Scientific Organizations as Environmental Actors:

Knowledge, Politics, and Synergy[1]

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Introduction

Consider the following examples of scientist environmental activism:

Example one: Alonzo[2] is a molecular biologist with a newly minted Ph.D. from New York University and well-established connections to high-profile research programs in the San Francisco Bay area. After graduating, Alonzo chose not to follow the traditional post-doctoral path into academic or industry life science research. Instead, he is applying for a patent on an RNA-analysis technique (the result of dissertation research) that provides a new way of measuring the molecular-level effects of chemicals in living organisms. At the same time, and with the help of a handful of like-minded colleagues, Alonzo also is soliciting private foundations for seed grants. Their goal: to establish and develop a non-profit organization devoted to adapting the tools of molecular genetics and biochemistry for use by grassroots environmental justice activists.

Example two: Sylvia is a chemist who owns and operates one of dozens of environmental testing laboratories in heavily polluted Southern Louisiana. A small business owner with a family to support, bills to pay, and her credibility to protect, Sylvia devotes roughly considerable time each month to pro bono chemical analysis work and courtroom testimony in environmental justice cases. A large portion of her voluntary work involves analyzing air samples collected in five gallon buckets by citizens living in low-income communities along Louisiana's "cancer alley"; the sampling kits were developed by EPA scientists to assist data collection efforts of a growing number of grassroots "bucket brigades."

Example three: A six-year collaboration between an environmental justice organization, a community health center, and a university research center in Harlem developed a

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[2] This and other names of individual scientists used in this paper are pseudonyms.

"community-based participatory research" model for addressing environmental justice concerns. Funded by the National Institute of Environmental Health Sciences, the Harlem project has involved "scientists work[ing] in close collaboration with community partners involved in all phases of the research, from inception of the research questions and study design, to the collection of the data, monitoring of ethical concerns, and interpretation of the study results" (Shepard, Northridge, and Stover 2002: 139). This is one of 15 demonstration projects sponsored by the Interagency Working Group on Environmental Justice (Lee 2002).

Molecular biologists embracing cutting-edge science as a high-tech approach to radical urban environmental and social justice . . . . A private enterprise chemist whose environmental and political values are shaping many of her business decisions . . . . A federal environmental justice research program that is literally "by the people, for the people" . . . . What's going on here? If the sociological literature on the relationship between environmental health science and environmental justice movements is any guide, these examples of role-reversing scientists who regularly traverse institutional, ideological, and economic class boundaries and whose social criticism includes self-reflexive critiques of science, make sense primarily as empirical anomalies.

More than a decade ago, Steven Yearley (1991) examined the "uneasy" alliance that seemed to persist among environmental scientists and environmental activists. Yearley explained sciences' ambiguous relationship to environmentalism in terms of mutual dependence (for credible knowledge and public support, respectively) in an atmosphere of reciprocal mistrust. For scientists, the mistrust was based on the professional dangers represented by value-laden environmental politics, and for activists, the mistrust was based on the perception that science and technology deserved much of the blame for creating environmental problems to begin with. Research on environmental illness (Brown and Mikkelsen 1990; Kroll-Smith, Brown, and Gunter 2000; Kroll-Smith and Floyd 1997) tends to invoke a similar script in which citizens and experts are cast as

opposing forces in a lop-sided struggle for credibility and control in the politics of environmental knowledge. In these narratives, the minor supporting roles played by "oppositional professionals" are theorized, if at all, as exceptions to the distanced professionalism that health scientists typically maintain between themselves and community groups seeking to legitimate "local" knowledge.

Consider the possibility, however, that the examples cited above are not mere anomalies that can be easily brushed aside, but rather illustrate broader-scale phenomena akin to social movements *within* science. These three instances of scientist-activism may in fact represent moments in an emergent scientific populism that runs parallel to and in complex ways intertwines with and informs the kinds of "popular epidemiology" (Brown 2000) and "citizen science" (Irwin 1995) that has attracted so much sociological attention in recent years. If that interpretation is even partly correct, we would do well to ask how these emerging social arrangements are likely to transform relationships between science, the state, and civil society. Unfortunately, environmental social theory leaves us relatively ill-equipped to explain social action that falls outside some relatively narrowly drawn conceptualizations of what scientists do, where and how they do it, and why it is or is not socially and ecologically relevant.

This paper argues for the institutional analysis of scientist environmental activism. Institutional analyses engage the question of how political and economic relationships shape or channel social choices, constraining certain courses of action and enabling others (DiMaggio and Powell 1991). From this perspective, decisions are made and social action is pursued in the context of "complex, historically emergent patterns of interaction that are embodied in social structures and taken for granted by individuals that

work within them" (Evans 1995:28). I am interested in the ways in which environmental knowledge and politics are mediated by and co-constructed through research networks, professional organizations, and environmental/citizens groups. These and other collective structures are important sites for examining the opportunities and constraints to scientist collective action and for identifying the various forms that scientist environmental activism takes as a *collective* response to the degradation of ecosystems and human communities.

This paper examines the problem of scientist environmental activism through the lens of "state-society synergy," as developed by political sociologist Peter Evans and his colleagues (Evans 1995; Evans 1996b; Evans 2002). Evans'(1996a: 1034) basic premise is that, under certain conditions, states and civil society actors develop positive and reciprocating linkages to one another such that "civic engagement strengthens state institutions and effective state institutions create an environment in which civic engagement is more likely to thrive." Synergy is an agency-oriented perspective that also recognizes social structure as a constraining force on individual and organizational social action.[3] Although Evans (1995) developed the synergy model initially to explain developmental potentialities in technology sectors in newly industrializing countries, the notion of synergy as dynamic state-civil society interaction also has broad applicability for thinking about nature-societal relationships. More recently, for example, Evans (2002) and his colleagues have used this framework in case study research to examine

[3] The literature addressing the role of social networks in coordinating social action, whether among states, markets, and civil society (Hollingsworth and Boyer 1997), organizational fields (DiMaggio 1991), or within organizations (Granovetter and Swedberg 1992) is vast. While much of this scholarship is generally relevant to some of the broad issues of institutional change that frame the arguments outlined below, my specific concern in this paper is not social networks, but scientist environmental activism. I find Evans' formulation of synergy a particularly useful framework for thinking about the forms that this particular type

efforts by community groups and local government in developing countries to create "livable cities" that balance economic requirements with sustainability goals. As Buttel (2000) has argued, synergy models bear close affinities to environmental social theories that seek to understand the way in which linkages between states, industry, and civil society actors are bringing about "ecological modernization" in some of the advanced industrialized nations of Northern Europe (e.g. Mol 1995). Additionally, I believe research on state-society synergy can provide a general framework for reorienting analyses in the United States on the relationship between the health sciences, the state, and environmental justice movements (Frickel and Davidson 2002).

The paper is organized in four main parts. Following a brief summary of the main conceptual elements of what I will refer to as Evans' "synergy thesis," I develop a set of related arguments that make a case for studying the creation of synergy in and through environmental health sciences. The third section brings organizations into the picture and describes the role that environmental "boundary organizations" play in building synergy. The fourth section describes some of the contributions that the meso-level analysis of scientist environmental collective action can make to theories of state-society synergy.

The Synergy thesis[4]

The synergy thesis is a theory that seeks to explain state action in terms of social capital formation – the creation of "ties that connect citizens and public officials across the public-private divide" (Evans 1996b: 1120). Synergy theorists argue for the political

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of collective action takes, the conditions in which it tends to emerge, and the factors that contribute to its failure or success.

[4] This section presents a selective summary of the conditions that characterize state-society synergy as developed in Evans 1996a and 1996b.

and analytical advantages of developing dense formal and informal social relationships among state managers and civic groups; the trust and loyalties that develop through day-to-day interaction are seen as a means of facilitating positive institutional change. Evans (1996a) distinguishes two complementary dimensions of synergy – "complementarity" and "embeddedness." He describes complementarity as a conventional way of thinking about exchanges between government bureaucracies and self-organized local communities. Complementarity is manifest through state provision of "lumpy collective goods" that communities cannot provide for themselves and that result in mutually supportive relations (Evans 1996b: 1123). Examples from research in developing country contexts include tangible inputs such as irrigation systems, sewers, dams and reservoirs, but also can include intangibles such as states' "provision and enforcement of universalistic rules," or legal norms; state-sponsored media campaigns are another type of intangible collective good that can spur actors' "sense of calling" to engage in public service and thus facilitate social capital formation (Ibid.). As these examples suggest, complementarity relationships maintain a distinct division of labor and are characterized by what Evans' (1996a: 1036) calls "an 'arm's length' interaction" between the state and community actors.

In contrast, embeddedness consists of "networks of trust and collaboration that are created to span the public/private boundary and bind state and civil society together" (Evans 1996b: 1122). Quite different from the arm's length interactions that characterize complementarity, embeddedness involves the development of reciprocal loyalties "among a set of tightly connected individuals who work closely together to achieve a common set of goals" (Ibid.: 1121). Through regular repeated interaction, state actors

become invested in community development projects and community activists develop productive levels of trust in state actors and their mutual goals. This collaborative dynamic, Evans argues, can offer poor, isolated communities concrete improvements as well as political and economic opportunities to strengthen and broaden institutional capacity and autonomy – particularly in situations where embeddedness is buoyed by complementarity-based social capital.

Evans (1996b:1124) notes that state-society synergy is highly context-dependent, shaped by historical patterns of state-building as well as by social structural features singly and in combination (e.g. degree of social inequality, type of political regime). The key point is to look for innovative ways to generate social ties in spite of the various historical/structural obstacles that may stand in the way. Research in developing countries demonstrates that even in impoverished communities struggling in contexts characterized by authoritarian political regimes, weak public institutions, and unevenly bureaucratized state agencies, "[t]here is every reason to believe that synergy is constructable. The trick is to temper the optimism inherent in a constructability perspective with the legitimate pessimism of contextual constraint." (1996b:1130). What might we learn about environmental knowledge and politics by applying a synergy-style framework to relationships among state managers, scientists, and environmental justice groups?

The case for synergy in environmental sociology of science

This section spells out some of the advantages to be gained by adopting Evans' synergy model in sociological accounts of environmental health science. I will argue that the benefits are both empirical and conceptual. On one hand, environmental scientists –

and environmental knowledge professionals more generally – are key actors in environmental conflict and are thus important targets for empirical research on social capital formation. On the other hand, the synergy model holds particular promise for better understanding the nature, scope, and social-transformative potential of scientist environmental collective action, particularly as it suggests ways in which the roles of scientists and the nature of scientist activism have been importantly under-theorized in environmental sociology. Since the synergy thesis demands that we pay careful attention to social structures and to broad institutional changes in society that constrain as well as provide opportunities for social capital formation, I begin with a brief consideration of the institutional conditions of environmental knowledge production.

The "in between-ness" of science

In 1999 employed life sciences Ph.D.s occupied 176,200 positions that spanned the major employment sectors structuring the United States knowledge economy (National Science Board 2002).[5] Although employment data on environmental life sciences are not published separately, we can safely assume that their employment profile achieves a similar distribution. Considered as an occupational class, environmental life scientists sit advantageously "in between" the state and civil society, thus raising the question: How does the heterogeneity of environmental scientists' institutional location facilitate or impede social capital formation? [6]

[5] For 1999, 54.8% of employed life scientists with Ph.D.s were employed in education, 35.4% in business/industry (including non-profits), and 9.8% in government. Data source: National Science Board. 2002. *Science and Engineering Indicators - 2002 (NSB 02-01)*, Appendix table 3-18. Arlington, VA: National Science Foundation.

[6] "Environmental life sciences" in the NSF data is defined somewhat narrowly to include "environmental science studies" and "forestry services," but notably does not include other relevant fields such as ecology or sub-fields in biology (e.g. ecological genetics) and the health sciences (e.g. environmental

While students of environmental knowledge production tend to place great emphasis on the specific, environmentally meaningful contexts in which scientific claims are generated, contested, and transmitted (e.g. Miller and Edwards 2001; Scarce 2000), most of this research overlooks the national context of scientific work and labor markets as it impacts environmental research. To date, for example, there is no study of the social organization of knowledge work in the environmental sciences comparable to, say, Busch and Lacey's (1983) institutional analysis of agricultural science. The gap is unfortunate since transformations currently underway will likely have broad implications for the social organization of environmental knowledge production and pose serious challenges to – but also potential opportunities for – scientist environmental activism.

Mounting evidence from organizational sociologists studying "university-industry relations" is suggestive in this respect. This research shows that the once-stable institutional and cultural divisions that distinguished industrial research from academic and government science are evaporating. This is particularly the case in biotechnology and related life sciences (e.g.Etzkowitz, Webster, and Healey 1998; Kenney 1986; Powell and Owen-Smith 1998). In recent work, Daniel Kleinman and Steven Vallas (2001) describe a more general process of "asymmetrical convergence" that is bringing about simultaneously the "industrialization" of academic research and the "collegialization" of industrial research.

These authors describe a process of institutional isomorphism in which "the codes and practices of industry are infiltrating the academy, even as academic norms are

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epidemiology). The employment and occupational data described in this section thus underestimate the size and scope of workforce participation in environmental life science research; by how much remains unclear. Source: National National Science Board. 2002. *Science and Engineering Indicators - 2002 (NSB 02-01),* Appendix table 3-1. Arlington, VA: National Science Foundation.

increasingly governing the work practices of selected knowledge workers in high technology firms and industries" (Kleinman and Vallas 2001: 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 pressures. Among them, Kleinman and Vallas note the tendency for university administrations make budgetary, hiring, tenure, and other decisions based on rate-of-return measures; the adoption of "standardized, quantitative measures of production" in reward decisions; and new institutional arrangements that facilitate licensing agreements and patent provisions (Ibid.: 467-8). Similarly, as corporations strive to gain access to the strategic knowledge resources housed at universities and compete with universities for top scientists, some evidence suggests that firms adopt 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 (Ibid.: 470-74).

Kleinman and Vallas (2001: 466) stress that asymmetrical convergence is "precarious, uneven, and rife with contradictions" and that the process will likely have "distinct impacts on different kinds of firms, varieties of universities, and strata of knowledge workers." There is little reason to suspect that environmental life science research – a labor market projected to grow by 21,000 jobs in the United States by 2010 – is immune from these broader structural processes (National Science Board 2002).[7]

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[7] Specifically, jobs for "environmental scientists and geoscientists" are expected to rise from 97,000 to 118,000 during 2000-2010. Data source: National Science Board. 2002. *Science and Engineering Indicators - 2002 (NSB 02-01)*, Appendix table 3-53. Arlington, VA: National Science Foundation.

Although we lack most of the data that will be needed to assess precisely how these processes are impacting environmental scientists and environmental knowledge production, at least one contradiction likely to develop from this convergence deserves preliminary consideration.

When compared to the proven economic potential of such research domains as biotechnology, materials science, biomedicine, and information technology, most environmental science remains economically marginal. As a rough indirect measure, we can note that expenditures for academic research in the environmental sciences in 1999 accounted for only 6.1% of total expenditures from federal, state, industry, and other sources. More telling is that since 1979, when the same expenditures totaled 8.4%, this percentage has gradually *declined*.[8] Thus, environmental science seems to have become increasingly vulnerable to the economic pressures driving institutional isomorphism in the new knowledge economy.

At the same time, the network structures linking environmental professionals to one another, often via research groups or professional organizations, represent what Evans (1996b: 1124) calls "existing endowments of social capital" that, when mobilized, can reduce the constraining pressures of social structure. In the past three decades or so the institutional presence of environmental science research not only in universities but also in medical schools, in the federal science system of national laboratories and research facilities in various federal departments and agencies, and in the private non-profit and for-profit sectors, has expanded considerably. Moreover, because

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[8] 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. Data source: National Science Board. 2002. *Science*

environmental research often has been legitimated by and organized through multi-disciplinary programs (Klein 1996: 96-101), and because state and federal laboratories have contributed as much to the historical development of many environmental sciences (systems ecology, pesticide research, environmental and genetic toxicology) as have university-based research (Bocking 1995; Frickel 2001; Halffman 1995; Kwa 1989; Palladino 1996), it is reasonable to expect that the networks that link different environmental research sectors constitute fairly dense and well-established bridging architectures.

In principle, existing endowments of social capital in the form of dense, heterogeneous professional networks can facilitate the forging of social ties between state managers and civil society actors. Spanning disciplinary, employment sector, national, and public-private boundaries, environmental science networks can operate vertically as important channels of institutional access to political elites and policy managers. They can also operate horizontally as mobilizing structures connecting environmental professionals to larger movements for social and environmental change. When activated, these channels of communication permit complementarity-based synergy, in the form of scientific advice to communities in need of expert knowledge and technical skills, as well as embeddedness-based synergy whereby environmental justice and anti-toxics groups modify scientific practices to better serve the needs of those communities (Tesh 2000).

Thus, asymmetrical convergence is marked by contradictory tensions that shape environmental science careers and practices. As the institutional boundaries separating corporate and university research blur, norms and practices that may once have

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and Engineering Indicators - 2002 (NSB 02-01), Appendix table 5-9. Arlington, VA: National Science Foundation

distinguished science research from science policy may also become increasingly difficult to delineate (Jasanoff 1987). As the corporatization of academic research marginalizes environmental scientists, the same processes create the means for resistance among science professionals working in environmental fields whose work has little or no direct market relevance. As the institutional distances separating environmental research in universities, industry, and government shrink, the formal and informal networks linking them are likely to multiply and thicken. These networks provide a select menu of opportunities and resources for activist scientists to challenge research priorities that favor private (corporate) interests over ecological and public goods. In short, the changing conditions of environmental knowledge production are likely to generate more scientist environmental activism, not less.

Scientist activism as embedded social relations

Evans' distinction between synergy based on complementarity and synergy based on embeddedness is also useful for rethinking some common assumptions regarding scientist activism. In rough terms, the "arm's length" interactions characteristic of "complementarity" conform to normative accounts of relationships among scientists, state actors and citizens groups. Conditions analogous to complementarity typically occur through the provision to state agencies or local communities of scientific or technical knowledge by "science advisors" or "experts."

This one-way information provision model has been the focus of considerable criticism from sociologists and social activists alike (Bullard 1993). All too often, critics charge, scientists don't share their research with affected communities, or scientists

provide knowledge that is inadequate, inconclusive or incorrect, or they provide knowledge that is different from that which states or communities actually need. Given the all too frequent failings of this model, however, we would do well to acknowledge, as Evans does, that this type of relationship *can be* mutually supportive. We can acknowledge – rightfully – that this model is neither always or universally appropriate, without dismissing out of hand the fact that scientists can and do provide reliable technical knowledge that communities and/or state actors need but cannot easily acquire on their own. In addition to such direct effects as the timely provision of useful knowledge, the relationships created through complementarity-based synergy lay a social foundation that can indirectly support and encourage synergy based on embeddedness (Evans 1996b).

The idea of embeddedness confounds standard accounts of expert-layperson relationships. The critical feature that defines conditions of embeddedness is the emergence of interwoven networks that are neither public nor private, but span the gap between these two spheres. These networks are constructed over time through regular interaction, as scientists in universities, government, and (probably less often) industry work with one another and with non-scientists toward common goals. Embeddedness doesn't imply a complete dissolution of a division of labor, but it does suggest an intensification of interaction and mutual involvement.[9]

[9] Applied to science, embeddedness-based synergy has close affinities to scholarly arguments for science's democratization (Kleinman 2000). But where the literature on democratizing science emphasizes the role that social movements have played in creating a role for citizens in science policy-making (Epstein 1996), embeddedness emphasizes conditions in which scientists venture beyond narrowly defined professional interests to engage research, policy, and politics "in the public interest." As I read them, democratization and embeddedness are complementary approaches that simply emphasize the roles of different actors.

Environmental sociologists come closest to studying the construction of embeddedness in case study research on popular epidemiology (Brown 2000). This literature inverts the standard account: "citizen-experts" and "local" knowledge take center stage against antagonistic forces in industry and government (Tesh 1999). While "oppositional professionals" at times play minor supporting roles, in the main, "regulatory agencies, health officials, and scientific organizations" are often "key obstacles" in grassroots efforts to connect industrial effluents to human disease (Brown, Kroll-Smith, and Gunter 2000: 9). While such situations are no doubt common, it is useful to note that the term "oppositional professional" reasonably describes only the first of the three examples of scientist environmental activism used to introduce this paper. The concept of embeddedness highlights at least two respects in which scientist activism is under-theorized.

One problem is that terms like "oppositional professional" emphasize the individual character of scientist activism over its social or organizational dimensions. As I argue below, conceptualizing scientist activism as a role played primarily by individuals, often on an ad hoc or intermittent basis, virtually assures that researchers will misrepresent and thus misunderstand the fundamentally social nature of this phenomenon. Another problem is that the term implies a level of mutual exclusivity of social action that underestimates the capacity of knowledge workers individually and collectively to devise workable strategies that balance or integrate economic/professional and moral/political choices. Among the scientists I have spoken to about this issue, one environmental toxicologist sought that balance by splitting his time between an adjunct teaching position at a major university and doing advocacy research for a national environmental

movement organization; an agricultural geneticist "boot-legged" monies from his USDA grant to support environmental research "under the table"; frustrated by the inadequacy of standard toxicology tests in assessing stream ecology as well as company prohibitions on publishing company-owned data, a researcher with Dow Chemical worked to establish the Society for Environmental Toxicology and Chemistry in order to promote the study of "eco-toxicology"; others wrote editorial essays or joined existing organizations or developed new research tools.[10] All of these examples constitute different varieties of scientist activism and none of them required these people to completely disengage from their professional spheres in order to do so. Embeddedness reminds us that scientists are citizens too.

Social capital and the consequences of scientist activism

Sociologists traditionally have assessed science's social importance primarily in terms of knowledge outcomes. Merton (1973) studied the social system of science to understand the conditions under which scientists create credible knowledge. For Bourdieu (1975), the circulation of "scientific capital" distinguished science from other cultural fields. A more recent concern, noted above, has been with the commodification of knowledge and the control of "intellectual property" (Etzkowitz and Webster 1995). These and other perspectives on science – e.g. Latour's (1987) efforts to understand "science-in-the-making" – emphasize the productive aspects of science in generating and distributing goods (facts, theories, practices) and services (advice-giving, policy-making, technology-generating). In contrast, Evans' approach to synergy, which focuses on the *formation* of social capital rather than the *production* of goods and services, encourages

[10] Transcripts and notes from these interviews are in the author's possession.

us to think about social capital as an additional outcome in science whose importance in environmental sociology is often overlooked. Synergy reminds us that there is more to science than fact- and policy-making and this insight, in turn, has important implications for how we conceptualize and study scientist activism in environmental politics.

I argued in the previous section that it is important to take a broad view of the various forms that scientist activism can take. New work by Kelly Moore shows why it is useful to approach the *consequences* of scientist activism from a similarly wide angle. Moore (Forthcoming)[11] provides an historical-institutional account of radical and liberal traditions of scientist activism in the United States during the three decades following the Second World War. She examines the organizations that scientists created to further their political goals and that embodied distinct beliefs and values concerning scientists' proper relationship to politics in democratic society. In assessing the relative success of organizations such as Science for the People and Union of Concerned Scientists, Moore argues that it is insufficient to consider only the organizations' influence on policy changes. While scientist activism can be effective in directing policy reform, other more indirect outcomes can also have important and lasting effects. Among these Moore counts the development of new ideas and values that influence scientists' research, social critique, and public service (p. 233); the transformation of scientific practices that enable the production of new kinds of knowledge and involve new ways of interacting with nature (p. 267); the creation of new social relationships forged through protest (p. 233); and, not least, new organizations (p.15).

Moore's research demonstrates that the social and institutional consequences of

[11] The page numbers cited in this paragraph refer to manuscript pages.

scientist activism sometimes involve powerful but subtle changes in scientific norms and practices that, over time, can transform relationships between science, the state, and civil society. Thus, analyses of the efficacy of environmental movements or the "greenness" of governments need not be limited to environmental policy assessments. We can and should look elsewhere to understand the social and institutional consequences of environmentalism. An important mechanism of institutional change in science, and a key marker of social capital formation are the innovative organizational forms, what Evans (1996b: 1129) refers to as "soft technologies," that help build synergy by rationalizing and legitimating regular interaction between state and civil society actors. The next section considers these.

Environmental boundary organizations

At present, sociologists know very little about the nature of scientist activism as a specialized form of environmental struggle. We know even less about how it is organized. As the previous discussion suggests, I believe that organizations and inter-organizational networks in science represent important actors and configurations in environmental politics, that have, with a few exceptions (e.g. scholarship on "epistemic communities" Haas 1989), been largely ignored.[12] Their analysis offers important opportunities to better understand the nature, scope, and transformative potential of scientist environmental activism, for at least four reasons.

First, organizations are important sources of stability and change, particularly in science. The authority of science is highly dependent on the perception of unity and

order, and organizations are important carriers of these institutional attributes. They represent and maintain order by regulating interaction among members and by legitimating those interactions through qualifications of membership and rules of conduct. Organizations are also cauldrons of change. They create and reproduce new meanings and identities, create new patterns of exchange, and promote new forms of social action (Moore Forthcoming: 16-17). Second, a meso-level analysis of scientist activism affords a view of scientific norms and practices in terms of complexes of relationships that, as embodied by organizations, are *relatively stable* over time. From this position, claims implicit in extant approaches – about, for example, the sway of professional commitments in constraining scientist activism, the uni-directional influence that corporations have on scientific research and science policy – are treated as empirical issues worthy of careful analysis, not as *de facto* assumptions. Third, research on the organization of scientist collective action allows us to empirically test the dual assumptions, implicit in much of the research on "oppositional professionals" in anti-toxics and environmental justice campaigns, that scientist activism is largely an individual and infrequent phenomena. Finally, focusing empirical research on organizations in science directs our attention to the very linkages between state, private capital, and civil society defined by Peter Evans as "synergy." Because scientific or science-oriented organizations often straddle institutional, ideological, and political boundaries, they provide an important context for examining how and under what conditions synergy is constructed.

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[12] Generally, organizations are social systems organized around specific goals whose members are governed by explicit norms or rules for behavior. I have in mind more specifically the kinds of voluntary associations common to professions, political parties, and social movements.

Some evidence for these claims are found in the rise of environmental "boundary organizations" that spread across the private-public divide and in interesting ways embody the intertwining of environmental knowledge and environmental politics. Hugh Guston (2000: 30) defines boundary organizations as "institutions that straddle the apparent science/politics boundary and, in doing so, internalize the provisional and ambiguous character of that boundary." Boundary organizations clarify or stabilize those boundaries to external view and thus maintain social order during moments when that order is called into question. As Kelly Moore (1996: 1596, italics in original) has noted, "the process of setting boundaries is not simply a struggle between a unified group of scientists and nonscientists, but a process of struggle *among* scientists as well." Environmental conflict presents many such moments, often involving struggles over multiple boundaries simultaneously (Frickel 2001). At least three distinct social forms confront the science-politics divide as environmental boundary organizations.

The first are *professional scientific societies*. The scopes of these organizations vary. Some are specifically structured to represent and promote the interests of scientific disciplines or disciplinary complexes, such as Ecological Society of America and the American Institute of Biological Sciences. Others are more specifically focused on addressing a particular problem or class of problems. Depending on the organization's scope, mission, size, and funding sources, professional scientific societies may attract a broadly multidisciplinary membership and one that additionally cuts across university, government, and industry sectors of the scientific labor force. The specific mix of factors will also shape the form and level of environmental activism that is promoted and/or pursued by any given organization. At a minimum we might expect some combination of

formalized education, outreach, and policy review components. A more extreme approach would be to mount an organized campaign to transform scientific research and policy toward ecological sustainability goals.

"Scientized" environmental movement organizations (EMOs) are a second arena in which the boundaries between science and environmentalism are formally and intentionally blurred. In the past few decades, many EMOs have not only adopted the discourse of science, but have taken steps to incorporate environmental knowledge production into their organizational agenda/program (Yearley 1996). Research, in other words, has become a protest strategy. The manner in which this occurs varies across the range of EMO actors. Greenpeace represents one end of the continuum, with its own laboratories, research funds, and Ph.D. and M.S. scientists on staff. At the other end, smaller EMOs, such as grassroots groups engaged in community health effects research might "piggy-back" on nearby universities, forming alliances with faculty members who may contribute research time, research findings, as well as provide training to laypeople as well as aid in data analysis, report preparation, and presentation of findings.

Radical environmental science organizations (RESOs) represent a third organizational type. RESOs are organizations comprised mostly but not exclusively of professional scientists who engage in reflexive examination of sciences' relationship to society, nature, and politics. RESOs are to the environmental science community what grass-roots environmental justice networks are to mainstream environmentalism – a radical response to and critique of environmental science-as-usual. Where the public education/outreach and policy components of professional scientific societies finesse the science-politics boundary, RESOs attack it, calling into question the political nature of

the boundary itself. One of the more notable RESOs is the Science and Environmental Health Network, which has been a vocal advocate for the "precautionary principle" (Tickner, Raffensperger, and Myers 1999). These organizations, funded by foundation grants and member donations, are becoming an important voice in society's reflexive critique in risk society (Beck 1999).

A second look at synergy

Just as Evans' theory of state-society synergy gives impetus to a new understanding of scientist environmental collective action, empirical research on environmental boundary organizations also can contribute to a broader understanding of synergy as a mechanism for sustainable governance. As noted, environmental boundary organizations are important sites for empirical research on synergy. This is not only because boundary organizations are arenas in which or through which synergy-like relationships among scientists, state managers, policy-makers, and community activists are likely to occur, but also because they differ markedly from the community development projects in developing countries that provide the empirical grist for most existing research on synergy (cites). Those case studies demonstrate the potential for synergy to enhance *development* – typically through collaborative public works projects that involve building rural infrastructure (dams, irrigation systems, community health centers). Studies of synergy in environmental boundary organizations can pursue the counter-issue of whether synergy also can strengthen efforts to *protect* ecological habitat and *defend* the integrity and health of communities – urban and rural.

The analysis of environmental boundary organizations also posits a different type of actor in synergy construction: scientists. In the urban environmental struggles in Asia, Eastern Europe, and Latin America described by Evans' and his colleagues (Evans 2002), professionals are depicted, if at all, as generally opposing local sustainability efforts. One might expect that in poor countries with relatively few indigenous scientists and autonomous research institutions, demographic and political-economic factors place high constraints on scientist-activism. My argument about the networked organization of scientist environmental activism as it may exist in the United States – the world leader in scientific infrastructure, workforce, expenditures, and output – posits a different dynamic. I have already suggested how the economic transformations in industry and academic science may be creating conditions that encourage broader-scale scientist activism. Demography may be another important precipitating factor. Measured in terms of the relative density of scientists per capita, there may be a large enough population of scientists to warrant talking about them as an occupational class that mediates between the interests of states and local communities – a conduit that (ideally) expands and strengthens state-society connections.

Discussions of synergy begin from the assumption that states and civil society are not distinct categories, but intertwined through enduring social relationships based on trust and encouraged by the interdependence of objective interests. Yet most empirical research on synergy is designed to demonstrate how those conditions *are created* in specific, often local, contexts. The implication one draws from empirical studies is that, contra depictions of synergy-as-theory, states and societies are confronted on the ground as a priori separate categories. My argument about the heterogeneous and dense character

of research networks in science identifies a dimension of state-society interaction that exists as institutionalized patterns of relationships. In studying scientist environmental activism and its mobilization through existing networks, we are able to observe synergy, not as it is created, but as it is *recreated*; we can interview actors who reside in both domains simultaneously; we can study the boundary organizations that not only form but continually reproduce the very categories their activist members regularly transgress.

Conclusion

My focus in this paper has been on how we might use the ideas of synergy, complementarity, and embeddedness to better understand the relationship between environmental knowledge and politics as they intertwine in the environmental health sciences. To sum up:

Evans' discussion of "state-society synergy" has direct theoretical and empirical relevance in environmental sociology of science. On the theory side, an approach to environmental science through synergy encourages a broader view of the nature of scientist environmental activism and its socially embedded character across the so-called "divide" between the state and civil society. Synergy also permits a broader appreciation for the institutional consequences of scientist activism. Accordingly, we should attend to the ways in which networks of scientists create social capital through linkages "upward" to political elites as well as "outward" to other spheres of civil society. Finally, synergy is an agency-oriented perspective, but one that recognizes social structure as a constraining force on individual and organizational social action. It is an approach to science and the

politics of science that happily avoids tired epistemological debate over the real vs. constructed nature of environmental problems.

On the empirical side, the environmental health sciences provide an especially advantageous site for investigating the construction of synergy. This is because the heterogeneity of environmental scientists' institutional locations – in universities, medical schools, government agencies and laboratories, private industry, non-profit research centers, and environmental movement organizations – means that the research networks linking scientists to one another, to state actors, and to environmental justice groups lie across the public-private divide. If that divide is where synergy is continuously reformed, scientists would seem to have an important advantage given their existing "endowments" of social capital. Whether they take advantage of that potential is another matter. However, the rise of various types of environmental boundary organizations that in one way or another straddle or confront taken-for-granted distinctions between "science" and "politics" provide concrete evidence that, in certain quarters, scientists are using their knowledge, technical skills, and social networks to link up citizens groups and state agencies in ways that can generate positive institutional and environmental change.

Reconsider the three examples of scientist activism I used to introduce this paper. While two of these examples ostensibly emphasize the efforts of lone "oppositional professionals," all three illustrate the fundamentally social character of scientist environmental activism, suggest the central role of organizations in constructing community-based knowledge claims, and depict forms of state-society synergy based on some combination of complementarity and embeddedness. Of course, there is plenty of evidence that does not support synergy; the literature documenting numerous varieties of

environmental injustice are replete with negative cases. That the structural cards of political and economic interests seem inevitably stacked against synergy should not pre-empt a "tempered optimism" toward the potential for positive outcomes of scientist environmental collective action. I'll close with Evans' (1996b: 1131) good advice:

> While it is always fun and often useful to expose the perfidies of public sector actors, this kind of news is already in oversupply. What is needed is more research on positive cases.

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