



## Just science? Organizing scientist activism in the US environmental justice movement

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# **JUST SCIENCE? Organizing Scientist Activism in the US Environmental Justice Movement**

SCOTT FRICKEL

A major focus of social research on mobilizations for environmental justice in the US has been a cataloguing of the various ways in which citizens' groups are adopting the methods and language of science to wage a grassroots offensive against industrial polluters and their allies in government.<sup>1</sup> Across the country, the mostly working-class and often minority residents living in at-risk communities conduct neighbourhood health surveys, map pollution flows through their streets and waterways, carry out 'body burden' studies, videotape visible evidence of chemical releases from industry smokestacks and pipelines, and monitor 'fenceline' air, water, and soil quality (Brown and Mikkelsen, 1990; Fischer, 2000; Irwin, 1995; Kroll-Smith and Floyd, 1997; O'Rourke and Macey, 2003). One result of this reorganization of activism has been to call into question the credibility of science, as expert knowledge and institutions face new and in some cases fundamental challenges from local community groups (Tesh, 2000).

Another result has been what appear to be changes in the professional culture of environmental science itself. Specifically, there is mounting evidence within the ecological and environmental health sciences that 'a new breed of scientist-advocate' is emerging (Brown, 2000). Barbara Allen's research on environmental conflict along Louisiana's industrial corridor goes even further (2003; this volume): scientists not only usefully advocate on behalf of aggrieved communities, they also are becoming deeply engaged in these movements as 'expert-activists', often in the face of fierce resistance from industry and at great risk to their professional and economic futures. Similar evidence from a growing number of scholarly accounts suggests that scientist

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environmental activism is a deeply complex and contradictory social phenomenon that belies simple explanations and raises important questions (Frickel, 2004b; Tesh, 2000; Woodhouse and Breyman, forthcoming).

What are the institutional conditions that are encouraging scientist-activism? Is this form of protest organized and if so, how? What are the implications for environmental knowledge and politics of an emergent scientist populism intertwining with and informing grassroots mobilizations for community health and environmental justice? While existing research examines the role of individual experts in specific community-based struggles, answers to these broader questions will be generated through analyses of scientist collective action that are rooted in research on organizations and networks.<sup>2</sup>

This article develops an institutional analysis of scientist environmental justice activism. Institutional analyses of science engage questions about how political and economic relationships shape or channel the distribution of resources and social choices, constraining certain courses of action and enabling others (Moore and Frickel, forthcoming). This perspective sees organizations as important catalysts for social change (Clemens and Cook, 1999). As contexts for contentious collective action, organizations provide cultural spaces in which individuals can more freely challenge conventional rules and normative assumptions guiding research goals and resource distributions (Lounsbury and Ventresca, 2003). Organizations are also collective actors that reshape broader political and cultural processes by identifying new problems, constructing new identities, and legitimating new practices and boundaries (Frickel, 2004a; Lamont and Molnar, 2002; Moore and Hala, 2002). More broadly, organizational networks can alter institutional 'logics' by reconfiguring social relationships that pattern the production of knowledge (Alford and Friedland, 1991, p. 243). Science-oriented organizations and organizational networks are thus important sites for examining the forms scientist activism takes as an organized response to environmental injustice. I begin by considering some of the changing conditions of knowledge production that are likely to spur increasing levels of scientist environmental activism in the coming years.

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## ■ ASYMMETRICAL CONVERGENCE IN ENVIRONMENTAL RESEARCH

Institutional and cultural divisions once thought to distinguish industrial research from academic and government science are rapidly eroding (e.g. Etzkowitz *et al.*, 1998; Krinsky, 2003). These transformations will have broad implications for the social organization of environmental knowledge production. They pose serious challenges to—but also potential opportunities for—scientist environmental activism.

The theory of ‘asymmetrical convergence’ explains ongoing transformations in science as a process of institutional isomorphism in which ‘the codes and practices of industry are infiltrating the academy, even as academic norms are increasingly governing the work practices of selected knowledge workers in high technology firms and industries’ (Kleinman and Vallas, 2001, p. 451). The corporatization of the academy is not limited to the impacts of direct corporate investment in university research, but also involves a number of indirect cultural pressures. Among them, Kleinman and Vallas note the tendency for university administrations to make budgetary, hiring, tenure, and other decisions based on rate-of-return measures; the adoption of ‘standardised, quantitative measures of production’ in reward decisions; and new institutional arrangements that facilitate licensing agreements and patent provisions (pp. 467–468). Similarly, as corporations strive to gain access to the strategic knowledge resources housed at universities and compete with universities for top scientists, firms are adopting academic norms and practices in order to increase their legitimacy among potential employees and investors. These changes include, but are not limited to, publishing research in peer-reviewed journals; an emphasis on collegial organizational culture and collaboration; and continuing educational opportunities for employees (pp. 470–474).

These changes are ‘asymmetrical’ in that they favour the economic logic of markets over the academic logic of knowledge production. Kleinman and Vallas caution that this imbalance is likely to increase the relative marginalization of less-economically viable research programmes and laboratories as universities, governments, and industries alike concentrate financial and human resources in knowledge sectors that promise big financial payoffs. The unevenness of the process renders institutional and cultural convergence in

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science 'precarious, uneven, and rife with contradictions' and will likely have 'distinct impacts on different kinds of firms, varieties of universities, and strata of knowledge workers' (p. 466).

Data needed to assess precisely how these processes are impacting environmental scientists are difficult to come by. What is clear, however, is that when compared to the proven economic potential of such research domains as biotechnology, materials science, biomedicine, and information technology, most environmental science is already economically marginal (Sarewitz, 2000). Academic research expenditures in the environmental sciences in 1999 accounted for only 6.1% of total expenditures from federal, state, industry, and other sources. This represents a relative *decrease* from two decades earlier, when total expenditures for 1979 totalled 8.4%.<sup>3</sup> Based on this measure, environmental research remains (perhaps increasingly) vulnerable to the economic pressures driving institutional isomorphism in the new knowledge economy. These structural processes will do much to shape the productive potential of environmental science research—a labour market projected to grow by 21,000 jobs in the United States by 2010 (National Science Board, 2002).<sup>4</sup>

Another result of this trend toward asymmetrical convergence, made more apparent when the model is expanded to include government-sector research, is that in absolute terms the institutional presence of environmental science has expanded considerably during the past four decades to include environmental studies programmes, sub-disciplinary structures in ecology and biology, and environmental health specialties, among other social forms (e.g. Shostak, 2003). This expansion has occurred in universities and medical schools to be sure, but also in the federal science system of national laboratories and research facilities in various federal and state departments and agencies, and in the private non-profit and for-profit sectors. Moreover, because environmental science and policy research often has been legitimated by and organized through multi-disciplinary programmes (Caldwell, 1983) and because state and federal laboratories have made substantial contributions to the historical development of many environmental sciences (e.g. Palladino, 1996), increasingly environmental research is conceptualized and carried out through social networks that span disciplinary, employment sector, national–international, and public–private boundaries.

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These interrelated historical trends, involving an absolute increase in the institutional expansion of environmental research and a relative increase in the marginalization of that research vis-à-vis more economically profitable knowledge sectors, represent contradictory tensions likely to shape practices, careers, and politics in the environmental sciences in the coming decades. As the institutional distances separating environmental research in universities, industry, and government shrink, the formal and informal networks linking them are multiplying and thickening. These networks provide conduits not only for the exchange of professional and technical information, but also can serve as collective resources for activist scientists to challenge research priorities favouring private (corporate) interests over ecological and public goods. Paradoxically, the same processes that threaten to marginalize environmental research may simultaneously be creating the means for resistance among science professionals whose work is perceived by corporate boards, university administrators, and policy makers as having little direct market relevance. An unexpected outcome of asymmetrical convergence, then, may be that marginalization spurs the politicization of environmental knowledge workers by increasing their economic incentives to protest, while thickening boundary-spanning networks simultaneously increase professionals' capacities to collectively challenge social institutions hampering environmental reform, including science.

Social networks linking politicized knowledge workers in universities, state agencies, and industry are not likely to lead automatically to deep institutional reform, however. Cooptation remains an ever-present possibility for those researchers who take on administrative or advisory roles within government (e.g. Primack and von Hippel, 1974) as well as among those employed in hazardous industries (e.g. Markowitz and Rosner 2002). Individuals who do dissent, as Rachel Carson and many other 'oppositional professionals' have done, often face severe and lasting sanction (Brown *et al.*, 2000). Other obstacles to institutional reform include the cultural and class differences that tend to distinguish professional scientists from citizens groups (Roberts and Toffolon-Weiss, 2001, pp. 18–20). These differences have had profound repercussions for the environmental justice movement in the United States, with activists charging that scientists are more often obstacles than allies in the struggle (Bullard, 1993). Even so, the boundary-spanning networks in science resulting from asym-

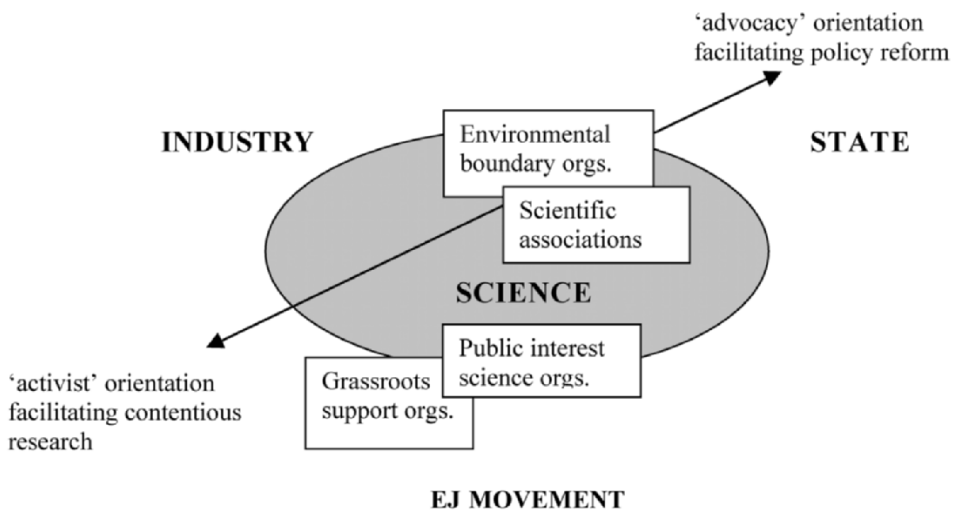
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metrical convergence represent a collective resource that would seem to possess significant, if as yet largely untapped, potential for mobilizing scientists who find their research and careers increasingly marginalized by those same convergence processes. That mobilizing potential increases considerably with the proliferation of organizations that serve as staging grounds for science activism.

### ■ **SCIENCE-ORIENTED ORGANIZATIONS AS MECHANISMS FOR ENVIRONMENTAL JUSTICE**

Sonnert and Holton (2002, pp. 54–55) have recently argued that the ‘little-known world of citizen-scientists’ organisations’ constitute an ‘important yet neglected “research site”’. Their broadly descriptive analysis profiling 86 ‘scientist’s public interest organisations’ is a step in the right direction, but much work remains. To date, there is no comprehensive analysis of scientists’ organizations that promote an activist orientation to research. And while the authors estimate that since World War II ‘several dozen such organisations have been founded’ (p. 54), the actual population of these organizations existing today is undoubtedly much higher, quite possibly numbering in the thousands if community–university collaborative research programmes are included (Loka Institute, 1998; Moore, forthcoming-b). Information gleaned from case study research suggests that while the topics that science-activists organize around vary widely, many seem to concentrate in the general areas of environmental and community health—the central concerns of movements for environmental justice.

Below I identify four types of science-oriented organizations that represent potentially important mechanisms for reshaping environmental justice conflict: environmental boundary organizations, scientific associations, public interest science organizations, and grassroots support organizations. Each organizational type confronts environmental justice from different social locations, involves different configurations of actors, and maintains different ‘attitudes’ toward boundaries distinguishing science from policy, and science from social movements. With regard to those boundaries, each also advances action strategies that fall along a continuum of political engagement (see Figure 1). Some pursue confrontational politics associated with participatory research pursued in direct opposition to



**Figure 1. An organizational ecology of scientist environmental justice activism**

‘mainstream’ science. Others tend toward reform-minded advocacy in specific policy contexts. I treat these types as analytically distinct social forms although in practice there is overlap. For example, some grassroots support groups are staffed by trained scientists, and some environmental boundary organizations include non-credentialed members. Moreover, the four types examined here do not exhaust the kinds of organization that structure scientist environmental justice activism. I do not consider university–community collaborations, for example, or scientists working for national environmental organizations. In describing each type, I selected cases that seemed to broadly illustrate important distinguishing features in order to derive a framework that can be developed in future research. Empirical evidence comes from secondary sources as well as analysis of public documents, websites, interviews, and data from an in-process social network analysis.

*Environmental boundary organizations*

The asymmetrical convergence of private and public interests in science raises numerous questions about sciences’ relationship to



politics, questions that 'boundary organizations' are designed to specifically address. David Guston (2000, p. 30) defines boundary organizations as 'institutions that straddle the apparent science/politics boundary and, in doing so, internalise the provisional and ambiguous character of that boundary'. Located in universities or government agencies, often with formal participation in or financial support from industry, boundary organizations operate at the edges 'of the two relatively different social worlds of politics and science, but they have distinct lines of accountability to each'. Formal accountability encourages a form of scientific pluralism in which research and policy serving the interests of participating parties emerge through compromise and 'co-production' (Guston, 2001, p. 401). When successfully implemented, boundary organizations in environmental science and policy seem likely to institutionalize new and lasting relationships among scientists, government officials, and industry actors.

One way these reconfigurations can play out is illustrated by the case of the Health Effects Institute (HEI), an institution whose research and policy reports on air quality are supported with equal funding from the US EPA and the auto industry. Created as 'a novel experiment' in 1980, HEI underwent organizational changes in the mid-1990s that included creating an independent board of directors and a dual advisory committee structure (see also Jasanoff, 1990; Keating, 2001, p. 409). Structural independence from its sponsors protects HEI from charges of bias. In order to avoid isolation from those same sponsors, HEI also now follows 'an approach of inclusion' by 'reaching out to sponsors, listening to their needs, and designing research programs to be responsive and timely' (Keating, 2001, p. 427). As a result, HEI now enjoys prestige as 'a central and respected institution in both the health effects research and air quality policy communities' (p. 409).

Environmental boundary organizations such as HEI serve an important function in helping to ensure that science has a place at policy-making tables traditionally reserved for the state and industry. However, they may be less-well suited for nurturing the democratization of knowledge-making that environmental justice movements demand. By targeting the science/policy boundary, environmental boundary organizations appear to do little to bridge the gulf between

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policy makers and community activists with limited access to policy arenas. In the absence of voices representing grassroots concerns, boundary organizations will tend to address a narrower range of more narrowly framed concerns. For example, conflict over the implementation and enforcement of existing environmental policy—issues that form the basis of many lawsuits and media campaigns brought by environmental justice groups against industrial polluters—do not seem to be pressing concerns for boundary organizations like the HEI that are focused on policy *innovation*.

A related set of concerns involves the importance that boundary organizations attach to institutional independence. Particularly because they tend to be so closely aligned with state and industry, boundary organizations' claims to autonomy deserve special scrutiny. At some level, HEI's continued existence depends on satisfying patrons' expectations and to the extent that this is generally so, boundary organizations serve a legitimating function for industry and the state. At stake in the case of HEI, is preservation of the auto industry's role in shaping federal environmental policy and furtherance of the public's perception that the state is supporting research that will translate into substantive policy reform (see Frickel and Davidson, 2004). Patronage ties also place limits on the range of contentious politics boundary organizations can productively engage. While they may provide activist scientists with a forum for raising politically contentious issues in policy arenas, it is not clear that boundary organizations fundamentally alter the power dynamics of policy decision-making, for example, by lessening the potential for government officials or industry representatives to have the first or final word. History suggests that those boundary organizations seen as threatening to the structure of state and economic power are simply eliminated, as the Office of Technology Assessment was in 1995 (Guston, 1999) and as the President's Scientific Advisory Committee was in 1973 (Sonnert and Holton, 2002, p. 13). Indeed, some scholars view boundary organizations less as a politicized response to asymmetrical convergence than as one of many new organizational forms emerging more or less naturally in the shift toward 'post-academic science' (Hellstrom *et al.*, 2003). Fortunately, environmental boundary organizations do not exhaust the potential for the intensification of productive state–societal networks. Rather, they represent one end of an organizational continuum.

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□ *Scientific associations*

Professional scientific associations are pivotal actors in institutionalizing 'scientific communication, norms, and professional identities' within and among scientific fields (Schofer, 2003, p. 732). As many scholars view scientific associations as an essentially conservative organizational form, their role in mobilizing autonomous science activism is less certain. For example, Kinchy and Kleinman (2003) argue that over time, isomorphic pressures operate on scientific associations in ways that enforce strict limits to societal and governmental interference in scientific research. This claim finds implicit support in research showing that scientific associations' functional goals, structural attributes, and discursive regimes exhibit relatively little variation historically or cross-nationally (Drori *et al.*, 2003; McClellan, 1985).

Nevertheless, scientific associations that formally represent environmental knowledge communities are potentially vital organizational resources for environmental justice movements. Scientific associations regularly defend scientists' autonomy and unlike most boundary organizations, scientific associations are funded mainly by membership dues rather than government grants or industry contracts. Thus scientific associations may find it in their collective interest to resist asymmetrical convergence processes that undermine the *prima facie* case for institutional independence and intellectual freedom. As importantly, this organizational type is ubiquitous in science. The formal and informal relationships connecting organizations representing allied fields and among national and regional associations within fields densely structures professional knowledge networks. In theory, each scientific association represents a 'weak bridging tie' that, if activated, could connect environmental justice movements to an elaborate network of intellectual resources (Granovetter, 1973).

Moreover, social politics do permeate the organizational structure of scientific associations, perhaps more than is generally appreciated. Kelly Moore has identified a historical shift in the way that scientific associations incorporated broader political concerns. She traces this shift in US science to the late-1960s and early-1970s, when science professionals politicized by that era's wave of social protest combined their political and professional interests by creating new organizations and committees. Sociologists for Women in Society and the

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Committee on Problems of Physics and Society (American Physical Society), both founded in 1969, are just two examples (Moore, forthcoming-a). Although organized dissent remains constrained by professional ideology and US tax laws prohibiting non-profit organizations from engaging in partisan political activity, today formal interest group politics has become a regular organizational feature of science.

Most contemporary scientific associations representing environmental fields now provide some combination of formalized education, outreach, and policy review activities. For example, the Society of Wetlands Scientists (2004), through its Wetlands Concerns Committee, makes available position papers in order 'to increase public understanding of wetland issues and promote sound public policy'. The Ecological Society of America's Public Affairs Office (2004) similarly 'works to give ecological science a voice on Capitol Hill and in the Administration and federal agencies' by issuing congressional briefs and statements on issues such as genetically modified foods or road-less areas. Similar examples from other scientific associations abound, and I believe it would be a mistake to discount these efforts as merely scientific business-as-usual. Doing so ignores the history of radical science activism that helped to further institutionalize interest group politics within disciplinary communities. It also presumes that science activism only counts as such if those actions visibly and directly pursue social change beyond science, whereas a small but growing body of research on activism in the environmental sciences suggests a different argument: scientist collective action that appears to outsiders as mundane practice may in fact constitute forms of contentious politics within the context of normative standards of scientific conduct. Furthermore, science activism pursued 'upstream' in laboratories, conferences, and classrooms can also have sociopolitical impacts that, if less publicly visible and less abrupt when they arrive, can be far-reaching (Frickel, 2004b; Woodhouse and Breyman, forthcoming).

Although the prospects for direct engagement with environmental justice movements remain limited, institutional trends toward asymmetrical convergence may provide scientific association members with the motivation and resources that encourage their indirect engagement through stepped-up advocacy, for example, by focusing public attention on lesser-known equity dimensions of environmental

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disruption, by giving voice to community concerns in scientific, advisory, and policy forums, or by reviewing industry-sponsored impact studies conducted 'in the public interest'.

□ *Public interest science organizations*

Public interest science organizations (PISOs) are 'distinguished by their explicit mission to seek ways to use science for the benefit of the public and by their connections to political movements' (Moore, 1996, p.1594, n.2). While PISOs have been around for the better part of a century (the American Association of Scientific Workers was founded in 1918), in recent years several newer organizations have emerged that take an active focus on environmental science, health, and justice. Unlike boundary organizations, PISOs are located 'outside the government, often in opposition to government policies' (Sonnert and Holton, 2002, p. 14). And unlike professional scientific associations, PISOs are organized in direct relation to political movements.

The Science and Environmental Health Network (SEHN) is one of the more prominent environmental and public health PISOs. Founded in 1994, SEHN's mission statement calls for 'the wise application of science to the protection of the environment and public health' and serves the environmental movement by 'framing concepts and ethical considerations that give direction to the movement in North America and internationally'. An 'organisation without walls', its small and very active paid staff is composed of a lawyer, a public health specialist, an oceanographer, and an educator, all with past academic experience, but SEHN's website generously attributes success mostly to 'work carried out by its 42 organisational members and by hundreds of volunteer scientists' (Science and Environmental Health Network, 2004b). Where most scientific associations see their service mission largely in terms of advising government and public education, SEHN's goals prominently include providing 'outlets and support for scientists to engage in public interest research and public service' and working to 'insure that public policy is informed by science that is grounded in ethics and logic' (Science and Environmental Health Network, 2004a). In line with these general goals, SEHN's action strategies have centred on challenging cultural assumptions that underlie the production of

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scientific knowledge and its public, legal, and regulatory consumption, particularly as they relate to five main projects: the precautionary principle, ecological medicine, US tort law reform, agricultural biotechnology, and public interest research. SEHN staff have organized conferences and workshops; made presentations to academic, medical, government, and general public audiences; published in legal and public health journals as well as in non-academic outlets; produced an on-line newsletter (*The Networker*) that includes dissenting letters-to-the-editor (Science and Environmental Health Network, 2002); and conducted research that applies environmental and social ethics to real world problems (e.g. Skov and Myers, 2004).

As these examples suggest, the explicit mission of many PISOs goes well beyond simple provision of knowledge, expert advice, or policy discussion that are hallmarks of scientific association advocacy. Indeed, SEHN works hard to establish organizational legitimacy as a *credible* critic of mainstream science, one whose goals and strategies will appeal to environmental knowledge workers. Through reflexive critique of ‘value-free’ science, PISOs such as SEHN call into question the political nature of the science/policy boundary that boundary organizations reproduce internally. Instead, or in addition, PISOs work aggressively in conjunction with movements to promote alternative research explicitly grounded in social values. By combining research with political action and by providing a virtual home where scientists can engage in critical debate and activist research without giving up their day jobs, SEHN and kindred PISOs are establishing new expectations for scientific engagement in public life and constructing cultural spaces that better accommodate scientists’ ‘professional’ and ‘activist’ identities. Aligned institutionally and ideologically closer to social movements than either boundary organizations or scientific associations, PISOs are more likely to work toward deeper institutional reform, in part by fostering relationships with organizational actors connected to the environmental justice movement’s grass roots.

*Grassroots support organizations*

As the term implies, grassroots support organizations (GSOs) assist locally-organized citizens’ groups engaged in environmental justice

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conflicts by ‘providing information on mobilizing members, running meetings, using scientific data, talking with the media, pressuring policy makers, and dealing with stress’ (Tesh, 2000, p. 3). Tesh identifies Center for Health, Environment, and Justice (formerly Citizens Clearinghouse for Hazardous Waste) as one of the largest GSOs, noting that some of the large national and international environmental organizations such as Greenpeace and Sierra Club also support grassroots organizing efforts. Most GSOs, however, tend to be locally or regionally focused and maintain comparatively small paid staffs with limited operating budgets.<sup>5</sup> While the distinctions between GSOs and PISOs sometimes blur, several general characteristics distinguish the former as an organizational type.

The main difference is that GSOs are social movement organizations that draw on scientific expertise, not scientific organizations that engage political movements. They are staffed by professional activists and volunteers, not professional scientists. In the organizational ecology of environmental and health movements, GSOs connect citizens’ groups to the broader movement infrastructure and facilitate communication among geographically distant community groups.

The longer term goals of GSOs generally correspond with environmental movement goals. For example, both demand that government agencies enforce existing regulations and that industrial plants clean up production and improve worker safety. But their near-term goals differ. When people’s lives and community health are at stake, environmentalist ideals give way to practical tasks such as community organizing, gathering industry accident report information, or convincing local media to cover environmental justice-related events. The day-to-day challenges for GSOs involve figuring out ways to achieve pragmatic results that directly impact at-risk communities, often in the context of rapidly changing political environments and under conditions of highly constrained access to time-sensitive information.

While their on-the-ground actions may involve ‘the wise application of science’, GSOs tend to be less concerned about maintaining the credibility of science than with contesting the credibility of industry and government claims that, for example, ‘no harm has resulted’ from accidental chemical releases. In contexts characterized by extreme imbalances of power, environmental professionals of

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various stripes can play a number of important roles in challenging the sometimes dubious assertions of fact put forth by the state and industry. But the input of technical expertise is not always useful or appropriate. As the director of one GSO admitted, 'we don't need a lot of data'. What they do need is the right data at the right time presented in the right fashion to the right audience. To optimize these context-specific needs, GSOs engage science on an as-needed basis, for example, when an accidental release at a chemical plant sends a plume of 'steam' into a nearby neighbourhood, or when a community organizing campaign is launched, or during government hearings convened to decide on a refinery's application for a permitting waiver. Opportunities to productively exploit science often emerge suddenly and dissipate just as quickly. Capitalizing on those opportunities is made easier by networks formed, for example, through alliances with environmental and health experts concentrated at nearby universities or colleges or through personal connections to experts further afield. What matters, this same director told me, is timely access to 'people who get stuff done' and to 'people who connect you to other people'.<sup>6</sup> Empirical evidence supports these observations.

The social network of my informant's GSO contained 15 environmental experts representing natural, social, administrative, and health sciences. These experts were concentrated in academics, but also included government scientists, self-employed researchers, and activist-experts working in PISOs. During the four years of this organization's existence, these experts have performed a wide range of specific services that involved social legitimation, technical skill provision, and community education. But levels of involvement varied a great deal. My informant categorized only three experts' relationships with the GSO as 'ongoing and regular' and noted that nearly half were not currently 'live' or active network nodes (data in author's files).

Although preliminary, these findings are instructive. They suggest that at the grassroots scientist activism tends to be intermittent and tailored to specific context-dependent tasks. They also speak to the importance of flexible and largely informal organizational networks that link local citizens, environmental organizers, technical experts, and government officials. These collective structures are important not only because they enable communication among differently

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located and interested actors, but also because the networks can endure beyond the limits (real or perceived) of any particular individual or campaign.

## ■ CONCLUSION

The asymmetrical convergence of university and industry research cultures is diverting academic resources away from environmental knowledge production toward more profitable research domains. Paradoxically, these same processes are simultaneously connecting environmental knowledge workers in different fields and occupational sectors in ways that increase the capacity for marginalized scientists to collectively challenge the shift from public to proprietary research. Whether or not scientists take collective advantage of these unanticipated opportunities remains an empirical question, but in the context of the US environmental justice movement, mounting evidence suggests that efforts to organize expert-activists are well underway. In the face of continuing professional pressures to remain above the political fray, the emergence of new science-oriented organizations and the politicization of existing ones are strong indications that a culture of activism among environmental research professionals is emerging as a legitimate means of political expression.

The four types of science-oriented organizations described in this article provide a starting point for mapping the organization of scientist environmental justice activism. Environmental boundary organizations, scientific associations, public interest science organizations (PISOs), and grassroots support organizations (GSOs) are challenging normative assumptions about the professional roles and responsibilities of scientists. I have argued that those challenges are taking different forms and having different impacts for the professional cultures and practices governing the production of environmental knowledge. Environmental boundary organizations are creating institutional space for environmental science in policy arenas, disciplinary communities are engaging more directly in interest group politics, PISOs are providing incentives for university researchers to engage in collaborative efforts with social movements, and GSOs are building networks that pull academic and other scientists into environmental justice struggles at the community

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level. Yet there is much that we do not know about the organizational dynamics of environmental scientist activism. How do organizational differences in size, topical breadth, level of available resources, and research orientation condition members' willingness and capacity to engage in science activism of one sort or another? Do different types of organizations produce styles of expertise that differ systematically in the way problems are defined, research is designed, and data is interpreted?

These are not merely academic questions. They also represent opportunities for building an 'environmentalist' *social* science better equipped to anticipate reactions from powerful institutional challengers aligned against environmental justice movements (see Tesh, 2000, ch. 4). For example, it is well established that the knowledge, technical skill, and professional credibility that scientists bring to aggrieved community groups can prove indispensable (Allen, 2003), but do similar exchanges operate in reverse? How do scientists translate their experiences in public interest research and grassroots struggle into resources for mobilizing their scientist peers in university departments and scientific association meetings? What can be done to maximize the reverse flow of information and mobilize professional research networks? Under what conditions are coordination and coalition-building across the science/politics divide most likely to occur? Answers to these and related questions provide a critical corollary to the economic marginalization and political mobilization paradoxically conditioned by asymmetrical convergence: this is the realization that in certain contexts credible research and effective activism can be (and perhaps should be) seen as mutually constitutive; that a more ecologically and socially just science requires more than 'just' science.

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## □ NOTES

1. Movements for 'environmental justice' are constituted by the 'mobilisation and radicalisation of politically and economically marginalised groups subjected to disproportionate levels of environmental disruption and risk that are perceived as jeopardizing those groups' health, culture, and livelihood' (Frickel and Davidson, 2004, p. 96; see also Szasz, 1994; Cole and Foster, 2001).
2. While conceptual inspiration for the present analysis is drawn mainly from neoinstitutionalist organizational theory, research on social movements clearly has much to say about the hows and whys of science activism. See Frickel (2004b) for a detailed social movement analysis applied to the formation of an interdiscipline.
3. By comparison, expenditures for medical sciences accounts for 29.1% of the 1999 total, an amount that has steadily *increased* over the same 20-year period. See National Science Board (2002), Appendix table 5–9.
4. Specifically, jobs for 'environmental scientists and geoscientists' are expected to rise from 97,000 to 118,000 during 2000–2010. National Science Board (2002), Appendix table 3–53.
5. A few examples include 'Ann Arbor Ecology Center, the Southwest Network for Economic and Environmental Justice, the Colorado Environmental Coalition, the Delaware Valley Toxics Coalition, and the Northwest Coalition Against Pesticides' (Tesh, 2000, p. 3).
6. Interview with Anne Rolfes, Executive Director, Louisiana Bucket Brigade (7 October 2002); transcript in author's files.

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