

“Science, Technology, and Social Movements”

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Increasingly the interdisciplinary STS field has turned to the problem of how to make research relevant to the pressing ethical and policy issues of the day, and STS-influenced researchers have examined how changes in governance and expertise would allow increased democratic participation (Fischer 2000). One of the pathways toward increased democratic participation is social movements, and consequently their study has come to occupy increasing attention among STS researchers. Social movements enhance public participation in scientific and technical decision-making, encourage inclusion of popular perspectives even in specialized fields, and contribute to changes in the policymaking process that favor greater participation from nongovernmental organizations and citizens generally.

As researchers informed by STS embark on studies of social movements, they draw on a well-developed literature in the social studies of social movements. At the same time, STS perspectives can contribute to the general study of social movements by bringing a sophisticated understanding of how the knowledge-making process works in science and how the politics of expertise play out in various political arenas. Although some social movement studies place science and technology in a black box, it is also true that some currents of general social movement studies, in particular feminist research, draws on a sophisticated understanding of the social shaping/social construction hypothesis that is continuous with the STS field.

An additional contribution that STS can make to social movement studies, and vice-versa, returns to the history of one current in the STS field, which developed out of reform movements within science and has a more activist orientation to scholarship (Woodhouse et al. 2002). That current can provide a helpful corrective to a scholarly social movement literature, not to mention STS literature, that is seldom read or used by activists, and it can pose the question of how research that departs from a social movement-directed and oriented agenda is different from research that departs from a scholar-directed and oriented research agenda. Just as social movements shape and are shaped by their environment, so social movement researchers shape and are shaped by theirs. The key question is, who does the shaping?

Background on Social Movement Theory

[This section reviews social movement theories, including theories of resource mobilization, framing, political process, contentious politics, and new social movements.]

Mappings of Science, Technology, and Social Movements

[This section reviews various processes for mapping the triangle of science, technology, and social movements: 1) the development of networks or movements within the scientific field that seek to change the field; 2) the adoption and reconfiguration of technology by social movements; 3) the activism and advocacy work of scientists, when they enter the politic arena to oppose specific policies and advocate others, including the issue of how

scientists negotiate their relations with social movements; and 4) the process that is the focus of this review essay, focuses on the inverse agency of social movements and their influence on the development of modern science and technology.]

	Oppose existing technologies	Develop alternative science and technology
Health	Anti-smoking, anti-vaccine	Health-care access, embodied health movements
Environmental	Anti-nuclear, anti-GM food, environmental justice	Organic food, recycling and remanufacturing, green chemistry
Peace/weapons	Disarmament	Nonviolent defense
Information/media	Media reform	Alternative media, open source

Table 1: Oppositional and Alternative Social Movements

Health Social Movements

Prior to the last decades of the twentieth century, when huge disease-based patient advocacy movements emerged around AIDS and breast cancer, the primary popular mobilizations in the health arena were based on increasing access to health care (e.g., health insurance and government programs) and public health works (e.g., sanitation systems). In the late twentieth century social movements responsive to the movements for civil rights and women's rights developed wings specifically directed towards increasing access to health care, changing the quality of health care, and reforming the caring professions. For example, women mobilized to gain greater access to reproductive technologies and control over reproduction (Clarke, 1998). Health reform was a cornerstone of early civil rights organizing in the United States during segregation, and a "medical" civil rights movement emerged in the 1950s to push for racial integration of the medical professions as well as community health initiatives (Smith, 1995). The women's health movement, which developed in close conjunction with the movement for sexual self-determination and the reproductive rights movement, established a clinical infrastructure that increased women's access to woman-friendly health care (Morgen, 2002).

There are many possible categorizations of health social movements (see the Epstein chapter in this volume); we focus here on a category that Brown and Zavestoski (2004: 685-686) have called embodied health movements, which address "disease, disability, or illness experience by challenging science on etiology, diagnosis, treatment, and prevention." Primary examples of embodied health social movements are those based on disease, such as the breast cancer movement, and those based on therapies, such as the complementary and alternative medicine (CAM) movement. Embodied health social movements problematize the biological body, challenge existing scientific and medical knowledge, and involve collaborations between activists and scientists and health professionals (Brown et al., 2004a). As a result, for the process that we are focusing on, they are the most significant type of health social movement.

The focus on the biological body emerged in the context of the second wave women's movement, which forged an especially strong link between self-identity, health, sexuality, and reproductive status (Boston Women's Health Book Collective, 1971). That focus, which was unique to health-related and sexual rights social movements, provided a model as well as an organizing base for HIV/AIDS, breast cancer, and other mobilizations around specific diseases. The AIDS, CAM, and feminist movements developed extensive epistemic challenges to health research in arenas such as clinical trials methods, alternative therapies, and the modernization of research funding to include patient advocates. Research on embodied health social movements has some parallels with environmental and other technology-oriented movements, so some of the findings can be generalized to other social movements where science and technology issues are salient.

Embodied health social movements to date have been more prominent in the U.S. and a few other English-speaking countries. One explanation is that because politicians and state agencies are more responsive to the agendas of powerful medical professions and corporations, citizen activism is more necessary to achieve a more balanced consideration of community welfare. In contrast, movements that focus on access to basic health care have been more visible across a wider range of countries, particularly when one takes into account advocacy and activist efforts to provide basic health care services in countries that lack basic medical resources or, as in the United States, are without universal health insurance.

Embodied health social movements often face and challenge a "dominant epidemiological paradigm" based on a biomedical model widely believed to represent consensus knowledge about a disease, its etiology, and its treatment (Zavestoski et al., 2001; see also Clarke and Olesen, 1999). Some movements have challenged diagnostic criteria as well as disease categories such as homosexuality (Fausto-Sterling, 2000; Terry, 1999). The challenges are particularly acute in cases of presumptive diseases, such as postpartum depression (Taylor, 1996) or Gulf War-related diseases (Zavestoski et al., 2001), where there is no expert consensus regarding the existence of the disease, in contrast with diseases for which the existence is undisputed, such as breast cancer. In the case of breast cancer activism, the goal has centered on the less epistemically challenging issues of increasing research spending on treatment, diversifying treatment choices, developing greater access to treatment choices (Casamayou, 2001; Lerner, 2001) and, to a lesser extent, promoting prevention through nutrition and reduced exposure to carcinogenic chemicals (Epstein et al., 1998). The result of such activism has been significant changes in the "regimes of practice" that breast cancer patients experience in the clinical setting (Klawiter, 2004). As breast cancer research and treatment extended into the medicalization of prevention, the breast cancer movement became embroiled in scientific and regulatory controversies over the value of the use of drugs such as tamoxifen in "at risk" healthy women. Analysis of social movement action on this issue has necessitated a broad theoretical framework that includes the pharmaceutical industry, regulatory policy, design controversies over clinical trials, clinical standards differences, and the doctor-patient relationship (Fosket, 2004; Klawiter, 2002; Wooddell, 2004).

The various movements for complementary and alternative medicine (CAM) usually involve recognized diseases, such as cancer, but they also involve scientific controversies over the etiology, best treatment, and design of clinical trials. As a result, the CAM movements share some of the features of "presumptive" diseases, and they can provoke intense political confrontations with the medical profession, regulators, and medical research community (Johnston, 2004). The movement for CAM cancer therapies in the U.S. exhibits two general features shared with other pro- or alternative "technology- and product-oriented movements," such as movements for sustainable agriculture, renewable energy, and open source software: opposition to a specific technology or product combined with support for an

alternative, and a mix of grassroots social movement and advocacy organizations with professional and/or industrial reform movements that involve scientists and/or entrepreneurs (Hess, 2005; 2006). Professional reform movements generally do not use extra-institutional strategies, but they are often sympathetic to social movements that do, even if they operate at some distance from them (Frickel, 2004a; Hoffman, 1989; Woodhouse and Breyman 2005). The organizational mixture of the CAM movement is one factor behind the complex set of organizational responses given by the medical mainstream; those responses include avoidance, compromise, acquiescence, manipulation, and defiance (Goldner, 2004).

Over time many health social movements, like other social movements, undergo diversification and transformation. Sometimes counter-movements develop, or movements emerge on both sides of a longstanding controversy, as in the case of pro- and anti-flouridation networks (McNeil, 1957; Martin, 1991). Often they divide into accommodationist and radical wings; the former results in organizations that tend towards professionalized advocacy rather than grassroots activism. The pharmaceutical industry has provided significant funding for U.S. breast cancer organizations, leading to the possibility of organizational capture, while at the same time the rise of private breast cancer research foundations has created opportunities for, and potential conflicts among, lay funders and scientist researchers (Gibbon, 2003).

Another effect of the diversification and transformation of health social movements is that in some cases, such as the AIDS movement, social movement leaders undergo an “expertification” process (Epstein, 1996). The crossing of lay-expert divisions has continued to attract attention in the study of health social movements. In the U.S. breast cancer movement the diversification of organizations to include a broader class and ethnic basis was accompanied by organizational conflict between longstanding staff, who acquired various forms of expertise, and newcomers, who possess new and different knowledges (Hoffman, 2004). In interactions with scientists, health organizations play a role of discriminating between science and non-science that is similar to the state-funded boundary organizations described by Guston (2001), but health movement organizations push the boundaries of science in new directions and challenge identities and interests on both sides of the lay-expert divide (Brown et al., 2004a). Those interactions emphasize the mutual learning that occurs among patients, researchers, and clinicians in “reflexive organization” (Rabeharisoa and Callon, 2004). In some cases activists make the transition from the “narrow-band” competence of lay expertise, which is largely “interactional” expertise in Collins’s terms (2002), by assembling networks of researchers to produce biomedical knowledge or by obtaining more education so that they become professional researchers (Hess, 2004b). Institutionally and historically, in the U.S. a process of “medical modernization”—which recognizes the legitimate participation of patient representatives in funding decisions—has tended to replace an earlier strategy of management of relations with social movements based on suppression of dissident scientist/activist coalitions and a paternalistic, transmission model of biomedical knowledge through practicing clinicians and the media (Hess, 2004b). Yet, the existence of a social movement has also tended to increase the surveillance and levels of suppression of scientists whose work can aid the movement (Martin, 1999).

In addition to diversifying lay-expert divisions through hybridization, health social movements also undergo fragmentation in social composition that typically accompanies growth and alliances across social categories. The original AIDS movement in the U.S. was largely middle-class, male, and white, but over time it struggled with new issues as the social address opened up to African Americans and women (Epstein, 1996). Anti-smoking campaigns have struggled with the politics of extension to ethnic communities in California, and with the politics of national cultural differences as the campaigns extend out from the English-speaking countries (Reid, 2005). In some cases, anti-tobacco and other anti-drug

movements have also become linked to other social justice issues such as structural inequality and gender equity (Campbell, 2000; Nathanson, 1999; Oaks, 2001). The heterogeneity of participants in the U.S. disability rights and reproductive rights movements led to the formation of “divided interests” in the reproductive technologies arena (Rapp, 1999). Thus while health social movements can fracture around gender, racial-ethnic categories, sexualities, categories of age and ability, and class-based identities, recognition of difference and health disparities has also stimulated greater attention to “culturally competent” health care provision; gender, age, and ability equity; and the inclusion of formerly stigmatized identities such as alcoholics, drug addicts, sex workers, or persons with AIDS (Campbell, 2000; Stoller, 1998). Social movements have exerted pressure for mechanisms to ensure greater accountability between “markets” composed of users, consumers, and patients and the government agencies, health care providers, scientific researchers, and technological designers that supply these markets (Clarke, 1998; Oudshoorn and Pinch, 2003). Finally, movements to promote or limit the use of specific reproductive technologies arise to address the diversity of power-laden cultural contexts in which health care decisions are made (Briggs, 2003; Sen and Snow, 1994).

Environmental Movements, Science, and Technology

Many scholars now recognize that “the” environmental movement is, like other social movement categories, a very diverse sociological entity. Historical studies generally delineate a major transition during the 1960s from a focus on wilderness preservation to industrial pollution, and in the U.S. and some other countries during the 1980s there was a second shift to a third-wave focus on environmental justice (Dowie, 1995; Gottlieb, 1993; Kline, 2000). Organizations tend to focus on one of the three types of environmental action, but many have mixed goals that reflect the influence of all three waves. In many countries striking divisions have emerged between the government-oriented, insider, advocacy organizations and the proliferation of struggles at the grassroots level around environmental justice. There is also tremendous diversity across world regions and even within the wealthy, Western regions. For example, in Europe there has been a relatively stronger policy articulation of environmental concerns in than in the United States, where green or left-wing parties have been much more marginalized in electoral politics.

Of the various opposition movements within the broader environmental movement that targeted mainstream science and technology, the worldwide movement against nuclear power and genetically modified food provide two examples of how movements challenge scientific knowledge and emergent technologies, particularly around issues of risk and safety. Activists have proceeded on the assumption that nuclear power is not inevitable, and likewise much STS scholarship has been devoted to analyzing and criticizing the idea of nuclear safety and risk (Falk, 1982; Smith and Marx, 1994; Winner, 1977; Woodhouse and Morone 1988). Activists and STS scholars alike developed a critique of the politics of design around nuclear power: it is expensive, potentially dangerous, dependent on experts, and thus antagonistic to democratic society (Patterson, 1977; Winner, 1986). Likewise, campaigns against genetically modified foods have challenged scientific and government assurances of safety. A second expression of the environmental movement relevant to science and technology has involved food politics (Bauer and Gaskell, 2002; Purdue, 2000; Schurman, 2004). However, although activists may feel the need to be drawn into a debate with experts over the risks of GM food, in Europe, India, and other world regions activists also frame the debate and protest events around concerns with globalization and U.S. food hegemony (Harper, 2004; Heller, 2001; Shiva, 2000).

As with health social movements, environmental movements not only challenge the epistemic assurances of governments and scientists, but they also encourage the development

of alternatives. In the 1970s proponents of appropriate technology—sometimes also called alternative technology or intermediate technology, among other names—argued that technologies embodied political values, and they developed and promoted technologies appropriate for communities (Kleiman, 2005). In poorer countries, appropriate technology ideally required low capital, used local resources, was labor intensive and small scale, could be controlled by villagers, could be locally produced and modified, brought people together, and was environmentally sound, thus combining both technical and social characteristics (Darrow and Saxenian, 1986). There have been many debates about the politics of appropriate technology (Boyle and Harper, 1976; Dickson, 1974; Illich, 1973; Kleiman, 2005; Lovins, 1977; Riedijk, 1986; Willoughby, 1990; Winner, 1986); the key point here is that the movement drew attention to the design of technology as a social goal. The appropriate technology movement today has left a legacy in developing countries of low-tech, locally controlled development projects; in wealthy countries such as the U.S. the principal legacy is advocacy around renewable energy and sustainable agriculture.

In many cases both renewable energy and sustainable agriculture gradually grew from social movements into industries with associated scientific research programs. For example, in wind energy in Denmark was once a social movement, but over time it became incorporated by the political and economic system (Jamison et al., 1990). As it became mainstreamed, the locus of design shifted from lay users to professionals located in an increasingly large industry, and the scale of the technology increased as it became integrated into off-shore wind farms (Jørgensen and Karnøe, 1996). In many cases the transformations of technology design involve a process of “complementarization,” or redesign to fit alternative, movement-based technologies into existing portfolios of industrial production technologies and industry products (Hess, 2005). Likewise, the organic food movement developed an alternative form of scientific knowledge that challenged dominant research programs and combined lay-expert knowledges (Hassanein, 1999). Over time organic food production underwent an industrialization process, and a portion of the movement became mainstreamed, but a social movement side regrouped around the anti-globalization politics of local, sustainable agriculture (Guthman, 2004; Hess, 2004c). The organic food movement also plays a significant role in the anti-GM food mobilization, a process that demonstrates the fluidity of movements that oppose some forms of technology and support alternatives for other forms (Reed, 2002). Similar changes occurred with the recycling movement, which eventually became incorporated into the waste industry (Pellow 2002; Scheinberg, 2003; Weinberg et al., 2000).

More generally, the environmental movement underwent an historical development from activism to brokerage as protest politics shifted toward the development of green business networks (Jamison 2001b). By the 1990s the “cultural appropriation” of environmentalism as a social movement had resulted in professionalization, green businesses, and an orientation toward environmental innovation around “sustainable development,” but a new polarization had also emerged between the ecological modernization frame of green business and the environmental justice orientation of critical ecology proponents (Hård and Jamison, 2005; Mol, 2000). As environmentalism has undergone professionalization and industrialization, “object conflicts” have developed over definitions of what the technology/product should be. The conflicts take place in three arenas: research agendas, consumer decisions and loyalties, and standards set by regulatory agencies or industrial groups (Hess, 2005). Furthermore, the processes of institutionalizing environmental social movement goals has also led to a “systematic discounting” of efforts by activists and advocates to build corporate responsibility goals into legislation and corporate policies, as occurred in the case of the failure to respond completely to the calls for reform in the wake of the Bhopal disaster (Fortun, 2001).

In addition to problems that occur with industrialization, activists and scientists also encounter problems in their efforts to work together. As activists and environmental professionals work together, many have become convinced of the need for heterogeneity in environmental problem-solving models (Di Chiro, 2003; 2004). Those models need to recognize the different bases of lay and scientific knowledges and may benefit from deliberative processes that allow for the interaction of lay and expert knowledges (Breyman, 1993; Brown and Mikkelsen, 1990; Carson and Martin, 2002; Fischer, 2000; Wynne, 1996). Likewise, movements may split over opportunities and risks afforded by access to new research methods and technologies. For example, the influence of molecular biology on environmental health research (Frickel, 2004a) has created opportunities for activists in the form of new tools for documenting risks and exposures, but at the same time it has individualized and medicalized scientific research, therefore making it more difficult for activists to make claims of environmental causation (Shostak, 2004).

Environmental activists also encounter epistemic/political differences, as well as opportunities, when building bridges to other social movements. Examples of bridges where issues of expertise and design are salient are relations between environmental justice and sustainability groups (Agyeman et al., 2003), civil rights and urban transportation design (Bullard et al., 2004), and labor and environmental coalitions (Burgmann and Burgmann, 1998; Munday, 1981; Roddewig, 1978; Grossman and Daneker, 1979; Obach, 2002; Gould et al., 2004; Rose, 2000). Another synergy has developed around the connections between the environmental breast cancer movement (a wing of the larger breast cancer movement that focuses on environmental factors and allies with other environmental groups) and the environmental justice movement, which have synergies regarding exposure to endocrine-disrupting chemicals (Ley 2003). The two movements may each be in a “steering” or “guiding” role with respect to the broader breast cancer and environmental movements (Brown et al., 2004b). Likewise, food-based politics provide a point of connection between health and environmental movements (Cohen, 2004; Hess, 2002).

Other Movements

[This section reviews the anti-nuclear weapons movement, the nonviolence movement, and information and media movements.]

Conclusions

Social movement organizations that emerge from grassroots grievances frequently challenge consensus scientific knowledge, official assessments of safety and risk, and the technology trajectories of corporate elites. They seek alliances with scientists and already established interest groups as well as with entrepreneurs and the business sector. Yet, relations among social movements, scientific research networks, and business organizations are frequently beset by conflict as much as cooperation. At a technical level, the success of alternative technologies and products comes at the cost of a “complementarization” process in which the more politically charged design elements and social organizational innovations drop out. At the discursive level, social movements must often pitch critical alternatives in a language that reflects the dominant “governing mentalities” that prevail in a particular policy arena in order to be heard as credible (Campbell, 2000). As a result, some social movements that seek changes in science and technology issues often find their goals incorporated at a technical level but at a cost of severing the technical goals from the broader political and justice goals. In summary, social movements, scientists, and entrepreneurs are uneasy allies and partners, and alliances sometimes shift into conflict and hostility—or they simply drift in

different directions—even as they generate new research programs, technologies, and material culture.

Uneasy partnerships of social movements, scientists, and entrepreneurs are likely to grow over the coming decades. Social movements in general, but especially those oriented toward science and technology, have been particularly salient since the 1960s, and an underlying analysis of the causes suggests why they will continue to be prominent. However, the episodic trajectory of peace movements suggests the high level of contingency in citizen mobilization and the difficulty of developing historical explanations for the increased salience of science and technology to social movements. There is still much to be learned in explaining the prevalence and dynamics of social movements.

It would be possible to chart out several areas for further exploration. Several questions emerge out of this review, among them the following: Is it true that issues of science and technology have become more salient in social movements, and, if so, what explanations can be mounted? How does the science, technology, and movement interface vary not only across time, but across space? To what extent are comparative differences less important as movements become more globalized? How are the four processes in our mapping of science, technology, and movements related to each other, and what other processes are worth studying? How do science and technology issues work in conservative and anti-democratic movements, which were not the focus of this essay?

Yet, before charting out an agenda for the study of STS and social movements, we suggest that it would be valuable to step back and return to the broader issue of science, technology, and democracy that was raised at the beginning of this essay. If the study of social movements is to be more than an academic enterprise, but one that contributes to the success of social movements, then the first question might be how can the study of science, technology, and social movements be configured in a way that is of value to activists? This question returns STS to one of its originary strands, when portions of the interdisciplinary field were closely connected to scientific and technological reform movements.

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References

[See the handbook chapter for the full references.]