as a whole, see Hess in Downey & Dumit (eds), op. cit. note 4. For assessments of the field, see, for example: Stephen H. Cutcliffe, *Ideas, Machines, and Values: An Introduction to Science, Technology, and Society Studies* (Lanham, MA: Rowman & Littlefield, 2000); Lars Fuglsang, *Technology and New Institutions: A Comparison of Strategic Choices and Technology Studies in the United States, Denmark and Sweden* (Copenhagen: Academic Press, 1993); and (with a less institutional focus than the foregoing), David J. Hess, *Science Studies* (New York: NYU Press, 1997).

53. See Lindblom & Cohen, op. cit. note 23, esp. 79–80.

54. Brian Wynne, 'SSK's Identity Parade: Signing-Up, Off-and-On', *Social Studies of Science*, Vol. 26, No. 2 (May 1996), 357–91.

55. Juan Ilerbaig, 'The Two STS Subcultures and the Sociological Revolution', *Science, Technology & Society* (Lehigh University *Curriculum Newsletter*), No. 90 (June 1992), 1–6.

56. Steve Fuller, 'STS as a Social Movement: On the Purpose of Graduate Programs', *Science, Technology & Society*, No. 91 (October 1992), 1–5; see also S. Fuller, *Philosophy, Rhetoric, and the End of Knowledge: The Coming of Science and Technology Studies* (Madison: University of Wisconsin Press, 1993), esp. xiii–xiv.

57. Martin (1993), op. cit. note 4.

58. Bruno Latour, 'Acceptance' (of the 1992 Bernal Prize), *Science, Technology, & Human Values*, Vol. 18, No. 3 (Summer 1993), 384–88, at 386.

59. Langdon Winner, 'On Opening the Black Box and Finding it Empty: Social Constructivism and the Philosophy of Technology', *Science, Technology, & Human Values*, Vol. 18, No. 3 (Summer 1993), 362–78, at 374.

60. Brian Martin, 'Sticking a Needle into Science: The Case of Polio Vaccines and the Origin of AIDS', *Social Studies of Science*, Vol. 26, No. 2 (May 1996), 245–76.
61. Hess, in Downey & Dumit (eds), op. cit. note 4.
62. Dick Pels, 'The Politics of Symmetry', *Social Studies of Science*, Vol. 26, No. 2 (May 1996), 277–304.
63. Evelleen Richards, '(Un)Boxing the Monster', ibid., 323–56.
64. Sheila Jasanoff, 'Beyond Epistemology: Relativism and Engagement in the Politics of Science', ibid., 393–418.
65. Harding, op. cit. note 5; Donna Haraway, *Primate Visions: Gender, Race, and Nature in the World of Modern Science* (New York: Routledge, 1989); D. Haraway, *Modest_Witness@Second_Millennium.Female_Man©_Meets_OncoMouse^{TM}: Feminism and Technoscience* (New York: Routledge, 1997).
66. See the title of Collins (1996), op. cit. note 6.
67. Giere, op. cit. note 6, 109.
68. Steven Epstein, *Impure Science: AIDS, Activism, and the Politics of Knowledge* (Berkeley: University of California Press, 1996).
69. Wooddell & Hess, op. cit. note 48; Hess, op. cit. note 48.
70. Daniel Sarewitz and Roger Pielke, Jr, 'Breaking the Global-Warming Gridlock', *The Atlantic*, Vol. 286 (July 2000), 54–64.
71. Popularization obviously need not be limited to activist scholars, as Trevor Pinch and Harry Collins (among others) have demonstrated with their cross-over *Golem* books, which are normative in the subtler senses of the term.
72. Brian Martin, 'Academics and Social Action', *Higher Education Review*, Vol. 16 (Spring 1984), 17–33.
73. A reviewer of this manuscript noted that 'plenty of rewards (big salaries, fame, sex, whatever) can accrue to academics whose work circulates widely, and who do not hesitate to speak up in the face of demands for "normative" pronouncements'. True, but misleading: such a route is about the opposite of assured, constituting in our eyes a high-risk exception to the normal reward system.
74. See, for example, Hess (2001), op. cit. note 41, esp. 'A Note on the Publication Format', 128–30.
75. Nicholas Maxwell's distinction between a 'philosophy of knowledge' – namely, science oriented to production of knowledge – and a 'philosophy of wisdom' – science oriented to solving the world's most pressing problems, such as poverty, war and environmental degradation – provides another way of positioning activist-oriented STS: see N. Maxwell, *From Knowledge to Wisdom: A Revolution in the Aims and Methods of Science* (Oxford: Basil Blackwell, 1984); N. Maxwell, 'What Kind of Inquiry Can Best Help Us Create a Good World?', *Science, Technology, & Human Values*, Vol. 17, No. 2 (Spring 1992), 205–27.

Edward Woodhouse is a democratic theorist interested in political-economic institutions, processes, and decision strategies for steering technoscience more wisely and more fairly.

David Hess has written on health and public understanding of science in Brazil and the United States, as well as more general essays and books on STS and anthropology. His most recent work is a series called *Alternative Pathways in Globalization* (see note 41, above).

Steve Breyman is author most recently of *Why Movements Matter: The West German Peace Movement and US Arms Control* (SUNY Press, 2001), and is active in many peace, environmental, human rights and justice organizations. Tune into his weekly progressive public affairs radio programme – 'On the Barricades' – over the web at < *www.wrpi.org* >.

Address: Department of Science and Technology Studies, Rensselaer Polytechnic Institute, Troy, New York 12180–3590, USA; fax: +1 518 276 2659; emails: woodhouse@rpi.edu; hessd@rpi.edu; breyms@rpi.edu

Brian Martin is the author of many books and articles on the critique of science, suppression of dissent, scientific controversies, the rôle of experts, information in a free society, and nonviolent alternatives to the war system. He is active in networks and groups promoting dissent and nonviolent defence.

Address: Science, Technology and Society, University of Wollongong, Wollongong, New South Wales 2522, Australia; fax: +61 2 4221 3452; email: brian_martin@uow.edu.au

We invite readers to contribute to the discussion initiated by this Discussion Paper. Candidate draft Responses should, in the first instance, be sent electronically to the Editor at *mel27@cornell.edu*, together with a covering note to confirm that all contributing authors have agreed to the submission, and that it does not contain material currently being considered for publication by any other journal.