CHEMICAL BODY BURDEN
AND PLACE-BASED STRUGGLES FOR ENVIRONMENTAL HEALTH AND JUSTICE
(A MULTI-SITE ETHNOGRAPHY OF BIOMONITORING SCIENCE)

By
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BOOK CHAPTERS


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“Toxic Ignorance and the Right-to-Know: Ethical and Scientific Challenges of Reporting Data in Biomonitoring Research.” Rachel Morello-Frosch, Julia Green Brody, Margaret Frye, Phil Brown, Rebecca Gasior Altman, Ruthann A. Rudel, and Carla Perez.

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“Sustained Participation in Social Movements: The Significance of Transformative Events in Communities and Families.” Rebecca Gasior Altman.


NON-REFEREED PUBLICATIONS


CONFERENCE PRESENTATIONS

“Pollution Comes Home and Gets Personal: Women’s Experience of Household Toxic Exposure.” Rebecca Gasior Altman, Rachel Morello-Frosch, Julia Brody, Ruthann A. Rudel, Phil Brown, and Mara Averick. 2007. The American Sociological Association Annual Meetings, New York.
“Right-to-Know, the Right-to-Act, and the Right Not-to-Know: Ethical and Scientific Dilemmas of Reporting Data in Biomonitoring and Environmental Exposure Studies.” Rachel Morello-Frosch, Julia Brody, Margaret Frye, Phil Brown, Rebecca Gasior Altman, Ruthann Rudel, and AJ Napolis. 2006. The American Sociological Association Annual Meetings, Montreal.


“Embodied Health Movements: Responses to a “Scientized” World.” Rachel Morello-Frosch, Stephen M. Zavestoski, Phil Brown, Brian Mayer, Sabrina McCormick, and Rebecca Gasior Altman. American Sociological Association Annual Meetings, San Francisco.


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“Policy Ethnography and Field Analysis: New Directions in Theory and Methods for Studying Health Social Movements.” Phil Brown, Rachel Morello-Frosch, Stephen Zavestoski, Laura Senier, Rebecca Gasior Altman, Elizabeth Hoover, Sabrina McCormick, Brian Mayer, and Crystal Adams. Invited for presentation at the University of Michigan Social Movements and Health Institutes Conference, October 2007, Ann Arbor, MI.

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RESEARCH EXPERIENCE

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An interdisciplinary working group. Substantive focus on health social movements, environmental health science, regional environmental health and justice advocacy, and public disputes over illness etiology and treatment. Research uses qualitative, multi-sited ethnographic, and engaged and/or community-based participatory approaches to research.

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Organizational Theories of the Public and Private Sector (Ann Dill, Sociology), Brown University, 2003.
Introduction to Community Health (Edith Balbach, Community Health), Tufts University, 2001.

Pedagogical Training


Guest Lecturer

“Chemicals in Bodies: Implications for Precautionary Thinking.” Fall 2007. Introduction to Community Health (Edith Balbach, Community Health Program), Tufts University.
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“Science and Environmental Organizing: Contests, Complexities & Consequences.” Fall 2006. The Science and Political Economy of Environmental Health and Social Justice (Rachel Morello-Frosch and Phil Brown), Brown University.

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Medical Sociology
Science, Knowledge & Technology
Social Movements & Collective Behavior


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To Gregory Andrew Altman (born mid-dissertation) who amiably has endured twin burdens—those burdens brought about as his post-partum, first-time mother scrambled to finish writing, and the chemical burdens he inherited as he grew inside and feeds from my body.

As Gwen Heistand once noted to me, biomonitoring enables us to read our bodies’ environmental histories like rings of a redwood, or borings sliced deep into the earth. Even if we do not know what the health implications might be, nevertheless our chemical body burden reveals much about living during the late 20th and early 21st century. What will future bodies say about our collective response?

“May the world’s feast be made safe for women and children. May mother’s milk run clean again. May denial give way to courageous action. May I (and we) always have faith.” Sandra Steingraber (2001: 283).
# Table of Contents

Chapter 1. Chemical Body Burden and Place-Based Struggles for Environmental Health and Justice

Chapter 2. Burden in Context: A Social History of Biomonitoring and Chemical Contestation

Chapter 3. A Lifecycle Approach to Body Burden Science and Advocacy

Chapter 4. Tracking Chemical Molecules: Multi-Sited Ethnography and Ethics

Chapter 5. Body Burden at the Fenceline: *Fluorinated-Compounds in the Mid-Ohio Valley*

Chapter 6. “Home is Where the Harm Is:” *Body Burden, Consumer Products, and Green Production in Maine*

Chapter 7. Persistence and Subsistence: *Transboundary Legacy Contaminants in Alaska*

Chapter 8. The Lifecycle of Legacy Chemicals and the Legacy of Biomonitoring

References

xiv
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>Belly brigade at the World Vinyl Forum</td>
</tr>
<tr>
<td>1-2</td>
<td>Non-Profit Organization and Community Biomonitoring, 2002-2007</td>
</tr>
<tr>
<td>1-3</td>
<td>Sites of Contact and Contestation across the Chemical Lifecycle</td>
</tr>
<tr>
<td>2-1</td>
<td>Key U.S. Environmental Policy Established 1969-2000</td>
</tr>
<tr>
<td>4-1</td>
<td>Relationship between Research Sites</td>
</tr>
<tr>
<td>4-2</td>
<td>Catalog of Observations and Participant Observations by Case</td>
</tr>
<tr>
<td>4-3</td>
<td>Catalog of Documents Collected by Case</td>
</tr>
<tr>
<td>5-1</td>
<td>Map of the Mid-Ohio Valley Region of Mid-Appalachia</td>
</tr>
<tr>
<td>5-2</td>
<td>DuPont’s Washington Works Plant and the Ohio River</td>
</tr>
<tr>
<td>5-3</td>
<td>Little Hocking Water Association Well Fields with DuPont in the Background</td>
</tr>
<tr>
<td>5-4</td>
<td>Relay For Life American Cancer Society fundraiser, Belpre, Ohio</td>
</tr>
<tr>
<td>5-5</td>
<td>Timeline of Key Events in Mid-Ohio Valley Case</td>
</tr>
<tr>
<td>5-6</td>
<td>Bottled Water Distribution, Warren County High School</td>
</tr>
<tr>
<td>6-1</td>
<td>Sample Participant Results for the Alliance for a Clean and Healthy Maine’s Body of Evidence Project</td>
</tr>
<tr>
<td>6-2</td>
<td>Alliance for a Clean and Healthy Maine “Wring Your Legislators” Ad</td>
</tr>
<tr>
<td>6-3</td>
<td>Alliance for a Clean and Healthy Maine Sponge</td>
</tr>
<tr>
<td>6-4</td>
<td>Body of Evidence Report Cover, the Alliance for a Clean and Healthy Maine</td>
</tr>
<tr>
<td>6-5</td>
<td>Flyer for the Growing Maine’s Green Economy Workshop</td>
</tr>
<tr>
<td>7-1</td>
<td>Formerly Used Defense Sites, St. Lawrence Island, Alaska</td>
</tr>
<tr>
<td>7-2</td>
<td>Environmental Justice for St. Lawrence Island Project Report Cover</td>
</tr>
</tbody>
</table>
Chapter 1

CHEMICAL BODY BURDEN
AND PLACE-BASED STRUGGLES FOR ENVIRONMENTAL HEALTH AND JUSTICE

FOLLOWING CHEMICAL MOLECULES

Through this dissertation, you, the reader, embark on a journey through places remote and, at first, seemingly unrelated—the Mid-Ohio Valley of Ohio and West Virginia, Maine, and Alaska. However, these places are connected by the migration of billions of chemical molecules that pass through them. This migration begins where chemical molecules are first synthesized and used by industry; it ends in the “receptor communities” (Downie and Fenge 2003) of the circumpolar North, who, as it turns out, inherit the legacy of persistent chemicals released into the environment. This dissertation not only follows chemicals as they journey from cradle to grave, but also the scientific techniques and social arrangements developed to count and contest their passage into human bodies at different stops along the way.

At issue are chemicals first synthesized in the boom years following World War II to build a consumer economy of affordable and convenient materials. These chemicals help eggs to slide from frying pans, and water to bead on breathable fabrics. They also impart flame retardancy to computers and furniture upholstered with synthetic fabrics. However, beginning during the late 1940s and intensifying throughout the 1960s and 1970s, scientific research documented synthetic chemicals in unexpected places. Scientists found pesticides and industrial solvents in human fat, and building up in the food chains of places remote from centers of industrial production, like the Arctic. These discoveries surprised scientists who had traveled to these regions to find unexposed, “control” populations to compare against workers and populations living close to industry. Instead, they found that chemical body burdens among residents of these seemingly “pristine” communities often were higher than burdens detected in people living in urban areas (see Cone 2006). Thus, only after thousands of synthetic chemicals went into widespread use did scientists and regulators come to realize that some are highly stable and capable of traveling
the globe on air and wind currents. They also learned that such chemicals have an affinity for the fat-rich inner environments of animals and humans, though the implications such accumulations have for human health remain poorly understood.

Today, scientists fervently map the routes molecules travel through space and across places. For example, scientists trace synthetic molecules from factories through smokestacks and into the air and water currents that transport them globally. They track their uptake into flora and fauna. They study how molecules migrate through both marine and land-based food chains, a process called biomagnification. Scientists also follow chemicals inside the human body, where they research how molecules, or their metabolites and breakdown products, circulate through blood vessels or travel across placentas.

However, the journey for molecules of persistent bioaccumulative chemicals does not end inside the human body. In these pages, I concern myself with what happens as scientists, and of particular note, civil society organizations, document the quantity and kinds of chemicals found in the human body using the technique of biological monitoring, or biomonitoring. At the point these groups convert molecules into “data,” another more complex and circuitous journey begins, as the meaning this data has for social relations, policy, and industrial practices is debated in an array of social fora.

This dissertation examines how different stakeholders in three places participate in, interpret, and debate the significance of human body burden science. Each place marks a stop in the journey of chemical molecules as they move from the cradles of industrial production to their metaphoric graves in circumpolar communities. By body burden science, I refer to implementation of a biomonitoring study to measure the presence of chemicals in human samples

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1 Not all synthetic chemicals are persistent or bioaccumulative. In fact, many chemicals that are measurable in human tissue or samples are neither persistent nor bioaccumulative. That is, some are so ubiquitous in the human environment, that people are exposed and re-exposed such that levels in the body remain continuous. Nonetheless, these, too, can affect human physiology and function. For this dissertation, however, I focus almost exclusively on biopersistent chemicals, as one class of synthetic materials that have become an important scientific, policy, and advocacy focus (Easthope and Valeriano 2005).
such as blood or urine, as well as different perspectives on *chemical body burden,*\(^2\) the condition that biomonitoring science makes visible. In particular, I explore how the conduct of biomonitoring science—and the meaning drawn from it—differs depending on where in production systems and across the chemical lifecycle these debates ensue, as each locale involves a different configuration of stakeholders and power arrangements. Throughout, my focus is on the relationship between biomonitoring science, advocacy, and environmental and social change.

Over the past three years, I have followed community groups and organizations in Appalachia’s Mid-Ohio Valley, Maine, and Alaska who participate in human biomonitoring to spur debate and action around human exposure to synthetic chemicals. All are places with rural-industrial economies in various stages of transition; and all are sites of place-based struggles for environmental health and justice. This dissertation begins in the Mid-Ohio Valley, where I track community responses to chemicals emitted by a manufacturing plant there. From these rural communities, I follow chemicals as they disperse through the consumer economy into homes as constituents of consumer goods. The “homefront” of environmental advocacy has emerged over the past decade in places like Maine, where activists contest chemicals in consumer goods and where chemical manufacturers and chemically intensive industries have a minimal political or economic presence. Finally, I follow the northward migration of chemical molecules to several Alaska Native communities of the Norton Sound region. These communities, in alliance with a small, environmental justice organization, find themselves on the frontline of chemical policy battles and on the frontline of what Marla Cone (2006) calls the greatest environmental injustice ever perpetrated.

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\(^2\) Often thought of as an activist or public term in contemporary times, the phrase “body burden,” rather, has roots in the language of government scientists who conducted population surveillance research to study the health implications of nuclear weapons testing. For example, reports detailing government surveillance for nuclear isotopes in the bodies of Alaska Natives include some of the earliest recorded uses of the term “body burden.” For example, see the following government documents: “Public Health Service Alaskan Radiation Surveillance.” Memo. Unknown author. Written: 12 October 1965; and, Snow, Donald L., Chief, Radiation Surveillance Center, Division of Radiological Health. 20 June 1965. Memo written to Dr. Wayne C. Hanson, Biology Department, Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington.
Thus, like environmental health scientists, I, too, “follow molecules” (Casper 2003). However, as a sociologist, when I “follow molecules,” I move through the social spaces where the meaning and political implications of biomonitoring and chemical body burden are debated. For this project, my analysis shifts from a rural high school auditorium to a bustling West Virginian court room; from country fairgrounds to the chambers of the Maine Legislature; from international treaty forums to a conference room in a small advocacy organization in midtown Anchorage. In these diverse locales, stakeholders deliberate over the meaning of biomonitoring science, and call for various social and governmental responses to address chemical body burden. In “following molecules” in this way, my approach builds on previous sociology of science research that considers how chemicals, as bio-physical entities and non-human or material “actors,” reflect and organize social relations (Latour 1987; Casper 2003).

**BLEEDING FOR CHANGE: BIOMONITORING AS PUBLIC SCIENCE**

Human biological monitoring, or biomonitoring, is a fast-growing area of the environmental health sciences (Needham et al. 2005). Scientists use biomonitoring, which draws on the capabilities of analytic chemistry, to assess what chemicals and heavy metals are in human tissue and fluids, and at what levels. Biomonitoring also entails screening human samples for biomarkers—biological signals that a foreign, synthetic material has altered, or could alter—physiological processes, cells, or DNA. Scientists can use markers as an internal dosimeter. In turn, this information is used to characterize how bodies uptake, process, and interact with chemicals. In this study, I focus on biomonitoring for markers of chemical exposure, rather than as indicators of biological effect or susceptibility for health effects, which is another branch of this science (DeCaprio 1997).

While biomonitoring is considered at the frontier of environmental health science, it is not, in fact, new science. Humans have long been fascinated with and challenged by detecting and measuring “foreign” substances in human tissues or fluids. As described in Chapter Two, the
practice dates to experiments by early alchemists and can be traced throughout the history of Western science, medicine, and industrialization. What is new here follows from technological development during the mid-twentieth century. It is now possible to measure more chemicals faster and at lower concentrations. Rather than measuring a single chemical in a single population, human biomonitoring is used to measure hundreds of chemicals in diverse populations, especially those not expected to have extensive occupational exposures. As a result, scientists, and in turn the public, know more than ever about the number of chemicals to which humans are exposed.

One consequence has been that bodies and biological samples have become salient signifiers of meaning. With the expansion of biomonitoring science, bodies are emblems of environmental activism, leveraged for symbolic persuasion much like Szasz (1994) describes the 55-gallon drum signified hazardous waste activism during the 1970s through 1990s. Concerned communities and social movement organizations alike have capitalized on the powerful image of “contaminated bodies.” For example, several years ago, The Anniston Star (Alabama) pictured a local resident proclaiming her “body burden” of PCBs, an industrial solvent and insulator formerly manufactured by nearby Monsanto (later Solutia) plant. In red and black marker, the protestor’s hand-made sign publicized, “Look what Monsanto done to me. Blood level 24% PCB.”

In another example, the World Wildlife Foundation-United Kingdom sponsored a blood draw as public spectacle. Protesters donated blood samples in an urban square. Afterwards, wearing orange shirts emblazoned with the slogan “I am a chemical dump,” activists took to the streets, carrying dumpsters and blood bags labeled as “contaminated.” Like the UK street sampling event, other activists are symbolically “bleeding for the cause”—publicly offering blood samples and demanding chemical screening. Greenpeace-UK’s website pictures a white-coated phlebotomist drawing a blood in the foreground of an industrial plant. In 2000, a Richmond, California woman, Ethel Dobson, was featured in the San Francisco Chronicle presenting ten vials of her blood to the state Hazardous Material Laboratory (Sarker 2000). More than just blood itself,
other biological samples like breast milk and cord blood have been collected, analyzed, and publicized in a similar fashion.

In these examples, monitored bodies and populations come to signify the chemical pollutants within them. Bodies of Inuit women, whose high chemical body burdens initially shocked the scientific community, have been imbued with meaning in international forums on regulating chemicals with the highest potential to bioaccumulate and persist. During early negotiations of the United Nations Stockholm Convention on Persistent Organic Pollutants (POPs Treaty), Sheila Watt-Cloutier, of the Inuit Circumpolar Conference, presented a stone carving of an Inuit mother and child to John Buccini, who moderated the negotiations during the late 1990s. That statue presided over the treaty deliberations—the stone body symbolizing the disproportionate burdens borne by indigenous communities of the circumpolar region. Buccini since acknowledged that, “when fatigue threatened, we would only have to look to the carving for further energy and strength” (Downie and Fenge 2003: xxix).

Similarly, before treaty negotiations commenced, Greenpeace and their international allies through the International POPs Elimination Network and the Indigenous Environmental Network staged a silent “belly brigade,” an action where women, wearing plaster-of-paris belly casts molded from pregnant women’s breasts and bellies lined the entryway to the POPs Treaty meetings in Montreal. Their bodies signified for delegates the gravity of the policy issues under consideration: how the accumulation of PCBs, DDT, and other persistent organic pollutants in women’s bodies were becoming the unintentional legacies women pass to the next generation (Drumbeat for Mother Earth 1999). Since Montreal, the Center for Health, Environment, and Justice in Washington D.C. has coordinated several other belly brigades, where women wear belly casts to protest the trespass of chemicals into bodies, including an event staged in downtown Boston in September 2007.
Figure 1-1. A belly brigade silently congregated outside the 2007 World Vinyl Forum to protest women’s body burdens of industrial chemicals that are passed from mother to child through cord blood and breast milk. Photo: Rebecca Gasior Altman (Boston Massachusetts, September 2007).

Also new, and of keen interest to this dissertation, is the appreciable and rapid increase of public involvement in human biomonitoring. During the 1950s through 1970s, public groups were involved in the conduct or critique of biomonitoring, but to a lesser degree than is now observable. For example, as will be discussed in the next chapter, citizens donated baby teeth for analysis of strontium-90 and lead. These early examples of public participation in biomonitoring science are important for the historical lessons they offer and for how they prefigure contemporary policy debates around human body burden and the translation of biomonitoring into policy. Recently, opportunities for public groups to raise public and private financial support have made biomonitoring even more of a public science. Both environmental advocacy organizations and communities now participate in producing knowledge about chemicals inside the human body.

**Biomonitoring as Advocacy Science**

Over the past decade, environmental advocacy organizations have become producers of body burden knowledge. Resource-rich advocacy organizations, particularly those with scientific and fundraising capacity, or network ties to foundations, have raised substantial funds to conduct
biological monitoring studies as part of their ongoing public education and policy advocacy campaigns. Organizations like Environmental Working Group, Commonweal, The World Wildlife Federation, Washington Toxics Coalition, and Greenpeace have orchestrated biomonitoring studies of relatively small, unrepresentative samples that include recognizable community figures (e.g., elected officials, religious leaders, local media personalities) to document the extent of chemical body burden, (see Figure 1-2). These studies have an explicit public and policy focus, with the intent to overlay quantitative data with human faces and personal experience. As well, the studies select a sample to represent symbolically the “person next door” as a way to demonstrate the ubiquity of “chemical trespass” within human bodies. Such studies highlight commonalities across human exposure and illustrate that all humans have chemicals in their bodies that are also omnipresent in household building materials, furnishings and consumer products. Many of these studies are powerful because they prompt readers to wonder, “Could this be in me?” These organizations use body burden data to command public, regulatory, and scientific attention, shift public opinion, build movement constituencies, secure funding for more comprehensive environmental monitoring, or advocate for reduction in industry toxics use and other precautionary environmental policies.
<table>
<thead>
<tr>
<th>Figure 1-2. Biomonitoring Conducted with or by Non-Profit and Community Organizations, 2002-2007 (in alphabetical order).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alaska Community Action on Toxics</strong> with the Villages of Savoonga and Gambell, St. Lawrence Island (Alaska), the State University of New York, Albany, and Norton Sound Health Corporation.</td>
</tr>
<tr>
<td><strong>Alliance for a Clean and Healthy Maine</strong></td>
</tr>
<tr>
<td><strong>The Coming Clean Collaborative Body Burden Workgroup</strong></td>
</tr>
<tr>
<td>*Includes: Alaska Community Action on Toxics (AK), The Alliance for a Healthy Tomorrow (MA), The Coalition for a Safe and Healthy Connecticut (CT), Commonweal Biomonitoring Resource Center (CA), The Environmental Health Fund, Environment Illinois (IL), The Just Green Partnership (NY), and The Michigan Network for Children’s Environmental Health</td>
</tr>
<tr>
<td>Is It In Us? (2007)</td>
</tr>
<tr>
<td><strong>Commonweal Biomonitoring Resources Center</strong>, Bolinas, CA</td>
</tr>
<tr>
<td>*with The Breast Cancer Fund</td>
</tr>
<tr>
<td><strong>with El Quinto Sol, Californians for Pesticide Reform and Pesticide Action Network</strong></td>
</tr>
<tr>
<td>Taking It All In—Documenting Chemical Pollution in Californians Through Biomonitoring (2005)*</td>
</tr>
<tr>
<td>The BioDrift Project (2007)**</td>
</tr>
<tr>
<td><strong>Environmental Defence</strong>, Canada</td>
</tr>
<tr>
<td><strong>Environmental Working Group</strong>, Washington, D.C.</td>
</tr>
<tr>
<td>* with Commonweal</td>
</tr>
<tr>
<td><strong>with Mt. Sinai School of Medicine</strong></td>
</tr>
<tr>
<td>Body Burden: Pollution in People (2003)* **</td>
</tr>
<tr>
<td>Mother’s Milk (2003)</td>
</tr>
<tr>
<td>BodyBurden2: The Pollution in Newborns (2005)*</td>
</tr>
<tr>
<td>The Human Toxome Project (2006)</td>
</tr>
<tr>
<td><strong>Greenpeace International</strong></td>
</tr>
<tr>
<td>* with World Wildlife Foundation-UK</td>
</tr>
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<td>Present for Life: Hazardous Chemicals in Umbilical Cord Blood (2005)*</td>
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<td>An Investigation of Factors Related to Levels of Mercury in Human Hair (2005)</td>
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<td><strong>Greenpeace</strong>, Netherlands</td>
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<td><strong>Health Care Without Harm</strong></td>
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<td>Rocking the Cradle: Phthalate Exposure in NICU Infants (2005) Published in <em>Environmental Health Perspectives</em></td>
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<td><strong>Mossville Environmental Action Now, Inc</strong></td>
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<td>*with Wilma Supra (the Supra Company) and Advocates for Environmental Human Rights</td>
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<td>Industrial Sources of Dioxin Poisoning in Mossville, Louisiana: A Report Based on the Government’s Own Data (2007)</td>
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<td><strong>Sightline Institute</strong> (formerly, Northwest)</td>
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<td>Flame Retardants in the Bodies of Pacific **</td>
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<td><em>with the US CDC, Southwest Research Institute, Harvard School of Public Health</em></td>
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For example, the Washington D.C.-based Environmental Working Group was among the first in a succession of non-profit, advocacy organizations to coordinate an extensive study of chemicals in human samples (2003). EWG teamed with scientists from the Mt. Sinai School of Medicine and environmental health advocates from Commonweal (California) to analyze the blood and urine of nine high-profile Americans. Their project screened for 210 environmental chemicals, a number far greater than included in the then newly expanded Centers for Disease Control and Prevention National Exposure Survey (2007a). The study’s release was timed to coincide with the release of the first National Exposure Report—to both raise attention to the first profile of chemical exposures in a nationally-representative and to bring human faces and experiences to the CDC’s otherwise anonymous, de-personalized findings (2001; 2003; 2005). EWG’s foray into the arena of biomonitoring follows a previous track-record of conducting scientific studies or data analyses and then conveying that information to the media, press, and policy-makers. Founded in 1993, this D.C. based organization seeks to promote government and
corporate accountability, environmental and chemical policy, and public awareness about environmental exposures using science and information-based strategies. Information-based advocacy is so central to their work that on employees’ business cards, a running data stream of information serves as the backdrop for their organizational slogan: “the power of information.”

**Biomonitoring in Contaminated Places**

Communities concerned about toxics and environmental contamination also seek out biomonitoring to help document the public health significance of chemical exposures in the community and catalyze political action around disproportionate environmental exposures (Shostak 2004; Sze and Prakash 2004). Significant financial and infrastructure demands pose a substantial barrier to biomonitoring, relative to established social movement organizations, and thus, communities are often hard pressed for the resources or contacts to carry out such studies independently. Nevertheless, placed-based biomonitoring is a growing trend among communities who often see biomonitoring as a powerful tool for aiding in their struggles against industry, policy, and regulators.

Communities such as the Mohawk Nation living in Akwesasne, New York and farmworkers from Lindsay, California have involved themselves in biomonitoring by partnering with scientists, medical doctors, government officials, or advocacy organizations. Community groups such as these have applied for both public and private funding sources to pay for human biomonitoring. Private foundations also have supported biomonitoring in communities, as is the case of the Lindsay, California farm community, which, with several other state and non-profit partners, tracked the relationship between pesticide levels in urine with the timing of spraying on

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3 Biological monitoring is an expensive and resource-intensive science, not easily conducted without crucial financial resources or connections within the scientific establishment due to the expense of the equipment and the technical capacity to run them. For example, when David Duncan, a National Geographic journalist had his body analyzed for 321 chemicals, the final price tag totaled $15,000 (2006). It is yet to be seen whether the price of lab equipment and tests will fall over time. In the meantime, only the most resource- or network-rich non-profit organizations can access this technology. However, sometimes collaborations enable communities access to the necessary equipment and expertise to carry out such complicated chemical analyses.
the fields that rim their community (Fischer 2007). Federal grants have been another mechanism of support for communities. The National Institutes of Environmental Health Sciences, which supports community-based participatory research projects through its Environmental Justice: Partnerships for Communication Program, has been instrumental in availing communities access to researchers and institutions where biomonitoring would have been otherwise inaccessible. Communities in Alaska, Appalachia, California, Massachusetts, and New York have all participated in biomonitoring studies in which community-based organizations partner with scientists and health providers, and depending on the nature of the relationship, have been active in the conduct, interpretation, and translation of the findings.

Usually, though, there are few opportunities for communities to access experts and equipment by pursuing private or public funding. Grant-writing requires significant time, technical skills, and often extensive network connections to which few newly-formed grassroots or community groups have access. Instead, communities may achieve blood tests through lawsuits, or their settlements, such has been the case in Anniston, Alabama (see Tolbert Qualified Settlement Fund 2004), whose residents have undergone widespread blood analyses for PCBs from the local Monsanto (now Solutia) plant. In this case, blood PCB levels were used to determine the amount paid out to each claimant from the lawsuit (see Tolbert v. Monsanto/Solutia).

Communities also have appealed for assistance from regulatory and other federal agencies, such as the Agency for Toxic Substances and Disease Registry (ATSDR) and the Environmental Protection Agency, though often agency assistance is hindered by over-stretched budgets and other political constraints on their limited resources. For example, in the Mid-Ohio Valley, community leaders asked EPA to help conduct blood analyses for perfluorinated compounds known to be prevalent in their drinking water supply, though EPA deferred the community’s request as beyond their jurisdiction. In other cases, communities receive support from federal agencies, but do not find the results helpful. This was the case in a major PVC manufacturing hub in Mossville, Louisiana. Both ATSDR and EPA examined dioxin levels in residents’ blood,
with some residents having three times higher the dioxin concentrations than in the general U.S. population (ATSDR 1998). However, residents challenged these agencies for producing data, but not linking local industries that release dioxins with the disproportionate blood concentrations in neighboring communities. In response, community members organized through the local grassroots group, Mossville Environmental Action Now, Inc., worked with the Subra Company (an environmental health consulting firm led by long-time environmental justice activist, Wilma Subra) and Advocates for Environmental Human Rights to re-analyze the federal data in light of area emissions (Mossville Environmental Action Now, Inc. et al. 2007). Federal agencies, like lawsuits, though important community access points for this pricey science, offer far fewer opportunities for public participation in the scientific process and for ensuring the results, once compiled, are meaningful.

In summary, this dissertation examines how both communities and advocacy groups bring biomonitoring science to bear on place-based struggles over environmental contamination and human exposure to chemicals. In each instance, though biomonitoring (as a scientific technique) is not new, in each particular locale its introduction to ongoing contestation and debates is new. I follow what happens when biomonitoring knowledge is brought to bear on existing problems, how and by whom that knowledge is produced, and what are the consequences for advocacy, policy, production systems specifically, and social relations, in general.

**RESEARCH QUESTIONS AND DESIGN**

This research is guided by three questions:

1. *How do community and social movement organizations engage in biomonitoring research to address concerns over human exposure to chemicals? How do they recruit scientific arguments to make social and political claims?*

   These questions examine how different public groups involve themselves in biomonitoring projects, whether through lawsuits, contracting with private laboratories, or through federally
funded research grants, community-based participatory research and citizen-science advocacy alliances. My analysis examines the entire scientific process, beginning with how various publics participate in biomonitoring or carry out investigations themselves. I also focus on the intricacies and debates over scientific interpretation, and ultimately, on how biomonitoring science is translated into a wide array of actions ranging from grassroots advocacy to remediation to policy initiatives. To observe scientific interpretation and application, I trace how various organizations in each site describe the results and their significance, and then record the range of solutions proposed to the problem.

2. How does the political and economic context into which biomonitoring science is introduced shape or structure its meaning, application, and implications?

I borrow the concept of “lifecycle analysis” from the applied field of industrial ecology, and develop it as a tool for social scientific investigation of environmental problems, what I call a “lifecycle approach to environmental problems.” I use the chemical lifecycle to break down my analysis into three discrete arenas of contestation, each a point of contact between chemicals and communities. Within each locale, I examine how biomonitoring research, as well as its meaning and translation, are shaped by different political-economic relations and histories. Using secondary literature about the history and sociology of environmental science and policy, I characterize the formation of each of these historically, organizationally, and institutionally discrete arenas of public challenges to chemical exposures. This informs my analysis of how the social relations in each locale shape the conduct, interpretation, and translation of biomonitoring science.

Conversely, I study how the introduction of biomonitoring into the public and political arena alters social relations. In particular, I examine how biomonitoring science fosters connections or rifts among groups located in different stages of the chemical lifecycle and the resultant implications for advocacy, politics, and social relations. I also draw on environmental sociology,
sociology of science and social scientific inquiries into policy and the law to point me toward key stakeholder groups and to define the expected political arrangements and social relations within each site.

3. *What does the introduction of biomonitoring science accomplish, lead to, and preclude?*

My approach to answering this question is shaped by the perspective that scientific knowledge and social order are produced in tandem. Existing social relations play a role in shaping how science is conducted, what meaning is drawn from the results, how the results are applied, and with what result. The converse is also true. As new scientific information about chemicals in bodies is produced, that knowledge has direct implications for social relations, particularly between those entities that produce and regulate chemical exposures and those who are exposed. Thus, as I research each site, I characterize the key social relations in each locale, and then trace the implications that the introduction of new body burden information has on those relationships. In particular, I focus on the implications biomonitoring science has in defining new social relations among civil society, production systems, and policy.

These questions will be answered through an analysis of biomonitoring research and body burden debates in three case studies that span the life course of a synthetic chemical from “cradle-to-grave.” The case studies include a community where chemicals are produced (the Ohio River Valley of Ohio and West Virginia), where consumers encounter chemicals in everyday products (Maine), and where communities are end-recipients for persistent and accumulating chemical wastes (Alaska Native communities of Northwest Alaska).

My approach to pursuing these questions relies on the methodology of multi-sited research. Given the spatial organization of this topic—i.e., the spread of relevant stakeholders that produce, regulate, and contest chemical exposures—each case includes “remote” individuals and organizations. Thus, each case study is “multi-sited” to capture the influence and perspectives of remotely located players (Gille and O’Riain 2002). Social scientists have adapted ethnography in
new and exciting ways over the past decade, primarily by extending the ethnographer’s field of vision and recreating ethnography as a mobile method. Multi-sited ethnography (Marcus 1995; Gille and O’Riain 2002), and similar approaches such as the extended case method (Burawoy et al. 1991; 2000), and more recently, policy ethnography (Brown et al. 2007), adapted ethnographic research in order to research emergent social relations that are no longer solely embedded in communities and places. Chemicals, information, networks of activists, lobbyists, and scientists, are all in constant motion and often key organizations are located elsewhere than the primary site of contact and contestation. Lobbyists representing the manufacturers of bromine-based flame retardants fly from Belgium to Maine to challenge a proposed bill that would counteract the build-up of chemical flame retardants in women’s bodies. Activists from Washington D.C. rely on data and narratives about chemical body burdens in the Mid-Ohio Valley of Ohio and West Virginia to push federal and California policy; this situation in turn, shifts public and regulatory focus off the pressing concerns faced by those in the Mid-Ohio Valley. Scientists from New York research and debate the public health implications of chemical body burdens experienced by people living on St. Lawrence Island in Alaska.

My primary units of analysis are sites of chemical contact and contestation, each of them a node or stage in the life-course of persistent synthetic chemicals. Within each site, I focus on the key organizations involved in carrying out, interpreting, contesting, or acting upon biomonitoring knowledge. The primary data stem from an analysis of public documents that report, analyze, and contest biomonitoring and human body burden, which are interpreted and triangulated through field observations, participant observations, and interviews with scientists, activists, community members and other informants who experienced, or have knowledge, about biomonitoring that took place in each of these three sites. Data analysis involved mapping the organizational and political-economic terrain of each site to elucidate how power and science operate in localized debates over body burden; a cross-case comparison to discern what contextual and institutional differences affect how science and power interrelate; and lastly, an
examination of the connections between and across cases, since each case is linked by institutional and organization networks that comprise the life-cycle of synthetic chemicals.

**A LIFE CYCLE APPROACH TO STUDYING CHEMICAL POLITICS**

The goal of this dissertation is to develop and implement a place-based, lifecycle approach to studying environmental contestation. The processes by which biomonitoring shapes social relations and chemical politics—and in which social relations and chemical politics shape science—are not uniform across all places. To explore this, I define a framework for examining three typical, yet contrasting arenas where biomonitoring science is conducted to measure and address human exposure to persistent, bioaccumulative chemicals. Using a combination of environmental sociology, sociology of science, and a political-economic analysis of production systems, I characterize three *sites of contact and contestation*: (1) sites of production, where chemicals are synthesized, produced, and used in industrial applications; (2) sites of consumption, where consumers use products and goods that contain chemical additives or residues; and (3) sites of persistence, the intended and unintended places where chemicals accumulate over time (see Figure 1-3). I offer both empirical and theoretical support for this framework. In the background chapter, I draw on both a history of how science and policy unfolded in the United States to parcel the realm of chemical politics into three arenas or spheres that define my three sites.

Chemicals, and the systems of production through which they flow, link what traditionally have been fractured arenas of environmental contestation. I make the connections among these domains more explicit by merging two areas of research within sociology and environmental engineering. Industrial ecology, an emerging field within environmental science and planning, adopts a holistic view of industrial systems by considering all environmental consequences

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4 By “typical,” I refer to the Weberian process of characterizing “ideal types” based upon an analytic typology or model. Thus, each locale I study is unique and hardly “typical” in the conventional use of the term; however, I consider each locale within the broader context of other “types” of locales contesting chemical exposures.
generated by production systems throughout the chemical lifecycle. Among their many research activities, industrial ecologists track chemicals and their consequence from cradle-to-grave, from their point of production to their disposal. I overlay society into industrial ecological models. I populate production, consumption, and waste management systems with the people and places affected as chemicals flow from factories to consumer goods to landfills. To do this, as described in Chapter Three, I draw from the new environmental sociology of flows (Spaargaren et al. 2006), which merges a spatial and systems perspective on how materials move across people and places, and how environmental problems are caused by and resolved through the movement of capital, information, and advocacy networks.

**Figure 1-3.** Sites of Contact and Contestation across the Chemical Lifecycle.

By coupling political-economic descriptions of production systems with sociological insight about the relationship between science and power systems, I define how each domain has a
distinct set of power relations. For example, each site occupies a different location within production systems, and as a result, exposed populations in each site operate from a different social position vis-à-vis these broader political-economic systems. Sites differ in the spatial relationship between the exposure source and the exposed population, as well as the distance to the loci of power and decision-making. Consumers, for example, who can lobby big-box retailers to shift to products that are free of polyvinyl chloride (PVC) plastics, have a different vantage point from which to address chemical exposures than do workers or communities who share a fenceline with the factory that produces consumer goods made from PVC and is significant for its contribution to regional employment and taxes.

I also consider how distinctions in political and economic landscapes translate into different opportunities to address chemical exposures because of the unique relationship between science and policy in each domain. That is, each site not only varies by location in the political economy, but also by the role of the regulatory state and how science historically has been factored into decision-making about each type of exposure. The US policy context has focused more on chemical pollution released into the environment than on chemicals in products or chemicals in and of themselves. Further, science and economics are factored into decision-making rubric that makes regulatory decisions in the United States particularly adversarial (Jasanoff 2005). Regulatory decisions in the U.S. are often scientific duels. In sites of persistence, the dominant approach to addressing chemical pollution has long been science-intensive, involving the quantification of risks, weighing public health against economic costs, and instituting pollution controls based on calculated allowable limits and best available technologies. As a result, in sites of persistence, debates focus on how to translate biomonitoring science into existing formulas and frameworks for decision-making. Therefore, the social relations and political-economic conditions the characterize sites of production can constrain communities and social movement groups from proposing alternatives for when and how scientific data is brought to bear on environmental and public health decisions. However, as I argue, both sites of consumption and
sites of persistence are relatively unorganized policy spaces, where policy-makers and regulators just now are deciding how to respond. As a result, stakeholder groups in sites of consumption and persistence have more room in which to propose alternative strategies for incorporating science into decision-making.

The unfolding of science and policy in the US created discrete arenas in which chemical exposures are regulated and contested. The wave of environmental legislation in the 1970s tasked the oversight of chemicals—principally in the form of pollution—to an array of sub-units within the Environmental Protection Agency. In turn, the infrastructure laid down by these policies segmented how the federal government oversaw industrial manufacturing and waste management practices. These policies focused regulators’ attention on single chemicals, rather than groups or classes, on those chemicals’ presence in a single environmental medium (i.e., air, water, soil). This means that, if regulated at all, the same chemical would be regulated differently if found in a worksite, detected in industrial run-off, added to a consumer product, found in drinking water, or loaded into a barrel or tanker car for off-site burial or incineration. Furthermore, regulations and policies never kept pace with accruing knowledge about the potential of chemicals to both persist in the environment and to build-up in the bodies of humans and their food supply. As a result, for many years, regulators largely overlooked exposures that were happening in places far from industrial center and agribusiness. This wave of legislation, and the infrastructure and assumptions it embedded into regulatory agencies, remains unchanged today, though increasingly it is challenged by social movement organizations, community groups, and professionals within the environmental health movement. Though the issues may overlap and intersect in important ways, how each issue was overseen and addressed by regulators often segmented them into “bounded” settings of (Gottlieb 2001) environmental health and justice activism, creating “issue silos.” Concerns about chemical exposures, for example, have been

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5 Some 62,000 chemicals were already in commerce and were “grandfathered” past regulatory scrutiny when Congress passed the Toxic Substances Control Act in 1976 (General Accountability Office 2005).
carved into worksite issues, “contaminated communities” on the fenceline of industry and agribusiness, hazardous waste problems, or an issue of everyday exposures to chemical residues or additives in consumer products.

To further understand the significance of relationships and social interaction in biomonitoring, in Chapter Three I examine public participation in biomonitoring through the lens of social movement theory and the sociology of science. In particular, I pay attention to the implications for relationships and alliances, which enable and constrain the translation of biomonitoring science into policy and actions that build toward progressive social and environmental change.

As both sociologists and activists have noted, engaging in science as a means to push debate, action, or policy can be a double-edged sword—a tactic that provides advantages and opportunities, while also yielding drawbacks and unintended consequences for public producers and users. Science-based advocacy has become an important tactic for seeking change in the context of what has been called the scientization of policy and society (Morello-Frosch et al. 2006a). In many instances, public groups feel pressured to speak in the parlance of science and to bolster their arguments using scientific evidence.

I also rely on work that characterizes how science shapes the political context in which these communities and advocacy organizations pursue change. I draw from recent social movement scholarship that incorporates science as part of a complex, multi-institutional field in which public groups push for change. Environmental health and justice advocates find that it is no longer effective only to target the state. Instead, groups must navigate and untangle a complex web of authority systems involving the state, industry, and science (Myers and Cress 2005). Thus, due to the complex relationship between science, power and policy, I also examine science for how it functions as part of the political-economic context that sets the rules of engagement. That is, science helps define priority issues and possible strategies for addressing them, a view of power that draws from and extends Gaventa’s (1980) definition of power as shaping both problem definition and consciousness about who can participate and comment on science. As
well, I draw on a sociology of science framework to highlight how different norms about scientific practice and expertise function to include or exclude the public from various processes of conducting, interpreting, or acting on science.

Finally, I examine how alliances and relationships shape and are shaped by the broader political-economic and scientific context in which biomonitoring science occurs. That is, I examine whether and how science shapes social relationships, which in turn, influences how science functions as a tool to navigate a complex political arena. Put differently, I look at how science is conducted and interpreted as relationships are formed, evolved, or dissolved—or, as Jasanoff (2005) notes, how these entities are co-produced. My framework for understanding how biomonitoring results are interpreted, what opportunities for framing and acting on biomonitoring results are possible, and what consequences result when public groups involve themselves in biomonitoring, is first and foremost interactional. I develop a framework for looking at the interaction between what public groups claim and do, and to account for the influence of contextual factors, including social and political-economic relations. I draw from Jasanoff’s work on co-production, which examines the interaction between science and society, with social movement theorists’ conceptual models for studying how public groups interact with and challenge existing social relations and political-economic structures. This allows me to study complex interactions between science-based claims and action, and how social structures are shaped by politics, economics, and science. Overall, I integrate these two theoretical bodies of work to study how interaction between these entities shape both political discourse and the distribution of power over addressing social and environmental problems.

In conclusion, rather than explore these issues in a single case study, as is common in the sociologies of science, social movements, and the environment, this study considers the meaning and implications biomonitoring science has in three places using the methodology of multi-sited ethnography (Marcus 1995; Gille and O’Riain 2002). Each of my three cases is unique and could constitute a stand-alone case study. However, as I argue, a single case study approach would
overlook the dynamic and varied ways in which biomonitoring (science) and political-economic factors (social order) can both enable and constrain affected groups from challenging the structural conditions that produce and allow chemical exposures. As well, a focus on just one moment in the chemical lifecycle would preclude an understanding of an emergent reality for environmental health and justice organizing—how advocacy, policy, and science that occurs in one stage of the lifecycle bears implications for others.

FOLLOWING CHEMICALS THROUGH THREE RESEARCH SITES

At the Fenceline—Appalachia’s Mid-Ohio Valley as a Site of Production

In central Appalachia, the Ohio River splits West Virginia from Ohio. By day, barges sluggishly crawl along the river; by night, the rhythmic lull of trains rumble through the valley. Both service dozens of plants nestled into the region’s verdant river valleys. This is the lesser-known U.S. “Chemical Valley”—a center for producing high-performance plastics and polymers. Nestled among these facilities are the many “fenceline” communities of the mid-Ohio Valley—Parkersburg, Vienna, and Lubeck on the West Virginia side; Marietta, Belpre, Little Hocking, Pomeroy, and Tuppers-Plains on the Ohio side. This rural, yet industrialized region, in 2002, became the epi-center for a now widescale investigation into the safety of PFOA, perfluorooctanoic acid (also referred to as C8), a processing aid used to manufacture surface-coated goods, most notably Teflon™, since the 1950s. Though now present in ecosystems throughout the world, scientists have recorded in the Mid-Ohio Valley some of the highest known concentrations of PFOA in drinking water and human blood.

When PFOA’s presence in water became public, neither scientists nor state and federal regulators knew much about the chemical or its consequence for human health. Since the discovery of contaminated drinking water, the people of the Mid-Ohio Valley have become one of the largest cohorts to have their blood analyzed for chemicals, mostly with funds from a class action lawsuit against the polluter, E.I. DuPont de Nemours, Co (DuPont). Prior to the
settlement-funded biomonitoring, other biomonitoring was conducted by a locally-run, rural water association, a federally-funded research team, which launched a community-based epidemiologic study in 2004, and by DuPont, who monitored its workers dating as far back as the 1970s (Lyons 2007a). EPA began a review of the safety of PFOA in 2003 and announced in 2006, that PFOA is a “likely carcinogen.”

By 2006 over 70,000 people of the Mid-Ohio Valley knew the concentration of PFOA in their blood. Talk of blood PFOA levels pervaded the social environment. As one local journalist observed, parts per billion became diner counter conversation (Lyons 2007a). Though gallons of blood have been analyzed and hundreds of thousand gallons of alternative drinking water supplied, the Mid-Ohio Valley awaits the numbers to “mean something,” as a jury of court-appointed scientists scrambles to collect and evaluate health data. Longer-term remediation of public drinking water supplies hinges on their verdict, as does the ultimate fate of PFOA and fluorine-based compounds in the global marketplace. In February 2007, EPA announced that the global manufacturers voluntarily will stop producing PFOA by 2015, though DuPont, the sole US manufacturer, persists in its conclusion that PFOA poses no health problems (McIntosh 2005) and industry has struggled to find viable alternatives for PFOA’s myriad of applications. Amidst this buzz of global action to chart PFOA’s global and physiological journeys, on the fenceline, affected communities await the next batch of news. At sites of production where chemicals are synthesized and released, chemical exposures are often the hardest for communities to address, especially when their source is a major employer and a fixture on the community skyline.

**On the Homefront—Maine as a Site of Consumption**

Eight hundred miles north of the Mid-Ohio Valley, PFOA, along with a suite of other chemicals were measured in the blood of a small group of Maine residents. There, a coalition of non-profit organizations—The Alliance for a Clean and Healthy Maine—teamed community organizers with a local physician and toxicologist to conduct chemical analyses of blood, blood
serum, and urine samples donated by thirteen long-term Maine residents, including two state legislators. Few, if any, Maine industries rely on PFOA in their manufacturing processes. In fact, the chemical and plastics industries have a negligible presence in Maine, a state where the once rural-industrial economy is undergoing rapid transition toward service-provision and tourism. Nevertheless, the project detected PFOA in the blood serum of all thirteen participants, including Republican Senator Dana Dow, who runs a family furniture business when not at the State House.

The research group opted to measure the donated samples for PFOA, as well as other perflourinated compounds, plastics additives, heavy metals, and a class of commonly-used flame retardants. This suite of chemicals was selected strategically—principally because they are found in commonly used consumer products, such as furniture, electronics, and plastics, and because “high profile” chemicals are already facing scrutiny among state, national and international regulatory bodies. In addition to PFOA, activists drew attention to polybrominated dipheyl ethers, or PBDEs, a class of commonly-used flame retardants. At the time the project began, Maine had already passed one of the nation’s first efforts to restrict the use of two commercial PBDE formulations in electronics and upholstered furniture. As data from the chemical analyses became available, the state legislature revisited their policy on PDBEs in consumer products, this time seeking to limit use of a third, and far more popularly-used commercial formulation, deca-BDE, or simply, deca. By the time the bill entered the committee process, the Alliance pilot study had detected PBDEs in the blood of Representative Hannah Pingree, the thirty year-old House Majority Leader and chief sponsor of the bill. Armed with results about deca in her body, Pingree implored her colleagues to sponsor the bill, which later sailed through the legislative process with bipartisan support and backing from an unparalleled coalition of the public health, academic, environmental communities, as well as from firefighters and government environmental agencies.
Even before the Alliance generated the first snapshot on chemical burdens in Maine residents, data from academic, government, and advocacy organizations biomonitoring projects united diverse stakeholder groups in Maine. Citizens, non-profits, industry representatives, policy-makers, and regulators have mobilized around this issue in ways that are quite striking, when compared to the experience of the Mid-Ohio Valley. Importantly, body burden, as an issue, catalyzed significant changes within the Maine environmental and public health community. The Alliance for a Clean and Healthy Maine, as well as the non-profit organization which helped bring that coalition together, the Environmental Health Strategy Center, were founded with the sole purpose of eliminating the build-up of chemicals in human bodies within a single generation. This Alliance brought together the environment, labor, and public health communities in unprecedented ways, relative to Maine’s long history of environmental advocacy. The Alliance continues to reach across social sectors to widen its base of support.

For example, with evidence of body burdens among residents, the Alliance has used the results as an opportunity for relationship building among public sector organizations/NGOs, government agencies, and local industry. The Alliance framed the results of their biomonitoring study and other similar research as a creative opportunity to revitalize the Maine economy. As well, they use these issues to open discussions over how industry manufactures products, including what raw materials and feedstocks are used. For example, they used results from their biomonitoring project to support construction of a multi-sector coalition that would bring green chemistry, engineering, and production to Maine to make plastics not from petroleum and petroleum-based synthetic materials, but from the humble Maine potato. Advocates framed body burden as both an opportunity to build a broad-base of support to rewrite Maine chemical policy, and to revitalize the state’s economy through research and development on green chemistry and engineering to support these regulatory and market shifts. Mounting evidence from biomonitoring studies have prompted several bills that have come before the state legislature that seek to regulate particularly those chemicals that are detectable in the bodies of women and
children. As well, Maine Governor John Baldacci signed an executive order that created the infrastructure and a cross-sector task force to help the state rethink its chemical policies (2006).

Yet, there are also some noteworthy downsides to these initiatives. Policy change has historically been a strong suit in Maine, and indeed, when it comes to chemical policies and chemical policy reform, Maine again leads the nation. However, historically, there have been numerous challenges to enforce policies and reduce exemptions that can, in some instances, exacerbate exposures and environmental inequalities, particularly for Maine tribes. Thus, while the issue of body burden has brought about coalitions of unparalleled make-up and strength, new gaps have arisen between chemical policy advocates on one hand, and tribes and natural resource groups working to address the continued flow of pollution into area rivers from the state’s remaining production facilities.

On the Frontline of Chemical Politics—Alaska as a Site of Persistence

Off the coast of Nome, Alaska, sits St. Lawrence Island, a 100-mile island in the Bering Sea that rests under the outstretched arm of Siberia’s Chukot Peninsula. There, two Siberian Yu’pik communities, led by elder and community health aide, Annie Alowa, asked Pam Miller, to help them clean-up widespread military contamination, as Alowa observed, from which her people were “catching cancer.” At the time, Miller recently had founded Alaska Community Action on Toxics (ACAT) to address environmental health and justice issues unique to Alaska. Initially concerned with the abandoned Cold War military sites that leached then-unknown contaminants into territories used for seasonal, subsistence hunting, over time, the communities also learned they were inheriting pollution from the northward migration of the very same compounds. At the community’s request, ACAT teamed with scientists from the State University of New York to win federal funds to analyze residents’ blood serum for chemical contaminants. From the eight-year research project that followed, the St. Lawrence Island community discovered their blood
contains six to nine times the level of PCBs—an industrial insulator that is now banned in the US—than people living at lower, more temperate latitudes.

The legacy of PCBs is instructive for the fate of the next generation of contaminants, like PFOA and its sibling compounds. In November of 2007, ACAT organizer, Shawna Larson, Aleut on her mother’s side and Athabascan on her father’s, flew from Anchorage, Alaska to Geneva, Switzerland to speak on behalf of the Indigenous Environmental Network, ACAT, and the indigenous people of Alaska. There, she participated in an international convention to decide which persistent chemicals would next be addressed under the UN Stockholm Convention on Persistent Organic Pollutions, popularly called the POPs Treaty. As Larson testified, persistent pollutants wreak havoc on the indigenous communities in Alaska and the North.

Larson also was present when U.N. delegates first ratified the POPs Treaty several years earlier—a multinational agreement to ban or restrict the use of twelve persistent pollutants, including PCBs, that have left a particularly destructive legacy on Alaska. Communities and bodies of the circumpolar region have been doubly insulted, doubly taxed by both local and global sources of chemicals, including many, like PCBs, that were banned by the United States some thirty years earlier.

Though PCBs and other post-World War II molecular innovations (e.g, organochlorine pesticides used throughout the mid-20th century) remain a significant concern for communities of the circumpolar region, scientists continue to discover the build-up of additional classes of chemicals, some invented to replace those regulated or banned in previous decades. These molecules have coated generations of consumer, industrial, and military goods to conduct electricity, retard flames, kill pests, or repel stains, grease, and water. For chemicals that readily disperse, are highly persistent, and tend to build up in blood and fat tissue—so called “legacy contaminants”—communities of the circumpolar north are the frontline for mounting policy struggles over whether and how to redefine the relationship between chemicals, the economy, and
society. These are the primary receptor communities for the waste and byproducts of the globe’s industrial and military systems.

The disproportionate build-up of synthetic chemicals—at higher concentrations than in bodies that reside even in industrial centers—reveal how previous strategies to regulate chemicals have not accounted for, or prevented, the reality that chemicals enter the body, with some staying on for years. Though some states and nations have begun taking action on chemicals that exhibit tendencies to persist and accumulate in human bodies, the United States has been slower to respond, if at all. One impediment is the scientific and political debates over how to interpret the fast-accumulating evidence of chemicals in people. In Alaska, tribes and environmental justice organizers frame human body burden—and the political and scientific quagmires that delay action—as a violation to human rights. The more that molecules build up in human bodies at longer time and geographical distance from the point of release, the greater the need for action—not more science—and the greater the imperative that affected citizens must be involved in decision-making over chemicals in commerce. Thus, in places that are the farthest in space and furthest in time from points of production, the greater the potential for exposed groups to leverage body burden science in ways that build public oversight over industry decision-making and how science is entangled within them.

IMPLICATIONS

From the fenceline, to the homefront, to the frontline of debates over human biomonitoring and chemical burdens, this dissertation looks across several, simultaneously occurring discussions about the meaning body burden science holds for U.S.-based advocacy, policy and society. In doing so, this dissertation is unique not only in its lifecycle and multi-sited approach to studying environmental science and advocacy, but also for how each case offers an original contribution to the rich tradition of ethnographies in environmental sociology. This framework also provides an
overarching framework in which to organize and contextualize existing studies of place-based environmental health and justice advocacy.

First, though many of the classic ethnographies and sociological case studies about environmental crises detail the politics, economics, and social dimensions of sites of production (Allen 2003; Lerner 2005; Ottinger 2005; Roberts and Toffolon-Weiss 2001), my focus on the Mid-Ohio Valley as a site of production examines a less-studied region of petrochemical production and manufacturing. Moreover, this study examines environmental debates in sites of production located in rural America, where chemically intensive industries are interspersed among the farmland and rural, economically-marginalized communities of middle Appalachia. The Mid-Ohio Valley is also a region where community-industrial relations are especially salient, since labor unions are generally weak, or altogether absent, given that chemical and plastics production in the Mid-Ohio Valley is one of the only sources of steady employment and wages. Finally, though sociologists have long documented how people living in sites of production use science to capture regulators’ attention, (e.g., for a discussion of bucket brigade air monitoring, see O’Rourke and Macey 2003), none as of yet have focused on what is achieved when biomonitoring science is introduced into an already in-progress struggle over environmental contamination.

Second, my lifecycle framework forced my analysis downstream from production systems to examine other, newer arenas of environmental contestation. I offer one of the first in-depth examinations of public challenges to chemical exposures in sites of consumption and persistence. Environmental sociology has long featured ethnographies of sites of production, but far fewer examine what happens once chemicals leave the factory fenceline as consumer products or when they pose environmental challenges decades following use or release.

For example, environmental sociologists focus more on extraction and production systems than consumption (Princen et al. 2002). Here, however, my focus on consumption demonstrates how the shifting political and economic arrangements of commodity production and
consumption, coupled with the knowledge and powerful symbols created through biomonitoring science, has opened up new channels through which activists can push for regulatory and policy change. Whereas regulatory and policy battles in sites of production have been entrenched and are quite challenging, activists in sites of consumption create new opportunities to change policy and industrial practices by shifting their efforts later in the chemical lifecycle.

Though never before characterized through a lifecycle perspective, several studies do analyze community struggles with historical sources or in arenas far from sites of production. From these, we have a foundation for studying advocacy in sites of persistence. For example, sociologists have examined the dynamic political-economic and social relations of community challenges to hazardous waste and the persistent human exposures that result. Levine (1982) illuminated the experience of Love Canal, New York residents who discovered and fought for relocation away from an area where Hooker Chemical stored its industrial wastes. Brown and Mikkelsen (1990) detailed the struggles of Woburn, Massachusetts residents to trace the seepage of hazardous wastes into the drinking water supply and to the elevated incidence of leukemia among the town’s children. Bullard (1994) profiled the efforts of Warren County residents to stop the development of a PCB landfill in their neighborhood. My analysis of military toxics as one type of hazardous waste and legacy contaminant in Alaska contributes to this literature, as well as to a small, but growing focus on the environmental justice implications of militarization, particularly for Native American and Alaska Native populations (Hooks and Smith 2004; Kuletz 1998; Pulido 1996).

However, in contrast to these, my analysis of Alaska adopts and extends the recent trend of tracking the globally dispersed implications of chemical and hazardous waste. World-systems theorists and other sociologists that study industrial ecology (Cohen and Howard 2006; Pellow 2007) now track the flows of hazardous materials throughout the world-system through the trade in hazardous waste. In contrast, my analysis of Alaska characterizes de facto, unintended hazardous waste sites—what Downie and Fenge (2003) have called “receptor communities,”
which are an emergent and relatively unstudied arena of environmental debate and action. By unintended waste sites, I refer to how the by-products and products of industrial production travel on their own accord, as chemicals are swept into air and wind currents, embed themselves in the flesh of marine and land animals or in the plant-based food chain, and thus are dispersed through a vast global network.

**Theoretical Contributions and Broader Significance**

This research contributes to sociological theory and research in several ways. First, it provides a unique lifecycle model for studying ubiquitous human exposure to synthetic chemicals as an environmental, public health, and social problem. Though much research has examined environmental problems as tied to production processes and resource extraction, Pellow (2000), Casper (2003), and Buttel (2006) call for research on the significance of social relations in creating and resolving such problems, and to extend the analysis of environmental problems throughout production chains and across the entire product lifecycle. This research project addresses both gaps by contributing one of the first examinations of the complex social systems by which synthetic chemical exposures are produced, (bio)monitored, and contested. This is achieved not only by moving away from a traditional single-case study research design, but also by incorporating a political analysis of science and social movements into what has traditionally only focused on political-economic factors. Such an approach can inform or be adapted to examine other scenarios where civil society challenges social problems in different moments or arenas of contestation.

Second, this study also adds new theoretical insights into qualitative analysis of spatial and place-based processes, a growing area of theorizing within all three arenas of sociological research that inform this work (Gieryn 2000). Sociologists have just begun to examine how place-based and spatial processes affect the production of and responses to environmental problems (Spaargaren et al. 2006); the conduct and implications of scientific research (Gieryn
33

This dissertation, with the lifecycle approach to studying place-based advocacy, uniquely offers insight in each area as well as at the intersection of all three. I accomplish this by analyzing variation in the spatial orientation of political and economic relationships among the production (and, in the Alaskan case, military) systems that generate chemical exposures, the communities affected by these relations, and the social movement organizations and citizens that contest chemical exposures.

Third, this dissertation merges two subfields of sociological inquiry that have been moving toward one another: the sociology of science and the sociology of social movements. Such an approach widens the purview of science and technology studies beyond the laboratory or field site to better account for the diverse public contexts in which scientific knowledge, such as human body burden science, is produced, interpreted, and applied (Frickel and Moore 2006). It also adds to a new area of social movement research on how movements use science to engage not only the state, but also multiple, often intertwined systems of institutional authority to achieve social and environmental change (Myers and Cress 2005). I do so by merging the study of public science and the co-production of science and social order (Jasanoff 2005)—both key concepts and analytical foci of sociology of science—to the study of social movements, which has readily available frameworks for analyzing public involvement in science as a strategy for addressing social, health, and/or environmental problems. Thus, by examining the intersection among science, citizens, and movements, this research answers the joint call for a less science-centered and more political analysis of science (Frickel and Moore 2006; Morello-Frosch et al. 2005), and a less movement-centered, more encompassing analysis of social movements (Giugni et al. 1999; Myers and Cress 2005).

Pragmatically, this dissertation is among the first investigations into the social and political implications of biomonitoring and the new, though highly contested insight it provides on human exposure to synthetic chemicals. Biomonitoring data proliferates at a blinding pace. In its wake
are out-of-date frameworks with which to interpret the radical information biomonitoring provides. As recently noted by the National Research Council (2006), scant attention has been given to the social implications of biomonitoring and to the specific consequences biomonitoring has for communities and social movements. This dissertation, through the lens of how communities and advocacy groups navigate the uncertain and contested terrain of biomonitoring science, will provide one of the first investigations into the social and political consequences of human body burden science as it plays out across three local contexts. This research aims to infuse ongoing public, legal, medical, scientific, and policy debates over the accumulation of chemicals in bodies with a critical social analysis.

OVERVIEW OF DISSERTATION CHAPTERS

To better situate my cases, in Chapter Two, I examine the evolution of biomonitoring science to highlight that, while itself not a new technology, it has rapidly expanded in recent years, and has become an important component of place-based environmental health and justice organizing. I examine both the technological evolution of biomonitoring science, as well as its public applications. I also offer an historical overview of how biomonitoring science has been translated into public action and policy-making. I trace the use of biomonitoring as a public science to public intellectuals, whose work illuminated something new, and politically-motivating, about the public health consequences of industrialization and militarization following World War Two.

I situate the resurgence of public concern and involvement in body burden science within a broader historical pattern of public groups and social movements involving themselves in science as an essential component of challenging status quo relations and pushing for change. I discuss the significant hurdles that public groups face both in using science, and in bearing the burden of proving chemicals harmful, given the current environmental policies and regulations. Part of this struggle involves navigating alliances with researchers and negotiating the politics of expertise.
Chapter Two concludes with further characterization of the political-economic context into which biomonitoring science is introduced. I make an empirical argument for how the unfolding history of environmental policy and science constructed and solidified different arenas of environmental and chemical politics, and how this in turn shaped the potential for alliances and altered patterns of social relations. This scenario is changing, however, and is perhaps among the most significant changes to follow from the rapid expansion of biomonitoring science into the public sphere. As I argue here, one of the main implications of human biomonitoring science is that it has helped forge connections across disparate groups, disparate struggles, and disparate locales along production chains and across the chemical lifecycle.

Chapter Three builds on this foundation by providing a theoretical rationale for the social, economic, and political systems that link together what historically have been separate sites of contact and contestation. I combine insights from the sociology of science, social movements, environmental sociology, and industrial ecology literatures to anticipate the implications of biomonitoring and science-based advocacy in each domain as well as across them. I develop a model for examining the interaction between science-based advocacy and a political-economic context where science and politics are tightly interwoven. My approach examines the relationships between scientific knowledge and social relations in each locale, and how this interaction, in turn, enables and constrains public efforts to address and reduce chemical exposures. This model also accounts for how these factors may differ depending on the location within the chemical lifecycle.

Chapter Four articulates how my methodological approach—multi-sited ethnography—provides the tools and perspectives to examine three case studies, as well as the understand the relationships between them. Multi-sited ethnography is a recent adaptation to a classic approach to data collection and analysis in the social sciences that accounts for how chemicals, production systems, advocacy networks, and information, for example, link together geographically-disparate places. I also further describe my case selection process, what data I collected, how I
approached analyzing it, and conclude with the ethical implications raised by working in and across three research sites.

Three case study chapters anchor the middle portion of this dissertation. Each chapter focuses on the key events and players that shaped the interpretation and translation of biomonitoring science. For each case, I articulate the prevailing features of the political-economic and scientific context, what biomonitoring took place there, how the findings were interpreted, what actions were suggested or taken, and then trace the implications of biomonitoring for social relationships.

Chapter Five depicts several biomonitoring projects in the Mid-Ohio Valley of West Virginia and Ohio, where these communities offer a window into biomonitoring in a site of production. In this chapter, I highlight the relationship between the flurry of science conducted there, and the extent to which further action hinges upon—and is delayed by—additional research to determine its implications. From the Mid-Ohio Valley, we leave the main corridors of U.S. industrial production to a site of consumption, Maine, where in Chapter Six, I examine how a broad-based advocacy coalition conducts biomonitoring science to push a broader conversation about chemical exposures. Though the coalition focuses on human exposures resulting from the chemical constituents of everyday consumer products, these groups leverage biomonitoring because they see human body burden as presenting political and economic opportunities for the state of Maine. This chapter highlights a different set of political opportunities and implications, and in particular highlights the new and quite novel coalitions and alliances that have been built around the conduct and translation of biomonitoring science.

Finally, in Chapter Seven, which is set in Alaska, a site of persistence, I document the efforts of an environmental justice organization to coordinate several biomonitoring studies, with a specific focus on a study conducted with two Alaska Native communities on St. Lawrence Island. This chapter illuminates the complex tensions between science and action when chemicals have already been regulated, but nevertheless pose an immediate threat to human well-being.
In the concluding chapter, I draw comparisons across the three sites and discuss cross-cutting themes, thus completing the life-cycle analysis of biomonitoring science and politics. I describe how political economic arrangements in each site serve to structure “scientific opportunities,” by which I refer to the potential that communities and advocacy groups have, through their use of biomonitoring science, to challenge and bring about changes that uproot the structural causes driving ubiquitous human exposure to toxic chemicals. I describe how the specific social relations that characterize each site differentially shape how biomonitoring is conducted, which in turn has implications for what meanings and applications can follow from it. I describe how, depending on the social arrangements through which biomonitoring science is conducted, different social groups can use biomonitoring science to redefine the environmental problem in each locale, and in so doing, avail—or preclude—different remedies or solutions. I also describe the relationship between biomonitoring and advocacy in each site, with particular attention given to how biomonitoring science influences social relationships among advocacy groups located in other sites of contact and contestation.

Finally, I consider how biomonitoring has opened up new arenas of advocacy and policy debates later in the chemical lifecycle (e.g., sites of consumption and persistence), and what implications these struggles have had for communities living in sites of production. While on the one hand, struggles in sites of consumption and persistence have afforded new angles with which to push policy and move industry away from persistence, bioaccumulative, and toxic materials. On the other hand, however, these struggles have captured much public and policy attention, sometimes to the detriment of communities still on the fenceline, who realize the importance of campaigns to push national and international chemical policy reform, but also still face the more immediate problems of ongoing industrial pollution and lax regulatory enforcemen
Chapter 2

BODY BURDEN IN CONTEXT:
A SOCIAL HISTORY OF BIOMONITORING AND THE BURDENS OF PROOF

INTRODUCTION

In February of 2007, Ken Cook, the president of Environmental Working Group, a non-profit environmental health advocacy organization, flew from Washington, D.C. to Maine to address the Governor’s Task Force on Safer Chemicals in Consumer Products and Services. At the time of his visit, the Task Force and state legislators were considering landmark initiatives to regulate chemical exposures through everyday consumer products. Three weeks later, Cook returned to New England, this time to address the Massachusetts legislature on Beacon Hill. Massachusetts was deliberating a bill that would address the use of the most harmful industrial chemicals—including hexavalent chromium, made popular by the film, Erin Brokovich (2000), and trichloroethylene, which was the primary pollutant in A Civil Action (1998), which depicts Woburn, Massachusetts’ struggle to identify the causes of a childhood leukemia cluster. The Massachusetts bill would require the replacement of these and eight other chemicals with readily available, safer alternatives for industrial applications.

The purpose of Cook’s talk was to relay the findings from EWG’s latest in a series of biomonitoring pilot projects. Cook’s presentation to the governing bodies was entitled simply “Ten Americans.” As Cook recounted, though EWG’s in-house scientists knew very little about the ten volunteers—the Red Cross Research Program donated anonymous samples for the study—they did know they were analyzing the blood of ten unique Americans for two distinct reasons. This group was the first to have their blood tested so comprehensively—413 chemicals in all. They found 287, with an average of two hundred in each person. These compounds include industrial chemicals, pesticides, DDT and break-down products of DDT, unintended waste products like dioxins, and chemicals banned decades earlier, such as PCBs. Some
chemical, however, are still on the market—such as flame retardants added to electronics or to the foam in mattresses, as well as chemicals that help consumer products repel water or grease.

Second, Cook reported that EWG scientists knew this group had accumulated these chemicals through a distinct exposure pathway. This particular sample had not been exposed from air, or through water, even though both are significant exposure sources for most Americans. Nor were chemical burdens attributable to other common exposure sources such as work, diet, or consumer products.

In fact, as Cook noted with a slowed, metered cadence, “the only thing we know for sure about these ten Americans is that when the exposures took place, they looked like this.” Cook advanced his PowerPoint presentation from a data-intensive slide to a single, wordless, and startling image—a human baby cocooned in its mother’s womb. When Cook delivered the presentation at the Massachusetts state house, at the exact moment his slides changed, the room collectively gasped, then fell silent. Few, it seemed, had expected umbilical cord blood to be the subject of EWG’s chemical analysis. The force of his message came from what the scientists had found; newborns, just as they drew their first breath, already had over two hundred chemicals in their bloodstreamsa revelation Cook orchestrated like a maestro, through commanding the deliberate, rising chorus of discordant information, until his message swept over his audience.

Following his February talk at the Maine state house, Maine Public Radio interviewed Cook (2007). During the segment—Body Contamination Detailed—Cook further described the data drawn from EWG’s biomonitoring project of umbilical cord blood, and relayed EWG’s take on its significance: “What this study tells us is that industrial pollution begins in the womb and that we’ve got a safety net for these chemicals that is letting them through, not just to babies in the womb, but to all of us with very little testing and certainly no examination of what all of these chemicals in combination are doing to us.”

“We’ve taken a look at this from a different perspective,” Cook told interviewer, Irwin Gratz:
We tested a gentleman named Jesse Johnson for toxic chemicals a few years ago. We found a chemical that’s in can linings, BADGE 40H. We found that in Jesse’s blood at a concentration of 97.5 parts per billion, at very low levels. We found some perfluorinated chemicals, the kinds of chemicals that are used in non-stick coatings, used to make Teflon-coated pans, non-stick pans, Gore-Tex, StainMaster. We found that at 45 parts per billion. When you take one dose of Cialis, which we all know is a very popular dose for erectile dysfunction, the dose in your blood after thirty hours is thirty parts per billion, lower than the levels of either of these two contaminants. That’s after thirty hours. Paxil, a very common anti-depressant, also active—one dose—at thirty parts per billion when taken as directed. You can even go lower. Jesse had these flame retardants, like one under consideration for being banned in here in Maine. It was at less than one part per billion in his blood—0.29 parts per billion, we were able to measure. NeuvaRing, the most popular birth control chemical on the market now, is active a 0.019 parts per billion, far below a tenth of a part per billion. So you can regulate human reproduction. You can change human moods—all for less than thirty parts per billion. And these [the pharmaceuticals] are chemicals that are rigorously tested. We don’t know what the health effects alone or in combination are of these low doses of other chemicals.

While their cord blood study was among the first of its kind, Cook’s interview with Gratz highlights the creative strategies EWG employs to convey the meaning of their findings to the public and policy-makers. In this example, Cook explains the possible significance of exposures to synthetic chemicals when found in the body at trace levels—a complex, though fast-developing area of environmental science called low-dose toxicity—by drawing parallels to subject material the public better understands: human-made chemicals, much like human-made drugs, act on the body, even in very small doses.

What is most striking about Cook’s speech and radio interview is that EWG is a non-profit environmental health advocacy organization. That EWG was in the position to report on policy-relevant science points to several important trends that will be the main feature of this chapter.

First, public groups, like EWG, continue to turn to science to push address environmental health issues, and biomonitoring is among the latest scientific techniques public groups have
appropriated. In order for the safety of current-use synthetic materials to be investigated, public groups often must document exposures and prove that chemical that are harmful in toxicological studies are showing up inside humans. For this, social movement organizations and community groups increasingly rely on human biomonitoring science to document the presence of chemicals in human tissues and/or fluids. These groups use the insights biomonitoring affords them to challenge why public groups bear the burden of proving humans are exposed to chemicals and to move public debate about chemicals policy and production. Non-profit and community groups have involved themselves in the conduct and interpretation of biomonitoring science—often pursuing novel questions, such as characterizing the chemical content of cord blood. As a result of their expertise in biomonitoring, non-profits and community advocates are called upon to interpret the human body burdens for diverse public and policy audiences, though not without critique and commentary from industry associations and pro-business think tanks such as the American Chemistry Council, the Environmental Health Research Foundation, and the American Council on Science and Health. These groups have not so much criticized public groups for their conduct of biomonitoring science, but for their interpretation and application of its findings. In particular, industry groups claim that advocates make too much out of chemicals being detected in human tissue and fluids.

As novel as biomonitoring and human body burden may seem, the practice of monitoring human tissues for synthetic materials and environmental chemicals dates back more than a century. This chapter reveals that throughout the rich history of screening human bodies for foreign substances, this scientific technique, when brought into public view, has been both salient and scrutinized. Dating to early efforts to detect heavy metal poisons in human samples, detection and quantification of foreign materials has always been technically complex, typically

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6 See the information clearinghouse at www.biomonitoringinfo.org, managed by the Environmental Health Research Foundation. Also, see the position statement from the American Council on Science and Health, which is available at: http://www.acsh.org/publications/pubID.1148/pub_detail.asp. (Accessed 5 September 2007).
uncertain, and always fraught with direct public, policy, and legal applications (Bertomeu-Sanchez and Nieto-Galan 2006). This combination of uncertainty and broad utility makes for public and professional dispute (Clarke 1990). In previous decades, most (though not all) biomonitoring was done out of public view, for example by government agencies monitoring nuclear fallout or industry monitoring their workforce for chemical exposures. Today, government surveillance programs and social movement campaigns make information about chemicals in human bodies more accessible to the public.

Importantly, just as the scientific technique is not new, neither is public and community involvement in human biomonitoring science new. As reviewed in this chapter, there are important historical examples where public groups involved themselves in research and public dialogue about the meaning of human chemical burdens, though this history has rarely been linked to contemporary applications or debates over human biomonitoring. A look at historical examples of human biomonitoring illustrates the roots for many contemporary debates over the appropriate use and interpretation of body burden science, while also revealing the complexities for community groups pursuing this line of inquiry.

What is new is the extent to which biomonitoring is practiced as a public science and the implications of its relatively new introduction into ongoing, place-based environmental health and justice struggles. More recently, public groups have become more wide-spread end-users of biomonitoring science as well as strong voices in the debate over whether and how chemical body burden should be addressed. Environmental Working Group was on the leading edge of these trends. During the early 2000s, EWG coordinated a series of novel, human biomonitoring projects, solidifying their role as experts and educators to the public, policymakers, and the media. At the same time, EWG presented the environmental health movement with a model for using human biomonitoring to support public education and policy advocacy campaigns around chemicals. In subsequent years, state-level environmental health advocacy organizations and communities facing heavy exposure burdens developed similar biomonitoring pilot projects to
coordinate with their ongoing campaigns that address chemical exposures and the policy and regulatory loopholes that enable them.

As introduced in the previous chapter, this dissertation explores differences in the arenas where public groups involve themselves in biomonitoring science. For example, EWG’s science and commentary are situated on the consumer- and home-front of environmental politics, where they employ these issues as an entrée into a broader conversation about chemical regulation and safety. However, other groups continue to work on chemical exposures that occur in communities that neighbor big industry, or in regions where industry has little foothold, but where the products and by-products of their operations are nonetheless present. In these places, as previously noted, the political-economic relations and opportunities are quite different. So, too, are the strategies and the stakes. Stated differently, in each setting, there groups are in a different social position vis-à-vis the systems that produce, regulate, and quantify chemical pollution. As a result, they face different complexities and consequences when they engage the issue of chemical exposures and deal with biomonitoring science.

This chapter examines how science and policy unfolded in the United States in ways that solidified these three political arenas, and begins to raise the complexities and consequences of science-based advocacy, given these political realities. In Chapter Three, I return to this issue again, where I lay out a framework for how sites of contact and contestation differ and how those differences matter, and sites of contact and contestation are linked and how those linkages matter.

**Human Biomonitoring: Expanded, but Not New**

Human biological monitoring, or biomonitoring, is a fast-growing area of the environmental health sciences (Needham et al. 2005). The field encompasses technologies to identify and quantify the presence of chemical molecules and their metabolites (i.e., break-down products) in human fluids and tissue. Biomonitoring also entails screening human samples for biomarkers—signals that a foreign, synthetic material has altered or could alter physiological processes, cells,
or DNA. Scientists can use these as an internal dosimeter to indicate the former presence of synthetic and environmental chemicals. Thus, in total, human biomonitoring is used to assess what chemicals and heavy metals are in bodies and at what levels, as well as how bodies uptake, process, and interact with environmental chemicals (e.g. DeCaprio 1997). In this dissertation, I am primarily concerned with the use of biomonitoring for markers of exposure rather than effect or susceptibility.

The emphasis on studying synthetic materials in bodies and the chemical and compositional changes these bring about is part of the “biomarker” paradigm, first introduced by the National Research Council in 1987 (Committee on Biological Markers of the National Research Council). More generally, biomonitoring and biomarker research is part of a broader trend in the environmental health sciences to research the environment-body interface, and how environmental exposures might affect human systems at a molecular, genetic, and sub-clinical level (Shostak 2005; Frickel 2004). It is also part of a trend in which regulators, scientists, and environmental health activists consider cumulative exposures to a varied range of synthetic materials and heavy metals from all possible sources.

Though in recent decades there has been a rapid increase in biological monitoring for chemical exposures, it is not a new technique. Historical descriptions of early alchemy, chemistry, and medicine portray a long-standing fascination with identifying the constituents of bodily fluids. Consider, for example, the many medieval carvings and oil paintings depicting alchemists holding matula of urine to the light (Roberts, 2007). The practice of detecting foreign constituents in human fluids dates to the burgeoning development of early industrial hygiene (Bates et al. 2005) and long before that, the rise of analytic chemical, toxicology, and medico-legal forensics (Bertomeu-Sanchez and Nieto-Galan 2006). For instance, early nineteenth century forensic toxicologists developed a succession of sensory methods (e.g., smell and taste tests) of heated blood and organs to test for the presence of heavy metal poisons as part of medico-legal investigations of death. During the 1830s and 1840s, western European chemists
developed chemical analytic techniques to replace the taste test in screening for arsenic in the mortal remains of suspected murder victims. These efforts received intense public and professional scrutiny, given their importance in several, high-profile murder trials of that era. At issue were many of the same debates seen today: the best strategies for sample collection, analysis, and presentation of findings to the mass public (Bertomeu-Sanchez and Nieto-Galan 2006).

By the latter half of the nineteenth century, the practical application of chemical analytic methods increased alongside rapid development of more sensitive techniques for a wider array of substances of concern. For example, the German physician, Adolf Reinsch, found that if he combined urine with acid and heated the mixture in the presence of a copper foil, these elements would react to produce sediment of different colors, each indicating the presence of a particular heavy metal: for example, mercury yielded purple sediment (Bertomeu-Sanchez and Nieto-Galan 2006). Similarly, nineteenth century physicians developed techniques to test for the myriad of pharmaceutical agents entering into common use. Sexton and colleagues (2004) note that physicians would track the presence of pharmacological agents in human fluids, for instance, monitoring urinary levels of salicyluric acid in patients treated with salicylic acid for rheumatitis.

The practice of clinical and biochemical surveillance of workers expanded in step with industrial production during the 1800s. Following Behrend’s 1899 discovery that lead exposure damaged red blood cells, the practice of counting stippled, or spotted, cells as a biomarker of exposure became an essential practice in worker health surveillance at the turn of the twentieth century. This practice continued until new analytic methods for testing urine and later blood serum were developed and standardized in the latter half of the twentieth century (Hernberg 2000; Markowitz and Rosner 2002; Warren 2000). Importantly, firms monitored lead exposures in workers long before governments began monitoring lead in the general population, in part because the technology was not available to detect metals at levels relevant to population exposure. It was not until 1961 that the United States government began developing an extensive
public health infrastructure to monitor population and clinical blood lead levels in children. In 
that year, the US Public Health Service collected blood and soil levels in Los Angeles, Cincinnati, 
and Philadelphia (Warren 2002). More widespread monitoring of US population blood lead 
levels began in 1976 at the behest of the Food and Drug Administration, who expressed concern 
about population exposures through food stored in lead-soldered cans. Though it was the FDA’s 
concern about lead-soldered cans that prompted widespread monitoring, at the same time, there 
was significant interest in tracking whether population lead levels, particularly in children, were 
dropping in response to removing lead from household pain and gasoline (Sexton et al. 2004). A 
similar pattern of industry biomonitoring preceding federal or academic monitoring occurred 
more recently in the case of perfluorinated compounds, known colloquially as the “non-stick and 
stain-resistant chemicals,” which are discussed in Chapter Five.

The technical capacity to monitor human samples for chemicals has expanded rapidly since 
these earlier uses. By the turn of the twentieth century, scientists outside the medical, medico-
legal, or industrial health contexts began developing new methods to detect and characterize 
molecular components. The rapid technological expansion in analytic chemistry occurred 
alongside and partly due to the blossoming of the petrochemical industry, as well as the 
government-backed incentives to develop an atom bomb. These pursuits required that scientists 
first develop more specific techniques to analyze molecular structure and chemical constituents. 
As a result, scientists developed new techniques to parse out, identify, and quantify individual 
molecules in chemical mixtures, including the mass spectrometer, developed during the first two 
decades of the twentieth century. Using the complex print-outs produced by this machine, 
specialists in mass spectrum structure elucidation would decipher—often quite arduously—the 
ratio of a compound’s mass-to-charge. This ratio was unique for each chemical substance. By 
specifying this relationship for each constituent found in an unknown mixture, scientists could 
use these ratios to identify the presence of chemicals in unknown mixtures. During the 1950s, 
researchers published some of the first research on DDT (a pesticide) concentrations in human fat
and mothers’ milk (e.g., Laug et al. 1951) which later received greater public attention when cited by Rachel Carson in *Silent Spring* (1962).

However, mass spectrometry remained confined to elite research institutions and hospitals until computers became standard in analytic laboratories. Computers meant that the complex mass-spectral charts no longer had to be interpreted by hand. Scientists could program computers to calculate the mass-to-charge ratios. Other scientists later used the collective knowledge to identify compounds in blood, urine, air and other complex mixtures. The development of chemical databases followed computer automation, such as the database maintained by the National Institute of Standards and Technology, which houses the unique structural profile of each known chemical to facilitate scientists’ identification of components based on mass-spec printouts (Heller 1999). Yet, analyses were still somewhat crude, relative to later era capabilities. Few labs could conduct targeted searches for specific chemicals, and those that could were only capable of targeting a small number of specific chemicals. Rather, most labs conducted broad scans of biological specimen. These scientists were looking for whatever chemicals were present and getting modest estimations of their concentrations (Washburn 2007).

Over time, scientists increased their capacity not only to identify specific chemicals, but also to quantify their presence at increasingly lower detection limits. Archer Martin and Tony James invented the first gas chromatograph to parse out the constituents of chemical mixtures, a technology greatly enhanced by James Lovelock’s subsequent development of the electron capture detector (ECD). The ECD was highly sensitive compared to other equipment of that era, particularly for halogenated compounds, i.e., those whose basic stock contained one of the halogens: chlorine, fluorine, or bromine. So sensitive was the ECD that it could parse out specific constituents at the parts-per-trillion level. Yet, at the time of its invention, Lovelock did not consider the ECD of great importance, though both the US government and scores of environmental scientists did. As reported in his memoirs, when Lovelock filed for a US patent on the ECD, the US government pressured him to turn the patent over to them (Lovelock 2000).
Much to Lovelock’s further surprise, the ECD and the inventions it paved the way for, became the “midwife” of the environmental movement (Lovelock 2000: 200). Though not developed expressly for the measurement of chemical constituents in an environmental or biological medium, scientists in a variety of settings rapidly adopted the technology to measure CFCs in the atmosphere; FDA researchers used it to analyze pesticide residue in foods; and scientists, including Goulden and others at Shell, employed it to track the global distribution of halogenated pesticides (Lovelock 2000). Since iterations used during the 1950s, the gas chromatograph with electron capture detector has undergone a series of technological developments. When coupled to the capacity of the mass spectrometer, the latest chromatographers continue to push the field of trace chemical analysis to detect chemicals at increasingly lower concentrations. Today, some chemicals, for example a family of bromine-based flame retardants, can be detected at the level of a femptogram, one thousand times smaller that one part-per-trillion.\(^7\)

Recent expansion in technological development has increased the throughput capacity to run faster and more complex analyses, with increased sensitivity and specificity. This means scientists can test for more chemicals at lower levels, even if there is limited toxicological and epidemiological data with which to interpret what such concentrations mean for human health. Most importantly, these technological developments enabled scientists to measure chemicals that were significant to public health, rather than constrained by the available technology to only measure what was possible. Early detection equipment was best suited to detect chlorinated persistent organics, including DDT and PCBs.

Scientists also developed techniques to look for markers, or signals, that a chemical had entered the body, rather than actually detecting the chemical itself. Biomarkers include chemical metabolites or break-down products in the urine, or for example, DNA adducts, the product of a foreign chemical binding to a human genetic material. Just as scientists screen for such DNA

\(^7\) For example, see research conducted by Michael Ikonomou, a research scientist with the Canadian government's Department of Fisheries and Oceans' Institute of Ocean Sciences in Sidney, B.C.
adducts, they also look for other types of these chemical-biological hybrids, such as hemoglobin adducts—when a chemical, like an aromatic amine, binds with the constituent in blood (hemoglobin) critical for transportation of oxygen to cells (Schmidt 2006). However, the ability to detect biomarkers for specific chemicals requires extensive development and research to ensure validity. Given the amount of work analytic validation requires, and the sheer volume of chemicals to which humans are likely exposed, valid analytic techniques do not exist for the vast majority of chemicals in current commercial use. As of 2007, the US CDC monitored the general US population for a total of 275 chemicals (CDC 2007), though this is but a fraction of the chemicals in current use (US General Accountability Office 2005).

Though biomonitoring science has undergone rapid innovation, at the same time, it remains an unsettled science. Depending on the specific chemical or class of compounds, scientists continue to grapple with issues of measurement validity, standardization across labs, and best strategies for communication of results, as evidenced by the recent National Academy of Sciences report (2006). In this context, many stakeholder groups—from industry to government agencies to scientists and now advocacy groups—suggest best strategies to conduct, interpret, and report findings.

Of Blood and Controversy

In the last section, I highlighted the evolution of biomonitoring as a scientific technique to point out that the idea of monitoring bodies for heavy metals, poisons, and other substances is not new, though today’s applications are quite sophisticated, relative to its earliest roots in alchemists labs. I also point out that throughout the history of monitoring bodies for such substances, the results—when made public—have been both meaningful and more importantly political.

Throughout the 20th century, human biomonitoring typically was carried out by experts, with the results rarely reaching a public audience. Examples include the Department of Radiological Health testing the human uptake of radioactive isotopes and byproducts around nuclear test sites,
such as what was done with Alaska Native populations in several regions. There, U.S.
government scientists monitored bodies for nuclear and radioactive elements as early as the
1950s. Body burdens of these radioactive materials, however, were largely out of the public’s
view.

Industry, too, conducted surveillance monitoring, with few results making their way to the
public, expect when forced, for example, by the discovery process in toxic tort lawsuits. As noted
previously, by the late 1800s and early 1900s, some industries were monitoring their workforce
routinely for heavy metal exposures, though they were not required to report to the government
about worker exposures.

Passage of the Toxics Substances Control Act in 1976 mandated the reporting of exposure
information not to the public, but to the government, which could theoretically be released to the
public once reported. In a precedent-setting example, EPA issued DuPont the largest fine in its
history for concealing data about blood and cord blood levels of PFOA, a perflourinated
compound used to surface coat consumer and industrial goods. An Ohio lawyer, who received
documentation of worker monitoring through the trial discovery process during a lawsuit against
DuPont, transferred the documents to EPA. These revealed that DuPont had monitored workers
since at least the 1970s, though a large-scale regulatory and scientific investigation of this
chemical did not begin until the late 1990s. This case also highlights the extent to which industry
scientists often are the first to develop the analytical capacity to detect substances (or specific
biomarkers for exposure) used in industrial processes. In the case of PFOA, industry controlled
the analytic techniques to measure PFOA and delayed transfer to public, academic, or
government scientists. That the technological capacity remained under their control played a
significant role, as will be discussed in Chapter Five, in the ability of residents, as well as local
and federal regulators, to investigate the implications of groundwater contamination in the Mid-
Ohio Valley.
Though much biomonitoring was performed out of the public view, throughout the mid-twentieth century, notable public intellectuals worked to bring the results from biomonitoring studies and the issue of human body burden to the public. In the 1950s, Rachel Carson’s *Silent Spring* brought public attention to an otherwise obscure set of scientific publications that reported the presence of DDT in breastmilk and adipose tissue. In the 1960s, Barry Commoner and colleagues from the Committee on Nuclear Information monitored baby teeth for strontium-90 to raise public awareness about the implications of nuclear fallout from above ground weapons testing (Egan 2007). In the 1970s, Herbert Needleman’s research prompted public outcry against the widespread use of leaded gasoline additives, which included a focus on concentrations of lead in children’s teeth (Rosner and Markowitz 2005). As these key historical cases reveal, public information about chemicals and heavy metals in bodies historically has captivated the public and served as a powerful rhetorical tool to address the proliferation of human-made environmental and public health problems.

To illustrate this point, I turn to the case of Committee for Nuclear Information, a science shop for public intellectuals that worked to offer the public information about the public health risks of nuclear fallout during a period in which the government kept human exposure science largely from view.

**Public Intellectuals and Biomonitoring Science: “I Gave My Tooth to Science”**

Consider for example the degree of public response to the St. Louis Baby Teeth Survey, conducted by the Great St. Louis Committee for Nuclear Information (CNI) during a period of mounting concern over nuclear fallout from atmospheric, or above-ground nuclear weapon testing (Commoner 1971).\(^8\) Despite public and scientific knowledge of the global spread of nuclear fallout, government discourse, including from the Office of the President, dismissed public health

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implications of fallout, a pattern of official pronouncements that would continue throughout the
decade (Egan 2007).

CNI was the brainchild of often celebrated public intellectual, Barry Commoner, whose many
contributions to U.S. environmental and social change initiatives are captured by historian
Michael Egan (2007). Commoner and his contemporaries advocated for the development of
grassroots organizations as a corrective for the increasingly secretive fashion in which important
environmental and public health science was conducted. He envisioned information
clearinghouses staffed with publicly minded scientists who would supply the public with
information needed to advance democratic process and increase public participation in
governance.

CNI, comprised of St. Louis’ civic leaders, scientists, and university officials, was founded
with the aim of providing the public with “impartial” information about the widespread dispersal
of and health implications posed by fallout—a rather radical agenda, given the Cold War politics
of that era. The most significant contribution was their analysis of hundreds of thousands of baby
teeth for a radioactive byproduct of above-ground nuclear testing, strontium-90, the most
significant by-product released by above-ground detonation.

In 1958, CNI successfully presented the idea of monitoring area baby teeth for nuclear fallout
to St. Louis civic leaders, area dentists, and professors at the nearby Washington University
School of Dentistry, who took to the proposal. Additional Washington University faculty later
joined the project by serving on the Tooth Survey’s Scientific Advisory Group. The School of

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9 Dr. Herman M. Kalckar, then a biochemist at Johns Hopkins University, first planted the seed to analyze baby teeth for strontium-
90. In a paper published by the journal Nature, Kalckar (1958) hypothesized that babies’ primary teeth would serve as an excellent
indicator of how the body absorbed radioactive elements, and accordingly proposed an “International Milk Teeth Radiation Census” to
track the implications of nuclear fallout. On the heels of this publication, the US Public Health Service also released its 10-city survey
of the radioactive content of cows’ milk, which identified St. Louis’ milk supply as having the highest levels of strontium-90 of all the
cities tested. This study established that St. Louis was in the path of dispersing nuclear fallout, and therefore was a meaningful study
site for assessing the affects using baby teeth.

10 Strontium-90, which structurally resembles calcium, follows a common ecological and biological migration through the food-chain
and human system, primarily entering the body through calcium-rich foods. While some passes through the system, strontium-90 also
collects in bone and bone marrow, including teeth, where it accumulates over time and doses the body internally with radiation.
Dentistry received financial support for the project from the National Institute of Dental Research, a part of the U.S. Public Health Service in the sum of $157,454 over a 5 year period. Additional support came from health voluntaries and support groups, especially The American Cancer Society and the Leukemia Guild of Missouri and Illinois.

The collection of baby teeth to be ground and analyzed involved a massive public effort both locally and nationally, making the St. Louis Baby Teeth Survey one of the first instances of public involvement in human biomonitoring science. Publicity for the study and recruitment of samples was aided by area professionals, including dentists, public school administrators, librarians, and government officials. Once word of the study spread, CNI received teeth from across the country, reportedly having to set hundreds aside because they were overwhelmed by the number of donated samples (Egan 2007).

Importantly, participant recruitment and sample collection became a cultural phenomenon and source of pride. Historic accounts report children proudly displaying certificates and pins picturing gap-toothed children and the slogan “I gave my tooth to science.” Egan (2007) recounts notes children penned that detail their decision to forgo the tooth fairy’s prize, and from frazzled parents requesting duplicate pins to pacify wanton siblings or a remiss child who had lost his or her original.

Nationally, other public groups involved themselves in sample collection, most notably a Long Island-based local of the Oil, Chemical and Atomic Workers led by Tony Mazzochi. In the following excerpt, Mazzochi comments on the value of his New York local participation in the survey:

Eighty percent of the membership of my local union are women, and when we heard about the Baby Tooth Survey, it was a way in which we could link our own members into a greater national question of nuclear fallout out… this was a tangible way of associating a subject that most people thought was too complicated for them to understand: the question of strontium-90 being taken up by humans and lodging in their bones. Here was a group that came out with a method to demonstrate that there was an association. Our members contributed thousands of
teeth. We had grandkids, and every morning someone would come into the local with a little package… and we would ship those teeth out. It was an incredible education program because people had a direct relationship to it. It was their kids’ teeth, and to think that these teeth had strontium-90 in them. The survey allowed me a political base to talk about this question to the union which was involved in developing nuclear weapons. Without that, I think I would not have survived politically in the union (1998: 30).

Public involvement in collecting human samples piqued national interest in the project while also conveying to the public—by virtue of the project’s intent—the potential health implications of nuclear fallout. The public eagerly awaited results. Preliminary findings first appeared in a November 1961 issue of *Science*. This initial article, while presenting a small slice of the tooth data, focused instead on the credibility of the method for analysis (Reis 1961). Over time, CNI was able to demonstrate that fluctuation in baby teeth levels paralleled fluctuations in the frequency of above-ground detonations (Egan 2007). As results filled column-space in newspapers across the country, new surveys sprung up in other cities (Egan 2007).

The baby tooth study both contributed to and occurred within a rising chorus of public critique against above-ground weapons testing. Some of the public response is attributable to widespread public mobilization by social movement organizations like the Student Peace Union, Physicians for Social Responsibility, and the National Committee for a Sane Nuclear Policy (SANE) (Boyer 1984). Other scholars describe the widespread public fascination with the dangers of nuclear technologies as a prevailing cultural motif of the late 1950s—a theme running throughout the music, poetry, television series, and movies of that era (Boyer 1984). These cultural and social movement activities augmented and reflected the prevailing global tensions and the threat of nuclear war, particularly during the Cuban Missile Crisis. Nuclear tensions crested just as the first waves of baby tooth data were released to the public and scientific community. This amalgamation of cultural, political, and scientific ferment was evident during the Congressional
test ban treaty hearings of 1963. Widespread public and political support prompted the U.S. to sign the test ban treaty and to force nuclear testing underground.

CNI’s baby tooth survey marks the first use of human biological data to educate the public about exposures to human-made materials, and is championed as successfully amassing enough public pressure to change the practice of atmospheric/above-ground nuclear testing. No researcher has tracked directly the chain of evidence linking the study, including its massive public following and media coverage, to the eventual signing of the treaty. Still, it is fair to argue that the baby tooth data was a significant contributor to public awareness in addition to media coverage of geopolitical conflict and strained international relations. It is especially significant, however, that the public came to such a nuanced understanding of nuclear-fallout during a period in which the science of nuclear weapons and their implications were kept as confidential or classified information. Moreover, there was an appreciable shift in political rhetoric during the study period. As Egan (2007) notes, the presidential candidate, Adlai Stevenson, proposed a test ban in 1956, but with little public response or outcry. Yet, seven years later, when the Joint Committee for Atomic Energy convened its hearings on the test ban, the Johnson administration and other politicians supported the test ban using strong rhetoric about the ubiquitous health risk, particularly for children, posed by widespread dispersion of fallout (Divine 1978). Letters also poured into Congress from the public, most especially from mothers in support of the ban (Sullivan 1982).

As this example raises, while biomonitoring science was compelling, public fascination and its political currency had a half-life of its own. Body burdens of radioactive materials like strontium-90, which had captivated the public during the 1960s, subsided from public view after the 1970s. Following the signing of the Partial Test Ban Treaty, there was a notable “sharp decline in activism, public discussion, and cultural expression devoted to the nuclear weapons issue” (Boyle 1984: 826), even as the Baby Tooth Survey continued, not ending until 1970. Since then, U.S. public response to public health concerns over nuclear materials has gone
through cycles of apathy and activism (Boyer 1984). Boyle attributes the decline in public advocacy to a combination of factors: altered public perceptions of diminished risk; a winnowing of the sense of urgency; isolation of nuclear R&D in elite, isolated think tanks and universities; a decrease in media coverage; the proliferation of rhetoric about peace-time benefits of nuclear technologies; and finally, by the subsequent shift of public and social movement attention to the Vietnam war. Subsequent efforts to revisit and extend the St. Louis Baby Tooth survey seemingly floundered due to questions of their legitimacy and lack of popular support.

Biomonitoring science has moved in and out of the public view. Following the wave of public discussion in the 1960s and 1970s, thanks to the work of Commoner, Carson, and Needleman, biomonitoring science, slipped again from public view. As the U.S. EPA launched its first surveillance programs of chemicals in adipose tissue, and after the wave of milestone environmental and chemical policies established during the 1970s, body burden faded from the public and policy arenas. During the period in which key environmental legislation was enacted, and the two subsequent decades, few environmental organizations publicly took on body burden (Boswell-Penc 2005), even though data about synthetic and industrial chemicals in human samples has been available and popularly communicated since publication of Carson’s *Silent Spring*. In particular, environmental organizations shied from dealing with blood or breast milk contamination because it appeared “alarmist,” and thus they feared had the potential to alienate important allies in a context where importantly-placed political allies were key to winning, then later defending, these legislative battles (Boswell-Penc 2005). Moreover, politicians, just as Udall (1969) predicted, found the issue too confrontational to the consumer economy to be a palatable platform.

The rise and fall of concern over nuclear body burdens—and the issue of human burdens more generally—raise important, yet-to-be answered questions about the public and political significance of body burden: at what point did the biological data stop being meaningful, motivating, or agitating, and why? Does the public salience of human burdens have a limited
shelf-life that, once reached, expires precipitously thereafter? In what ways does the political, social, and economic context help shape the meaning and import of human burdens? Both the import of teeth data during the era leading up to the ban, and its declining significance in the era immediately following it, signal that the meaning and social significance of body burden data is tightly hinged to the political, economic, and social contests in which its interpreted.

**Resurgence in Public Body Burden Science**

Since 2000, there has been a resurgence in the amount of information available to the public about human body burden, thanks to efforts not only by social movement organizations, as previously mentioned, but by academic scientists and the US government. For example, academics, often in collaboration with communities or community-based organizations—increasingly provide study participants with information about specific, individual-level burdens. This is part of a growing trend in which researchers who support communities’ and participants’ right-to-know offer study participants access to their own data (Brody et al. 2006; Morello-Frosch et al. 2006b; National Academy of Sciences 2006). As more biomonitoring studies are conducted, and as an increasingly wider pool of scientists subscribe to such a report-back ethic, more and more individuals have the unique experience of learning what chemicals are detectable in their bodies.

Government surveillance programs provide the public with an overview of chemicals in the average American population, though this information was not made expressly public until recently. The US government has run various population surveillance programs, beginning in the 1960s. Since 1967, the US government banked and analyzed human samples through the National Human Monitoring Program, which was initially housed in the US Public Health Service and later administered by the US EPA (Lee et al. 1995). This program—The National Human Adipose Tissue Survey—analyzed autopsy and surgical specimens in metropolitan areas. Over time, monitoring programs expanded from a focus on pesticides to include other kinds of
chemical exposures, as the program shifted institutional homes within the EPA. The EPA monitored 42 women’s breast milk for synthetic chemicals in New Jersey, Pennsylvania, and Louisiana in the early 1980s (Pellizzarri et al. 1982). Though funding was scaled back throughout the 1980s, after the National Research Council was commissioned to investigate US EPA efforts to track human exposures in 1990, increased attention was brought to the potential of biomonitoring (Lee et al. 1995; National Research Council 1991).

The CDC began monitoring human exposures to environmental chemicals in the second round of its National Health and Nutrition Examination Survey (NHANES), which collected samples between 1976 and 1980. After the FDA expressed concern about possible lead exposures through food stored in lead-soldered cans (Sexton et al. 2004: 42), the CDC included monitoring of lead in this data set. The EPA also used this opportunity to test for persistent pesticides in blood and non-persistent pesticides in urine. NHANES III, which collected samples during two three-year periods between 1988 and 1994, included not only further analysis of lead, but also cadmium and cotinine (a metabolite of nicotine and indicator of environmental tobacco smoke exposure) (Sexton et al. 2004). The CDC began a pilot study using 1000 of the NHANES III participants to measure new compounds: 32 volatile organic compounds in blood and twelve pesticides and their metabolites in urine.

More recently, government surveillance programs have become an important mechanism by which the public learns about chemicals in human bodies. When exposure monitoring became a continuously running component of NHANES in 1999, CDC began regularly providing the public with data about chemicals in people. The CDC’s Environmental Health Laboratory at the National Center for Environmental Health now reports average US population exposures every two years. The 2001 National Report on Human Exposures to Environmental Chemicals reported on the presence of 27 environmental chemicals sampled in the population in 1999. The 2003 2nd report included 116 compounds, the third report sampled for 148 (CDC 2005). The Federal Register solicited public comments on additional compounds to include for the fourth report,
scheduled for publication after 2007. States like California, with funding from the federal
government, now seek to implement state-level surveillance programs, which address specific
sub-population concerns and that seek to develop surveillance programs in consultation with
community and environmental advocacy organizations that operate within the state/region.¹¹

Social movement organizations, academic scientists, and governmental surveillance programs,
thus, continually release new information about human body burden to the public, albeit each in a
different way. In the previous chapter, I highlighted the increasing number of community groups
and social movement organizations who engage in biomonitoring science in the previous chapter
and earlier in this chapter. To contextualize the contemporary situation in which advocacy and
community-based studies occur, it is important to note that government surveillance programs
and academic scientists also bring biomonitoring science and body burden information to the
public, but in a different way. While government surveillance programs provide the public with
information about average exposures faced by the American population, academic scientists
report aggregate, not individual, results to the public, since most academic researchers protect the
confidentiality of all study participants. Many of the social movement organization studies, like
those conducted by Environmental Working Group, serve as a middle-ground between these two
types of studies. First, their studies put a human face on otherwise abstract data. Second,
advocacy studies, many with Institutional Review Board oversight, offer the public exposure data
that is both individualized and “generalizable,” though not in a statistical sense. While these
studies involve small samples, and therefore are not statistically representative of population
exposures, the study sample is designed to be qualitatively significant by measuring chemicals in
symbolically meaningful participants whose celebrity status, or “person next door” appeal
conjures a sense that his or her body burdens could represent anybody’s burdens. These studies

¹¹ In September 2006, California Governor, Arnold Schwarzenegger signed Senate Bill 1379 to establish
the first state-level biomonitoring program, The California Environmental Contaminant Biomonitoring
Program. For more information, see the California Department of Public Health at
http://www.cdpH.ca.gov.
have put a public face on biomonitoring science and raised the public visibility of the issue in ways unseen in earlier waves of science and advocacy.

**SCIENCE-BASED ADVOCACY AND THE SCIENTIFIC BURDENS OF PROOF**

Science has become an almost unavoidable component of what communities and organizations must do to seek redress, remediation, or change. However, science and power have worked historically in exposure assessment to stack the odds against communities. In this section, I address the burden of proof communities bear to demonstrate that exposures have happened and require attention. This burden of proof, in and of itself, poses challenges and consequences to public groups and movements. In addition to those, however, are added layers of complexity and challenges imposed by the uncertainties of human biomonitoring science. Finally, in order to engage science, public groups must also grapple with additional burdens stemming from the institution of science and the politics of expertise, especially in the context of a scientific technique, like biomonitoring, which (as noted in the previous chapter) often requires multi-institutional collaborations in order to happen.

**The Rising Necessity of Science-Based Advocacy**

Public participation and active engagement with biomonitoring science builds on the efforts by other public groups and social movements. Activists’ challenges for greater participation in scientific decision and fact-making and greater control over the conduct of science emerged during a period in which the legitimacy of science and other institutions, as well as scientists and expertise more generally, were increasingly challenged (Nelkin 1984; Fischer 2000). As the United States began regulating science and technology in the 1960s, debates brought research and development out of the private sector and into the public sphere (Nelkin 1984), and validated public concerns about the dangers of the unchecked progress of science and technology. At the same time, public confidence in science and scientists declined. While this decline is part of an overall trend of declining public confidence in institutions and experts, it remains significant that
the public began to question expertise as the primary means towards improving life and resolving social problems (Nelkin 1984: 22). In part, this is attributable to the failure of scientific advancements and new technologies during the 1960s (e.g., atomic energy) to remedy social problems, to the realization that science generates new, unintended social problems (Nelkin 1984), and to the increasing *scientization* of policy, governance (Fischer 2000) and social life (McCormick 2005). Activists have responded to the increasingly exclusive manner in which those with scientific expertise and credentials make policy decisions. Scientists became participants in policy decision-making by serving on special commissions, panels, advisory boards, or as consultants (Nelkin, 1984). As well, during the 1960s, the federal government, especially administrative agencies, began hiring scientists, and Congress established research arms to supply them with policy-relevant science, e.g., The Congressional Research Service in 1970 and the Office of Technology Assessment in 1972 (Nelkin 1984). The scientization of politics ultimately pulled the curtain back on the underlying social and political interests that influence science—as more experts were hired to adjudicate political disputes, the more scientific expertise, the mystique of scientific authority and the boundary between politics and science was eroded (Epstein 1996, p. 6).

However, the scientization of regulatory and policy debates was especially pronounced in the case of environmental decision-making. Many of the policy victories of the 1970s, even though an important success of environmental advocacy, ultimately narrowed “environmentalism” to debates over science (Fischer 2000). The National Environmental Policy Act of 1969 was one of the key pieces of legislation that mandated environmental issues be dealt with as a technical issues through scientific, rational environmental decision-making processes (Gottlieb 1995; Gottlieb 2005). Following NEPA, which delineated the technical process by which environmental impact statements should be created, technical knowledge became the prerequisite for participation in many environmental policy decisions. As a result, there was a dramatic shift in mainstream environmental advocacy. Environmentalism, as practiced by national membership
environmental organizations such as the Sierra Club, became increasingly policy-focused during
this period. Over time, national environment organizations hired professionals’ with credentials
in science or law. As some organizations professionalized, others were founded and principally
staffed by professional lawyers and scientists (Gottlieb 2005). These professionalized
organizations operated in technical, policy and legislative arenas, creating increasingly complex
environmental policy systems, which in turn, reinforced the demand for expertise in order to
engage them. Environmental debates were waged between experts that represented different
stakeholders. For professionalized groups, their involvement within these technical arenas further
mainstreamed their agenda, and often undermined any radical components of environmentalism
from the previous era. Another consequence of the increasing professionalization and
expertification of environmental discourse is that the public and grassroots groups without access
to scientific resources were shut out from environmental decision-making (Fischer 2000). This
reflects a critique issued by some environmental sociologists, who argue that science is an
establishment tool. As they argue, when social movement organizations must marshal scientific
evidence, this situation indicates how powerful economic actors have successfully shifted
environmental debates away from human rights and morals (Schnaiberg and Gould 1994).

**Exposure Assessment and the Burden of Proof**

Historically, documenting direct human exposures has been challenging for scientists, non-
profit organizations and communities. In the years before biological monitoring became more
available, faster, and specific, the internal dose of a chemical was estimated through information
about likely routes and timing of exposure among a given population (Sexton et al. 2004).
Modeling internal doses is least complicated in industrial settings, where more is known about
which chemicals workers are exposed to and through what routes during a given work shift.
Modeling becomes more complicated in community settings where multiple exposures, often via
unknown exposure pathways, occur over longer, more ambiguous timeframes.
The sociology literature provides numerous, in-depth case descriptions of the struggles of occupational or fence-line communities to document and legitimize exposures from adjacent production facilities, power plants, waste sites, and other point-sources of pollution. Communities facing ambiguous exposures from neighboring facilities document exposures by quantifying *effects*. For example, community groups survey residents and create lay maps of families affected by common symptoms or diagnoses, what Brown refers to as popular epidemiology (Brown 1997). Communities also request health studies from state and federal agencies, or work with sympathetic scientists to document and analyze health effects from suspected exposures (Brown 2007). However, another set of case studies recount the rising trend of community policing of exposures (O’Rourke and Macey 2003) where communities adjacent to point-sources of pollution document the actual presence of chemicals in their air, dust, water, or food. In these instances, citizens collect samples for exposure analysis through citizen-science alliances (Brown 2007), one institutional means by which communities gain access to expensive monitoring equipment. For example, community groups have worked in alliance with scientists to place air monitors near urban diesel bus depots and other community hotspots (Loh and Sugarman 2001), or run temporary monitors to collect air and dust of in the homes of communities living near an oil refinery.12 Similarly, social movement organizations adapt scientific equipment and train communities in the use of modified air samplers using inexpensive buckets, which Communities for a Better Environment (California) developed. Dozens of communities, particularly those along the industrial corridor between New Orleans and Baton Rouge, Louisiana, have taken advantage of the exposure equipment that “bucket brigades” have made more accessible, to capture air after industrial releases for analysis at certified labs (Lerner 2005; O’Rourke and Macey 2003; Ottinger 2005; Roberts and Toffolon-Weiss 2001).

As O’Rourke and Macey (2003) note, community-driven efforts to document potential exposures “has had marked effects on local residents’ perceptions and participation in emergency response and citizens’ right-to-know” (p. 383). Lerner (2005) similarly notes how bucket brigades helped groups prove industry has not been forthright about releases (p. 191) and document that emissions stray from the factory gates and expose residents. Community efforts to document exposures can capture regulators’ attention, and in some cases, alter state monitoring practices. For example, in Diamond, Louisiana, bucket brigade results prompted EPA to arrive with a mobile monitoring unit. Yet, much contention remains, even after communities document chemicals in their ambient environment. Overall, community efforts to document such exposures have not instituted fundamental changes in power relations and have not helped communities achieve their longer-term goals of a full-participation environmental governance and decision-making (O’Rourke and Macey 2003).

Once communities document chemicals in their everyday environment, regulators still want to know how much gets into people, through what route, and over what time—three crucial variables they need to determine the internal dose of a chemical, the targeted system or organ, and the potential physiological or health consequences. In addition, the farther exposures happen from points of production, the more difficult traditional methods of exposure assessment become, and the more scientists have to rely on assumptions to model internal dose. Standard scientific assumptions, however, can lead to gross underestimation of internal dosages. This was true when EPA estimated mercury exposures based on presumed fish consumption for the “average” adult. Their estimates overlooked the unique exposures faced by populations who consume subsistence, predominantly marine-based diets (Corburn 2005).

More importantly, communities and public groups bear the burden of documenting that people are exposed to chemicals and that such exposures warrant action, a role prescribed by U.S. chemical and environmental policy to an already overwhelmed regulatory agency, the U.S. Environmental Protection Agency. However, without the infrastructure or capacity to evaluate
the thousands of chemicals in commerce, as has been historically demonstrated by numerous government studies documenting how overburdened and restricted EPA is as a federal regulator (US General Accountability Office 2005; 2007), policy actually displaces the burden of proof onto affected communities and the non-profit groups that have expanded to fill the gap in oversight. These groups must demonstrate significant enough exposure to warrant the attention of government and regulators, who in turn, then face enormous burdens to collect additional evidence sufficient to warrant regulatory, remedial, or compensatory action. Thus, in practice, communities bear the burden of both proving exposures happen and that those exposures pose harm. For community groups and non-profit organizations concerned about chemical exposures, documenting that exposures occur has become a necessary first step to flag regulatory scrutiny of either a polluter or a chemical used in the production process.

In U.S chemical policy, the chemical/pollutant and its producers and users are considered harmless until proven otherwise. In other words, industry is afforded, as Myers notes (2006: 48), “the benefit of the doubt” that their products, chemical building-blocks, and waste products are safe until proven harmful. As these policies dictate, the burden of proof is on government to prove a chemical harmful enough to warrant regulation.

For a current use chemical to be regulated under the Toxics Substances Control Act (and not a single chemical has been regulated under TSCA in nearly twenty years), EPA must demonstrate two points through a multi-step decision-making process called “risk assessment.” First, EPA must show that a chemical more likely than not poses (or is likely to pose) an “unreasonable” health risk. Second, EPA must prove that regulating the chemical remains a beneficial decision after considering the economic and social consequences of controlling or banning its use.

These are not clear-cut determinations for regulators to make, as each entails convening scientific panels to examine and extrapolate from insufficient and uncertain scientific information. O’Brien (2000) characterizes risk assessment best: “in theory, risk assessment is an
objective, science-based process. In reality, risk assessment involves choices among numerous
guesses and estimates. Politics, money, and power affect those choices” (p. 17).

For example, whether a chemical poses a “hazard” may seem like a straightforward scientific
question, but it is often political and contested. Assigning the label “hazard” to a particular
chemical is often embroiled in broader issues of data gaps and different approaches to
synthesizing available evidence, which typically requires extrapolation and scientific calculations
such as reliance on modeling, extrapolation from high dose to low dose, and extrapolation from
animals to humans, which are often major areas of dispute. Different federal and international
agencies operate with different standards differ for establishing at what point the evidence
suggests a chemical is “hazardous” (i.e., likely to cause cancer, disrupt the endocrine system,
derail development, or comprise fertility or immune function). Added to these debates is the
question of whether other intrinsic properties of chemicals should trigger a chemical being
defined as hazardous enough to warrant regulatory oversight. Other intrinsic properties proposed
at the international and state levels include the propensity to bioaccumulate, biomagnify through
the food chain, or persistent in the environment – aside from, or even in the absence of toxicity
information.13

Estimation of “risk” is different from determining that a chemical poses an intrinsic “hazard,”
and infuses another layer of debate over questions of whether and when to act on a chemical. A
chemical poses a risk not necessarily when it has intrinsically toxic properties, but takes into
account its industrial or commercial uses, the extent of human exposure, and whether the
chemical is toxic at relatively low levels. In instances where policies specify the need for cost-
benefit analyses, regulators must weigh social and economic factors against determinations of
whether the chemical poses a risk or hazard. Thus, regulators must determine an “acceptable

13 The European Union recently enacted chemical policy reforms through its Registration, Evaluation, and Authorization of
Chemicals, or REACH legislation that use the inherent potential of a chemical to persist or bioaccumulate as triggering regulatory
action. The State of Maine’s Governor’s Task Force on Safer Chemicals made a similar argument—that chemicals shown to
bioaccumulate and biomagnify should be prioritized for regulatory review and/or action (2007).
risk” to warrant regulatory action and exact economic costs, perhaps the most political determination of them all.

One alternative to the risk assessment process just described, is another decision-making process called “alternatives assessment” (O’Brien 2000). As states have begun passing chemical policy in the absence of federal initiatives, another standard is being used to justify regulation. Rather than demonstrating toxicity of a particular substance in commerce, advocates can instead demonstrate that an alternative chemical is both safer and economically feasible. For example, as discussed in Chapter Six, Maine policymakers would not restrict the use of a Deca-BDE, a commercial flame retardant formulation in household goods because no known alternative seemed readily available (L.D. 1790, “An Act To Reduce Contamination of Breast Milk and the Environment from the Release of Brominated Chemicals in Consumer Products, 2004). Only when the Department of Environmental Protection identified an economically-feasible and safer alternative, did the legislature move to restrict use of Deca-BDE in 2007.

It is in this context that many affected communities and social movement organizations readily have adopted—and indeed practice themselves—the new “gold standard” of exposure assessment (Sexton et al. 2004). Biomonitoring enables scientists and affected groups to determine the actual internal dose of chemical or class of chemicals—to quantify exposures rather than estimate them through modeling. For some in the environmental health community, biomonitoring offers the promise to bridge the vast knowledge gaps that have hindered their progress toward affecting change—reducing chemical exposures across the board. As one activist has noted in the Oakland Tribune, “biomonitoring is the triumph of knowledge over ignorance” (Fischer 2006a).

**Burden of Proof in the Courts**

Besides the regulatory system, the courts area the other institutional arena in which citizens seek redress for chemical exposures. Courts historically have functioned as a critical safety net for citizens to raise concerns when the regulatory system has failed to protect them. Courts
impose a different standard of proof that plaintiffs’ counsel, on behalf of citizens, must prove in order to establish harm and argument for compensation. Legal standards of proof of harm require that citizens demonstrate both general causation (whether the chemical in question was the likely cause of harm) and specific causation (whether the chemical in question caused particular harms claimed by the citizens.) These must be provided based on what is deemed “a preponderance of evidence,” a less rigorous standard than is applied in criminal law, (i.e., “beyond a reasonable doubt.”) However, there are strict standards that oversee what scientific evidence is admitted for consideration, with many studies blocked from consideration. Federal Rules of Evidence, thus, require “smoking gun” evidence of harm, rather than a determination of harm based upon weighing the balance of available evidence used to make determinations of harm in the regulatory arena.

As a result of recent reforms in tort law which have restricted what scientific evidence is admissible, and given judges more discretion in overseeing the admissibility of science (Cranor 2007), toxic torts have actually worked to shift the burden “in the opposite direction—perpetrators of harm are being systematically relieved of responsibility for harm” (Raffensperger and Myers 2006: 297). Recent changes in tort law have followed from a series of decisions that have changed how scientific evidence and expert testimony is reviewed and admitted by the courts. Because tort cases raise scientific questions about the health significance of chemical exposures, the court system is placed in the position to consider, and often reach decisions based on, scientific questions for which there is little evidence, or that are on the frontier of scientific investigation. These changes undermine the ability of courts to ensure public health, and moreover, justice following exposure or harm from toxic chemicals (Cranor 2007).

When Science Poses Additional Burdens

The scientization of environmental decision-making affected environmental advocacy throughout the United States, but especially efforts that work at the grassroots level and frequently at the fence-line of major industrial facilities or other localized point-sources of pollution, which often have limited access to scientists or scientific resources. These groups respond not only to the increasingly technocratic environmental policies, but also to technoscientific environmentalism and the professionalized and scientized processes of environmental decision-making, which made effective environmental advocacy increasingly difficult for those constituencies with limited access to scientific resources and knowledge. Grassroots environmental justice organizations often critique the technoscientific tactics of mainstream environmentalism.

At the same time, while laws professionalized and scientized environmental decision-making, thus making it harder for many community groups to participate in environmental decision-making, they also availed community groups with another tool with which to organize—information. Chemical right-to-know initiatives and EPA’s Toxic Release Inventory, in addition to the establishment of electronic databases for regulatory documents, gave community groups access to an unprecedented amount of information about pollutants released from industrial facilities in and around their communities. Community groups reorganized themselves to take advantage of information available to them, which fundamentally changed advocacy and organizing strategies. In addition, they targeted the practices of regulatory and industry science, which typically produced critical information about chemical exposures and health implications that they needed to effectively address community concerns (Fischer 2000).

Many environmental advocacy organizations debate the strategic use of science in social movement advocacy. Science, for many communities and small organizations, can be a double-edged sword (Urban Habitat 2004), posing consequences particularly for community groups and advocacy organizations—timely, costly, and often with imbalances in power and control.
Communities and the organizations that represent their interests may find that engaging science detracts from the other important tasks and goals of movements. Research is a time- and resource-intensive enterprise; time and resources invested in scientific research are time and resources not spent toward advancing other goals. When using science as an advocacy tool, social movement organizations must delicately balance science with other advocacy strategies to meet their goals, which is difficult, because participatory projects can siphon volumes of time and resources. Partnership building and engaging in debates over scientific data and significance more generally, tax the finite and already over-stretched resources of community organizations (Tucker and Taylor 2004). Devoting a staff member’s time to working on research projects or attending to grant-writing and reporting requirements can draw that person off mission, and in a small organization, this can have profound effects on the overall direction of the organization (Gronbjerg 1992). Therefore, organizations that collaborate on community-based participatory research projects are pulled in many directions simultaneously. They work to build effective, equitable partnerships, engage in research, all-the-while attending to the myriad tasks of community organizing. As a result, environmental justice advocates caution that science must not become the sole focus of organizations, but remain one component of a multi-pronged campaign. Science cannot replace organizing and advocacy, it must supplement it (Pierce 2004).

These are just some examples of why engaging in science, for environmental justice organizations, can be like wielding a double edged sword (Akaba 2004).

Differential access to science can divide activists, scientists, and social movement organizations (Epstein 1996). Epstein argues that when some social movement actors or organizations engage in participatory research, there are important, unintended effects that result. Epstein found that as activists become more versed in the language and tools of science, as they themselves became experts, they too reaffirmed and reconstituted a hierarchy of knowledge, but within the movement. That is, the development of lay expertise creates a marked differential within movement actors between those who possess expert knowledge and scientific literacy from
those who do not. In the case of AIDS activists advocating for increased control over clinical trials, those activists involved in clinical trial research gained mastery over the biomedicine of AIDS treatment. This had implications for relationships between activists within the AIDS movement. It created differentials in terms of who had command of this esoteric knowledge, which was based on privileging of certain types of knowledge over others. Knowledge hierarchies within the movement are overlaid onto already present power differentials within organizations and movements, already stratified by education, credentials, or credibility. These knowledge differentials create tensions within movement organizations, and indeed exacerbate racial and class differentials. As well, activists’ expertification can have ramifications on the activists’ acceptance and credibility with movement constituents because they appear aligned, potentially even ‘co-opted’ by their ties with researchers, health promotion professionals, and other perceived ‘movement outsiders’ (Epstein 1996: 350-351). Moreover, there exists a potential for rifts within the movement in terms of which organizations can be awarded competitive but necessary funds, or devote limited resources to time-intensive research efforts. Thus, the relationship between science and movements is complex; science can serve as a wedge between potential allies, as Epstein (1996) points out, while at the same time, as this research also shows, it can build important political relations.

**SCIENCE, POLICY, AND ARENAS OF CHEMICAL CONTACT AND CONTESTATION**

I explore the intersection of policy, publics and science across three locales, rather than assuming that science and politics interact uniformly across places. Rather, one cannot get an accurate read on the salience and political implications of biomonitoring science unless first differentiating the social milieu in which these events take place. I investigate some of these differences by looking at three sites of contact and contestation— where people are exposed, where those exposures have been measured, and where the results—and what to do with them—have been openly debated. Here I describe how those arenas took shape. The unfolding history
of science and environmental policy created multiple arenas, what will be referred to as arenas of contact and contestation. As a result of the relationship between science, politics, and economics in each arena, public groups engage science through different means and in different ways, and potentially face different complexities and consequences as a result.

Environmental health and justice activism often involves discrete arenas of protest and challenge. Gottlieb (2001) first articulated the idea that environmental advocacy is “siloed” when he developed his notion of “bounded environmentalism.” As he argues, environmental advocacy has been carved into “separate spheres of daily living” (p. 43)—those that address work, those concerned with products, and those concerned with the environment.

Bounded arenas of chemical exposure (or contact) and contestation are not inevitable, but are the product of U.S. environmental policy. During the 1970s, the US government passed a wave of landmark environmental legislation (see Figure 2-1). When knit together, however, these policies form a patchwork of state, federal, and international statutes and agencies that oversee industrial waste and chemicals, but that address a single chemical, in one medium, and one chemical pathway at a time. Here, however, I highlight how these policies, in their application, created discrete political moments or arrangements between industry, communities, and the tools and channels available to address chemical exposures. The legacy of these policies is that, today, the same synthetic chemical is regulated differently if used in a worksite, added to consumer products, found in industrial run-off, contained in smokestack emissions, or loaded into a barrel for burial or incineration. As environmental sociologists have shown, this segmentation of chemical and pollution hazards stems from the tendency of regulatory agencies and policy to focus on chemicals as pollutants and wastes emitted from production systems. Policy and regulation narrowly address limiting emissions from the normal operating procedures of industry using the best available abatement technology. Secondarily, policy and regulation address how waste is controlled, released, or stored. Addressing the actual hazardous nature of materials used in industry was a tertiary concern that was not addressed until the passage of the Toxic
Substances Control Act (TSCA) in 1976. However, even after the passage of TSCA, which contained embedded assumptions that chemicals mattered, not just effluent, emissions or wastes, it was still difficult for EPA to address the hazardous nature of chemicals.

Importantly, science informed or prompted the creation of these policies. Science influenced what policy-makers knew at the time the key federal legislation was written and enacted. Equally influential were research silences, gaps, undone research, and never asked research questions. Scientific findings entered into debates over policy formation and implementation. Going forward, it was shaped by them, too. As I will argue in this section, in the U.S. context, science is incorporated into the regulatory process—into its own form of science, what Jasanoff (1990) terms “regulatory science”—the hybrid of “scientific evidence and reasoning with large doses of social and political judgment” (p. 229). In fact, often scientific policies do not inform, or shape, environmental policies in the least. Consider, for example, how US environmental policy has ignored scientific evidence regarding global climate change. As Jasanoff (1990) argues, it is the combination of science, but most importantly, imperfect knowledge and scientific limitations, plus politics that makes policy. Moreover, despite intentions otherwise, the inclusion of science rarely cools political debate. In fact, as Jasanoff (1990; 2005) argues, regulatory science and policy-making is typically adversarial, often by design. Regulatory decision-making is set up to highlight scientific uncertainty, polarize scientists into dueling camps, and by doing so, paralyzes policy- or regulatory action (Jasanoff, 2005). Also, regulatory science typically engages questions at the very leading edge or frontiers of scientific knowledge, “where consensus among scientists is most fragile” (Jasanoff 1987: 225). This is in part because regulators must manage chemicals or implement rules, but often the information they need to set standards is not available. They always have to regulate with incomplete information.

Once in place, regulatory policies lay the rules for the conduct, interpretation, and application of the environmental health sciences (Jasanoff 1990), including biomonitoring. Policy lays out the standards for evidence, what standard must be proven to justify action, formulations for
calculating and determining risk, and for weighing health risks versus economic costs. Highly technocratic policies also have the affect of cordonning off citizens and the public from the policy-making arena (Fischer 2000). Such a tightly interwoven relationship between science, and regulation and policy, means that science co-produces the current conditions of lay participation and mobilization.

Initially, the problem of hazardous waste was defined and then dealt with as three separate issues, or what Gottlieb and colleagues (1995) called the “the three pollutions” – The Clean Air Act addressed air pollution; the Clean Water Act, water pollution; and Resource Conservation and Recovery Act (RCRA) dealt with land-based pollution. These policies were passed in rapid-progression, and in response to specific “crisis” incidents of environmental contamination (Gottlieb 1995: 17). Though landmark environmental policy to control pollution at the time, in their outcome they were nonetheless haphazard in their ability to stem the tide of pollution (Gottlieb 1995: 17). As industrial pollution episodes bombarded US society, gaining in scale and momentum, rather than deal with pollution at a systemic level – for example, by regulating industrial uses of these materials at their source – Congress stayed out of the realm of industrial production and instead relied on technological and risk-based calculations to regulate how much of a given chemical industry could release, bury, and burn.

The underlying assumptions incorporated into these early policies further created the sites of contact and contestation in which contemporary movement organizations and pollution-affected communities currently contend. Synthetic materials, with the exception of pesticides, were assumed not to be inert because they were not designed to interfere with biological functions. As a result, basic toxicity testing of chemicals was not required for many chemicals. Moreover, environmental policies incorporated an assumption that the human handling of “wastes” – not the chemicals themselves – were hazardous. This assumption is most evident in RCRA language, which defined hazard as resulting from the mishandling of substances rather than the substances.
themselves. Following from these assumptions, policies aimed to oversee the technological
treatment and handling of “hazards” in the industrial waste stream.

Pollution control, as codified in these first three policies, also established a set of assumptions
about chemicals and regulatory and policy tools and processes to address them. These trio of
environmental policies set forth EPA’a mandate to deal with single chemicals, in one media, and
affecting humans through one route of exposure at the exclusion of at least two others
(occupational and consumer), a point which would become increasingly significant over time.
Furthermore, pollution control policies were not designed to stop pollution; rather, by working
backward pre-established permissible levels of pollutants in each media, regulators decide how
much each facility could release and then permitted them to do so. Thus, both unregulated
releases, in addition to permitted releases, have contributed to the current condition of widespread
environmental burdens of substances that build-up in ecological and biological systems.

Yet, as these U.S. policies went into effect, scientists found that substances like PCBs and
other organo-chlorinated materials, like the pesticide DDT, behave unexpectedly in the
environment. Molecules of synthetic chemicals were found to be highly-stable, capable of long
distance travel, and able to accumulate in the food chain and human bodies. During the 1950s,
scientists tracked the long-range dispersion of nuclear fallout from above-ground weapons tests,
and yet, it took another two decades before scientists clearly understood that many synthetic
chemicals were equally persistent and mobile. By the 1970s, widespread contaminants in Great
Lakes region helped draw the attention of scientists and policy-makers to the widespread
dispersion of chemicals.

TSCA was the first attempt by the US Congress to regulate synthetic chemicals as inherently
hazardous materials (rather than focus exclusively on waste products or industrial run-off). In
response to growing scientific evidence about the health implications of PCB exposure, TSCA
included an outright ban on their manufacture, processing, and use. However, for all other
industrial chemicals, policy-makers decided that the pre-market scrutiny and safety-checks
standard for pesticides and pharmaceuticals were not applicable to other chemicals. As TSCA was enacted, some sixty-two thousand chemicals already on the market and in wide use were ushered past the regulatory gaze (US General Accountability Office 2005). This means that, for the majority of chemicals in use today, there has been little regulatory oversight of their health and safety implications, the consequences of which will be discussed in Chapter Five. Only new substances, or substances being used in new applications, were subject to oversight by the U.S. Environmental Protection Agency, where TSCA requires manufacturers to submit known safety information to EPA before expanding production or going to market.

Figure 2-1. Key U.S. Environmental Policy Established 1969-2000

<table>
<thead>
<tr>
<th>Policy</th>
<th>Regulatory Domains</th>
<th>Agency w/ Jurisdiction</th>
<th>Policy-In-Practice</th>
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<tbody>
<tr>
<td>Toxic Substances Control Act (1976);</td>
<td>Multimedia</td>
<td>EPA</td>
<td>Mandates EPA to monitor and review new chemicals, gives EPA jurisdiction to request safety information on chemicals post-market, and requires industry to report safety data to EPA. In practice, however, EPA has regulated only a handful of chemicals under TSCA.</td>
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<td>Pollution Prevention Act (1990)</td>
<td>Multi-Media</td>
<td>EPA</td>
<td>Directed industry and government to consider source reduction rather than pollution control or manage industrial waste.</td>
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<td>Safe Drinking</td>
<td>Water</td>
<td>EPA</td>
<td>Limits industrial discharge into water.</td>
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<td>Act/Memo</td>
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<td><strong>Water Act (1974)</strong></td>
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<td><strong>Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) (1980; 1986)</strong></td>
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<td><strong>Occupational Safety and Health Act (1970)</strong></td>
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<td><strong>Consumer Product Safety Act (1972)</strong></td>
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<td><strong>Federal Hazardous Substances Act (1960)</strong></td>
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<td><strong>Federal Insecticide, Fungicide, and Rodenticide Act (1996)</strong></td>
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<td><strong>Federal Food, Drug, and Cosmetics Act (2002)</strong></td>
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<td><strong>EPA</strong></td>
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<td><strong>Land, Hazardous Waste</strong></td>
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<td><strong>Hazardous Waste</strong></td>
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<td><strong>Pesticides</strong></td>
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<tr>
<td><strong>Regulates treatment, storage, and land disposal of hazardous waste</strong></td>
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<td><strong>Extended pollution control system from focus on generation/release, to ultimate fate (here disposal and long-term storage) of hazards.</strong></td>
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<td><strong>Allocated money for clean up for hazardous waste, spills, releases, and accidents; EPA had authority to force responsible parties for cleanup.</strong></td>
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<td><strong>Regulate ambient air or dermal exposures in the workplace.</strong></td>
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<td><strong>Established Consumer Product Safety Commission; gave agency broad authority to issue product recalls, develop safety standards, or ban products if standards are not feasible. (Restricted jurisdiction—no oversight of cosmetics, pesticides, and other products used in the home).</strong></td>
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<td><strong>Requires labeling on household products containing substances deemed “hazardous.”</strong></td>
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<td><strong>Establishes that all pesticides sold and distributed in US must be registered and proven to not pose an unreasonable risk to the environment or generate food residues in violation of Food, Drug, and Cosmetics Act.</strong></td>
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<tr>
<td><strong>Authorizes EPA to set maximum levels of pesticide residues in food, and considers special vulnerability of infants and children.</strong></td>
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Toxics Substances Control Act (1976), and later the Pollution Prevent Act (1990), attempted to weave together pollution concerns across media. These policies incorporated assumptions that chemicals affected air, water, and land simultaneously, and that earlier pollution control efforts only transferred pollution from one media to another. As TSCA was an attempt to unify concerns across media, it might have dismantled the silos of politics and civic challenges to chemicals, but it failed to do so in its implementation. Institutional impediments that pre-existed the passage of TSCA prevented EPA from using TSCA to oversee chemicals using a comprehensive, cross-media approach. When founded, EPA merged several already existing agencies with environmental mandates under a single roof, though it never fully assimilated or restructured the media-specific focus of its predecessors. As a result, its organizational structure was defined by environmental media—residual of the earlier organization of government agencies. The media-specific policies of the 1970s further solidified these organizational divisions. By the time TSCA was enacted, EPA was subdivided into five divisions—one to handle water, another for air, a third for land-based pollution, and two others that regulated pesticides and radiation. Thus, despite TSCA’s intent, there was no institutional basis from which EPA could effectively regulate toxic substances that cross media (Gottlieb 1995). Furthermore, EPA has not been able to regulate chemicals effectively under TSCA (US GAO 2005).

**Discovery of Synthetic Chemicals at the Top of the World**

The study of long-range transport of chemicals opened up new arenas of environmental politics and contestation to address exposures far removed from centers of production, and at far outside the bounds of current policy instruments for addressing human exposures. New scientific evidence revealed that early policy assumptions created additional arenas of exposure and political contestation, as exposure to new classes of chemicals were documented in the bodies of wildlife and communities—far from smokestacks or centers of production. By the mid-1980s, community health aides from communities in the circumpolar North began
documenting a rise in chronic health problems, as scientists discovered shockingly high chemical burdens accumulating in the blood and tissue of Inuit and Indigenous people of northern Canada, now Nunavut (see Cone 2006; Colburn et al., 1996; Downie and Fenge 2003). Science and advocacy from the circumpolar region turned policy assumptions from previous decades on their head and brought to an end an era in which “the Arctic rarely impinge[d] on the consciousness of decision-makers in more southern capitals” (Downie and Fenge 2003: xvi). With respect to chemical body burdens and the potential implications of chemical materials, the Arctic came to serve as a global “indicator region,” as “canaries in a global POPs coal mine” (Downie and Fenge 2003: xvii).

Geiser (2001) notes that concern over transboundary dispersion is a more recent policy concern than toxicity. Toxicity, as he argues, though often contested, is a far more well-established claim with which to argue for reduced chemical exposure or policy action. In many instances, there exist (albeit crude and often outdated) benchmarks and standards for toxicity that nonetheless set in motion formal rules and procedures for calculating and redressing exposures, as well as credentials that set apart who can and cannot determine whether a substance posses toxicity. However, the science of chemical dispersion has just begun to spawn the emergence of a parallel sociopolitical apparatus around it, most especially at the international level.

Initially, U.S. policies and regulatory action address dispersion and persistence through bans of specific chemicals, such as DDT in 1972, PCBs, in 1979, and chlordane in 1988. New waves of research and regulatory concern addressed other chlorinated pesticides and chemicals one chemical at a time. Each chemical, though it exhibited similar tendencies for long-range transport and persistence, were dealt with singly rather than comprehensively. New classes of compounds made with other halogens, such as bromine and fluorine, were put into mass production as replacements. Under these conditions, policy allowed industry to introduce new chemical without documenting the potential for dispersion, accumulation and persistence (Colborn et al.
The industrial substitutes for the legacy chemicals of the 1960s and 1970s, such as PCBs and DDT, became the “emerging contaminants” of the 2000s and beyond.

The bi-national International Joint Commission (IJC) on the Great Lakes and the United National Stockholm Convention on Persistent Organic Pollutants exemplify a new generation of international governance structures that define persistent, mobile, and bioaccumulative chemicals as deserving of special regulatory and policy attention (Botts and Muldoon 2005; Downie and Fenge 2003). The first introduction of a more comprehensive approach to addressing chemical persistence and global fate came out of nearly two decades of science and deliberations over chemical persistent in the Great Lakes Region. By the 1990s, the International Joint Commission had proposed a sunset on the production of all organochlorine chemicals (see Botts and Muldoon 2005; Howard 2004; Thorton, 2000). Earlier, the IJC’s 1978 amendment to the Great Lakes Water Quality Agreement (1972) called for the “virtual elimination” of industrial releases for substances known to persist and move between medium—air to water to living organisms. One motivating factor behind the 1978 amendments, as noted by Botts and Muldoon (2005), was the growing recognition among the IJC and activist coalitions that banned substances were highly persistent and accumulating in Great Lakes fish. Going forward, persistence became the new policy focus of the IJC, followed later in 1991, by wildlife and human bioaccumulation, which together, prompted the IJC’s unprecedented call for a virtual elimination of all such substances taxing the Great Lakes ecosystem (IJC 1991). By 1992, in the Sixth Biennial IJC report, the Commission had recommended a sunset on the use of chlorine as a feed-stock for use in production and manufacturing. What began in the 1970s as narrow look at water quality compromised by a single-pollutant (phosphorus run-off), extended to broad, multi-media, multi-source interrogation of synthetic chemicals, with an entirely novel, but never realized policy solution—the phase-out of an entire line of chemical production (Howard 2004).

During the late 1980s and 1990s, there was a marked change in focus among national environmental and environmental health organizations. Persistent and highly-mobile pollutants
and industrial by-products such as mercury and dioxins became a central focus. For example, dioxin activism emerged as a significant arena of protest and public advocacy, particularly around the production of dioxin releases from incinerators that burned household, construction, and medical waste. National organizations like the Center for Health, Environment, and Justice, the Indigenous Environmental Network, and Health Care Without Harm coordinated local community groups to “ban the burn.” Also during this period, environmental and environmental justice activism took up the issue of widespread fish contamination with methyl mercury and the long-range transport and deposition of mercury, though, like dioxins, the scope of activists’ concerns had broadened considerably. They were challenging chemicals that crossed borders, media, and local jurisdictions; yet, strategically, much of their attention was concentrated locally—for example, on incinerators that were contributing to ambient dioxin and mercury releases (Gibbs and the Citizens Clearinghouse for Hazardous Waste 1995; Montague and Montague 1971).

The United Nations Stockholm convention on Persistent Organic Pollutants, signed in 2001 also addressed the issue of the unintended reach and persistence of chemicals and industrial byproducts. This treat set in motion a global phase-out on twelve chlorinated pollutants, primarily pesticides, but also PCBs (an insulator and industrial solvent), and dioxins and furans (by-products from chlorine-intensive industrial production and combustion). This policy restricted its attention to organic (i.e., carbon-based) chemicals, and thus did not deal with all substances, such as mercury, that also persist, bioaccumulate, and act as toxicants. Synthetic materials and heavy metals that exhibit these properties are now referred to as persistent, bioaccumulative toxicants, or PBTs, and have become a major category of chemicals prioritized for removal from market in the European Union, and at the state level, and a major area of dialogue and debate. What chemicals fit within the category, as well as the definition of the category itself, though, are still debated. Different policy mechanisms operate with divergent definitions of persistence, bioaccumulative, and toxicant, whereby some combination of the three
characteristics – rather than all three – are cited as enough to constitute regulatory action (Easthope and Valeriano 2005). For example the European Union’s recent REACH\textsuperscript{15} legislation created a new category of high-priority chemicals, called vPvBs (very persistent, very bioaccumulative), though the criteria and assays required for inclusion in this category are also under debate (Floyd, 2006), especially for metals and PFOS, a perfluorinated compound formerly used in stain-repellant applications. What is of particular note, here, though, is that biomonitoring data becomes critical information for making the argument that a chemical or chemical class should be categorized as high priority deserving immediate attention by regulators.

As new science poured in about the global fate, transport, and build-up of chemicals, science-based advocacy challenged current modes of regulation and governance. Yet, policy-makers only slowly came to incorporate scientific information about dispersion and later accumulation into policy (Geiser 2001). As they began to take up the question of how loopholes created the problem of persistence, accumulation, and long-range transport, science and chemical policy debates began occurring in new, unorganized policy space to challenge the loopholes and laxity of older policies. In these policy arenas, industry and NGOs – as well as industry- and NGO-science – played an essential role in deliberations over chemical policy. At the international level, the space to regulate the wide dispersion and persistence of chemicals is highly unstructured, though that is shifting, as new forms of international governance and institutions such as the 1997 Great Lakes Binational Toxics Strategy and UN POPS Treaty, the 1998 regional Arhus Protocol on Persistent Organic Pollutants (part of the 1979 UNECE Convention on Long-Range Transboundary Air Pollution), and later, the European Union’s REACH legislation. These international policies put in place new mechanisms to control and eliminate the trans-boundary movement of wastes and chemicals that, on their own accord, disperse across boundaries.

\textsuperscript{15} See: European Commission REACH website http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm
It was not until the late 1990s, that EPA and US government further developed the cross-office, multi-media programs to address priority PBTs, or persistent bioaccumulative and toxic pollutants that were first raised during negotiations of the Great Lakes Binational Toxics Strategy. In 1998, EPA issued its PBT Strategy to address exposures that were not handled adequately by previous policy, specific substance bans, and a patchwork of fish consumption advisories to lower human exposures. That same year, EPA also instituted (in cooperation with organizations in industry and the environmental health community), its High Production Volume (HPV) Challenge Program, which endeavors still to fill in missing toxicity data for hazards posed by 2800 chemicals produced in excess of million pounds according to 1990 estimates (US General Accountability Office 2005). Most importantly, however, is that production volume was a stand-in policy proxy for human exposure, again signaling the significance of exposure (rather than toxicity) for triggering regulatory attention. EPA has supported a number of voluntary actions on the part of industry to reduce chemical use and exposure. However, no U.S. federal legislation or chemical policy reform addresses exposures resulting from long-range transport, persistence, and bioaccumulation. Congress continues to wrestle with TSCA reform to bring US policy in line with the provisions of the U.N. Convention on Persistent Organic Pollutants, which the US has signed but not ratified.

**Discovery of Synthetic Chemicals at Home**

In many respects, homes have always been a site of chemical exposures (Murphy 2006). Previously, people resided among the smoke, soot, and fumes from heating systems, and in much closer proximity to the stream of organic food and human wastes. In fact, as Murphy (2006) raises, perhaps the indoor air quality of homes has drastically improved in recent decades thanks to improvements in plumbing and home heating, cooking, and waste systems. But what makes this issue particularly salient and emergent in latter decade of the 20th century into the first decade of the 21st is that these issues are “perceptible, definable, and knowable” (Murphy 2006: 5)—
objects that scientists and activists alike have sought to make visualizable, detectable, and thus changeable. These scientific and policy shifts were part of a broader trend in which scientists and regulators sought to document the full range of human exposure sources and pathways, particularly in indoor and home environments, where people spend the majority of their time and where air pollution often exceeds outdoor standards (Lioy 1990; Ott and Roberts 1998; Smith 1988; Wallace 1987).

As the CDC began more regularly monitoring exposures in populations not expected to have significant occupational exposures, scientists and regulators were pressed to explain the primary sources of human exposure in the average population. These concerns forced the scientific and regulatory lens down the production cycle to look at how consumers and other occupational end-users (who apply chemicals to finished goods) might be exposed through chemical additives or residues in ‘finished’ products.

No longer solely determined to measure pollutants from industrial smokestacks, by the 1990s, scientists more routinely began to examine chemicals found in household products and furnishings that have until now served as the unremarkable backdrop to everyday life in consumer societies—electronics, carpeting, household cleaners, building materials, and beauty products (Lioy et al. 2002). Beginning in the 1980s and 1990s, scientists, policy-makers, and activists entered the American home – the private domain – and therein found an ever-expanding list of chemicals that have become ubiquitous to consumer’s everyday built environment as constituents of house dust, indoor air, and even the blood or urine streams of inhabitants. In 1984, Congress mandated that EPA take up the issue of indoor exposures in a line item add-on to the agency’s budget in 1984 (Murphy 2006), and just a few years later, the issue received a full public airing during congressional hearings on the proposed Indoor Air Quality Act. The most significant emphasis was on environmental tobacco smoke and “sick building syndrome” (Murphy 2006)—issues first raised in worksites but then migrated to homes. As environmental justice activists gained increasing national and media attention, they, too, carried the message of chemical
exposures not just at factory fenceline, with the banner call to address chemicals wherever people “live, work, and play.”

As the regulatory focus expanded to include chemical exposures through consumer goods, EPA initially concerned themselves with the chemical content of household solvents (Eisenhower 1987; Maklan et al. 1987), for example in cleaning products, glues, and household pest control products. The regulatory hunt began in earnest for specific contaminants contributing to poor indoor air quality (Dickson 1994). As Murphy (2006) recounts:

Not everyone believed that indoor air pollution was a real menace. Some scientists, environmentalists, and doctors, bolstered by representatives from chemical manufacturers, held that slight exposures emanating from the commodities of daily life were not a significant worry. In contrast, other scientists, doctors, and activists, joined by experts sponsored by the tobacco industry, held that indoor pollution was in fact a significant worry, perhaps even more so than industrial pollution. They argued that tiny exposures accumulated in otherwise unremarkable interiors and that these exposures, in their sheer multitude, were impossible to untangle from their specific sources. Vapors seeped from the abundant and ubiquitous accoutrements of comfortable postwar culture (p. 4).

However, the quest for the smoking gun was not a fruitful one, which turned EPA and regulatory methods on their heads. There was no single culprit, just fluctuating and complex mixtures. Over time, EPA slowly began to recognize that “traditional modes of regulation, based on pollutant-by-pollutant risk assessments, are of limited utility” (Dickson 1994: 20) and leading policy-makers and regulators toward what was dubbed over a decade ago as the last frontier of environmental regulation (Dickson 1994).

One of the major obstacles to seeing chemical risks posed by consumer products was first the prioritization of cancer and morbidity as the chief health endpoints of concern in toxicological research, and in a related point, the assumption that exposure levels existed at which there would be no appreciable elevated risk of harm. However, as Iles (2007) notes, “the development of the endocrine disruptor hypotheses may have started eroding the idea that low doses do not cause
adverse health effects” (p. 379), which in turn, opened the possibility for more research and new approaches to studying chemical exposures stemming from consumer products.

Over time, researchers and regulators began looking into chemical residues, unintentional exposures from unintentional leaching of chemicals from products. Research focused on the complex exposures stemming from consumer goods that had, over time, evolved from natural to synthetic or treated materials, such as engineered wood products, synthesized adhesives, and surface treatments to impart weather resistance. Research also turned to the complex chemical mixtures formed by the myriad of material items that populate the interior landscape of homes. These projects also investigated new understanding of the nature of human exposures. For example, in a 2003 study published in Environmental Science and Technology, the Silent Spring Institute, a non-profit, independent research organization focusing on links between women’s health and the environment, reported finding 67 endocrine-disrupting compounds in household air and dust (Rudel et al. 2003). Studies such as these are novel not just because they measure chemicals in less expected places, but also because they move beyond measuring pollutants emitted from industrial smokestacks to include chemicals found in household products and furnishings that have until now served as the unremarkable, and previously unexamined backdrop to everyday life in consumer societies—electronics, carpeting, household cleaners, building materials, and beauty products (Lioy et al. 2002).

Until recently, the chemical content of the “accoutrements of comfortable postwar culture” escaped comprehensive regulatory attention, though the hazardous potential of consumer products has been recognized for much longer. In 1967, President Lyndon B. Johnson remarked to Congress that “the march of technology” affords “unparalleled abundance and opportunity to the consumer” while also bringing “new complexities and hazards” (quoted in Gottlieb 1995). At the national level, few policies address chemical content of consumer goods, with some exceptions. The Food and Drug Act of 1906, the Food, Drug and Cosmetics Act of 1938, the Hazardous Substances labeling Act of 1960, and later the Lead Paint Poisoning Prevention Act of
1971 and the Consumer Product Safety Act of 1972 are all examples of legislative initiatives that responded to (and sought to control) product hazards. Much of the focus has been on petrochemical based chemicals used as food additives or that linger on foods as residues. FDA adopted “tolerance limits” for chemical residues in foods in 1954; four years later, the Delaney Clause banned toxic ingredients in food (Gottlieb 1995). Cover over consumer-based chemical exposures has been spread across regulatory agencies, including not only the EPA, but also the FDA, the Consumer Product Safety Commission (CPSC), and the Department of Transportation, which oversees transport of hazardous materials). The role of EPA has been to inform consumers, increase research consumer-based exposures (a major research gap), and request voluntary phase-out from industry (Shore 2003).

With great support from the environmental and the consumer safety advocacy communities, the Consumer Product Safety Commission was formed by the Consumer Product Safety Act in 1972 to develop safety standards for consumer products, conduct research on the risks of product-based hazards, and serve as a clearinghouse for information about hazardous products. This was in response to proceedings by the National Commission or Product Safety, convened by Congress in 1967 to investigate whether more consumer protections were needed to ensure household products posed minimal risk consumers. The CPSA defined clear jurisdictional boundaries, such that the CPSC could not address product hazards addressed under other statutes. This put pesticides, tobacco products, motor vehicles, food, drugs, and cosmetics—all major categories of consumer products with toxicity concerns—beyond their authority and under the jurisdiction of other agencies. Furthermore, the CPSC was given jurisdiction only over products manufactured and used within the United States. Finally, the CPSC was afforded a broad mandate to address chemical hazards in products, including carcinogenicity of their content, but no specific mechanisms or procedures for doing so (Gottlieb 1994). The CPSA was silent on how to reduce toxicity of products, and instead directed the Commission toward other health and safety concerns such as the seemingly more “imminent threats” of amputation, electrocution, burns, and
asphyxiation. During its first decade, CPSC took some important steps to address specific hazards posed by specific chemicals in specific products. For example, CPSC banned brominated TRIS, a flame-retardant additive, from children’s sleepwear when it was found to be a potent carcinogen (in 1977) (Blum 2006). CPSC also has enacted bans or prompted voluntary action on the use of vinyl chloride as a propellant; carbon tetrachloride and perchlorethylene (still used by commercial dry-cleaners) as a solvent in stain removers; 1, 1, 1-trichlorethane from use in typewriter correction fluid; and required labeling for all products containing asbestos and for paint-strippers that included methylene chloride.

Regulating the chemical content of consumer products has been another gateway toward chemical policy reform, with particularly intense activity at the state and international levels, as in the case of brominated fire retardants. In the U.S., states such as Washington, California, and Maine and even cities (e.g., San Francisco) have enacted chemical bans and decreased chemical content in products and, create policy incentive for green products, green production, and regional economic development based on clean production. Chemical and product specific policy changes have also led the way toward calls for more comprehensive materials and chemicals policies. The E.U. formalized a new chemical regulatory regime in December 2006 that mandates, among other issues, elimination of some chemical additives in electronics and cosmetics. The effects of EU policy on global markets and US producers is still shaking out, but there is some evidence to suggest that some US markets are shifting as a result (e.g., electronics more than personal care products, see Shapiro 2007).

Public and policy attention to chemicals in consumer products is mounting, however. More recently, following nation-wide concerns about lead in children’s toys, several states (e.g., Vermont and Massachusetts) as well as Congress began to consider a policy response and gave careful review of the Consumer Product Safety Commission’s mandate. Moreover, with the urging of the environmental health advocacy community, TSCA reforms such as the Kid Safe
Chemical Act were recently introduced in the US and will continue to be debated in coming years.

CONCLUSION

Biomonitoring increasingly has moved to the center of environmental advocacy and policy debates. Given this, and with the flood of new data about chemicals in people, biomonitoring may appear like a recent innovation. In this chapter, I set out to distinguish between what is and is not new about biomonitoring and the new public focus on chemical body burden. In the first third of the chapter, I detailed how the technique of biomonitoring has evolved and expanded in recent years and recounted its historical salience to position my current cases within a broader sweep of environmental advocacy and policy-making. I also point out that biomonitoring increasingly has become a public science, with advocacy organizations and communities actively pursuing and participating in biomonitoring research. While community groups have long engaged science as an advocacy tool, in part out of necessity, biomonitoring is a more recent introduction into these ongoing, place-based struggles for environmental health and justice.

To understand the implications biomonitoring has for such place-based struggles, in the last third of the chapter, I characterized how the unfolding history of policy and science in the US created three, often fragmented sites of contact and contestation. In particular, I drew attention to how policy and science created new arenas of advocacy that challenge chemical persistence and chemicals in consumer products, rather than just chemical pollution released from industry. Into these three advocacy arenas, communities and social movement organizations now introduce biomonitoring science and the issue of chemical body burden. In the next chapter, I further define these arenas, and my approach to studying them, by drawing on research and concepts from environmental sociology, industrial ecology, and the study of public science and social movements.
Chapter 3

A LIFECYCLE APPROACH
TO BODY BURDEN SCIENCE AND ADVOCACY

INTRODUCTION

As science has defined the physical properties of chemicals, policy-makers, activists, and the public have come to understand chemicals as not just a localized problem for those closest to factories and other pollution point-sources, but also a problem for consumers and receptor communities far from centers of production or application. With the advent of more specific and widely available human biomonitoring, particularly as social movement organizations and community groups created opportunities to conduct their own sampling, slowly the linkages between these arena have become increasingly clear. Chemicals flow from cradle-to-grave, and throughout their journey, lead to human exposures. The problem now is no longer simply about hazardous waste or pollution, or the constituents of consumer products. The problem has become reframed as about the chemical molecules themselves and the regulatory system that could not stop the introduction of new persistent and bioaccumulative materials.

In the last chapter, I described how the unfolding of science and policy in the United States concentrated the conduct and debates over body burden science into three typical sites or points of contact along the chemical lifecycle. This dissertation studies sites where chemicals are (1) synthesized, produced, and used in industrial applications, sites of chemical production, (2) where consumers use products and goods that contain chemical additives, or sites of consumption, and (3) places where chemicals accumulate over time, or sites of persistence, which are often distant in space and time from sites of production or consumption. Each site varies by location in the political economy; the role of the regulatory state; how science is incorporated into policy; the spatial relationship between the exposure source and the exposed population; and the spatial distance to loci of power and decision-making, which have implications for the interpretation and
meaning of body burden science and advocacy. These contextual factors, shape how and under what conditions human biomonitoring is conducted, interpreted, and translated into action.

In this chapter, I articulate the political-economic relations in each of the arenas of contact and contestation. My approach to examining each site, and the relationships between them, is informed by three intellectual currents within sociology: one that articulates the spatial structure of power in chemical production and regulation; another that informs the nature of science in political debates; and a third that analyzes how movements strategically use science to move political and public debates. Taken together, these perspectives are synthesized into a life-cycle approach for studying environmental science and politics from a chemical’s cradle-to-grave using multi-sited (or extended case) approaches to ethnography. Across the chemical lifecycle, I examine how social structures and political relations shape the practice of scientific knowledge production, and in turn, how scientific knowledge shapes social structures and political relations.

These sites of contact and contestation, while linked, are not in and of themselves mutually exclusive. Exposures to persistent chemicals, such PCBs, brominated flame retardants, or perfluorinated compounds, are often cumulative, emanating from many sources simultaneously. A site of production is also, at the same time, a site of consumption, for example. While residents may be exposed from chemicals released by a local plant into their drinking water, they may also be exposed to that same chemical, when using food packaging, as is the case for PFOA exposures in the Mid-Ohio Valley. Yet, these struggles often occur in parallel because the typically require challenging separate sources of authority and power (e.g., industry versus the state) or seeking redress through different institutional channels, since different routes of chemical exposure, as previously discussed, are governed by different policies and different regulatory agencies.

In each site, multiple types of exposures occur. For example, people that live and work near industrial facilities likely bear exposures from local emissions and releases, but they also may incur exposures through consumption of commercial products and through food, as fish, meat, and dairy are common sources of exposures of persistent, bioaccumulative toxicants. Thus, each
site, involves struggles over production-, consumption-, and persistence-based exposures. However, the cases I selected are illustrative of particular sites of contact and contestation, while also more broadly reflecting where the politics of pollution and social positionality intersect, and particularly where new linkages are being forged.

In the remainder of this chapter, I first specify a theoretical model for studying the interplay of science, advocacy, and political-economic context in which chemical exposures happen and public groups involve themselves in research and advocacy. I draw from recent work on the rise of science as a strategic tool by which community groups and advocacy organizations push for policy and regulatory change. I also argue that environmental health science contributes to the social, political, and regulatory environments in which communities and social movement organizations research and seek remedies to chemical body burdens.

I seek to better conceptualize how science interacts with other institutions to influence each site of contact and contestation. To do this, I demonstrate the theoretical basis for mapping the institutional arrangements and opposition that movements and concerned citizens confront when addressing environmental chemicals using biomonitoring science, including a focus on the state, industry, and their relationship these institutions have with science. Thus, I examine how public groups use and engage with science in multi-authority fields (Myers and Cress 2005: 284). In so doing, my work fits with other research that documents non-state forms of social control and demobilization (Myers and Cress 2005), particularly the ways in which science can demobilize and subdue, or conversely, accentuate and accelerate advocacy.

After specifying my approach to studying science-based advocacy, I articulate my theoretical framework for examining the different political-economic and scientific contexts in which the public challenges chemical body burden and involve themselves in biomonitoring. This framework merges key insights from the field of industrial ecology with environmental sociology to develop what I call a chemical lifecycle approach to studying the relationship between science and environmental health and justice organizing.
THEORIZING SCIENCE-BASED ADVOCACY

This dissertation explores the promises and perils of a fast-developing science as it becomes incorporated into policy, science, and social movement strategies. Key questions in this regard include: what are the implications of engaging in cutting-edge science for movements and communities concerned about environmental exposures? What does that engagement achieve, and what consequences does it produce, and for whom? These are not necessarily questions about outcomes, but instead raise a wide-range of implications that follow when multiple institutions and civil society groups wrestle with the significance of science during a time when the rules and norms governing its interpretation are largely unsettled. To understand these implications requires looking at the interaction among various stakeholder groups involved in these conversations and debates. As well, I consider interactions between activists and community groups addressing chemical exposure and the broader political-economic and scientific context in which they engage that issue. Chief among my concerns is how science has infused these interactions. Stated more conceptually, I look at science-based advocacy in the context of a political arena in which science is a major part of the power structure.

This study borrows from and theoretically extends a growing area of social movement research—the study of how social movements affect the social worlds in which they work. In this dissertation, I am concerned about the intendend and unintended implications for advocacy strategies, constituency-building, and for social relationships more generally. This builds on an important development in social movement scholarship. Rather than a focus on outcomes, however, researchers are starting to look more at consequences (Amenta and Young 1999: 35)—a more nuanced and dynamic concept that accounts for a wider array of implications. Historically, research typically focused on policy or state-centered outcomes (such as legislation or court rulings), rather than effects on culture, bystanders, identity, institutions, corporations, and other institutions or authority systems (Giugni et al. 1999; Myers and Cress, 2005). For example, Giugni et al. (1999) widened scholars focus from policy outcomes to include mobilization
dynamics. That is, rather than just study how movements affect policy, he broadened the field of
analysis to include how movements shift public opinion, or the actions of movement opponents.
Myers and Cress (2005) further broadened this focus to examine how public movements
influence science, medicine, and industry. As well, scholars began studying the unintended
csequences of advocacy (Amenta and Young 1999, Tilly 1999). As summarized by Tilly
(1999): “movements also leave political by-products that lie outside their programs and
sometimes even contradict them” (p. 268). “Independent actions of authorities, interventions of
other interested parties, environmental changes, and the grinding of non-movement politics all
produce consequences in the zone of a given social movement’s activity and interests” (Tilly
1999: 268).

Thus, of particular relevance here is Abbott’s (1997) reminder that the key to understanding
social life and social arrangements lies in identifying interactional fields—the complex tangle of
social groups and institutions—and studying “the rules and regularities of interaction throughout
the field (p. 1157). Thus, to understand the consequences of working with science requires
mapping the organizational and institutional setting and mobilization context in which
collectivities seek social change. Doing so enables an interactional analysis of contextual factors
and what movements claim and do, and it is the interactions among these elements that produce
consequences—intentional and unintentional, positives and negatives, setbacks and gains.

Social movement scholars have long studied the strategic action of social movements. I focus
on a specific category of movement and public claims and actions—those involving
biomonitoring science—as they are used to target a diverse array of authority systems and
institutions that shape the meaning of that science. Thus, to the study of social movement
strategies, I add insights from sociology of science, which has a long history of studying publics
as end-users of science public understandings of science (Irwin and Wynne 1996), and citizen
participation in science (Brown 2007; Hess 2007). This brings into view the full spectrum of civil
society/public groups from loosely-defined, inchoate community groups to more structured social movement organizations that involve themselves in body burden research and advocacy.

Following from social movement scholarship, I focus on how contextual conditions affect strategic action (Tilly 1999). However, other theoretical developments in social movement research push me to consider more than just the state as a key influence on how public groups challenge environmental problems. I thus consider a broader set of social forces, institutions, and authority systems than the state (Myers and Cress 2005), including how political opportunities are opened or shut off by science in interaction with the practices of the state, industry and social movements themselves. To better define the context in which public groups involve themselves in biomonitoring and the issue of chemical body burden, first, I draw on co-production theory as developed by Jasanoff and colleagues (2004). This concept helps me to articulate how the political-economic context is complicated. Jasanoff’s work helps specify how social relations are shaped, indeed co-produced, by the articulation of science with society and governance. In the following two sections, I articulate how civil society groups use and critique science, then how science shapes the context in which public groups challenge environmental problems.

**Science as a Tool for Public Participation and Social Movement Action**

Couch and Kroll-Smith (2000) suggest there is a new populism in the environmental sciences, as various public groups appropriate environmental science for their own uses. Since the first waves of federal environmental policy, science and information has become central to participation in environmental decision-making and environmentalism (Fischer 2000; McCormick 2007). Scholars of science and scholars of social movements have studied the rising salience of science for public action. For example, social movement scholars have turned their attention to characterizing social movement engagement with science (Brown 2007; Frickel and Moore 2006; Hess 2007; McCormick 2007).
Social movement researchers have not always focused on science as a strategic tool. Before sociologists recognized how movements use science for strategic purposes, social movement theory was primarily concerned with three sets of strategies groups mobilized to gain concessions and pursue their agendas. As Piven and Cloward (1977) note, movements acquire attention from elites by disrupting bureaucratic routines of the state. They can also garner third-party allies and concessions through persuasion, rhetoric, and symbolic protest. Castells (2003) notes that constituencies mobilized around environmental issues have been particularly effective at creating symbolic and spectacular events that “strike minds, provoke debate, and induce mobilization” (p. 187). Third, mobilized groups also negotiate with elites, as Diani (1997) puts it, by becoming insiders, and by routinizing or deradicalizing the contentious, non-institutionally sanctioned elements of their dissent. Strategies such as these, often termed negotiation tactics, involve interacting with elites on their terms and in their social spaces, through traditional, institutionalized mechanisms of public input to state practices: electoral politics, lobbying, and litigation. Andrews (2004) argues that movements frequently draw on all three strategies, sometimes creating hybrid forms of contention that, for example, merge symbolic persuasion with insider negotiation. Advocacy groups use science in these same ways, though surprisingly social movement scholars have hardly noticed that.

In following the tradition of sociology of science scholars, who also study public engagement with science, but extend their analysis to more civil society groups than just movements (Irwin and Wynne 1996), I extend my focus from social movement organizations to civil society groups. I merge these two foci, since biomonitoring is a science is engaged by community-based organizations, and other types of community associations, as well as by social movement and non-governmental organizations. Not all community-based organizations I study see themselves as part of a movement, though they engage in the production, interpretation, or translation of biomonitoring science. By more broadly conceptualizing the public groups participating in and using science to make claims about chemical exposures, I merge social movement scholars’ focus
on science-based advocacy strategies with sociology of science scholars who study the interface between science and publics (Irwin and Wynne 1996).

The sociology of science characterizes different models for how public groups strategically engage science based upon contrasting assumptions about expertise and who can credibly participate in science (Kleinman 2000). Publics can serve as research participants in expert-driven science, where scientists work unfettered by public oversight or involvement. Similarly, social movements or affected communities can seek out scientists to carry out research for them. In sharp contrast to expert-driven science is public- or community-driven science, where public groups independently use scientific methods or techniques to conduct their own research. Many public groups engage science during all steps of the scientific process— from doing science, to interpreting and acting on the results (Morello-Frosch et al. 2006a). These groups adopt scientific methods for creating knowledge, develop new lines of research questions, and encourage (or create) new methods of knowledge-making. Morello-Frosch and colleagues (2005) draw on the metaphor “data judo” to describe how social movement organizations in the environmental justice movement use data to engage in the policy arena.

Activists and members from community groups engage in science through various arrangements with science and scientists. Some enter into citizen-science alliances (Brown et al. 2004), conduct their own popular epidemiology investigations (Brown 1995; 1997) or street science (Corburn 2005), or they co-apply for government or foundations money to support community-based participatory research (Israel et al. 2001; Minkler and Wallerstein 2003; Morello-Frosch et al. 2005). Community-based participatory research, which can occur both within or outside the context of a social movement, is characterized by (1) the active involvement of affected populations in all aspects of research, from shaping the research questions and study design to devising interventions based on data analysis, and (2) the creation of information for the explicit purpose of working toward progressive social change (Minkler and Wallerstein 2003).
These contrasting research relationships differ according to what extent civil society groups are involved in directing the conduct, interpretation, communication and translation of science. Other axes of variation include who defines the terms of the relationship and the extent communities and lay people rely on scientists and experts to frame issues, translate data, or interpret and convey the information to a wider audience. Can members of the public actively contribute to problem definition or interpretation of the research findings, or is their input restricted to assisting with recruitment and achieving community “buy in” of the results? The final axis of variation is the extent to which traditional paradigmatic norms about science and knowledge production are challenged (Brown 2007; Epstein 1996; Kleinman 2000).

Social movement organizations and community groups envision science as a way to “reawaken community power” and build community and movement capacity (Bhatia et al. 2004). Capacity building involves learning research skills, such as collecting air samples, designing effective community surveys, or learning the science of air particulates, or scientific concepts like statistical significance or scientific uncertainty, which offers community members the tools to conduct and/or evaluate scientific research when needed to effect change. Participating in science can empower community members politically, by providing opportunities to realize community strengths and the potential of organized, grassroots campaigns to address community needs. Through participation in research projects, “rather than seeing themselves as victims requiring an outside savior, they [community members] begin to see themselves as key change agents” (Loh et al. 2002). Capacity-building through research partnerships involves more than just scientific knowledge or research skills. It includes provision of tangible improvements to the organization’s or community’s infrastructure, e.g., community air monitors, as was the case for the Roxbury community (Loh et al. 2002). As such, engagement in science is but a “means to an organizational or advocacy end, rather than an end in itself” (Prakash 2004: 19).

Importantly, however, sociology of science scholars have treated these different orientations to science as fairly fixed arrangements, rather than investigate how the underlying assumptions
about science and expertise might change in response to circumstances, such as scientific debate or critique. As activists and other stakeholders vie for the authority to interpret and control biomonitoring information, and the level of public debate increases, there is often a parallel ratcheting-up of the level of technical discourse required to discuss body burden. This follows from Latour’s (1987) notion that the more controversial a scientific subject, the more public debate there is, the more technocratic the scientific literature becomes. This can lead public groups to a desire for more expert-driven science to better participate in such debates, or it can engender a stronger critique of science and refutation of traditional notions of expertise. One potential implication is that, though research may start out on one end of the scientific continuum presented in, it can shift over time, as activists’ science, methodology, interpretation is challenged. Thus, one question this literature leaves unexplored is how public groups’ orientation to science and expertise may shift in response to how science is interpreted, used, and contested.

Such a shift is likely, given that scholars of science and social movements observe how civil society groups often have a fluid, evolving relationship with science. For example, movements can evolve toward science-based claims and strategies, whereby groups mobilize and increasingly involve themselves with science over time (Kaplan 2000). Awareness of and responses to social and environmental problems typically progress through stages—public awareness, problem legitimization, citizen action, institutional response, and sustained citizen interaction with authority systems (Reich 1991). Communities facing environmental health issues, at any given time, are in different phases of social problem recognition and their involvement in science can vary accordingly. As well, movements can become increasingly involved in science, while also developing over time a strong critique of its dominant assumptions and techniques, such as seen in the case of the environmental breast cancer movement (Brown 2007; McCormick 2005).
Science as Political-Economic Context

Thus far, I have discussed how science serves as a tool or strategy for environmental organizing. However, the relationship between science and social movements is far more complex. In this section, I consider how science plays an important role in establishing the political-economic relations and authority systems public groups face in seeking environmental and policy change. These conditions necessitate that public groups and social movements critique and challenge science as part of their broader efforts to change environmental or regulatory decision-making processes.

My perspective on science as integral to the political-economic context of each site of contact and contestation reflects a number of frameworks that inform sociological and science studies research. I rely on the co-production framework Jasanoff and subsequently many others in the field developed (see Jasanoff 2004; Reardon 2004). Co-production defines science and social relations as constitutive of one another, and as a result, suggests that I merge my analysis of biomonitoring and science-based advocacy with an analysis of political institutions and social relations. In other words, a co-production framework conceptualizes how science has played a role in the emergence, stabilization, and maintenance of political-economic relationships and “relations of authority” (Jasanoff 2004: 4) that characterize each site of contact and contestation. Such a perspective charts a course through the middle of a central debate within the science studies community over the appropriate analytic orientation to science. As informed by Jasanoff, I approach biomonitoring science as neither “a transcendent mirror of reality… nor an epiphenomenon of social and political interests” (Jasanoff 2004: 3). Rather, biomonitoring science, social relations, and political interests are essential components of one another. From the theoretical lens of co-production, body burden science also can be understood as not just revealing or making visible chemicals in the body, but also as producing social relations, institutions, and discourses that help society deal with and incorporate this new knowledge in ways that both validate and/or restructure existing social relations (Jasanoff, 2004: 39). Therefore,
my analytical task, is to uncover what is social and political about certain scientific practices, and in turn, what social and political implications follow from science, and how these are similar and different across the chemical lifecycle stages or sites.

Often conflict and contests surround emergent scientific phenomena (Brown 2007). However, overt confrontation or contests do not always need to be present in order to see these processes at work. As Jasanoff writes (2004), a co-production framework helps elucidate how new science and new social and political arrangements emerge from many types of social relations—those that are contentious as well as those that are collegial. Reardon (2004) elaborates this point, noting that a co-production framework is appropriate for studying emergent scientific phenomena such as knowledge about chemicals in people: “it is at the point of emergence, when actors are deciding how to recognize, name, investigate, and interpret new objects, that one can most easily view the ways in which scientific ideas and practices and societal arrangements come into being” (p. 7).

In a parallel manner, Foucault’s (1977) work linking power with the production and application of knowledge shows how the two operate through one another, interdependently, a relationship he strategically symbolized in the direct juxtaposition of these two terms (pouvoir-savoir or power/knowledge). For Foucault, “there is no power relation without the correlative constitution of a field of knowledge” (Foucault 1977; p. 27). Not only is power acted through institutional practices; scientific research and the production of particular kinds of knowledge form the basis and justification of much contemporary policy and governance (Jasanoff 1990). Similarly, I am interested in the relationship between knowledge production and public consciousness about social and environmental problems (Gaventa 1980), in particular, how key issues are defined and framed with consequences for public organizing. Following Gaventa’s (1980) work on power and quiescence deep in Appalachian coal country, I consider how science and information are entwined in the processes by which issues are framed and prioritized; that is, how research and scientific knowledge can enable or constrain whether issues are viewed as
problematic, as well as define which modes of retribution, redress, or challenge seem plausible. One of the chief mechanisms through which power is conveyed, in this case, is through notions of expertise and who can, or cannot, rightfully participate in the scientific process. I take these two theoretical threads and weave them together to understand the role of environmental science and regulatory science in shaping the relations of authority within each site of contact and contestation. This work also brings into view how science is part of a complex field of authority systems that public groups face when challenging environmental problems. As I will discuss, no longer do movements concerned about health and the environment solely target state actors and policy goals; they further spotlight how other institutions, namely science, have been integral to the formation and maintenance of current policies and political relations.

In summation, like the entire “New Political Sociology of Science” (2005) project formulated by Kelly Moore and Scott Frickel, I adopt an institutional focus. That is, I look at how social structures and political relations shape the practice of scientific knowledge production, and in turn, how scientific knowledge shapes social structures and political relations. I carry out this analysis not at the macro level through a focus on science and markets, states and movements. Nor do I carry out this analysis at the micro-level by focusing on interpersonal interactions. Like Reardon, in her study of the genome diversity project (2004), my attention is focus at the meso level of organizations—at the intersection and interactions of public groups, sometimes advocacy organizations, as well as state agencies, scientific research teams, state legislatures, and other forms of community or organizational association.

To understand how movements engage science requires broadening the scope of investigation beyond state-centered politics and political opportunities. As contests over knowledge and knowledge production have become a central terrain of social movements (McCormick 2007), social movements increasingly seek concessions from institutions and other authority systems than the state because they shape, mediate, and control information and knowledge production (Powell and DiMaggio 1991; Moore 1999). One challenge is to examine how movements seek
concessions from and through other systems of authority besides (or in addition) to the state, including institutions such as medicine, religion, science, education, and law. Emergent social movement approaches now transcend a narrow focus on state-centered politics to investigate the intersecting systems of authority. Expanding the focus of social movement scholarship to capture the dynamic contexts of mobilization has been a significant project led by Myers and Cress (2005).

Many institutions and systems of authority (including industry, science, and government) overlap in complex ways. Documenting how overlapping systems of authority matter to social movements is a recent project for scholars of science and social movements (Myers and Cress 2005; Frickel and Moore, 2006). Many institutions besides science bear on scientific conduct and interpretation, including industry, law and medicine, both of which claim special authority to interpret and act on scientific information. These institutions are significant to public and movement engagement with science because they shape, mediate, and channel the meaning of information (Frickel and Moore 2006, Powell and DiMaggio 1991). They accomplish this by defining the human body and psyche as “knowable” objects, and then create and draw upon vast knowledge systems to name, characterize, normalize, ‘surveil,’ administer, and control them (Foucault 1977). Institutions and the professionals that populate them also lobby to control the meaning of information. For example, in the case of human genetics, medicine, industry, law and education all vied for control over the meaning of genetic information as the science rapidly grew from bench science to applied science (Kerr 2004, Nelkin and Tancredi 1989). Even more than their function in establishing what scientific data means, institutions play a key role in defining expertise. Institutions have different standards for evaluating who can participate in scientific processes and who has the authority to determine whether scientific data warrants action. Thus, many institutions define the rules in which social movements engage science.

As different social groups interpret, translate, and act on biomonitoring science, I examine what new social relationships and arrangements result. Such relationships can occur both within
particular sites as well as across them. Within sites of contact and contestation, stakeholder
groups can align according to common interpretations of the meaning and political value of body
burden science. That is, common perspectives can galvanize new alliances and coalitions, or it
foster new divisions and debates. As well, the science itself can create new social categories of
people who share common knowledge of exposures. That is the science creates new social
categories, a notion reflected in Petryna’s concept, “biological citizenship” (2002). This term
reflects the idea that a common embodied experience illuminated by science becomes the basis
for association. Petryna’s (2002) biological citizenship goes one step further to suggest how
science reveals a common biological circumstance that, in turn, becomes the basis not only for
social membership, but also for staking claims to citizenship, rights, or retribution. Thus, this line
of thinking points to the importance of science in creating relationships that can, over time,
become the basis for future alliance and action.

Importantly, how science shapes the political-economic context and how groups engage
science is not uniform across all places. In the next section, I introduce a framework for thinking
across different types of places where public groups involve themselves in biomonitoring. This
model, what I call a lifecycle approach, provides an overarching framework to analyze the
interaction of biomonitoring science and environmental health and justice advocacy, and in which
to raise these broader themes about public engagement in and critique of science.

**Tracking Molecules, Science and Politics Across the Chemical Life-Cycle**

Social scientists of environmental problems now readily acknowledge that chemical molecules
not only are significant objects of analysis (Casper 2003; Geiser 2001), but that they are on the
move and their implications are dispersed broadly (Spaargaren et al. 2006). The implications of
chemicals, therefore, must be studied within the broader system in which they are situated, rather
than solely for their localized and contingent implications for specific places. Thus, while my
focus is place-based, I also must conceptualize the systems and underlying structures (here, production systems and the chemical life-cycle) in which particular places are embedded.

This perspective reflects key developments in environmental science and policy, particularly the burgeoning and increasingly influential field of industrial ecology, or IE. IE takes as its central unit of analysis entire systems, rather than single firms or product-lines and their contribution to human exposure. For example, industrial ecologists study the global movement of chemicals through production systems, supply chains, and distribution and waste management systems (Geiser 2001). In so doing, “its frameworks challenge scholars and practitioners alike to think beyond a mechanistic, fragmented view of environmental problems (and solutions) and instead to focus on the holistic industrial system” (Hoffman 2003: 66).

However, rarely have industrial ecology scholars fully positioned chemicals and their consequences within their complete political-economic, scientific, and social contexts. Historically industrial ecologists and life-cycle analysts (both fields developed out of engineering and the sciences) study chemicals in production and material chains, but strip from them the broader social and political milieu in which those chains exist (Casper 2003; Hoffman 2003; O’Rourke 2005; Spaargaren et al. 2006). Much IE research incorporates the assumption that environmental problems are technical in origin, rather than institutional or political; moreover, such analyses overlook the institutional values and commitments that influence the production decisions of firms (Hoffman 2003; O’Rourke 2005). Also absent are the people and places that live and work among production systems. I aim to bring these concepts to bear on social questions, and thus, seek to create a social scientific approach to studying the chemical life-cycle.

Yet, surprisingly little social science research addresses the social dimensions of synthetic chemicals (Casper 2003). When social scientists do study chemicals, chemicals are treated as inputs or outputs of a specific production systems, such as electronics manufacturing, rather than as materials that span multiple production systems. Or, social scientists locate chemicals within a single social sector or institution, such as the market. For example, recent attention to synthetic
chemicals has analyzed them within material life-cycles (Geiser 2001), commodity chains (Princen et al. 2002), treadmills of production (Schnaiberg and Gould 1994), and post-industrial markets (Mol 1995). For example, O’Rourke and Connoly (2003) trace environmental justice impacts imposed by the global oil industry, not just at centers of production but also around fuel consumption. Similar, Iles (2004), like Pellow (2007), examines the environmental justice implications of electronics production and e-waste export and management, rather than “discrete outcomes in particular locations” (Iles 2004: 89), as has traditionally been the focus.

In other research, sociologists and anthropologists also have located chemicals within networks of scientists and social movements (Brown et al. 2004; Frickel 2004; Shostak 2004; 2005) or eco-histories of specific places (Pulido 1996; Gille 2006). However, new research models are emerging that situate chemicals within the fuller range of social sectors and systems. This dissertation aims to situate synthetic chemicals within a fuller rendering of their relevant social systems—those that produce and use chemicals, that regulate them, and that experience, scientifically research, and contest them.

Merging the social into the political and economic fits with the recent ideas introduced by Spaargaren et al. (2006) on environmental flows. They consider flows as a new, more all-encompassing unit of analysis for the study of environmental problems generally and synthetic materials in particular. Their approach to studying environmental flows is akin to material flows analysis or life-cycle analysis in industrial ecology, but adds to these an explicit social dimension. My concern spans the power relations and social arrangements that move chemicals, that govern their movement, and that measure, legitimize or problematize their presence in human bodies and ecological and social environments.

Following Gille (2006), I envision the flow of chemicals through these lifecycle chains as a series of interactions among government, industry, and public groups. From O’Rourke (2004; 2005), I consider the influence of non-governmental social movement organizations on regulation and policy. To this, I incorporate how these groups engage in science as a strategy to measure and
challenge chemical exposures. By drawing on Pellow (2001; 2007) and others (Myers and Cress 2005; Schurman 2004), I also consider how transnational corporations, who produce, use, transport, and handle chemicals, often have more control than the state to define the political structures and social milieu in which movements and community groups challenge environmental exposures. This body of work describes how corporations have become influential over political institutions, such as legislative bodies, and the policy-making and regulatory process. In part, their influence is channeled through and sustained by their significant scientific capacity to measure and quantify chemical hazards. Thus, I follow the recommendation of Princen (2002) to follow not just the molecule, but also to “follow the power” as it courses through chemical chains and across the chemical life cycle.

Synthetic chemicals are far more than materials; they are organizers of socio-political relations (Casper 2003) as they move through space and across place. If one were to “follow a molecule [of a synthetic chemical] from its point of origin” and trace it throughout its life-cycle from cradle-to-grave (Casper 2003; Pellow 2000), one would see how chemicals pass through and link together a vast network of places and people. These linkages of political, economic, social, and scientific relations can be thought of as the “chemical lifecycle.” To develop this concept, I adapt Gereffi and colleagues’ (1994) work on commodity chains, which draws attention to the inter-organizational networks linked by a single industrial product. Here, I consider the inter-organizational networks linked by the common use of—and subsequent human exposure to—a synthetic chemical or class of chemicals from its metaphorical cradle to grave. The lifecycle begins where chemicals are synthesized and produced, and extend to where they are used or applied. Once incorporated into consumer or commercial products, they travel along the vast networks of goods distribution, and throughout they are released into the environment as by-products or wastes. Chemical chains encompass many commodity or production chains, since a single chemical or class of chemicals can be used in many different products, and in a variety of markets, and thus knit together various commodity chains comprised of firms, industrial sectors,
states, households, and individuals. In addition to this spatial dimension, chemical chains also exhibit a temporal dimension. Again, following a single molecule from start to finish—that is, tracking it from production to its end stage as a historical source of exposure—one sees time elapse as each chemical molecule progresses from one phase to the next. Thus, we can also think about chemicals using a metaphor borrowed from ecology or human demography—the life-cycle—which chunks the passage of time into discrete lifecourse stages.

This flow of chemicals is shaped by political-economic structures that pattern the production, release, and dispersion of chemicals, while also patterning the unequal distribution of exposure risks across people and places (Cutter and Solecki 1996; Morello-Frosch 2002). Importantly, though human movement of raw materials, finished goods, and wastes move synthetic chemicals from place to place, many synthetic materials also travel using other modes of transit. That is, the physical characteristic of many classes of synthetic molecules make them highly mobile, persistent in the environment, and likely to accumulate in the human food chain and, in many instances, the human body itself.

**Sites of Contact and Contestation**

The arenas I consider follow the temporal logic of the chemical life-cycle: (1) where chemicals are synthesized, produced, or used in industrial applications (*sites of chemical production*) to (2) where consumers use products with chemical additives or residues (*sites of consumption*), to (3) the myriad of *de facto* repositories where chemicals accumulate over time (*sites of persistence*). These arenas map onto the “bounded environmentalisms” or “issue silos” created by the unfolding of science and policy in the United States. Stated more plainly, though environmental exposures historically have been isolated depending on where they happen and from what source they originate, each place where community and social movement groups count and contest chemical exposures are nodes in an expansive network of places linked by production systems and chemicals. My framework makes these connections more explicit, as well as point
to the people and places that populate the routes molecules travel from where they are produced and consumed, to their final resting places in circumpolar ecosystems.

I use both a temporal and spatial strategy to define three typical sites and situations in which body burdens are measured and acted upon. Social and environmental problems play out quite differently across the stages of the chemical life-course. Certainly, environmental health problems posed by synthetic chemicals are shaped by the local dynamics of the communities where they are experienced and challenged. Though contingencies and particularities are important, so are the entangled systems that both produce and regulate environmental chemicals, and that pattern exposure and available avenues for redress in ways that have not been fully explored by social scientists.

Using this lifecycle framework, I consider the broad themes I raised in the previous section—how, dependingly on the location in the chemical life-cycle, science contributes to political-economic conditions, and what role science plays in creating and sustaining, or alternatively altering, social arrangements. Thus, for each site or moment in the chemical life-cycle, my goal is to specify the constellation of social, political, and scientific contextual factors that make each site unique. As the full life-cycle of synthesized materials is recognized by industry, policy-makers, activists, and scientists, sociologists, too, are beginning to ask what implications these molecules have where humans come into contact with them. What is different about the social or political experience of human exposure across the chemical lifecycle and throughout the production chains of consumer society? What is the experience of environmental exposures where synthetic chemicals are produced, applied, consumed, and for those who live in places where chemicals arrive at their ultimate fates? I consider the different dimensions in which humans encounter synthetic materials and challenge their trespass into the human body.
Power Relations in Sites of Production

Exposures at sites of production occur within workplaces and in the neighboring communities that share a fence line with industry or some other point-source for pollution (e.g., an incinerator, agricultural fields, or a power plant). These include sites where chemicals are produced, used, or applied. The source of workers’ and residents’ exposures is proximal and observable—effluent spilling from pipes, billowing smokestacks, or dump trucks and trains hauling away waste. Struggles within sites of production tend to be what Laura Pulido (1996) calls subaltern environmental struggles, which capture the experience of environmental pollution within a broader context of political and socioeconomic marginalization. The most exposed populations often occupy the least powerful positions within the political economy. While they may be spatially distant from the systems that produce and govern exposure effects, even more so are they constrained by a stratification in power that provides few access points for redress. As a result, addressing chemical exposures in sites of production often require an interrogation of how industry comes to be sited in particular places, and the relationship between communities, workers, and industry. However, social relations within sites of production often redirect such a structural focus or prevent community mobilization that can raise such challenges.

This characterization draws from Logan and Molotch (1987) and Logan et al. (1997) to view sites of production as comprising one node in an expansive, spatially-arrayed economic system that is controlled extra-locally. The materials economy is a vast network of production systems that span multiple sectors, and that produce and use a dizzying array of synthetic chemicals. Sites of production are the many plants and industrial sites where chemicals are made or applied en mass (so, my conceptualization includes agribusiness), and include the communities that neighbor these facilities. As a result, workers and communities are proximal to the exposure source, yet distant from decision-makers. They are also economically tied to the exposure source through wages or corporate funding for local services, and often have an extended history of worker-
producer relations that continue to bear on contemporary social relations (Erikson 1976; Gaventa 1980).

I also understand sites of production through the long history of social relations between local industries and the regional workforce, which as noted by Erikson (1976) and Gaventa (1980), often stymie mobilization, or redirect dissent through institutionally-sanctioned channels for remediation and redress (e.g., law suits, medical monitoring). When redress or remediation are pursued through such institutional channels, grassroots mobilization is often tempered or deradicalized (Gaventa 1980; Piven and Cloward 1977). Thus, the more a site of contact is oriented around production, the more public demands for redress and/or mobilization will either be blocked or directed through institutional channels.

This is likely to have significant implications for the conduct, use, interpretation, and implications of biomonitoring science. Though community mobilization is prevalent throughout sites of production, often science-based strategies are less accessible. This is particularly true in cases of human biomonitoring, given the expense or professional networks with scientists and funders needed to carry out this work. With few the opportunities to access biomonitoring, dozens of communities near industry and military bases have requested federal assistance with biomonitoring, even decades before scientific capacity could detect accurately they chemicals over which communities were concerned (Harris 1983). Communities in these circumstances may turn to the courts for redress and remediation, which temper the more radical dimensions of community mobilization. Community groups sue for relief to fund medical monitoring, including biomonitoring. In other instances, biomonitoring is conducted to support a class action case or in the distribution of settlement funds, as was the case in Anniston, Alabama residents’

16 Over the past fifteen years, toxic tort lawsuits have sought funds to pay for medical monitoring of plaintiffs in cases where physical injury or symptoms are not present or have yet to develop (e.g., it may be decades before an exposure to a carcinogenic substance manifests as cancer). Pursuit of medical monitoring funds—which could include coverage for biomonitoring—is a controversial issue since medical monitoring claims seek payout from potentially responsible parties without first demonstrating injury (see McCall, 1999).
suit against Monsanto. However, again, there is some friction between the data biomonitoring offers and the legal frameworks that determine how courts define the burden of proof and interpret questions of injury, harm, and responsibility.

Given this, if we want to understand how science influences the social and political relations of sites of production, we must understand how science and power interrelate within the court system and within the regulatory arena. I also rely on Cranor’s (2007) conceptualization of the tensions between science and the law, particularly in the context of toxic torts. He explains that the court system has become a critical arena in which science is interpreted and applied, though often courts are ill-equipped to make such determinations. This has major implications for the ability of the court system to remedy harms that befall citizens on the behalf of chemical dumping or releases.

To further conceptualize how science operates in political relations and decision-making in sites of production, I draw on the work of Jasanoff (1990; 2004; 2005), whose research highlights the adversarial nature of technocratic decision-making in the United States regulatory context. I also use Weinberg’s (1972) work, which highlights how regulatory decision-making engages questions that lie in the gray area between science and politics. Moreover, many policy and regulatory questions lie beyond the capacity of science to answer altogether. These are what Weinberg calls, trans-scientific questions. Yet, despite this, the particularities of U.S. technocratic decision-making regards science as objective, and that it can be unfettered from political considerations if it follows procedural norms (i.e., risk assessment and risk management). Regulatory decision-making treats scientific information as capable of resolving regulatory decisions, even in the most disputed cases, though more often, adding new science or new experts into the process serves only to fuel debate and delay action (Jasanoff 1990). While this characterization does not only apply to sites of production, it is here where the regulatory arena is most established, and where institutional and procedural arrangements are most well-characterized. As will be discussed further, this dissertation considers how sites of consumption
and persistence differ expressly because regulatory science is not as well institutionalized for sites of consumption and persistence. Moreover, that other points of contact even exist—i.e., that consumer products and the persistence of chemicals used in previous decade pose exposures—raises further challenges for the regulatory procedures that have overseen sites of production since the 1970s.

There is a second way in which I examine how mobilization and advocacy in sites of production is affected by the emergence and proliferation of new arenas of policy, science, and advocacy over chemical exposures (e.g., sites of consumption and persistence). To understand the relationship among different points of contact along chemical lifecycles, I draw from how other social scientists have conceptualized production and commodity chains. The economic ties and spatial distance between point of contact within and across the chemical lifecycle, even when they occupy a shared position within production systems and the chemical lifecycle, keep them disconnected from one another, through a social process referred to as “distanciation” (Princen 2002). This concept characterizes how social, political and economic forces conceal the relationship between places both within these complex systems of production and throughout the chemical lifecycle. Such social distance works to fragment movement allies working in separate sites of contact and contestation, even though those parties share the same exposure. Following from this conceptualization, then, concealment or obviation of relationships among places within systems of production and/or within different points of contact throughout the chemical lifecycle system will result in fragmentation among potential allies with shared exposures.

**Power Relations in Sites of Consumption**

Exposures that happen in sites of consumption are not directly from factory or industrial activities that release chemicals into the air, water, or landfill. Instead, they occur anywhere where people have purchased, use, or otherwise live and work among the material stuffs of everyday life—electronics, building materials, and other consumer goods that contain chemicals
or harbor residue (Rudel et al. 2003). Thus, when exposures happen in these locales they are cumulative exposures from hundreds of material items, which in turn, implicates the practices of a myriad of firms, commodity chains, and market sectors, rather than a single node (e.g., a factory town) in an industrial production network.

Sites of consumption are politically rather than geographically defined places. These are sites where activists strategically involve themselves in research and advocacy around exposures through consumer products, not just where consumer-based exposures occur. Sites of consumption are socially, and often spatially, distant from industrial production centers (Princen 2002). This distance is perhaps the key characteristic of the increasingly, complex and multi-organizational production systems that comprise the contemporary materials economy (Princen 2002). By distance, Princen (2002) refers to how the implications of production are felt remotely from where goods are produced, yet the connections between where goods are produced and consumed are often concealed. Information about environmental hazards produced in these different sites does not travel from one end of the commodity chain to the other because there are so many complex steps between the producer and the end-user. As products move through complex supply chains, information about chemicals used in earlier phases of production gets lost. In addition, there is little historical data on what chemicals are used in products. Product labeling is unregulated and sporadic, and moreover, information about chemicals used in products is often unknowable to the end-user, retailer, or consumer. Thus, end-users and consumers often know little about the environmental externalities or costs that result from chemicals used in the production of consumer goods.

However, a parallel development is the expansion of green chemistry and industry (Woodhouse 2003). Recently the field of green chemistry and engineering has become increasingly institutionalized and well-funded (Woodhouse 2003) to generate a new generation of less-toxic, less bioaccumulative, and “greener” products. These trends follow what ecological modernization theory (Mol 1995; 2001) has suggested—that there is an interest and momentum
among industry to shift toward cleaner production. At the same time, governments are facing increasing citizen pressure to address chemical body burden and environmental health problems potentially linked to exposures from consumer products. Thus, there is a convergence between the demands governments face and the market opportunities industries are pursuing. As a result, green production is an issue around which other scholars have seen convergence between government and business interests.

Given sweeping changes towards greener production, previous research also documents that there may also be a cultural tendency toward individualized, commodified solutions. That is, a cultural incentive to purchase greener products to resolve the problem of chemical body burden, rather than on political solutions. Murphy (2006) and Szasz (2007), like Beck (1992) before them, describe the rising anxieties about environmental risks among Americans, particularly among the white, middle- and upper-classes and the development of new consumer practices to gird against chemical exposures. Szasz (2007) names the broader set of practices to gird oneself, even if only symbolically, against a variety of social and health risks. Moderating consumer-based exposures through consumer purchases is, as Murphy (2006) explains, a new manifestation of micromanagement practices, which are culturally familiar particularly to women who are already primed to purchase products to alter and self-monitor their bodies. These new micromanagement practices center on purging the home and detoxifying the body (p. 173), though often they are somewhat illusory. Thus, research on human responses to human body burden suggest there may be a new “consumption fallacy” at work—the belief that exposures to chemicals can be prevented primarily through altered consumer habits (e.g., buying fragrance-free rather than scented cleaning products). This notion builds on Edelstein’s (2004) “technological fallacy,” the popular presumption that environmental exposures are technical problems to be “cleaned up” by engineers and through ever more-sophisticated scientific innovation to filter out harmful chemicals from industrial processes and products.
Similarly, other scholars have described a base of readily mobilizable “citizen-consumers” socialized to “protect the environment” through consumption (e.g., recycling, green purchasing) (Gottlieb 2005). Individualized environmentalism centered around personalized consumer solutions (buy green, recycle) is a rising trend within mainstream environmentalism in the United States (Gottlieb 2005) and in US culture more generally (Szasz 2007). As Princen notes:

> When confronted by environmental ills —ills many confess to carrying deeply about—Americans seem capable of understanding themselves solely as consumers who must buy “environmentally sound” products (and then recycle them), rather than as citizens who might come together and develop political clout sufficient to alter institutional arrangements that drive a pervasive consumerism. The relentless ability of contemporary capitalism to commodify dissent and sell it back to dissenters is surely one explanation for the elevation of consumer over citizen (2002: 51).

However, though these dynamics are present in the case of other environmental problems such as energy consumption, for the problem of chemical exposures through products, consumers are faced with a reality that challenges consumeristic solutions, even as they may be a prevalent and tempting alternative. Changing consumption patterns often can do little to reduce individual exposures, given the ubiquity of chemicals in everyday, household goods such as mattresses, lotions, and clothing. Thus, in sites of consumption, there is a central dilemma that activitists must contend with. They must play on cultural tendencies toward commodified, individualized solutions embolded by the growth of green products, and counteract them at the same time.

However, the literature suggests another avenue by which consumers can affect change. Retailers, and by extension consumers, have increasing influence over what chemicals are used in the production of material goods, i.e., their chemical content (Princen et al. 2002). This is what Conca (2002) refers to as power shifting down production chains. For example, decisions over what chemicals are used in some consumer products has shifted from producers to big-box retailers, like Wal-Mart, over whom consumer demand has had considerable influence (Princen et
Wal-Mart issued a list of twenty chemicals it does not want in the products sold on its shelves. This corporate policy change has sent reverberations in the production practices throughout the hundreds of firms linked into its vast supply chain network, as noted by Langsner, from Innovest Strategic Value Advisors. As Langsner explained, any supplier who wants to sell goods to Wal-Mart needs to reformulate their products or risk losing access to this critical market. Consumer demand also has helped drive firms to respond to market opportunities in green and clean production, meaning that firms and scientists alike are working to re-engineer consumer goods, and the chemicals that are used in their manufacture. Thus, as Iles (2006) summarizes, the market has become “a crucial arena for change.” (p. 344).

Other social analysts have documented the rising political power of informed consumer-citizens, who increasingly can make demands of industry and shift production and supply to meet them (Spaargaren 1997; van den Burg et al. 2003). This trend has been most extensively written about in the field of food politics and agribusiness, where consumer-led efforts have placed demands for more organic farming and food, to the extent that even big box stores like Wal-Mart are now proffering organic goods, but also in other forms of consumer-oriented environmental monitored that shape consumer-producer relations in ways that shift production (van den Burg 2003).

Importantly, these economic changes – both among individual firms and the impact of consumers to shift markets – are attributable in large measure to massive chemical policy reform overseas, which have created new economic incentives for producers to change how what chemicals they use. Thus, much of the shift in power balances and political opportunities available in the US to shift production and reduce consumer-based chemical exposures – both individually and through policy reform—is due to these broader changes (Schapiro 2007).

Conca (2002) argues that, given these political and economic conditions, for environmental activism to bring about meaningful changes successfully, activists must shift their tactics as well. Where previously, activists focused on shifting industry behavior, this works suggests that it would be more fruitful for activists to target consumers. That is, in the words of Conca (2002), to be successful under these conditions, “activism and advocacy will have to follow power downstream to the ideologies, symbols, relationships, and practices that drive consumption” (p. 136), or in this instance, that drive shifting dynamics of power over the materials of commodity good production.

When viewed from these perspectives, documenting consumer-based exposures and translating them into symbolically-rich consumer-advocacy campaigns can be a powerful component of social and policy change. This means that appeals to consumers are likely to bring more individuals into the fold of those concerned about chemical exposures. As noted by Maniates (2002: 55), “although public support for things environmental has never been greater, it is so because the public increasingly understands environmentalism as an individual, rational, and cleanly apolitical process that can deliver a future that works without raising voices or mobilizing constituencies.” Many critical observers posit that environmental change is brought about not by mobilized, informed constituencies through democratic institutions, but by “informed, decentralized, apolitical, individualized” consumers (p. 55). Moreover, new science about consumer products being linked to possible exposures and body burden furthers these commitments; now the call to consume green(er) products is not just about saving the planet, but about saving oneself, one’s family. Thus, there is already the necessary pre-condition with which to mobilize broad public support—a class of citizen-consumers who will find these concerns compelling and who will form the broad base of support for more far reaching coordinated policy.

Thus, on the basis of this work, I expect that consumer-advocacy campaigns that focus on biomonitoring and body burden in sites of consumption are in a strong position to introduce changes to both policy and industry practices, given the political opportunities afforded by the
restructuring of commodity chains. These opportunities result from how power has shifted
downstream from producers to consumers, who are a readily mobilizable force for environmental
change when advocates translate biomonitoring science into persuasive images and symbols,
rather than using science to make technical arguments.

Thus, biomonitoring for consumer-chemicals capitalizes on political opportunities created by
these restructured commodity chains (Princen et al. 2002), and a base of “citizen-consumers”
socialized to “protect the environment” through green purchasing. Advocacy groups, thus, seek
to change either the materials used by industry (e.g., chemical phase-outs, substitution, or enticing
‘green’ economic development) or the relationship between industry and the public (e.g., through
new standards for public and worker participation in production decisions, new policies and
regulation that place the burden of proving safety onto industry, and that encourages new modes
of production).

**Power Relations in Sites of Persistence**

The end-recipients of chemicals comprise the final node in the chemical life-cycle. Sites of
persistent are “receptor communities” (Downie and Fenge 2003) that are spatially, temporally,
and often socially distant from exposures sources; they include abandoned chemical wastes or
landfills, and *de facto* areas of waste accumulation formed when highly stable chemical
molecules migrate in air and wind currents, and concentrate in ecosystems and the food chain.
Often, exposures that happen in sites of persistence are from historical uses of chemicals that are
persist in the environment and the food chain, and thus are a continued source of exposure.

*Unanticipated* sites of persistence are quite different from the politics of challenging
hazardous waste sites described by early social science research (Brown and Mikkelsen 1990;
Bullard 1994; Levine 1982; Kuletz 1998). Sites of persistence result not because of global
transport and distribution of industrial waste, but because wastes themselves –without human
intervention or machine – migrate despite current regulatory practices in industrialized countries.
As this dissertation highlights, the by-products and products of industrial production flow through other pathways, as they intermingle with air and wind currents, embed themselves in the flesh of marine and land animals or in the plant-based food chain, and are dispersed through a different and equally vast global network.

This means that affected groups have different avenues for redress. Though federal and international regulations specify standards for the release, transport and storage of chemical wastes, chemicals disperse and concentrate in less defined places, and leach far beyond the bounds into which waste policy relegate them. Second, thousands of actors that span market sectors are implicated, and ultimately responsibility falls on an entire, global network of producers and regulators dating to the earliest days of World War I and II era chemistry. Exact sources are often unidentifiable, in part because the scientific technique to fingerprint or attribute specific sources is a new area of science, developed on a chemical-by-chemical basis. Moreover, some potentially responsible parties may no longer be incorporated. Over time governments may ban substances, industries cease production, change ownership or close, as in the case of PCBs, though exposures persist (Colborn et al. 1996).

Furthermore, the effects of these physical migrations tend to accumulate and disproportionately affect some populations, in particular, indigenous communities of the circumpolar region, and other U.S. subsistence communities, since many traditional and subsistence foods (e.g., fish and marine life) that these communities rely on harbor—and thus convey—persistent chemicals (Boswell-Penc 2006; Nutall 1998). Therefore, in many cases, sites of persistence are also characterized by the political and social relations between the governments of indigenous and state, federal, and international governing bodies.

To match the global character of the problem, there has been extensive mobilization about chemical exposures and human body burden across sites of persistence, particularly in support of the UN treaty negotiations for what became the Stockholm Convention on Persistent Organic Pollutants (Downie and Fenge 2003). Shared body burdens avail activists with new
opportunities to push for chemical regulation based on their dispersive and accumulative
ccharacter, and to skirt trenchant, politicized, often circular debates over human toxicity.
Activists, including many from subsistence communities, have pushed for international
governance to define persistent, mobile, and bioaccumulative chemicals as deserving of special
policynment and regulatory enforcement (U.N. Convention on Persistent Organic Pollutants)
(Downie and Fenge 2003). These groups assert that society generally and indigenous
communities of the circumpolar region specifically should have a greater say over who makes
decisions about industry practices, and as a result, face coordinated industry opposition (who are
willing to cease production of a single chemical, but are generally opposed to increased public or
regulatory oversight over production decisions).

Locally, however, pollution-affected groups have encountered considerable resistance to
efforts to overhaul federal policy that would enable the US to implement the U.N. treaty and to
prompt EPA or state environmental agencies to consider impacts to end-recipients when issuing
permits or approving chemicals for use. In these instances, these groups find themselves
embroiled in debates fueled by a added measure of uncertainty, as regulatory procedures are
flooded with new science for which they do not yet know how to process. While the influx of
new science may lead to increased conflict; at the same time, however, new knowledge can
disrupt institutional assumptions and practices, and therein, creates opportunities through which
reforms become possible (Moore 1999). That is, there are specific instances when institutional
vulnerability brought about by the imposition of new scientific information provides a window
for collective action to prompt institutional change—an institutional opportunity structure.

CONCLUSION

In conclusion, the life-cycle framework helps me understand how the different political,
economic, and scientific contexts in which public groups involve themselves in biomonitoring.
Across the chemical life cycle, science and society intersect and interrelate differently, given
contrasting political-economic conditions in each site of contact and contestation. By infusing a co-production and institutional perspective on science throughout my entire analysis, I can see how science-based advocacy operates in a context where science has helped establish and maintain political order and social relations. More than that, my model enables me to examine how science, power, and society are produced in tandem, and look for how social relations shift through, and as a result of, scientific efforts to document chemicals in bodies and to make decisions about whether and how to respond to the results. Thus, in each site, public action and political arrangements intersect to produce an array of sequelae and implications, both intended and unintended. As science documents the presence of industrial chemicals and byproducts in bodies, these frameworks focus my attention on the subsequent changes in industrial organization, in the relationship between society, synthetic materials, and the industries that produce them, and finally, in the relationships between different social sectors and civil society groups.

Studying sites of contact and contestation allows me to understand how political-economic conditions, and their relationship to science, offer communities and movements new political and institutional opportunities further down the production chain (Anderberg 1998), where the regulatory apparatus and institutional mechanisms that interpret science are less defined. As a result, I expect that when civil society groups employ science, but avoid traditional regulatory and/or policy-making processes, they most likely find that biomonitoring works to their advantage, since they avoid particularly trenchant scientific conflict and the institutionalized rules and assumptions that dictate its interpretation and use in decision-making processes. This may be particularly true for sites of consumption, where economic restructuring has given consumers more influence over industrial production, and by extension, chemical exposures (Buttel 2006; Princen et al. 2002; Mol and van den Burg 2004).
Chapter 4

TRACKING CHEMICAL MOLECULES:
MULTI-SITED ETHNOGRAPHY AND ETHICS

CHAPTER OVERVIEW

In this chapter, I outline how I designed this project to analyze three multi-sited cases that represent theoretically defined political moments where public groups have involved themselves in research and advocacy to address human exposures to synthetic chemicals. My analysis involves more than just moving between and comparing three distinct cases. Each case is connected to the other two by virtue of occupying a moment or stage in industrial production chains involving synthetic chemicals. In this research, I follow synthetic chemicals along their life course from cradle-to-grave: from the places where chemicals are produced and applied to post commercial distribution places where they are consumed as constituents of ordinary household products, to the receptor communities (Downie and Fenge 2003) where they ultimately concentrate and persist. In other words, this research is multi-sited on two levels (Yin 2003). First, this project involves analysis of three case studies, each requiring multi-sited data collection. However, the entire project also can be defined as a single case study of the science and politics of measuring human exposures across their lifecycle of persistent bioaccumulative chemicals, where the broader case is comprised of multiple, interconnected research sites.

This project is more than a comparison of three distinct cases; the cases are interconnected. I treat the entire project as a single case-study comprised of multiple research sites. This is what I mean when I say, this project is a multi-sited ethnography of science and politics along a chemical lifecycle. To account for the interconnected nature of the cases, analysis moves on multiple tracks: within case, across case, and nested case analysis. This involves looking at how the cases work together to tell a broader story about measuring synthetic chemicals in bodies.
After detailing my approach to multi-sited ethnography, I next describe lessons learned about research ethics specific to multi-sited ethnographies. Conducting multi-sited ethnography, generally, and on the topic of human body burden in particular, poses unique ethical dilemmas that altered my research design, data collection, and research relations. I recount key ethical dilemmas posed by being an “outsider” in many places at once, for short periods, and often in places already experiencing research fatigue or a history of complicated, sometimes harmful, interactions with scientists, researchers, and other outsiders. I close out the chapter with a description of collected data, while noting some of issues faced along the way. Included in this section is a brief mention of digital, or distance, approaches to data collection, which enabled me to conduct such a complex, geographically dispersed, and otherwise resource-intensive project.

“FOLLOWING CHEMICAL MOLECULES” THROUGH SITES OF CONTACT AND CONTESTATION

As prompted by Casper (2003), to understand the social significance of contests about human body burdens of industrial chemicals requires “following the molecule” on its material and symbolic journey through environmental media, human bodies, vials of blood, scientific equipment, and as represented in public discourse as data point, symbol, or marker. Both their material and their symbolic journeys are long and circuitous. Throughout their travels, my task is to examine three typical destinations or stages in the chemical life course, and “the impacts [molecules] have in and across different social spaces” (Casper 2003: xxiii). This notion of “following the molecule” is borne from a tradition within science studies that considers both human and non-human entities as organizers of social relations (Latour 1987). In this tradition, materials matter. A molecule of a synthetic chemical turned environmental contaminant functions as both a social and spatial object. It originates from a particular place. It travels and relocates. It is distributed differentially across people and places. Wherever it goes, the molecule both organizes and is embedded within social relations (Casper 2003: xviii).
How might a sociologist “follow the molecule?” A study situated squarely in science and technology studies might follow the collection of biological samples, their transport to a research lab for analysis, and the translation of biological samples into data points or biomarkers of exposure. The science of detecting and measuring chemicals in human samples remains unsettled—an open black box (Latour 1987) with many different stakeholders vying to establish protocols for sample collection, data interpretation, and risk communication. For many chemicals, including both brominated flame retardants and perflourinated compounds, the scientific community still works to validate and standardize analytic methods across laboratories. However, though I do consider these processes in all three cases, as a sociologist with broader interests in the articulation of science with publics and politics, I also am interested in tracing how various organizations and institutions interpret and act on findings given the degree of uncertainty and flux. Interpretation and communication of data and data gaps are uneven processes, negotiated within organizational, institutional, and political-economic contexts. Scientific results are communicated through multiple media where they enter various public and social domains. Once communicated, molecules of synthetic chemicals and their symbolic markers travel through many social and institutional spaces where they are framed as problematic, or not, and that framing is strategically used to justify action or inaction. There, additional stakeholders attach or impute meaning and retransmit the “molecule” to new spaces for deliberation.

Casper’s (2003) invitation to take materials seriously serves as method and analytic strategy. To organize this study, I followed molecules of persistent synthetic materials from their manufacture and release to their accumulation in receptor communities of the circumpolar north, and then asked: what happens along the way? How does discourse about contests over the science and significance of biomonitoring vary over the lifecycle of these kinds of chemical molecules and across the places where people encounter them? How does scientific practice understand and act on this lifecycle? How do policymakers do the same? As I will discuss, Casper’s notion of
“following molecules” informs the selection of my cases—typical sites of human-chemical contact and contestations. Similarly, it also gives analytic focus to my data collection and analysis, as I seek out the places through which molecules travel, especially through the institutional, organization, and geographically dispersed places where its meaning is framed, adjudicated, and contested.

A Multi-Sited Approach to Ethnography

Social scientists have adapted ethnography in new and exciting ways over the past decade, primarily by extending the ethnographer’s field of vision and recreating ethnography as a mobile method. Multi-sited ethnography (Marcus 1995; Gille and O’Riain 2002), the extended case method (Burawoy et al. 1991; 2000), and more recently, policy ethnography (Brown et al. 2007) were developed from and in response to emergent social relations that are no longer solely embedded in communities and places. There is much debate about the changing structure of social relations, particularly over the relative importance of translocal versus local social relations and structures. Recounting these debates and arguments here would take me far afield; instead I refer interested readers to the following research.

This literature, and the trends they describe, have influenced the development and practice of multi-sited methods, which no longer assume ethnographic research sites involving place-bound data collection (Gille and O’Riain 2002). In trying to grapple with changing social relations, ethnographers faced a methodological dilemma since extended stays within single places did not adequately afford understanding of social phenomena. Ethnographers were pressed to identify “where” to be and what boundaries define the “field.” In response, Marcus (1995) proposed a “multi-sited” approach to ethnography to account for the declining significance of individual research sites in answering research questions that required analyses of social, political and

18 On the nature of these changes, see Urry (2000) and Castells (1996), for example. On the relationship between these changes and ethnographic method, see Gille and O’Riain (2000).
economic relations. Gille and O’Riain (2002) further developed Marcus’s approach by providing more concrete guidance on how to trace processes across diverse sites. Using a slightly different approach, Burawoy and his students (Burawoy et al. 1991; 2000) developed the “extended case method” to push ethnographic work beyond its traditional, place-based bounds. In this method, Burawoy uses participant observation to situate everyday life in its extralocal and historical contexts, thus extending it beyond the immediate site of study. In both cases, these mobile forms of ethnography enable the researcher to have a more emergent and complex view of the local site than would be possible by merely studying a single site (Marcus 1995).

Typically, extended case studies or multi-sited ethnographies have engaged one of three issues (Burawoy et al., 2000; Gille and O’Riain 2002; Rapp 1999). The first line of inquiry investigates how global social forces, such as capitalism or science, act unevenly across places: “These ethnographies at their best reveal not just the impact of an impersonal force but also how localities are made penetrable by forces, how localities assimilate these forces into their own socioscapes, and how forces are resisted, accommodated to, and fled from” (Gille and O’Riain 2002: 280). A second category grapples with on-the-ground contests over definitions of place and the scale at which place-based problems must be addressed (i.e., as local or extra- or trans-local problems). The final category of multi-sited work examines the factors that link sites and localities, such as migration or social movement networking. This dissertation fits within this trend in multi-sited work by looking at how policy, production systems, and, most importantly, the lifecycle of persistent, synthetic materials link together places that otherwise appear as isolated sites of chemical exposure.

While working on this research, I also was part of a larger research team working towards a third approach to multi-sited ethnography, what Brown, Morello-Frosch, Zavestoski, and colleagues eventually named policy ethnography (2007). This approach, while similar to the methods described above, was designed as an explicit strategy for studying these shifts as they affected both scientific practice and social movement challenges occurring within an increasingly
“scientized” political space. A policy ethnography approach acknowledges and responds to important developments in social movement theory and research that find social movements and less-formally organized public groups do not just confront the state or a lone authority structure when challenging environmental health issues. Rather, these groups must engage multiple, interconnected authorities of policy structures and science (Zavestoski et al. 2004; Myers and Cress 2005). Thus, in their use of the term “policy ethnography,” policy broadly includes legislative or regulatory policy, as well as institutional and organizational policy (e.g., such as policy that shapes the norms and protocols of scientific practice).

Parsing out these complexities required a different approach to conducting observations and selecting interviews or gathering archival material. In this regard, policy ethnography had to be both multi-sited and multi-sighted (Brown et al. 2007). That is, policy ethnography engages multiple perspectives from the vantage point of multiple social sectors, including (though certainly not limited to) social movements, industry, policy-makers, and scientists. Multiple stakeholders hold different standpoints towards environmental problems and chemical hazards. A multi-sited approach works to document these diverse perspectives and to locate them within broader discursive and political trends in policy and science.

At the same time, policy ethnography also engages multiple sectors. With the increasing involvement of science, industry, and social movements in policy-making, understanding the conduct and interpretation of human biomonitoring also requires researchers to span multiple sectors—to observe in scientific laboratories or conferences and in policy chambers, as well as at street corner protests and diner counters where social movements and publics call for, challenge, and deliberate policy. In Brown and colleagues’ policy ethnography of the breast cancer movement (2006), they observed how policymakers allocated money for etiological research, sat bench-side with breast cancer scientists, entered surgical suites as patients underwent mastectomies, and marched alongside survivors and women living with breast cancer at public rallies. Thus, in policy ethnographies, researchers often move between disparate sectors.
Moreover, the method leads researchers into new hybrid spaces where the work of science, policy-making, and social change is both discussed and implemented. Throughout, the method involves traveling to and among “interstitial spaces” that cross boundaries between science, policy, and civil society (Brown et al. 2007). Biomonitoring science and the framing of human body burdens are defined and debated through interactions and exchanges among these sectors rather than in any one sector in particular. Science is conducted outside laboratories, policy beyond policy chambers, and community or social movement groups often bridge or transcend multiple sector boundaries (i.e., as conveyed in concepts like boundary work (Gieryn 1999) and interpenetration (Wolfson 2001)), for example, such as social movement coalition-sponsored press conference to release scientific findings at the Maine state house.

In addition to studying multiple perspectives and moving between sectors, policy ethnographies sometimes study these issues across multiple cases. Doing so allows researchers to tease out the influences of different contextual factors such as social movement fields, lineages, or political-economic relations on social movement behavior. In the next section, I describe how this project was not only multi-sighted and multi-sited, but also, importantly, how similar questions were pursued in each of three cases.

**Cases and Case Selection**

This project involves the analysis of three interconnected case studies, each involving data collection in more than one geographic locale. Relying on cases is appropriate, given my aim is both an interpretative and mechanistic analysis—to understand how various organizations and community groups conduct, interpret, use, and contest biomonitoring science, and how science in turn shapes political and social movement action (Snow and Trom 2002). My primary unit of analysis is three cases. Each is a site of contact between bodies and environmental chemicals and a site of contestation over the science that documents chemical-body contact. Given the logistical nature of biomonitoring research and the spatially distant stakeholders that produce, regulate, and
contest chemical exposures, each case includes individuals, organizations, or institutions located in multiple geographic locations. This necessitates that the case study methodology be multisited to capture the influence of extra-local stakeholders and political-economic structures (Gille and O’Riain 2002). For the final chapter, I broaden my unit of analysis to consider how the three cases fit together.

In addition to adopting a lifecycle approach to the measurement and politics of contaminants in bodies, I also opted to focus on three cases because the subject matter specifically required analyzing what happens in different kinds of sites of contact and contestation, as there are key points of difference among them in their political and economic relations (discussed in next section). In addition, both biomonitoring science and environmental health organizing are decentralized and loosely coordinated. In order to understand their interplay, I needed to study how these entities operate on the ground. Though there are some national-level efforts to coordinate biomonitoring science and advocacy strategies using biomonitoring (again, see footnote), overall much would be missed if I trained my attention at such national efforts without

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19 While science as a profession has many institutional rules and norms that work to standardize practice across time and place, biomonitoring – as a rapidly expanding science – is not centrally coordinated. Though there is often variation in the practice of science across places (Gieryn 2006; Livingstone 2003), in the case of biomonitoring, there is much effort to control this wide variation. Though there are standards and validated measures that standardize some analytic methods across place, sampling, and results, communication of results and interpretation of concentrations remain an open black box, unsettled, with uncertainties resolved differently by different groups in different locales (Latour 1987). However, the US Centers for Disease Control, who coordinate a national survey of contaminants in a representative sample of the US population (CDC 2001; 2003; 2005), also works to define best practices, standardize labs, and validate analytic methods (Needham 2007.) At the same time, many stakeholders, including government agencies, industry, and the environmental health advocacy community have convened conferences and released reports that define what they see as best practices for the conduct and communication of biomonitoring science (National Academy of Sciences 2006; International Council of Chemical Associations 2006; US EPA and the International Council of Chemical Associations 2007). Second, there is no centrally coordinated process for how public groups involve themselves in scientific critique and research. As described in the theory chapter, communities and SMOs are involved in research and science-based advocacy through different organizational and instructional arrangements. More generally, as Andrews (2004) notes, though organizing around a particular issue may be a national phenomena, action is often regionally or locally grounded, leading to substantial variation across places. Such decentralization and loose coordination among social movement organizations and community groups is especially observable for organized protest around environmental health and justice issues. The Environmental Justice movement is characteristically, and purposely, a loosely organized network rather than a centrally coordinated movement (Pellow and Brulle 2005) thus environmental justice activism plays out differently in Alaska than in Richmond, California; Port Arthur, Texas; or Williamsburg, New York. These reasons support my decision to examine biomonitoring science and advocacy as they play out in geographically disperse locales in order to grasp broader theoretical patterns (Andrews 2004).
first understanding interaction dynamics as they unfold within specific locales. Andrews (2004) terms this latter approach, observing from below, the bottom-up dynamics of change (p. 6).

However, the central analytic method used in this project is more than just an analysis and comparison of three disparate cases, each involving extensive multi-sited data collection. Rather, I also approach the project as a single, large case study of the science and politics of the chemical lifecycle, as it plays out for persistent, bioaccumulative materials. In other words, each of the primary research cases—sites of production, consumption, or persistence—also function as one “site” in a multi-sited study of politics and the science of measuring chemicals in human bodies. Yin (2003) refers to such a research design as nested case studies, with two levels or tiers of case studies.

Thus, to study the case of biomonitoring science and its implications across a chemical lifecycle requires a different case selection logic than other case study approaches (Mahoney 2004; Clarke 2005; Ragin 1987; Yin 2003). Cases were not selected solely based on their difference or sameness, but also based on their connectedness. Marcus (1998) and later Gille and O’Riain (2002) note that, in multi-sited ethnography, cases are linked by a common conflict, metaphor, or material. Gille and O’Riain (2002) argue that these linkages are often constructed by political and economic processes and relations. For example, Widener (2007) studied four localized contests over oil development by multi-national companies in Ecuador. Her cases were linked—physically—by an oil pipeline that stretched across the country, linking several cities in its path. By looking at contests where the pipeline started, where it terminated, and where it was politically controlled and fiscally backed, Widener examined not just the differences between cases, but also the interrelationships among them. While the sites may differ in key ways, for example in mobilization capacity and linkages to transnational social movement organizations, what is more important is that they are linked by political-economic factors driving pipeline construction and transnational oil development. These factors combine to produce different social relations, discourses, debates, and stakes for the public groups that contest exposures there.
Studying such cases for their differences *and* their interconnections opened new lines of analysis and insight. Similarly, my process for selecting where to go and what to study is rooted in an analysis of chemical production chains and how the consequences of chemical production are monitored and regulated. Case selection involves grappling first with the literature about material (here, chemical) and environmental flows (discussed in the previous chapter) through production systems and translating theory into cases for further inquiry. The end result is both a detailed analysis of three sites, and a comprehensive picture of biomonitoring as a method of detecting chemical contamination.

This method also differs from Clarke’s approach to situation analysis (2005), which would lead me to select different places to go and what to observe. First and foremost, situational analysis is less case centered. Consider, for example, how Rachel Washburn, one of Clarke’s doctoral students, builds her study of human biomonitoring science around a theoretical situation. Washburn tracks a single sensitizing concept, what she calls “chemical optics” – how biomonitoring science is a lens into the social – wherever it leads her, from situation to contrasting situation in order to flesh out that central concept (2007). In contrast, I’ve drawn on sociological and political-economic theory to settle on three cases from the outset, rather than discovering key situations as I moved through the research process.

**Logic of Case Selection**

I am centrally concerned with how contests over chemical exposures and the meaning of human body burdens tend to cluster into one of three typographical scenarios based on patterns of social relations and the distribution of power over chemical production and regulation. These are theoretically defined, political-economic scenarios, or *sites of contact and contestation*. These are places where bodies and contaminants intersect along the “lifecourse” of a synthetic, persistent and bioaccumulative chemical: (a) sites of chemical synthesis, production, or industrial use, (b) sites of consumption, and (c) sites of post-production, post-consumption persistence.
This typology of sites represents “ideal types” rather than representations of mutually-exclusive sites of contact and contestation. Exposures are often cumulative, emanating from many sources in the same locale simultaneously. I present them as separate sites for descriptive purposes and to construct an entry point to analyze the articulation of publics, science, and politics. Exposures are cumulative, emanating from many sources; oftentimes persistence-, consumption-, and production-based exposures happen conterminously. To portray this relationship, I depict these three sites using a Venn diagram (see Figure 4-1), rather than the lifecycle depicted in the Introduction (see Figure 1-2).

For example, people that live and work near industrial facilities – in sites of production – bear exposures on the job and/or from environmental releases from the plant. But they also may incur exposures through consumption of commercial products and through food, such as fish, meat, and dairy, which are common sources of exposures for some persistent, bioaccumulative toxicants. However, for analytic purposes, I examine the political and social contests around biomonitoring and chemical exposures in cases selected to represent the central exposure pathway of each “ideal type.” This apparent separation of site types is precisely important since scholars have not looked at environmental contamination when exposure happens through different routes and in different political-economic contexts.

Figure 4-4. Relationship between research sites.
I drew on preliminary fieldwork, informal interviews, and literature searches to map the universe of possible cases where public groups had involved themselves in biomonitoring research. From these, I chose three exemplary places, or, regions, where exposures have been documented and contested through various types of biomonitoring projects. In each instance, I chose a case that fulfilled the theoretical criteria that defined sites of production, consumption, or persistence. In other words, in each case, one exposure source emerged as the central arena of research and debate, often (though not exclusively) to the exclusion of other coterminous types of exposures. However, each site, while illustrative of particular sites of contact and contestation, also could be analyzed for how production-, consumption-, or persistence-based exposures intersect and overlap, as well as how discourse conceals or connects, privileges or diminishes other exposures along the chemical lifecycle. Second, once I had identified several possible cases that met the analytic criteria established for sites of production, consumption, and persistence, I selected the combination of the Mid-Ohio Valley, Maine, and Alaska based on feasibility (in terms of travel time and costs) and access.

DATA COLLECTION AND ANALYSIS

Multiple methods of data collection add rigor, complexity, and richness to research (Flick 2006). This dissertation relies on several sources of data to develop a complete picture of each locale, the biomonitoring science conducted there, and how various organizations within or connected to that locale conduct, interpret, and act on information about human burdens of chemicals. My sources include: (a) fieldwork, key informant interviews, and archival and secondary sources to map the key organizational players, institutions, and stakeholder groups in each locale; (b) secondary sources that, in broad brush, paint the political, economic, and environmental histories of each locale; (c) scientific literature, particularly review articles on the key chemicals of concern in each chapter; (d) archival analysis of historical, government, and organizational documents, (e) interviews, document analysis, and observations/participant
observations to document how biomonitoring research was conducted, interpreted, communicated, and deliberated in a variety of public forums; and (f) digital media, including documentary films, documentary shorts, TV news clips, radio interviews, and website information including short video clips made available through advocacy organizations or posted by activists.

**Entry into the Field and Data Sources**

My first analytic task was to map the organizational and institutional field in which biological monitoring was being carried out, communicated, and discussed. For this, I drew on Clarke’s (2005) mapping techniques to define the organizational field in which biomonitoring was being conducted. Although I was not following Clarke’s entire method of inquiry, i.e., I had selected my cases based on theories about the political and economic organization of chemical production and regulation, I did find the process she delineated for mapping fields useful. It dovetailed well with (a) Dill’s (2001) process for laying out the organizational and institutional terrain and (b) mapping fields of movements and SMOs (Brown et al. 2007). This latter technique evolved from social movements researchers who plot organizations and institutions that matter to both movements and the locales in which communities or SMOs operate (i.e., mobilization context).

To map the contemporary terrain of each site, I consulted numerous secondary sources on the history of environmental problems, regulation, and mobilization. In addition to texts, I also spoke with historians and experts in each site. I adopted what Gaventa (1980) and Erikson (1976) call the long-view on each case. By mapping the history and players in each site, I had a broader foundation with which to understand who the key stakeholder groups were and how they have interacted historically. Over time, I continued to flesh out my understanding of the key organizations and institutions in each case, as well as their historical and contemporary interactions using a combination of documents, interviews, and observations.
To further understand key contextual or, in Tilly’s terms (1999), exogenous factors, I also had to understand the scientific and regulatory history of the chemical or chemicals that drew public concern. To do this, I reviewed the regulatory and scientific literatures to understand what was known and unknown about the primary chemicals at each site. I also considered how scientific and regulatory action in each site contributed to the broader research and regulatory agenda around that chemical or chemical class.

My next analytic task involved documenting how organizations and institutions in each site participated in or responded to human biomonitoring. I looked at who conducted research in what relationship to affected or exposed groups, how that research was interpreted and by whom, and how science figured into and informed action and discourse. My key analytic goal was to characterize how the diverse organizational venues and forums through which publics engage in biomonitoring science navigate the constraints, consequences, and opportunities they encounter when engaging science to affect the production or regulation of synthetic chemicals. I identified (a) how communities and social movement organizations engage in biomonitoring (e.g., how they understand their field, the nature of research relationships, research design, how decisions are made, who implements the research plan, etc.) and (b) how they understand the value and effectiveness of biomonitoring science in their work. In addition, (c) I documented how activists recruit biomonitoring researchers to make political and social claims. What is achieved by using science to substantiate embodiment as a counter-authority in environmental politics? Finally, (d) I documented the implications of what organizations and community groups perceive as following from involvement with biomonitoring? How and under what conditions does science avail political and institutional opportunities, and conversely, how and when does it impose constraints, such as fracture activists into knowledge hierarchies (Epstein 1996), or embroil them in irresolvable scientific disputes (Jasanoff 2005)? Analytic tasks include comparing organizational forums, social arrangements, and research- or science-based claims or actions. I studied these to
discern what differences in the contextual, institutional, or movement dynamics makes a difference to how science and power operate.

To ground my analysis, I relied on a mix of: a) in-depth interviews, and b) whenever possible, observations of the organizational life of advocacy groups, including strategic scientific and advocacy planning meetings, and at other venues where biomonitoring science is communicated or discussed. Most important, however, were documents, including research reports, government documents, social movement organization archives, public testimony, court documents, and media accounts. Which data source was the most important differed in each case was dictated by feasibility and access. In the Mid-Ohio Valley, due to past, pending, or potential lawsuits, interviews were not granted with two important organizations that both conducted, interpreted, and acted on information about chemical concentrations in human blood. In both Alaska and Appalachia, where observations that involved extensive travel were limited because of feasibility and expense, documents became an increasingly important source of data so long as they could be supplemented by and triangulated against interviews and observations.

Observations. In all three cases, I initially entered the research site through a single organization involved in the collection and interpretation of biological data. In Maine and Alaska, it was through a social movement organizations, e.g., the Environmental Health Strategy Center and Alaska Community Action on Toxics, respectively. In the Mid-Ohio Valley, I gained access through the scientific team conducting a federally-funded epidemiologic study of chemical exposures in the Little Hocking water district of eastern Ohio. At the time, I served as a research assistant on a project by the National Institute of Environmental Health Sciences’ Environmental Justice Program, and had opportunities to meet the lead researcher when grantees gathered at an annual meeting.

However, I needed to enter each research site through multiple pathways and to see the site through multiple perspectives. When possible, I also entered the site through other organizations that also were conducting or staking a claim in biological monitoring in the region. In the Mid-
Ohio Valley case, no single organization drew the public into the science or became the sole means through which the public involved themselves. Rather, many organizations were involved in the collection, analysis, and interpretation of blood drawn from some 70,000 people in the Mid-Ohio Valley. I also entered the community through several other key informants, including key informants in the media, the small farm community (since consumption of local produce was deemed an important exposure source, see Emmett et al. 2006a), the legal community, and the social movement and advocacy community. I attempted to enter through two other pathways that were blocked at the time, where my access was restricted due to many organizations’ involvement in pending and potential lawsuits around contamination and remediation.

Direct observations were conducted as often as possible in forums where biomonitoring science was reported, discussed, or leveraged for political means, including conference presentations, media events, and public testimony (see Figure 4-2). My observations were designed to elicit multiple perspectives and reports of scientific findings: what is presented as fact, what and how uncertainty is described, what debates are raised, how the particularities and politics of place figured into scientific debates, what other kinds of evidence or resources are marshaled to make claims, and prescriptions about whether and what action (or inactions) should be taken, and by what jurisdiction.

I also conducted supplemental observations to push my thinking and to construct alternative explanations. For example, I also conducted observations in other venues where the meaning of biological monitoring was presented and discussed. This including serving as a observer, note-taker, and consultant for the Boston University Public Consensus Conference on Biomonitoring, which spanned four weeks during the fall and early winter of 2006. I also attended conferences on human biomonitoring, for example, the New Chemical Bodies Conference, which, in March 2007, assembled scientists and social scientists to discuss biological monitoring at the Chemical Heritage Foundation. Similarly, I attended two three-day conferences where environmental health and justice organizations from around the country could network and collaborate on
chemical policy and public advocacy initiatives, including the three-day First National
Conference on Precaution organized by The Center for Health, Environment, and Justice, the
Science and Environmental Health Network, and the Environmental Health Network in June of
2006. Finally, I conducted an additional eight month of participant observations as a project
consultant for a biomonitoring research project coordinated by an unnamed (at their request)
environmental health and justice organization in conjunction with several scientists and
physicians.

In all three cases, I began observations and interviewing at different phases in the
biomonitoring projects. This afforded me the opportunity to see and participate in the whole
process and to understand how studies come together, the nature of the work, and the challenges
and implications that resulted. These supplemental observations gave me a keener sense of key
decision-points about why social movement organizations take on the challenge of collaborating
with scientists and carrying out complex data collection protocols, and for reporting the findings
to each study participant before public release of the findings. Finally, through participation in
planning sessions, I was given a window into when and why some communities and
organizations opt not to participate or involve themselves in such undertakings.

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**Figure 4-5. Catalog of Observations and Participant Observations by Case.**

<table>
<thead>
<tr>
<th>Mid-Ohio Valley</th>
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<tbody>
<tr>
<td>Site visit, University of Pennsylvania, Medical School, Philadelphia, PA (March 2007).</td>
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<tr>
<td>The American Cancer Society’s Relay for Life, Belpre, OH (May 2007).</td>
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<tr>
<td>5-day intensive community tour, environmental history, mid-Ohio Valley, Ohio and West Virginia (May 2007).</td>
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<tr>
<td>Supplemental observations: five teleseminars on perflourinated compounds, chemical policy, and persistent bioaccumulative toxicants, Coordinated by the Collaborative on Health and the Environment and a national environmental health and policy advocacy organization (February 2006 through May 2007).</td>
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Scientific presentation, Dr. Edward Emmett, NIEHS Grantee Conference, Boston, MA (December 2007).

### Maine

- Two presentations, Environmental Health Strategy Center staff, First Conference on Precaution, Baltimore, MD (June 2006).
- Two public bill hearings and two committee work-sessions, Maine Legislature, State House, Augusta, ME (February-May, 2007).
- Press Release and Media Event, Body of Evidence: Pollution in Maine People, State House, August, ME (June 2007).
- Three meetings of the Governor’s Task Force on Safer Chemicals, (September-October 2007).
- Conference, Greening Maine’s Economy, University of Southern Maine, Portland, ME (October 2007).

Supplemental observations: participant observations (over 8 months) with another (unnamed) advocacy biomonitoring study from conception through implementation and data release.

### Alaska

- Seven presentations by Alaska Community Action on Toxics staff, including at the NIEHS Grantee Conference, Talkeetna, Alaska (September 2005); the First Conference on Precaution, Baltimore, MD (June 2006); annual national meeting of environmental health and justice organizations, Los Angeles, CA (March 2007); and the NIEHS Grantee Conference, Boston, MA (Dec 2007).
- Conducted 2 week intensive fieldwork and participant observation at Alaska Community Action on Toxics offices, Anchorage, Alaska (October 2006).
- Participation in 12 ACAT organized teleconference calls (October 2006-present).

Supplemental observations: NIEHS Environmental Justice Partnerships for Communication Grantee Meeting, Talkeetna, AK (September 2005); the Alaska Native Medical Center, Anchorage Alaska, the Annual Alaska Tribal Conference on Environmental Management (October 2006); and at a “Belly Brigade” action, Boston, MA (September 2007).
**Documents.** Document collection and analysis served as the primary source of data, since it is through documents that various stakeholders communicate claims about the significance, both scientific and social, of scientific findings. I collected several categories of documents, which I list here by general category. Figure 4-3 lists more details about the documents used in the analysis of each case.

*Social Movement, Scientific, and Community-Based Organization Archives.* A myriad of organizational archives supplied important documents. Documents collected from these were related to research and advocacy campaigns, grants, reports to funders, action alerts, and media clippings, also meeting minutes, community newsletters, and other issue updates. Especially rich sources were the many community-based organizations (not necessarily associated with social movement organizations) that functioned as informational clearinghouses for communities, such as the Little Hocking Water Association (www.littlehockingwater.org) and the Community Advisory Board to the NIEHS-funded epidemiological study in Ohio (www.lhwc8study.org).

*Research collaboration and organizational archives.* Though these were not always available or accessible for every case, in some instances scientific teams made all or some portion of these available. Previous work on multi-institutional scientific collaborations (Chompalov and Shrum 1999) notes that research collaborations generate massive amounts of documentation – notes, memoranda, proposals, plans, meeting minutes, analyses, raw data, publication drafts, presentations – which are circulated among collaborators, and, in that process, are imbued with layers of commentary, as messages are crafted and contested. First noted by Latour (1987) and as summarized by Chompalov and Shrum (1999), “such documentary practice is not the detritus of science but the very stuff of its construction, the backbone of its work organization” (342-343). For those collaborations that have already done significant work together, the reconstruction of accounts and meaning rely on access to and careful analysis of preserved written documents – internal notes and meeting minutes, semi-public documents, and those written with public audiences in mind, such as community newsletters.
**Government Documents.** I waded through archives of public court documents, state legislative libraries that maintain public testimony and other files produced during the policy process. The EPA Docket and federal register was another source of historical documents reviewed and used in this project; these were particularly helpful in writing about PFOA in the mid-Ohio Valley, since the EPA docket became a prime vehicle through which information about that chemical became public knowledge. It was also a vehicle through which residents of the mid-Ohio Valley – in the form of public comment submissions – spoke publicly about their concerns over groundwater contamination. State agency files and documents were also helpful in all three cases. In particular, some documents were collected from the Army Corps of Engineers about the clean-up efforts they coordinated in Alaska.

**Media Archives.** Finally, I draw on news media accounts as an important web of communication and dissemination for various stakeholders, especially in the context of multi-lateral credibility contests (Epstein 1996). In cases of contested science, the media plays a role in anointing certain figures with authority or credibility in community and scientific contents, and thus changes the particular set of social relations within credibility and scientific contents (Epstein 1996), enough to warrant review and for media analysis to be considered as one among many sources of triangulated data. As well, media sources helped me map the key organizations and players at each site, especially during the early phases of research. Regional news sources were of particular importance, including local television and radio, as well as newspapers, most especially *The Kennebec Journal, Portland Press Herald* (ME); *Bangor Daily News, Anchorage Daily News, Nome Nugget, and Tundra Times* (AK); *The Charleston Gazette, Parkersburg News and Sentinel* (WV); and *The Marietta Times* (OH).
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<th>Mid-Ohio Valley</th>
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<tbody>
<tr>
<td>1</td>
<td>State environmental and public health regulatory <strong>agency documents</strong> from Ohio and West Virginia.</td>
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<td>2</td>
<td><strong>Regional and national social movement</strong> organization documents reporting on PFOA and perfluorinated chemicals, includes internet reports, press releases, action updates, news reviews and issue chronologies from the following: United Steel Workers; Environmental Working Group; Ohio Citizen Action; DuPont Shareholders; and the Fluoride Action Network.</td>
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<tr>
<td>3</td>
<td>Documents and community updates provided by <strong>The Little Hocking Water Association</strong>, including water quality reports, public EPA testimony, news and community updates, as well as results from small community blood sampling.</td>
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<td>4</td>
<td><strong>Media coverage</strong> by local and national papers, re: discovery of contamination, class action suits, various biomonitoring projects, EPA and Department of Justice investigations into PFOA and DuPont; also state and federal regulatory action, and coverage of other PFOA “hotspots” discovered after the mid-Ohio Valley (including in Michigan, New Jersey, and North Carolina).</td>
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<tr>
<td>5</td>
<td><strong>Scientific documents</strong> from NIEHS-funded C8 epidemiological study of residents on the Little Hocking water supply, including publications and presentations; all materials maintained on a public website set-up for the community to disseminate findings, minutes from meetings of the community advisory board, community newsletters.</td>
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<td>6</td>
<td>Documentation about regulatory history of PFOA and PFCs pounds available through the <strong>EPA docket</strong>, including public testimony and internal corporate memos from manufacturers and users of PFOA. Also, research and reports about the primary contaminant, the broader category of compounds to which it belongs, its history, and market and use data.</td>
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<td>7</td>
<td><strong>Internal corporate memos</strong> from manufacturers and users of PFOA available through the Chemical Industry Archives, maintained by the Environmental Working Group.</td>
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<tr>
<td>8</td>
<td>Documents produced and distributed by the <strong>Brookmar, Inc. and the C8 Panel Science Panel</strong>, science the results from lawsuit. Also, data about the Brookmar Project and C8 Science Panel deliberations managed and presented via West Virginia University and through public court documents.</td>
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<tr>
<td>9</td>
<td><strong>Public court documents</strong> from 2 class action lawsuits filed on behalf of WV and OH citizens against DuPont.</td>
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<td>10</td>
<td><strong>Films and documentaries</strong> made by (a) Ohio Citizen Action regarding air pollution from other area factors; (b) Ohio University students; (c) art installation by Ohio University visiting faculty; (d) documentary on Institute, West Virginia plant explosion; (e) Bubble, re: life in the mid-Ohio Valley; and (f) early images and conceptualization of Mary Hufford and colleague’s documentary in production, The Plough and the Polymer.</td>
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Maine

1. **Government documents:**
   a. Bill texts for both consumer-product based bills, nearly 300 pages of public testimony gathered at the Maine State Law and Legislation Library, and house and senate floor speeches for/against bills.
   b. Documents pertaining to the Governor’s Executive Order on Safer Chemicals in Consumer Products.
   c. Documents maintained by the state Department of Environmental Protection re: the deliberations of the Governor’s Task Force on Safer Chemicals, including interim and final reports, drafts, meeting minutes, presentation materials, and materials collected by the Task Force on chemical policy, safety, and alternatives.
   d. Regulatory and legislative documents pertaining to prior bills and state agency policy regarding chemicals and pollution.
   e. DEP documents and reports on brominated flame retardants, “feasible” alternatives, their position on the support of the bill

2. **Social movement organization documents,** pertaining to the conduct and communication of the Alliance for a Clean and Healthy Maine’s Pollution in Maine project – including informed consent, IRB protocol, example of reporting of information and packets given to study participants; press kits, final reports, executive summaries, and project websites.

3. **Print and other media coverage** re: biomonitoring study, pending legislation, and issues pertaining to chemical policy and safety. Includes, transcripts of Maine TV and radio coverage, public speeches and press releases by study participants speaking about participation in study.

4. **Social movement organization** documents, including action alerts, briefings, news releases, etc., from three environmental and environmental health organizations (Environmental Health Strategy Center, Natural Resources Council Maine, and the Alliance for a Clean and Healthy Maine). Also includes digital and webcast media used for organizing and TV/radio/and print advertisements.

5. **Market analysis** of chemical industry generally, brominated flame retardant industry specifically (Innovest, Clean Production Action, American Chemistry Council, Washington state, etc).

6. **Documentation from public-private partnerships,** regarding fundraising and advocacy for building Maine research and manufacturing capacity in green chemistry, engineering, and production, including from the Potatoes-to-Plastics Consortium, and economic research and analysis published by non-profit research agencies and Maine university researchers.

8. Documentation on environmental pollution in Maine waterways from the Penobscot Nation and the Natural Resources Council on Maine.
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<tr>
<td><strong>1. Social movement organization documents</strong></td>
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<tr>
<td>a. Community reports, newsletters, publications, updates to federal funding agencies regarding St. Lawrence Island and Norton Sound federally-funded research projects. PCB monitoring project.</td>
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<td>b. Organizational archives of <strong>scientific and organizing grants to government, foundations</strong>, etc., re: environmental justice and toxics, including present and former, awarded and rejected, from ACAT grant files.</td>
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<tr>
<td>c. Published reports and <strong>newsletters regarding organizing and research</strong> efforts around military toxics, chemical policy, northern contaminants in Alaska, and other organizing campaigns.</td>
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<td>d. Organizational archives re: participation at the international meetings around The Stockholm Convention on Persistent Organic Pollutants.</td>
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<tr>
<td>e. <strong>Documentation and education materials</strong> re: The Democracy School curriculum on environmental problems, which is central to ACAT’s shift from a regulatory to a rights-based organizing paradigm.</td>
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<td>f. <strong>Videos</strong> made by ACAT or shown at ACAT-sponsored community events: I Will Fight Until I Melt; Drumbeat for Mother Earth; Beloved Community (ACAT hosted showing for AK community).</td>
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<tr>
<td>2. Documents pertaining to the <strong>Restoration Advisory Board</strong>, community-military body charged with overseeing the clean-up of the contaminated formerly used defense sites on St. Lawrence Island.</td>
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<tr>
<td>3. <strong>News coverage</strong> (including print, news, and radio) about ACAT and organizing around northern contaminants and military toxics from ACATs media files. Also, extensive notes from watching videos made by ACAT about St. Lawrence Island, contaminants there, and research project.</td>
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<tr>
<td>4. <strong>Public testimonies</strong> given about northern contaminants and military toxics on St. Lawrence Island.</td>
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<td>5. <strong>Government documents.</strong></td>
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<tr>
<td>a. <strong>Documentation from the Army Corp of Engineers</strong> charged with military clean-up of St. Lawrence Island.</td>
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<tr>
<td>b. Documents published by the Department of Environmental Epidemiology and State Department of Public Health regarding fish advisories and biomonitoring in Alaska.</td>
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<tr>
<td>6. <strong>Non-profit, academic, or government reports</strong> re: political economy of environmental problems in Alaska, among Alaska Natives, also re: land and food sovereignty, re: political and tribal sovereignty, which set the stage for the struggles over military toxics and northern contaminants. Publications produced by The Alaskan Federation of Natives and the Alaska Native Tribal Health Consortium.</td>
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</table>
7. **Research and reports about specific contaminants** that affect Alaska and are of concern to ACAT, principally PCBs, lindane, chlorinated-pesticides. Also, information about history and markets for these compounds, including how regulatory agencies and international agreements are (and are not) handling it. Finally, that document history of biomonitoring in Alaska, including from the Arctic Monitoring Assessment Programme.

**Interviews.** Document analysis and direct observations were supplemented with in-depth interviews of key informants often undergoing multiple rounds of interviews. These included key actors within community organizations, scientists, political or community leaders, and other local figures who may be involved in the research or its interpretation (e.g., regional/state regulatory officials or lawyers). Interview questions probed how scientific information was gathered, understood, used, reported, and received, and how various stakeholder groups understand the value of biomonitoring research for their work, and what consequences they observed as following from how they acted upon the results. I conducted a total of thirteen interviews for the mid-Ohio Valley case, which included a combination of informal, unquoted conversations about historical events (N=3), verbally-consented conversations (N=2), and formal, semi-structured interviews for which I obtained written informed consent (N=8). In Maine, I conducted twelve interviews, again a combination of informal historical background-gathering conversations and formally-consented semi-structured interviews (N=7). Finally, for the Alaska case, I participated in fifteen informal conversations and semi-structured, fully-consented formal interviews (N=11).

**Data Management**

Interviews for which I gained written consent were audio recorded and then transcribed. Post-interview notes were recorded within two days of the interview, to capture themes as theoretical and analytic questions emerges from interview material. Fieldwork notes also were recorded throughout, according to the recommendations set out by Emerson et al. (1995), who encourage thick, descriptive note-taking of interactions followed by early analysis of patterns and
alternative explanations. Over two years, I filled numerous (N=10) blank journals, one set dedicated to each case for recording field observations, interview notes, and future questions, interviews, or observations to pursue. Another set of field journals was dedicated to recording notes on theory, methods, and emerging analytic themes across research sites. I also routinely typed process notes after each interview and field observation, using notes from research journals as a starting point. Periodically, I would review handwritten and typed notes, and follow this review with a writing or memo-ing to capture emerging themes.

Documents, most in hard copy, were cataloged and filed by subject material in a large file box, one dedicated to each case. During sorting exercises, I would read the documents, highlighting entire passages and jotting notes in the margins about key themes, while also recording my thoughts in the appropriate notebook.

Though previously I have used software to assist with data management and coding, and though I have attended two training sessions for NVIVO 7.0, for this project, I preferred working with the documents by hand and manually coding by creating theme-based memos using Word. I periodically would sort and resort the materials into new file boxes and my understanding of each case shifted over time. As I moved from outline stage to first draft, I culled the most important documents from each research site and stored them in a magazine file for easy accessing and reference while writing. What steered me away from using electronic data management was the sheer number of documents I obtained in hard copy and the additional labor required to scan individual pages into an electronic file. Going forward, as I return to this project in the future, I would like to use NVivo to help store and manage digital media, including audio and video files, code pictures, track changes to websites, and to incorporate into these the memos I already created about their content and key themes.
Strategy for Analysis

Qualitative analysis implies an emphasis on the qualities of entities, processes, and meanings that are not experimentally examined or measured in terms of quantity, amount, intensity, or frequency. The primary concern of qualitative inquiry is how social experience is produced and meaning assigned. To examine this, data collection often involves multiple methods for triangulating and verifying, to gain an in-depth understanding of a social phenomenon.

Multi-sited ethnography allows me to learn about social situations, places, or experiences, but, more importantly, through the interpolation of theory and data, I can also learn from those situations, places, or experiences. Through multi-sited ethnographic methods, I transform observations into explanations, work data into theory. My goal is explanation and theoretical generalizability. The ability to learn from my observations, not just about the settings I observe, rests on the rigor of my methodology and how systematically and carefully I connect research questions and analytic methods to social theories (Burawoy et al. 1991: 5).

Throughout the project, I worked to create a systematic dialogue between theory and data and to cultivate a “deep engagement with the ideas of others” (Burawoy et al. 1991: 7). In adapting Burawoy’s approach to multi-sited ethnography, I began by selecting a research site (of contact and contestation over chemical exposures); I then searched for social theory that presents that social site as anomalous, unexpected, paradoxical, or unique. Rather than reject theory for being partial or incorrect, Burawoy (1991) challenges students to work with theory and reconstruct it by extending our analytical gaze to the broader structural forces in play. In other words, this approach to ethnography and qualitative data analysis begins at the margins of social theory where possibilities exist for extension by empirical investigation of an illustrative or anomalous case. To work from theory, Burawoy (1991) instructs students to begin with an overarching macro theme – such as institutions, knowledge, and power – and to trace that theme through different social contexts, specifically examining how social situations are shaped, distorted, enabled, or constrained by macro-level structures. Seeing the macro operate in the micro is the
main objective of interpretative case analysis, but seeing how the macro operates on the micro, as well as what the micro illuminates about the macro, is what Burawoy calls the extended case method. This approach fits in the tradition of C. Wright Mills (1959/1976) – of using the sociological imagination to connect personal troubles with public, structural problems. That is, to ask: what are the effects of the macro on the micro? How does the macro play out in the micro?

The reason Burawoy uses the term “extended case method” is because it involves extending out from and beyond a particular case, social situation, or site, to see how external factors shape it. Thus, by beginning with theory, by bringing theoretical concepts and theorized relations to bear on data, I can reconstruct theory, add to it, and extend it when it falls short of explaining the particular social phenomena I observe. This process enables me to work across my cases, rather than treating them as three, discrete research sites.

My analysis is primarily text-based, including primary documents collected in the field, or transcripts and fieldnotes I create from interviews and observations. There are two primary schools of thought informing text-based analysis. In the linguistic tradition, a researcher treats text as an object of analysis, primarily focusing on conversation, discourse, and grammatical structure. In contrast, I am interested in texts as windows into the human experience. Human experience is gleaned from texts by sorting and organizing texts, and by systematically culling meaning in contiguous blocks of text, or coding. My coding technique is based in the school of analytic induction, rather than grounded theory. I use theory to engage my data, with the goal of expanding and adding to existing theory, rather than use my data to develop new theory. The literature review and background research provided a critical source of themes and concepts. Additional theoretical concepts were identified during and after the formal period of “data collection,” as this is an ongoing, iterative analytic process.

There are three analytic steps or processes involved in analysis. First, within each case, I move between “tracks of analysis” (Alford 1998). I analyze what activists, scientists, policymakers, and other stakeholders do and say with regards to biomonitoring, and then pan out
to examine the historic patterns of relations and political-economic structures that put those actions and statements in context. Second, my analysis involves cross-case comparisons that compares contextual and institutional differences present in each site that create different opportunities and consequences for groups that conduct biomonitoring science and engage science as a way to move policy, debate, or change.

Finally, as the last portion of my analysis, I considered the relationship between different analytic sites. Because the cases are interconnected by political-economic structures and by activist and scientist networks, I examine how what happens in one site of contact and contestation theoretically links to what happens elsewhere in the system. Thus, sites of contact are neither isolated nor detached sites, but co-occur and nest themselves into one larger case about science and politics across the lifecycle of persistent, bioaccumulative chemicals. In this last track of analysis, I worked to glean patterns in how science affects power over environmental decision-making across the chemical lifecycle. To do this, I looked across the lifecycle of persistent chemicals by examining how sites of contact and contestation interact, co-occur, and mutually act upon one another. The interviews and documents collected also were considered with attention to what fragments sites of contact and contestation such that they are dealt with differently depending on whether resulting from production, consumption, or release and persistence? Conversely, under what conditions does scientific documentation of shared chemical exposures unify and ally across nodes, across cites of contact and contestation? This latter track can be thought of as a chemical lifecycle analysis, and its primary goal is to understand commonalities and relationships between sites. Central analytic questions include: how does what happen in one political moment reverberate throughout the system. What social forces establish these defined political moments? What social forces work to blur boundaries and to link together these different political moments in which science is put to work, transmits power, and distributes consequences?
As Gille and O’Riain (2002) note, there are many challenges to conducting data collection “in sites that extend across multiple places and spatial scales, that extend in time, and [over which] the boundaries [can be] deeply contested” (p. 272). Pragmatically, there are issues of funding and time, which I discuss, but there are also unique and complex implications for research ethics, the topical focus of this section.

Feasibility

For ethnographers working with a multi-sited approach, time and research funds may delimit extended stays within a single location. However, such classic “ethnographic” field visits can also be both impractical and, at best, partial (Gille and O’Riain 2002). Sitting on a street corner for many months, depending on the researcher’s driving question, may not paint a complete picture of the complex social relations that matter. Particular places, instead, function as a jumping off point, a “launching pad outward into networks, backward into history, and ultimately into the politics of place itself” (Gille and O’Riain 2002: 287). Indeed, if one were to count the number of days spent in the particular places that served as the jumping off point for this research (in Appalachia, Maine, and Alaska), I spent far less time than I might have, had I been conducting a single case or comparative study using traditional ethnographic methods. In total, I was on-site three weeks in Alaska; two weeks in Maine, spread over numerous, single- and multi-day road trips; and a week in Appalachia. Though I would have liked to spend more time on-site, particularly in Appalachia and Alaska, I planned trips according to available research funds and a tight research schedule.

As required by this method, I also took several satellite research trips. These trips brought me, for example, to Los Angeles, Baltimore, and Philadelphia, and, on several occasions, to various events fortuitously near where I live in Boston. In these instances, I followed key actors as they traveled to public forums to discuss body burden research and its implications findings. For
example, I observed representatives from Alaska Community Action on Toxics present at four conferences in the Lower Forty-Eight, and traveled to meet them whenever they were on the East Coast. I also met with key actors or stakeholders who, though located away from the primary site of interest, had influence over what happened there. I visited the University of Pennsylvania campus in Philadelphia to see the offices where the National Institutes of Environmental Health Sciences-funded project team coordinated research on chemical burdens and human health consequences in the mid-Ohio Valley of Appalachia.

For each case, I also observed and participated remotely, conducting interviews and “observations” by phone. Scientists and social movement organizations increased use of tele-seminars, webinars, and teleconferences availed me with over forty additional hours of observations and participant observations. For example, the Maine legislature broadcasts Senate and House floor debate, as well as committee hearings and work sessions on bills I tracked through the legislature. In February of 2007, when a winter storm grounded me in Boston, I was able to “observe” and transcribe over four hours of public hearings in real-time through the Internet. Similarly, Alaska Community Action on Toxics regularly coordinates monthly teleseminars or “webinars” on a variety of issues important to the organization, from military toxics to reproductive consequences of northern contaminants and the health implications of mining. They facilitate two to three invited presentations, followed by discussion among a community of professionals, scientists, and activists concerned about environmental health and justice in the state. These teleseminars helped me understand the full range of ACAT’s organizational priorities, and served as a window into their environmental and political contexts. My involvement in planning a couple of those teleseminars also kept me connected to the organization, despite the geographical distance. I also actively participated in two national networks of environmental scientists and activists who commune regularly through such telephone and digital forums. For example, the Collaborative on Health and the Environment hosted a call about perflourinated compounds on which two leading activists from the
Environmental Working Group and Ohio Citizen Action gave presentations. Some of these are public venues, while others required me to negotiate permission to join, and for which I participated for my own learning, rather than for direct citation use. Again, though not ideal, overall, my participation through digital venues supplemented field-based observations (I did miss out on rich opportunities to observe interactions, nonverbal cues, and for engaging people in the hallways afterwards). The remote activities also facilitated access to details and insights that would otherwise have not been feasible for me. In several instances, I was able to monitor simultaneously unfolding events at different research sites because I could participate remotely through conference calls. I am not suggesting that distance data collection strategies could or should function as a primary mode of data collection; rather, these kinds of observations help close gaps that might otherwise remain unfilled when tracking so many people, events, and places with limited time and funds.

Though I address the issue of access more in the next section, while on the topic of feasibility, I want to describe briefly access issues as an element of feasibility. The topic of human body burden poses an interesting challenge for researchers. Moving between and among so many field sites poses numerous challenges. Principally, mobility affects the trust and access researchers must cultivate. Accessing organizations and interviews was, at times, overwhelmingly easy, and at others, quite constrained. Many individuals (scientists and activists alike) and organizations felt passionately about the science of human biomonitoring and human chemical burdens more generally. Often, I was welcomed warmly to conduct observations and interviews, or to participate in various events around human biomonitoring research. I never failed to be surprised by the openness and candor with which the topic engages people.

At the same time, however, access was not universally easy to obtain. The availability and willingness of organizations and individuals to speak with me was circumscribed by the broader political and legal environments in which this project took place. While the groups I studied did not mention it, other community organizations who have engaged in scientific work feel
vulnerable to attack by corporations or industry trade groups that have been quite critical of community groups or other organizations that actively participate in scientific research. In addition, many organizations, that have been, or could become, involved in a lawsuit, expressed that speaking could conflict or bear implications for their cases. While I was in contact with several lawyers and they pointed me toward important public court documents, I was not able to interview the trial lawyers who were so instrumental in bringing to light DuPont’s longstanding monitoring of workers’ blood and who created the opportunity for nearly 70,000 residents living on contaminated groundwater supplies in the mid-Ohio Valley. Nor was I able to speak directly with the manager of the contaminated water district in the mid-Ohio Valley, even though that water association served an immensely important role by representing the community and furbishing them with information when few other agencies could or would. In both instances, pending trials, or the potential for future litigation, made participating in a research interview not in their interest as well as a potentially liability to their future activities.

**Ethnography as Extractive Enterprise?**

Multi-sited ethnography, while posing numerous pragmatic dilemmas for researchers, also raises unique ethical concerns as well, particularly multi-sited ethnographies that substantively address issues related to health, justice, and the environment. These ethical issues are multifold, stemming from moving between sites, across sectors, and from working among heavily researched populations or social movement organizations on the “front-lines” of controversial and difficult issues (Newman 2002).

Though the ethical implications of sociological research has been a central theme throughout my graduate training, this project raised numerous new issues. These issues first came into view as I sat aboard an Anchorage-bound airplane, on my second trip to Alaska, where I began a methodological and philosophical conversation with myself, one that deeply infused my approach to this research. On board that flight, I sat among contract laborers for companies that
mine Alaska for its natural resources. Historically, the potential to extract Alaskan resources has lured steady waves of Outsiders, so much so, that the phrase “Outsider” routinely appears capitalized in Alaska. Outsiders came first to harvest whale oil and furs, then seafood and pulp, followed by metals, coal, then oil (Haycox 2002). Alaska’s strategic geographic location also lured the U.S. military during World War II and the Cold War that followed. In response, Outsiders flocked into Alaska to serve at hundreds of bases stretching across the Alaskan landscape. More recently, especially since Alaska was named “ground zero” for the U.S. experience of climate change, another demographic of Outsiders has flocked to the state – researchers. Herein lies the central problematic for my sense of methodology and research ethics. In the outcome achieved, what is the difference between an (environmental) ethnographer such as myself, and an extractive enterprise? Research is a different kind of resource exaction, to be sure, but a form of extraction all the same: do we not harvest stories and life experiences? Even if unintentionally, am I but another prospector, an Outsider, come to harvest Alaska for its human resources or its strategic location as receiving grounds for global contaminants, or to Appalachia, another region harvested by both Outside prospectors and researchers. What realistically can I hope to offer in exchange for what I’ve learned, for the knowledge I’ve taken? What do these questions mean for methodology and for the practice of research ethics in ethnography and sociology more generally? Finally, how should these interrogations be incorporated into the very conduct of research and not as the standard ethnographic confession buried in the prologue or methodological appendix?

My iterative and working answers to these questions in some instances drew from other scholars writing on research ethics (i.e., on a community-centered research ethic), but in others, I found myself at the edge of the research ethics literature. When thinking about the implications for communities, I drew from a burgeoning literature on the nature of community-based research ethics, which extends research protections from individuals to communities and, in doing so, considers how communities bear different consequences than the individuals that comprise them
(Quigley 2001). However, as I began this research project, the *Chronicle of Higher Education* covered a conflict between a social movement researcher and the social movement organization she had researched (Glenn 2006). This experience led me to think more critically about what an organizationally-centered ethic might look like as well. There were fewer published materials to support the ethical questions that arose from working with organizations. Instead, I drew from previous experience researching with and for social movement organizations and elicited other scholars’ accounts of the intricacies of conducting research with these types of organizations.

Finally, as I navigated through this research, I realized that conducting multi-sited research does not just pose specific ethical issues for communities or for organizations in isolation from one another. Multi-sited ethnography raises a third set of ethical issues that are drawn into sharper relief because of the nature of this approach. Multi-sited ethnography makes plain the implications of short-lived stays. There is a fine line between doing this kind of work ethically, and falling into the trap of “helicopter research” – the historic practice where scientists parachute into a place, collect their data, and then extract themselves from the field with little notice and no benefit to the research site. Furthermore, by virtue of moving between sites and across different communities and organizations, my work, at times, linked or juxtaposed various entities that were in conflict or that worked to distance themselves from one another. Multi-sited ethnography, thus, raises many new ethical challenges, two of which comprise predominately unexplored ethical terrain. The following three sections are my humble attempt to specify both my conduct, and what I learned along the way.

**Community-Oriented Research Ethics**

Whereas in previous research, I began with research questions arising from an organization or a community’s concerns, for this project, I began with my own intellectual curiosities. My research questions are rooted in theoretical and sociological research gaps and my desire to understand the long-term implications of human biomonitoring science at a time when it was still
largely unsettled. Though I felt my questions could have policy and perhaps public relevance, I was aware my questions were primarily self-motivated. As a result, I adopted an approach to this research project that, in each case, led me to proceed differently than I would, had the questions evolved from direct collaboration with and for the community groups and NGOs that I eventually enrolled in this study.

These concerns shaped my research questions by steering me towards organizational questions and away from questions that required extensive community interviews. I allowed myself to be guided by community-oriented research ethics (Quigley 2001), in which the unique harms and benefits to communities – rather than the individuals that comprise them – were a paramount concern.

The centrality of this form of ethics – what is sometimes termed a community approach to human subjects protection – means that some traditional notions of research methods must be adapted. For example, I opted not to pursue research questions that required community-based interviews when I felt a community already had been inundated by researchers. I was cognizant that many community members were already experiencing research fatigue at the hands of earlier waves of either social scientists or scientists with a diverse array of research concerns about life in economically marginalized regions such as Appalachia or Alaska Native communities. In both Alaska and Appalachia, I arrived at this decision after seeking counsel with trusted contacts and key informants about the need to tread softly as a researcher and to be most cognizant of what my retrospective prodding might stir up in communities already struggling with pressing concerns about chemicals in their everyday surrounds. In Appalachia, I reworked my research plan to rely on other sources of data besides intensive interviews in the community because I also did not want to duplicate research efforts and further burden an already over-researched community, since an ethnographer was already doing deep ethnographic work in the region. In Alaska, I opted to not pursue interviews with community members, leaders, or elders. I came to this decision after several frank conversations with members of Alaska Community Action on Toxics,
who were helping these Alaska Native communities conduct research on contaminants in their blood. Rather, I focused my attention on the organization that coordinated research on their behalf, or that was, at times, a voice for the community, since ACAT also employs community members on staff or as field researchers.

I relied heavily on what was available to me through the public record – through publicly available databases and documents, as well as accounts conveyed through social movement organizations, the media, or community groups. I used information collected through observations and interviews to inform my analysis of these materials. By doing so, I was able to present the public record in a new way. This also allowed me use interview data in a way that did not raise the potential risk of revealing the identities of who I interviewed. This approach resembles the approach Clarence Stone, an urban sociologist, uses when studying urban “regime politics” (Stone 1989).

In both these cases, I had to balance having less interview data with the need to write and speak about the issues these communities faced with sensitivity and in a way that was grounded in the community’s experience. I endeavored to relay the issues these communities faced without crossing the fine line of attempting to speak for them. These dual concerns, for a novice writer and researcher, are tricky to negotiate, and perhaps even at odds. I tried to capture community members’ voices through public data sources (e.g., media interviews, documentaries, public commentaries submitted during regulatory hearings and the like). I hope that I have portrayed the events that have unfolded in these places in ways that validate the communities’ struggles – particularly those communities on the fence of chemical production in Appalachia, and those in Alaska who, like many other communities in the circumpolar north, are the at front-line for dealing with the legacy of post-World War II chemistry and militarization.
Organization-Based Research and Ethics

Yet, at the same time that I opted to focus on organizations within research sites, I also began questioning organizational ethics posed by working with community groups and social movement organizations. There is little discussion in both the social movements and research ethics literatures to guide researchers working with organizations, particularly social movement organizations, whose political reputations and financial solvency are tightly hinged to public perception and support. Whether or not I could offer organizational confidentiality also raised several issues. Though increasingly organizations involve themselves in biomonitoring research, there was still a small enough universe of cases that I could not, in good conscience, offer organizations confidentiality. In some cases, researchers’ promises to protect organizational confidentiality fail to protect them once the study is published (Glenn 2006), such as the case reported by the Chronicle for Higher Education in which a sociologist conducted research with a social movement organization easily identifiable because of its unique advocacy work. Rather, the best I could offer was confidentiality to individuals affiliated with specific organizations.

Another concern is whether researchers will divulge organizational strategies or problems that leaders, understandably, may not want public. Social movement organizations have a certain strategic vulnerabilities as well that I felt obligated to protect, whether or not they arose in any of the cases here (i.e., this was a decision I made at the outset, rather than a decision that responded to any one incident that was revealed to me during the course of research). In this study, I followed the example of community groups and non-governmental organizations (many, though not all social movement organizations) that involve themselves in an uncertain and, at times, controversial science on a pitched playing field and in a tricky-to-negotiate arena of science-based advocacy. While I worked to portray accurately the details of each case, I also felt ethically obligated to select carefully what I reported.

Even with such an organizational focus, readers may be struck by how few direct, though anonymized quotes appear throughout the three case study chapters. Instead, I have relied in my
case chapters on voices from public documents and venues, in instances where I felt including a
direct quote would make the speaker too recognizable. This is a strategic decision on my part to
protect staff in organizations that kindly agreed to be interviewed, many at some length, on
multiple occasions.

Another concern is that ethnographic observations and interviewing within organizations can
draw down one of an organization’s most precious resources: time. In instances where an
organization welcomed me to conduct extended interviews and observations, I conducted these as
participant observations. In exchange for the time that ACAT and its staff hosted me in
Anchorage, I involved myself in the day-to-day activities of the organization. I quickly
acclimated myself to organizational tasks and needs, at times answering the phones, making tea
for staff meetings, hanging flyers, or washing dishes. Participating in the organization in this way
is a routine component of conducting participant observations. Participant observations, versus
conducting more hands-off observation, was a strategic methodological strategy employed to
understand the organization, its priorities, and its daily activities.\(^{20}\)

However, I also contributed in ways that transcended participant observation. I remain
motivated by a deeply felt sympathy and synchronicity to ACAT’s mission and work in Alaska,
and to the pressing legacy of northern contaminants and military toxicants on Alaska Native
communities. I also have a strong personal commitment to find ways to make my sociological
research skills, professional networks, and, where feasible, access to institutional resources
accessible to communities and organizations that feel they could benefit from them. Since my

\(^{20}\) In other sites, I did not develop such close organizational ties. For example, though I spent more time in Maine, I did not spend
time observing in an advocacy organization there as I did in Alaska, though I had connections to both the Maine and Alaska
organizations through prior research and involvement with social movement organizations. There are several reasons for this, the most
significant being that there was no single center of gravity for Maine’s Environmental Health Strategy Center. EHSC is comprised of
three employees located in three different Maine cities, with another organization (The Tides Foundation) coordinating administrative
details from Washington, D.C. My more limited organizational relationship was also a function of timing. I learned of this study well
after it was underway. As a result, I did not participate in any of the early meetings of the Alliance for a Clean and Healthy Maine. By
the time I started work in Maine, both of these organizational entities, while kindly granting interviews and in general welcoming me
as a researcher, had already completed the time- and meeting-intensive study planning process and were rarely in the same place at the
same time to enable observations.
last visit to Alaska in October of 2006, I have written a peer-reviewed literature review on environmental health science about reproductive toxicants for Alaskan health care providers, helped the organization compile and organize teleseminars through the Collaborative on Health and Environment-Alaska network of professionals and activists, and also generally served as a network spokesperson for new research of relevance to the organization and its mission. I also have supported ACAT by commenting on drafts handouts and reports.

**Multi-Sited Researcher as Perpetual Outsider**

I began this section by placing myself among the many transient Outsiders that travel to places like Alaska, but also to Maine and Appalachia. These are tourist destinations that attract droves of outsider visitors. They also are places with rural-industrial or natural-resource based economies which lure waves of outsiders, first those who extract these resources, and then those who come to regulate, challenge, or research what follows as a result.

Regardless of how much time one spends in the field, a researcher remains an outsider by virtue of her eventual withdrawal from the field. In the case of multi-sited ethnography, the sense of Outsider status is even more heightened than in ethnographic work involving longer stays, where the researcher does not divide time across many people, places, and organizations.

At no time was my identity as Outsider more striking to me than the morning I left the mid-Ohio Valley after a multi-day research trip. At the time, I was newly pregnant, and the idea of my body harboring chemicals that my baby would inherit had made this research project all the more salient. On my final morning in the Valley, as I was packing to leave, a plant sounded their warning sirens, though I never found out what prompted the alarm. While trying to stay in the ethnographic moment – to stay attuned to how people were responding around me – my mind wandered to whether the siren signaled I had been exposed to something that could affect my pregnancy, or the child inside me. Not long afterward, as I raced westward toward the Columbus airport, my mind rolled over two opposing thoughts. I was relieved that I could drive away, even
though PFOA was ubiquitous outside the region. I also felt ashamed for leaving, and humbled. In light of all the exposures and struggles I’d witnessed in Appalachia, like in Maine and Alaska, what could one sociologist, one single dissertation, ever hope to contribute? If I could contribute very little, despite my intentions, then I resolved to work even harder to avoid harm.

Not only was I aware of myself as an Outsider, I also knew I was studying the relationship between other kinds of outsiders and insiders. I was tracking highly mobile molecules, often the ultimate Outsider, as they drifted into places or bodies, often against the will of residents. Scientists, regulators, as well as lobbyists and chemical producers, in most instances Outsiders, also traveled into regions to address exposures, exposure science, or exposure mitigation and redress. In the mid-Ohio Valley, social movement organizations came from the outside to address contamination flowing from an insider firm—a long-standing presence in the mid-Ohio Valley economy and culture. In Maine, among scientists, policy-makers, and professional activists like, much pride was taken in building successful, multi-sector legislative coalitions despite, but also because of, the steady stream of corporate lobbyists flying in from out-of-state or overseas to oppose their policy initiatives.

As Gille and O’Riain (2002) note, when following people and materials across places, researchers often make connections along the way, including connections between outsiders and insiders. Though all research changes the field in which it takes place, there is an explicit way in which conducting this kind of field research alters the field, particularly as researchers negotiate across social sectors. In some cases, I interviewed representatives from organizations that were in conflict or at odds with other local groups. In other instances, by virtue of my approach, I was linking organizations that distanced themselves from one another.

For example, in Appalachia, because of the complex mix of pending lawsuits and research studies, organizations there worked to distance themselves from one another. One public water system affected by ground water contamination did not join the class action lawsuit; nor did they opt to partner with independent, academic research team from Pennsylvania. The independent
A research team from Pennsylvania was contacted by the class action lawyers during a period in which the researchers wanted to maintain their distance from both the lawsuit and from the company responsible for the ground water pollution. Community members that served on the scientific advisory board of a federally funded study had to draw boundaries between their work and that of local activists. Meanwhile, community activism and participation in the class action lawsuit also were at odds. Throughout, as an outsider researcher, I was navigating the boundaries different social groups established for themselves. In the pages of this dissertation, however, these groups appear together, often on the same page, despite their efforts at carving out distinct social spaces from one another. Throughout, I worried that the mere act of juxtaposing these groups somehow violated the community as a whole.

Similarly, for social movement organizations or community organizations that pursue research and public education alongside more traditional forms of social movement strategies, as I learned from supplemental observations outside my three cases, staffers work hard to distinguish these as separate tracks of their work. To those inside the organization, science and advocacy function as dual strategy to shift policy, for example. At the same time, however, to maintain organizational credibility, organizations feel pressure to present these tasks as explicitly discrete projects. Maintaining their credibility as conducting legitimate science rests on the organization’s ability to distance science from politics and to use science in ways that seem appropriate to those outsiders who judge its merits, e.g., policy-makers and other scientists. Thus, SMOs and community groups may work to separate research projects from advocacy or public campaigns, yet by virtue of writing about them in the same chapter, and by virtue of arguing that all science, at some level, is imbued with values and norms, I have commingled them in ways the organizations may have never intended.
Chapter 5

BODY BURDEN AT THE FENCELINE:
FLUORINATED-COMPOUNDS IN THE MID-OHIO VALLEY

INTRODUCTION

Routes 7 and 52, locally known as the “four-lane,” lead toward the eastern edge of Ohio, where rolling hills dip into the Ohio River, before rising again in West Virginia. As I travel, the road meanders through Athens then Washington counties, crossing in several places, likewise the winding Hocking River. I am headed to where the Hocking flows into the Ohio at Little Hocking, an unincorporated community of several thousand that sits directly across the Ohio River from DuPont’s Washington Works West Virginia plant. Little Hocking, like neighboring communities in both Ohio and West Virginia, has become the epicenter of a scientific and regulatory inquiry. Though manufactured for over fifty years, PFOA has been an otherwise unknown substance used in the production of apparel, food packaging, and cookware, that repels stains, grease, even water. As more became known about PFOA exposures in the Mid-Ohio Valley, in January of 2006, the United States EPA negotiated a voluntary phase-out with the eight global manufactures of PFOA. These firms, including DuPont, have agreed to reduce emissions and product content of PFOA by 95% by 2010 (US EPA 2006).

PFOA is an intermediary used in the production of Teflon and has become the focal point of attention in the mid-Ohio Valley. The discovery of PFOA in this region has sparked investigations in fenceline communities across the United States and abroad. Widespread PFOA contamination can be found across the mid-region of the United States, stretching along the Mississippi River from Minnesota to Mississippi, eastward into the Appalachians and North Carolina, northward as far as Connecticut. Moreover, federal biomonitoring of US exposures (US CDC 2007b), as well as pilot biomonitoring projects conducted in regions remote from production, such as Maine (The Alliance for a Clean and Healthy Maine 2007) found that PFOA has migrated into people living far from its centers of production.
Figure 5-1. Map of the Mid-Ohio Valley, which spans either side of the Ohio River. DuPont’s Washington Works plant sits on the eastern bank of the river in West Virginia. Communities affected by PFOA contamination are located both upriver and downstream from the plant. Source: Appalachia Regional Commission.

The region in which DuPont is located includes communities on both sides of the Ohio River—Washington, Meigs, and Athens Counties (Ohio) to the east and Wood, Mason, and Jackson Counties (West Virginia) to the west (see Figure 5-1). These communities are ranked among the most polluted in the United States, based on the annual release of chemicals that are mandated to be reported on the EPA’s Toxics Release Inventory. The Mid-Ohio Valley, much like the whole of mid-Appalachia, is a unique juxtaposition of sprawling production sites nestled along jagged mountainscapes and meandering river valleys. Such a portrait in contrasts makes this “chemical valley” somewhat unexpected in its appearance, much as it was in 1943 during the region’s heyday, when Bertram Fowler published a similar account in the Saturday Evening Post:
if you should go to the magic valley, be prepared for a surprise. Do not expect to see a smoke-shrouded industrial slot in the hills. For in outward appearance the valley has changed little since the days of Daniel Boone. The same almost impenetrable shroud of green covers the hills. The trees arch down and almost touch the laboratory windows with their branches. The valley is still one of America's beauty spots. (Fowler 1943: 70).

However, though much can obscure the plants—and their consequences—from view, the widespread “discovery” of PFOA in the region’s water supplies has cast the two realities of the mid-Ohio Valley River into even sharper relief, which has prompted artists and ethnographers alike to highlight the region’s dual identities—a verdant landscape and sputtering plants. At a 2006 art exhibit at Ohio University in nearby Athens, installation artist and art faculty, Ann Stoddard, played on contrasts, setting home grown foods next to the end products of perfluorinated applications: greens beside non-stick cookware, and radishes next to aerosolized cans of Scotchguard (Stoddard 2006). In a similar manner, University of Pennsylvania ethnographer, Mary Hufford, along with Lynthis Eiler, are developing a documentary film that plays on the co-existence of agrarian history and culture with the trappings and infrastructure of the chemical age, a project they’ve aptly titled, “The Plough and The Polymer” (Hufford 2007a).

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At dawn, the fog hangs low over the Ohio River. From where I stand on the Ohio side, there is only water, then shoreline, hardwoods then sky (see Figure 5-2). The mist transports early-risers to the river valley before 1948, when DuPont arrived—a time before World War II chemistry supplied American households with coated consumer goods, made pancakes slide from the skillet and raindrops bead on breathable fabrics. Then, a plant’s siren slices the fog. Across the river, under a veil of mist, something has happened. “They’ll sound the all-clear soon,” I’m told, “just after they play the melody from “A Close Encounter.” I wait, frozen, for the sound that never came. Around me, residents, who report growing accustomed to such interruptions, return to the
task at hand. As the fog lifts, DuPont’s Washington Works plant, and its neighbor, GE Advanced Plastics, emerge: a hazy shadow that sharpens like a photograph in darkroom chemicals. Combined, their stacks interrupt the horizon with blinking lights and trails of partial secrets, denuded forests of aging iron and steel, rimmed by the hardwoods of central Appalachia.

**Figure 5-2.** Early morning fog obscures view of DuPont’s Washington Works plant from across the Ohio River. Photo: Rebecca Gasior Altman.

DuPont’s Washington Works plant sits on a tract of land surveyed by George Washington in 1772. Construction of the Washington Works facility, named for Washington himself, began in 1945, opened for business in 1948, and commenced fluoropolymer production three years later. Today, the plant’s seven divisions span nearly a thousand acres stretched along river front property. According to the plant’s website, the facility, which employs some 2,200 workers, churns out performance plastics and surface coatings, primarily for the automotive industry: seat belt releases, fuse box covers, shatter-proof glass, radiator parts, and materials for automotive interiors and car seats.21 Though DuPont owns production facilities in over seventy countries, its Washington Works plant is its second largest operation in the world and its largest Teflon Division. According to internal documents furbished to both the West Virginia Department of

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Environmental Protection and the U.S. Environmental Protection Agency, DuPont routinely released spent PFOA into the air, the Ohio River, or stored PFOA-laced wastes in landfills or injection wells throughout West Virginia and Ohio.  

**Figure 5-3.** Well fields maintained by the Little Hocking Water Association (Ohio). Ohio River and DuPont’s Washington Works plant in the background. Photo: Rebecca Gasior Altman.

Across the Ohio River from the DuPont Washington Works plant sits the well fields for the Little Hocking Water Association (see Figure 5-3), a non-profit rural water association first formed some twenty years after DuPont set up its fluoropolymer and telomer division. Water sampled from these wells has the highest levels of PFOA recorded in any public drinking water supply to date. The well fields are a non-descript parcel of fenced land, mostly flat, save for the rise of the well pumps and the small sheds that sit atop them. Since its founding, the Little Hocking Water Association grew to service some 12,000 people in western Washington County and portions of eastern Athens County, with increasing demand to extend service and augment infrastructure. Internal DuPont memos publicly available through the EPA docket suggest that

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22 See EPA docket AR-226. In 2000, EPA created a public docket for information regarding PFOA and related flourinated chemicals, all contained within the file “Administrative Record AR-226.”
DuPont had been tracking PFOA levels in this water supply beginning in 1984, though consumers were not informed of the presence of PFOA until nearly twenty years later, when in 2002, the West Virginia Department of Environmental Protection found PFOA in all of Little Hocking’s production wells (Griffin 2003b). All told, the Little Hocking service area, like others in the region, had been exposed for some fifty years before those exposures were revealed to the public. Even as DuPont drastically reduced emissions from the plant, subsequent tests suggested that in 2003, levels of PFOA in the production wells continued to rise since the first measurements were taken in 2002 (Griffin 2005).

To date, at least a half dozen water systems both up and down-river from the Washington Works plant, in both Ohio and West Virginia, are implicated. DuPont, per order of the U.S. EPA, continues to test water systems in an ever-expanding radius from the plant (US EPA 2005a) and over 70,000 Mid-Ohio Valley residents have had their blood tested for the substance. Meanwhile, the US Centers for Disease Control has detected PFOA in the blood of most Americans (US CDC 2007b), albeit at significantly lower levels than found in samples drawn from Little Hocking residents and others in the Mid-Ohio Valley.

Driving northward, away from the Little Hocking well fields, DuPont and GE fold into the river bend. Secondary roads bypass the tangled pipes and flares of Kraton Polymers and Nova Chemicals. I’m headed to Belpre Civitan Park, where on a warm May weekend, residents gather for the annual “Relay-For-Life,” an all-night fundraiser for the American Cancer Society. At the relay, walkers representing each team lap make-shift encampments of slumbering team-mates, through walkways lined by cancer memorials—light-sticks in water-filled plastic cups, and printed labels that honor the dead in bleeding ink (see Figure 5-4). Wilted roses and chalk-scrawled messages break the regular spacing of memorials, transforming the plastic into repositories of memory and grief. Just beyond the walkway, American Cancer Society placards urge walkers to quit smoking and eat fruits and vegetables, while school-children’s signs, braced against picnic tables, remind wearied walkers that “cancer never takes a siesta.” I am invited to
take a lap, and I do, just as the incongruously titled, uptempo “Don’t Forget Me When I’m Gone”
flows through the loudspeakers. I walk during the fundraiser’s sixteenth hour. It is morning, the
next morning. As I pass, families sip coffee and snap pictures. Balloons, though deflated, catch
the breeze. Children play fair games and attempt to scale the rocking climbing wall. Walkers
step briskly; they had made it through the night and the new day brought much to be celebrated.

Figure 5-4. Memorials line the course at the Relay For Life American Cancer Society fundraiser,
Belpre, Ohio (May 2007). Photos: Rebecca Gasior Altman

PFOA exposures may be implicated in the types of human cancers for which these community
members walked, though this has neither been confirmed nor fully investigated. Just two years
earlier, the U.S. EPA’s Scientific Advisory Panel (2005b) characterized PFOA, also found in the
drinking water of Belpre’s residents, as a “likely carcinogen.” There is much scientists do not yet
understand about how PFOA may trigger cancer, as well as what role it may play in other health
outcomes, particularly in human reproduction and neurological development.

As I join the walkers, I am struck by the sheer numbers of memorials here. I mouth the names
on the memorials. I attempt to keep pace with the walkers around me, but there are more
memorials than I can read in a single stride. I slow to see entire families memorialized, to take in
the scene. Yet, nowhere—not from any vantage point in the park—could I see DuPont or GE or Kraton or Nova. Nowhere was there any sign that the people gathered were there to link cancer to the contamination. How easily these plants slip from view, hide in the fog. On this day, like many others, the plants are only visible in the proud tales of gainful employment within their gates, or in just one woman’s whispered and caveat-filled illness narratives about life in “crud valley.”

The communities of the mid-Ohio Valley, though they have launched a national investigation into PFOA, speak uneasily about it, if at all. On this day, as they do once yearly, they walk laps to commemorate those lost to cancer and in hope that cancer research will prevent others from following suit. It is unclear to me, however, whether residents link cancer rates to PFOA exposures, though I am told people suspect such a relationship. I also am told that talk about cancer in these communities is a stand-in, or code word, for expressing concerns about area pollution, an easier, less controversial subject than publicly raising concerns about the questionable practices of the plants who employ thousands in the region (Hufford 2007b).

I went to the Mid-Ohio Valley to understand the meaning of biomonitoring and human blood concentrations when the exposure source—the polluter—is at its most proximal, a fixture of the community landscape and the regional economy. I wanted to understand the significance of biomonitoring and the meaning of human body burden when industry and communities share a fenceline, when the source of the pollutant is both identifiable and obvious.

I begin by characterizing the political and economic landscape of the Mid-Ohio Valley as one of the country’s main, though often unknown, chemical and plastics producing regions. I highlight how many multi-national firms have served as economic, political, even cultural moorings in this region since the early decades of the twentieth century, which in turn, has defined contemporary social relations between communities and companies. These two points—that the Mid-Ohio Valley is a chemical corridor and what Ottinger (2005) has called an “occupational community”—set the stage in which to understand public responses to the
discovery that PFOA was in the water, and later, in their blood. I also describe how PFOA was discovered, and the different avenues through which the public sought to understand and address the contamination. I first recount how the courts and regulatory agencies were two avenues of public process that economically marginalized groups have historically used to address grievances about environmental problems (Gaventa 1980).

Here, I highlight the implications to community understanding and social relations that follow when these are two of the primary institutions through which already marginalized communities can understand and address their concerns. Next, I consider how the initial appeal to the regulatory and legal systems, and the biomonitoring that did or did not follow from these appeals, set the agenda for struggle; what questions came up for debate; and the rules of the game for later conduct, interpretation, and acting on the myriad of blood tests for PFOA that have taken place. In other words, these institutions shaped the contours of the issue, what questions were considered, and who was given the de facto authority to weigh in on it, even when some communities—through independent labs or community-based research projects with researchers from outside the region—participated in data gathering and blood analyses of their own.

This chapter points to how sites of production—particularly when they are sites where new environmental problems are “discovered”—contribute much to our collective understanding of environmental health problems. Were it not for the Mid-Ohio Valley, science and regulatory agencies would know far less about this chemical, which has since been found almost everywhere scientists look for it. Lawsuits, and in particular, lawyers committed to getting information out of industry file cabinets and into the public arena, have played an instrumental role in airing the industry’s substantial knowledge about this chemical. Lawsuits were instrumental, too, in generating new knowledge about PFOA, by generating funds from industry that supported biomonitoring and health studies. Yet, the other main theme conveyed by this chapter is that, even when sites of production contribute so much to public understanding of chemical
contamination, and lead to national advocacy and regulatory action, the primacy of the situation faced by these communities is too easily forgotten.

**POLITICAL-ECONOMIC CONTEXT: CHEMICAL VALLEY**

The Ohio River Basin, which includes the Ohio and Kanawha River valleys of Ohio and West Virginia, are rimmed with roughly several hundred plastics and chemical plants (Army Corps of Engineers 2005). Yet, even though these industries have a significant presence in the region, the chemical valleys of Appalachia are far less written about than its coalfields and effaced mountaintops, and are lesser known than the dense cluster of similar industrial facilities along the New Jersey Turnpike or the strip of Louisiana between Baton Rouge and New Orleans, known as “cancer alley.” Chemical feedstock production, and later the manufacture of consumer goods reliant on synthetic chemicals, have had a major presence in this region since World War I. Most of the major chemical manufacturers—including Dow, DuPont, and Union Carbide—set up operations in the Kanawha and Ohio River Valleys. The region, in its heyday, was essential to the U.S. economy and war efforts during both World Wars, not just for its coal, but also for the chemical feedstock, munitions, and later plastics and other synthetic materials, like synthetic rubber.

Development of chemical plants did not expand until the early 20th century, as the First World War changed US access to chemical feedstocks and dyes from abroad. As a result, the US needed to acquire these chemicals through other means and to increase output of supplies for the war. In response, the federal government backed two plants in West Virginia—one in Nitro for high-explosives, the other at Belle for mustard gas. These investments spurred other planned development in the post-war years. Union Carbide built the first petrochemical plant at Clendenin, West Virginia in 1920, which included the first commercial plant to produce ethylene, a wellspring for the synthetic and plastics-driven consumer economy.

Plants were located in the “Kingdom of Coal” to take advantage of two resources: the ample energy supply, as well as the vast riverways and rail lines already developed to move coal.
Moreover, the Kanahwa and Ohio River valleys contained all the necessary raw materials for chemical production. Coal, brine, and rock salt were in abundant supply and became the basis for a mass migration of chemists and manufacturing infrastructure to make chlorine, caustic acid, carbon, and other building blocks of plastics and synthetic materials, such as bromine, magnesium, sodium, barium, and ammonium. Initially, manufacturers produced only these feedstocks; however, over time, firms began using feedstocks to produce plastics, synthetic rubbers, textiles, automotive components, and polymers (Maddex 2003; Rice 1993).

**An Occupational Community**

Mid-Appalachia was an agrarian economy in the years before the timber and coal booms. Private and public capital flooded into the region to develop its natural resources: first salt, then timber, then coal, followed by oil and gas, and then returned to salt and limestone for their value in chemical feedstock production. As bountiful as Appalachia was, its inhabitants, from the industrial revolution forward, rarely reaped the rewards of its harvest. The history of Appalachian economic development is intertwined with a history of exploitation, first of the Native American tribes pushed from the land, then by the influx of industrialist capital that stripped the land of its minerals. Kai Erikson, in *Everything in Its Path* (1976) wrote extensively about exploitation in the context of coal mine development in southern West Virginia. Similar themes echo throughout John Gaventa’s *Power and Powerlessness* (1980) and in Eric Reese’s more recent exposition of mountain top coal removal, *Lost Mountain* (2006).

These facilities sparked the growth of new towns in the Ohio and Kanahwa River valleys and changed the character of towns that predated them. To this day, manufacturing supplies a significant number of jobs for the communities along these river valleys, and has historically served as one of the few steady sources of employment in an otherwise volatile economy, offering among the best wages in the region. Nestled along the West Virginia side of the river sit some of the more affluent homes in the mid-Ohio Valley, housing the managerial class. Plants
contribute a substantial portion of the tax base as well and typically are substantial benefactors for community projects. DuPont funds chemistry labs in area schools and maintains manicured soccer fields along the Ohio River, where schoolchildren play in the shadow of GE Advanced Plastics and DuPont’s Washington Works. Serving as more than just economic contributors, these companies are woven into community culture. Town and street names reflect area industries, or the products they produce. DuPont Circle. Nitro, West Virginia.

Many individuals within the communities along the Ohio River appear strongly allied to DuPont and other manufacturers in the area, a loyalty that led some community members to support DuPont ardently despite widespread public concern about the PFOA contamination. One resident relayed the following account of a co-worker, who was noted for having said: “DuPont wouldn’t hurt us. My husband’s worked there for years. I’d shoot whatever it is they’ve got over there directly into my veins (paraphrased).” Another resident made the following observation, which reflects comments made by others in the community. “Some people didn’t even want to be tested because they felt it would be disloyal to DuPont” (Fuquay 2006). The chief concern was that the issue would push DuPont to leave the area.

Maintaining polymer production in the region is a top priority, particularly for community business interests. Civic, political, and economic leaders actively recruit new industry to the region, hoping to maintain the mid-Ohio Valley’s reputation as one global base for polymer production. This relationship, in turn, has translated into a historically lax relationship between state regulators and area industries (Lyons 2007a). West Virginia welcomes drivers with the road-side billboard: “West Virginia: open for business.” Once inside West Virginia’s boundaries, spaced evenly on the roadsides throughout the mid-Ohio River Valley are the cobalt signs denoting the state’s “Polymer Alliance Zone.” When the EPA began hearings on its enforceable consent agreements to work toward voluntary phase-out of PFOA production and use (US EPA 2006a), local business and financial elites were listed among interested parties in the negotiations,
including the Chamber of Commerce of the Mid-Ohio Valley, the Parkersburg-Wood County Area Development Corporation, and the United Bank of West Virginia (Fuquay 2006).

As a result of public controversy around PFOA contamination, business elites and workers express concern about accelerating the rate of plant closings. DuPont has relocated PFOA production to Fayetteville, North Carolina, and has just completed construction of a new Teflon division in Changshu City, China (DuPont 2008a). While this division may relocate from West Virginia, the Washington Works plant makes other products and the plant is expected to stay open. However, the Mid-Ohio Valley already has survived several major plant closings. In the Mid-Ohio Valley, both production and employment levels peaked in the 1950s and have slowly dwindled over subsequent decades (Lyons 2007a). Though “magic valley” mushroomed into a major industrial hub in a very short time, it appears that the slow trickle of production overseas will soon give way to a widespread torrent. In 2003, Dow closed its plant in the Kanawha Valley. Prior to that, Dow had already cut production of specialty ketones due to poor market conditions and declining revenue (New York Times 2004). Other plants in the region have closed as well (Dunlap and Mancini 2007). These closings reflect a broader trend in which US petrochemical production is shifting to facilities overseas, including China, India, and the Middle East (Innovest Strategic Value Advisors 2007).

PFOA: Chemical Profile

In 2006, news reporters branded PFOA as the “next big thing,” the leader among a fast growing list of “emerging contaminants” (Calmai 2006). However, such a moniker does not acknowledge that PFOA and perfluorinated compounds (PFCs) have been in use since the 1950s. Teflon, of which PFOA is used as an intermediate in its production, was an accidental discovery in the 1940s, by an Ohio-trained DuPont scientist who was trying to develop new refrigerants for the company. As was DuPont’s custom, the scientists then tested these compounds’ properties to discern an exhaustive list of possible industrial and commercial applications. These long strands
of carbon-fluoride bonds—some of the strongest bonds in organic chemistry—proved indispensable. The same physical properties that made them so durable, also made them indestructible and highly persistent in environmental and biological media. By the time the U.S. Congress passed the Toxic Substances Control Act in 1976, PFOA and PFCs had been in widespread use for nearly two-decades. PFOA and some 60,000 other substances were awarded blanket approval for a wide variety of uses—all based on the underlying assumption that the compound was biologically inactive (Lau et al. 2007).

PFOA’s ubiquitous application cannot be understated. According to the wealth of information about the chemical on the EPA docket, PFCs, of which PFOA is one member, are used in paper coatings and as performance chemicals in industrial, commercial, and consumer applications (see Public Docket AR-226). More specifically, PFOA serves as a processing aid, or “intermediate,” in the application of surface coatings. In other words, PFOA serves to bind the otherwise antagonistic constituents that comprise surface coatings. These coatings impart oil, water, soil and stain resistance to a range of finished products, including the following, which account for the largest volume uses of the chemical: high performance lubricants; personal care products; architectural fabrics; films; cookware, breathable membranes for apparel; protective industrial coatings; wire and cable insulation; semiconductor chip manufacturing equipment; pump seals, liners and packing; medical tubing; aerospace devices; automotive hoses and tubing; and, a wide variety of electronic products.23 Even more, as Oakland Tribune reporter, Doug Fischer aptly noted, products created using PFOA “withstand the punishing and exacting environments modern industry can throw at them: pipe liners at oil refineries and semiconductor manufacturing plants, high-temperature car engines, surgical devices, even space suits” (2006b).

Though workers at the West Virginia facility use PFOA, it is not manufactured there. Prior to 2000, 3M was the largest US importer and manufacturer of PFOA due to the potential for increased regulatory oversight and because of evidence that it persists and bioaccumulates. After 3M phased out production and use of all PFCs, including PFOS and PFOA, DuPont designated its Fayetteville Works plant in North Carolina as the sole U.S. manufacturing site for the powdery substance.

Users of PFOA extend the production chain from industrial applications to use by consumers and commercial industries, such as furniture makers. Use data, because protected as confidential business information and because many end users are not aware of the chemical constituents or residues their productions contain, has only filtered slowly to the public. When DuPont and the seven global producers entered into an Enforceable Consent Agreement with the U.S. EPA to phase out its use of PFOA by 2015, research and development efforts to create a replacement for PFOA’s long list of uses increased exponentially (US EPA 2006a). Devising a substitute for PFOA’s varied uses has eluded DuPont scientists, DuPont has redoubled their research and design efforts, as have efforts by smaller firms hoping to take advantage of the openings in this multi- billion dollar market (Montgomery 2007).

PFOA is not intended to be incorporated into the final structure of polymer products, an important point because it could exempt PFOA from certain regulatory provisions that would otherwise govern similar polymers (EPA 2006b). However, there is much left to be understood about PFOA’s unintended presence in the blood of 90% of Americans (US CDC 2007b), and whether breakdown or residues from finished products is a source of human exposure.

Molecules of PFOA are constantly on the move. The handful of global producers ship PFOA, a white powder, through vast distribution networks for use in a dizzying, still-to-be-fully-cataloged array of consumer and industrial applications. PFOA then migrates from production facilities as coatings or residues on finished goods, as industrial or commercial users further disperse it by carrying it across state lines for disposal. Even without the aid of human transport,
PFOA is a global traveler. Once scientists began searching for PFOA in environmental and biological samples, they found it everywhere they looked, on every continent, in species from Arctic polar bears to birds on Pacific atolls (see summation in Betts 2007).

Early studies based on a handful of retirees who handled the chemical suggest that, on average, as many as four years must pass before half the body's store will decrease, many years more before the body is rid of it entirely (see Emmet et al. 2006). Yet, even as PFOA is detected in human blood serum, scientists who are independent from industry have just begun to document how it acts on the body and with what consequences. Equivocal evidence suggests different mechanisms of action in animals than humans, making it difficult for scientists to extrapolate anticipated human effects using assumptions typical to environmental health science. Moreover, epidemiologic evidence from the Mid-Ohio Valley paint a different, though still inchoate picture of PFOA’s effects on liver, renal, and thyroid function. Scientists claim more research is needed on whether and how PFOA triggers cancer, and particularly interferes with human reproduction and development (Kennedy et al. 2003; Emmett et al. 2006b).

**DISCOVERY OF PFOA IN THE MID-OHIO VALLEY: CATTLE-WASTING LAWSUIT REVEALED EXTENT OF CHRONIC HUMAN EXPOSURE**

DuPont began monitoring PFOA in community drinking water perhaps as early as 1984, though the company kept this knowledge from the public (Lyons 2007a). The extent of PFOA contamination, however, did not become public until an Ohio lawyer, Robert Bilott, provided EPA with internal DuPont memos furbished through a relatively unknown lawsuit brought against DuPont by a West Virginian cattle farmer. These memos documented just how much DuPont knew about the presence of PFOA in the region’s drinking water and in the blood of DuPont workers. Had it not been for this lawsuit, or Bilott’s populist leanings, perhaps the community might not have found out about PFOA in the water until much later.
In the 1980s, the Tennant family of West Virginia, cattle farmers for several generations, sold DuPont a parcel of land adjacent to their grazing pastures. It was not until much later that the Tennants realized DuPont used the property as a landfill for PFOA-laced waste. After selling to DuPont, several hundred of the Tennant’s cattle, which grazed on land neighboring the DuPont’s Dry Run Landfill, began dying from a curious wasting disease (Lyons 2007a). It was during the Tennant trial, which began in 1999, that the full extent of DuPont’s knowledge about PFOA exposures became public.

Though the details of the case were sealed when the Tennants settled with DuPont out of court, the trial nevertheless produced hundreds of pages of internal DuPont memos from the 1970s and 1980s that outlined industry research about the substance, including documentation of DuPont’s measurement of PFOA in workers’ bodies, cross-placenta transfer to the fetus of pregnant workers, and birth outcomes of plant workers similar to negative birth outcomes found in animal studies. Most importantly, the memos gave the first indication to the public that PFOA could enter the blood stream, since they documented the presence of PFOA in the blood of workers who handled the material.24 DuPont and 3M, who manufactured PFOA until 2000, historically had monitored workers’ blood for the presence of perfluorinated compounds. Internal documents also revealed that DuPont scientists had considered whether community residents might have levels similar to workers, given that DuPont had also been tracking the levels in community water supplies starting in the 1980s.

Robert Bilott, the trial lawyer, submitted these documents to the attention of the EPA (Bilott 2002), which publicly posted the internal company memos on its public docket. Using the information that these documents revealed, Environmental Working Group pressured EPA to

24 During the early 1980s, DuPont detected PFOA in the cord blood of female workers who had given birth while working at the Washington Works plant, a finding that revealed to DuPont that PFOA could cross the placenta. Furthermore, two of seven children born to female Washington Works plant workers between 1979 and 1981 had birth defects. Memos also detail how The Washington Works facility temporarily reassigned female workers to other areas of the production facility where PFOA was not directly handled. (Memos available through the EPA docket for PFOA or on Environmental Working Group’s Chemical Industry Archives.)
launch an investigation into DuPont. In withholding information about workers’ chemical burdens and evidence of cross-placental transfer of the chemical, DuPont had violated section eight of the Toxic Substances Control Act. Following EPA investigation, DuPont was issued one of the largest punitive fines in the history of the EPA—$16.5 million—though arguably a sum far smaller than the situation likely merited. EPA held DuPont accountable for multiple failures to report evidence that PFOA could bear significant implications for human health and the environment.

The Tennant lawsuit and its discovery documents also prompted the West Virginia Department of Environmental Protection to begin testing area water systems. Thus, as a result of the Tennant trial, the public came to understand the extent of the contamination, while also learning that DuPont had known about the contamination for perhaps as long as two decades. Yet, though it was clear that PFOA was in the water, the full implications of the contamination were not understood. Little about PFOA was known at the time of discovery. As will be reported in the next section, in the absence of information, various parties within the Mid-Ohio Valley appealed to regulators, lawyers, private laboratories, and doctors to help them understand the extent of community exposure and its potential implications. Meanwhile, water associations like Little Hocking, issued cautionary statements alerting customers that “they utilize and drink our water at their own risk” (Griffin 2005).

Soon after public discovery of PFOA in drinking water, with assistance from Bilott, thousands of residents from both sides of the Ohio River joined in a class action lawsuit against DuPont.

**ADDRESSING TOXIC TRESPASS THROUGH THE COURTS**

When residents of the mid-Ohio Valley received notification of PFOA contamination in their drinking water, there were few sources of public information about the potential health implications of chronic exposure to the chemical. Newspaper accounts during this period point to residents calling local environmental and public health agencies, which in turn, offered no
guidance on or information about this unknown contaminant (Conrad 2006). One of the few experts on PFOA was Robert Bilott, the trial attorney for the Tennant family who helped bring the issue of widespread PFOA contamination to public light.

In 2001, Bilott, along with lawyers from two other West Virginian law firm, brought a class action lawsuit against DuPont (State of West Virginia Ex Rel E.I. DuPont de Nemours and Company versus The Honorable George W. Hill, Jr., Judge of the Circuit Court of Wood County, West Virginia; and Jack W. Leach et al. 2003). The suit, in part, sought medical monitoring relief for the class, which would have included funds for biomonitoring. They also sought compensatory and punitive damages as well as abatement on the grounds of trespass, battery, nuisance, negligence, fraud and violation of the West Virginia Consumer Protection Act.

During the trial, the courtroom became a significant arena for debates about the utility and meaning of chemicals in the blood of workers and residents. On three different occasions, the court system ruled on who should be responsible for paying to test the blood of class members for PFOA. Initially, plaintiffs requested assistance to fund an analysis of PFOA in the plaintiffs’ blood. However, DuPont countered this demand, taking the issue to the West Virginia Supreme Court of Appeals which agreed that it was the plaintiffs’ responsibility, and not DuPont’s, to gather and fund biomonitoring for the class. To support the Opinion, the Court cited the case of Carter v. Monsanto Co (West Virginia 2002), where a West Virginia court found that the company was not responsible for paying plaintiffs’ costs of demonstrating dioxin land contamination. Similarly, in this case, the court also required plaintiffs to fund the exorbitant cost of doing discovery to show contamination of people as well.

However, not all of the Supreme Court of Appeals judges agreed with this opinion, raising the issue that to analyze the plaintiffs’ blood would requiring paying DuPont (the defendant) to do so, because DuPont owned one of the few labs in the country capable of conducting blood analyses for PFOA. DuPont was asked by the courts to cooperate with the plaintiffs to ensure that testing be offered at a “fair and reasonable price.”
Later still, the issue came up again. Wood County Court Judge George W. Hill, who presided over the case, ordered DuPont to fund biomonitoring of the entire class. DuPont appealed this decision to the West Virginia Supreme Court on the grounds that not only would the tests be costly, given the size of the class, which had grown to 50,000 people, but also that the tests would prompt “undue anxiety” among both class members and the community at large. In December 2003, DuPont won their appeal in a 4-1 decision. The West Virginia Supreme Court deemed the blood tests “unnecessary” (Clapp et al 2006).

 Though the plaintiffs’ lawyers were unable to secure funds for biomonitoring during the trial, they were able to fund a health survey and biomonitoring project through the unique settlement reached between the plaintiffs and DuPont in 2004.

**Science-Based Resolution?**

DuPont and the plaintiffs agreed upon a settlement that involved three components. First, DuPont would build and maintain filtration units capable of filtering PFOA out of municipal drinking water systems in all six of the affected water systems, as well as in some private wells in the region.

Second, the settlement also required DuPont to fund three court-appointed scientists—later termed, the “Science Panel”—to gather available toxicological, occupational, and epidemiological evidence on PFOA, and to conduct whatever other studies they deemed necessary, in order to determine whether PFOA is linked to human disease. Both parties agreed upon the appointment of three scientists to the Panel: Tony Fletcher of the London School of Hygiene, David Savitz from the Mt. Sinai School of Medicine, and Kyle Streenland, a professor at Emory University’s School of Public Health. Fletcher, Savitz, and Streenland proposed a series of ten studies, which they deemed would provide enough evidence to fulfill their charge of making a determination as to whether there is a “probable link” between PFAO exposure and human disease. The proposed studies will look at the association between exposure and such
outcomes as cancer, heart disease, stroke, diabetes, immune function, liver and hormone disorders, and birth outcomes. In addition, a sample of residents from two water service districts have been asked to give blood samples over an four year period to examine the half-life of PFOA in the human body. The panel believes it will take until 2011 to complete its findings. According to a press release issued from the panel (Science Panel 2006), the planned research, when completed, will be “the most comprehensive study of PFOA and human health ever done.”

If the scientists determine a “probable” link between PFOA exposure and negative human health outcome, DuPont will be required to provide further health monitoring for the class and class members will be free to pursue further legal action. If no link is found, class members cannot pursue further legal recourse. The ultimate resolution of the case rides on what the Panel finds.

Third, DuPont reached a monetary settlement with the class, which the lawyers and lead plaintiffs decided to put toward funding a health survey and regional biomonitoring project, rather than distribute money among class members. The intended project, later called the “C8 Health Project” was unparalled in scope, with the plan to collect health and blood data from nearly 60,000 individuals from across some of the most remote regions of the Mid-Ohio Valley. The Health Project was not required by the settlement, but resulted from a decision made afterwards based on the hope that the study would set “a standard for settlement reform” (Lyons 2007a: 88). If participants in the health survey consented, their data would then be turned over to the Science Panel as part of their broader scientific deliberations.

This mutually agreed upon “scientific solution to litigation,” as it was called by trial lawyer, Harry Dietzler, was exceptional among trial outcomes (Terry 2006). Had the settlement only yielded one of the science projects, either the health survey or the appointed Science Panel, it still would have been a unique resolution to a toxic tort case of this size. That the settlement produced funding for two science projects was especially noteworthy. As one of the trial lawyers

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25 C8 is another name for PFOA and one in which was more commonly used among those in the Mid-Ohio Valley.
summarized, “(with) the Science Panel, we achieved a scientific solution to the litigation as opposed to submitting it to jurors in a manner where they… they determine the answer on their own—regardless of whether any scientist disagrees or not.” (see public documents from Leach et al. v. DuPont 2005). This meant that public drinking water could be filtered faster, and not delayed by a lengthy appeals process. The settlement arrangement was hailed as a scientific rather than financial resolution. So novel was the settlement arrangement that the plaintiffs’ attorneys were honored as the 2005 Trial Attorney’s of the Year by Trial Lawyers for Public Justice (Trial Lawyers for Public Justice 2005). Furthermore, the lawyers were congratulated for producing an outcome that would have public benefits not just for the people of the Mid-Ohio Valley, but also for the public at large, scientists, and regulators who could benefit from the knowledge learned from the health survey and research projects that came directly from the settlement arrangement. The Mid-Ohio Valley was, for the purposes of scientific investigation, an ideal place to study the implications of an understudied class of chemicals. The degree to which these suits, and the lawyers that filed them, contributed information to the public cannot be understated.

Yet, the lawsuit established rules for the conduct and interpretation of monitoring. For example, it separated blood sampling and analysis from its interpretation. It placed interpretation of biomonitoring data into the hands of an expert panel, and set the timeline for that panel to arrive at a reasonable determination of what exposures mean for human health. At the same time, it implied that community members did not have the authority to interpret the results before the PFOA Science Panel reaches their verdict, thus leading one community analyst to suggest that the community “waits for the numbers to mean something.”

A Flurry of Biomonitoring, Gallons of Blood: The Brookmar “Health Project”

To implement the biomonitoring health study, the plaintiffs contracted with two prominent members of the Parkersburg medical community who had founded an independent medical
consulting firm, Brookmar, Inc., for the express purposes of carrying out the unprecedented study. Dr. Paul Brooks, a family physician and former executive with a statewide health maintenance organization, left his retirement to found Brookmar, Inc., with a former health care administrator and chief executive officer of a Parkersburg hospital, Art Maher. From the outset, Brookmar, Inc., had ambitious plans to collect health and blood samples from 60,000 residents living in the six water districts surrounding the Washington Works plant. They exceeded that goal, collecting data from nearly 70,000 people within the span of only eleven months and reportedly having turned away many more (Lyons 2007a).

To attract attention to the study and recruit participants, Maher and Brooks conducted town hall meetings, focus groups, and medical marketing campaigns, all designed to target people living in some of the most remote regions of the Mid-Ohio Valley. Each participant would be paid $400 for their participation, which involved a blood sample and completion of an extensive personal and occupational health survey. Blood samples were run through a battery of fifty chemical analyses, including a measurement of PFOA, as well as several other perfluorinated compounds, in addition to a full blood panel, including cholesterol, hormone levels, and other measures of blood chemistry.

Brooks and Maher drew from their extensive experience as health care administrators to manage the ambitious collection of nearly 70,000 blood samples. Brookmar distributed six mobile health units across the region, each with distinct areas for processing participants, drawing blood, and a lab for processing the samples. As noted by journalist, Callie Lyons (2007: 89), “with a total of six testing units fully staffed and working nine hours a day, Brookmar was able to test four hundred to five hundred people per day. In order to accomplish this task, the process was so streamlined that within a half an hour a participant could be through the eligibility verification, medical history interview, and blood testing, and be walking out the door with a check in hand.”
Brookmar, Inc. turned over communication of individual and aggregate results to the Department of Community Medicine and other researchers at West Virginia University. Individual results were sent by mail to participants within ten days of sample collection. Though the results came quickly, they nevertheless were difficult for participants to interpret. The concentration of PFOA in the blood serum appeared alongside cholesterol levels and other clinical blood tests, though without any comparative benchmarks to aid interpretation. As noted to me during an interview:

Well, it was several pages of blood chemistry, and lots and lots of [other] things. PFOA was just one point in that data, and there really wasn’t any type of explanatory information at all.

The only explanation of the PFOA results provided by Brookmar was the following, which appeared in a cover letter that accompanied the report:

In regard to the C8/PFOA levels, there is no interpretation as this is a number measurement only. At this time, there are no normal values as in high or low. Your physician cannot provide interpretation of these levels. However, these levels will be reviewed by the Science Panel in their review of the data to determine if there is a ‘probable’ link between C8 [PFOA] in your drinking water and human disease (Brookmar, Inc. 2005/2006).

Since no reference data was provided to participants, such as sample or population ranges, to help participants understand whether their levels were high, low, or average, the only way to understand what a blood level meant was to ask others in the community. Talk of PFOA levels pervaded the communities that participated in the regional health study. “What’s your number?” was diner counter conversation, or a common exchange at the check-out aisle in area supermarkets (Lyons 2007a). Body burden was a number that only became partially meaningful as residents began discussing their results and realizing community members “levels” were quite diverse in range. As one woman told me, “I am a thirty-six,” by which she meant, her blood concentration was 36 ppb. Another said, “I think I was in the three-hundreds, but I don’t
remember exactly.” Yet another woman, interviewed for a documentary produced by Ohio University students noted, “I was 100. My son was 200. My neighbor was a thousand…” (Averion et al. 2007).

Yet, community members, despite all the talk the numbers engendered, noted that PFOA levels appeared “meaningless.” For example, two residents offered this reflection on the experience:

It's so meaningless as far as comprehension to the masses… that number meant absolutely nothing… in any way, shape or form.

Considering I can't even remember whatever my magic number was, I'm just remembering that it seemed like it was higher than many people, and that's sort of what the conversations were about initially. People would say “Well, what did—what was your number?” And yet, I think why I didn't even bother to remember it was I couldn't figure out what it meant, and if, in fact, my […] because it was higher meant that I was more contaminated, how did that happen, and what was my recourse as a result? Because there was no straight or crooked line between the test and my actions, I just blew it off… Nobody has a frame of reference for should they be concerned or not concerned, how much is too much? And because there's no barometer on that, they went back to the other things that do have ratings and said, “Well, my good cholesterol is this,” and I remember taking it over – or, no… [my friend] came over here and I had her look at it, because I didn't even know what some of the stuff—the categories of stuff they evaluate, I don't even know what these things are.

Three years after the individual results were released, the community still waits for population results to, as the previous quote notes, help put the numbers into community perspective as a way to assess one’s level. Complete population results were expected to be released via the West Virginia University website in August 2007 (www.c8healthproject.org). However, this was delayed due to problems with standardization of analytical protocols at the lab, which may have overestimated blood PFOA levels by 25%. This problem required that nearly 20,000 samples be reanalyzed.
Several unexpected implications followed from the health survey. First, advertising designed
to recruit participants, in some instances, served as a first, and often startling, notification about
the presence of PFOA in drinking water (Lyons 2007a). For example, news of the water
contamination or class action suit, as much as these were covered by the local media, did not
reach everyone living in rural areas of Mason County, West Virginia, who pulled drinking water
from a well field located near one of DuPont’s off-site PFOA landfills, the Letart Landfill.
Second, the Health Project also brought the community together in unexpected ways. For
example, Lyons (2007a) recounts that participants congregated in public libraries, churches, or
the homes of friends and families with Internet access to fill out the online health questionnaires,
since many in people living in these communities did not have home computers.
Third, the health project provided an access point to health providers for very rural, poor
populations who otherwise did not have ready access to health care. As a result of the screenings,
doctors uncovered individuals with untreated diabetes, leukemia, and other cancers. Lastly, the
project infused the region’s economy with much needed money. Though a good portion of the
budget went to compensate for analysis of the blood samples by private laboratories out-of-state,
the project did infuse the local economy much needed money. Brookmar, Inc., hired local
residents to help administer and manage the study, and the reimbursement checks for participants
received for their involvement also provided much needed money to families living in a region
where $400 could exceed a week’s paycheck (Lyons 2007a).

Furthermore, the study had determined that PFOA was detectable in human blood, a point that
was significant when a second class action suit was filed against DuPont in 2006, this time by
residents of Parkersburg. The Parkersburg community initially had been delayed in gaining class
status due to initially “low” contamination levels. By 2006, however, the levels in Parkersburg
drinking water had risen, exceeding that level that would make residents eligible for class action
status. As a result of what was known, in general, about PFOA body burdens, the plaintiffs’
complaint specifically addressed the problem of PFOA in the bloodstream as well as public drinking water. For this, plaintiffs sought:

Declaratory relief, injunctive relief, equitable relief, compensatory and punitive damages, including medical monitoring, and costs incurred and to be incurred by plaintiffs and the other class members for bodily injury, emotional distress and property damage arising from the intentional, knowing, reckless, and negligent acts and omissions of DuPont in connection with contamination of human drinking water supplies used by plaintiffs and other class members (Rhodes et al., v. E.I. DuPont de Nemours and Company 2007).

The complaints brought against DuPont rested on several premises, including:

1) DuPont failed to notify the community of both the presence of the chemical in drinking water, and failed to note its potential for toxicity and bioaccumulation;

2) PFOA is not a naturally occurring substance, so when it is found in human blood serum and/or plasma, its presence is attributable to human activity;

3) PFOA blood concentrations, referred to in the complaint as “blood and/or bodily contamination via PFOA” functioned as an indicator, though not the sole indicator, of physical harm and the increased risk for biologic injury, and perhaps most significantly;

4) DuPont has and continues to release PFOA both under and onto plaintiffs’ property and into their bodies. Even after PFOA establishes itself on private property or in plaintiffs’ bodies, it is still DuPont’s property, and as such, is considered as unlawfully trespassing. PFOA, then, constitutes an invasion of plaintiffs’ properties and bodies without permission or authority, and may constitute battery.

Thus, as a result of the Health Project, and access to data about PFOA body burdens, the trial lawyers were able to test whether the concept “toxic trespass,” which previously has been a rhetorical device used by environmental advocates, holds legal merit. However, as will be seen across all three cases presented in this dissertation, as much as biomonitoring project yielded positive outcomes for the community—many unintended—there were also simultaneous
downsides. By providing the public with numbers devoid of any interpretive context, and by the Science Panel being granted the final authority to interpret what they mean, the issue was effectively taken out of the realm of mass politics and public debate.

UNDERSTANDING TOXIC TREPASS OUTSIDE THE COURTS: THE EXPERIENCE OF LITTLE HOCKING, OHIO

Before the first class action suit was filed, but after news broke about widespread PFOA contamination in drinking water, there were few avenues available for the public to understand whether the PFOA was harmful to human health, or for individuals and officials who managed public water systems who wanted to know the public health implications of their long-term exposure. As described in the previous section, concerned citizens turned to Robert Bilott, who because of his involvement in the Tennant suit was one of the few people in the country, besides DuPont scientists, familiar with what little science there was on PFOA. While thousands of residents joined the class in search of compensation from DuPont to cover medical monitoring and biomonitoring to better understand the implications of exposure, there were three other pathways through which citizens pursued information and redress: one was through appeals to the regulatory officials; another by privately contracting with a private lab; and a third, through a federally-funded research partnership. In this section, I outline how officials and citizens from the most heavily contaminated water system in the Mid-Ohio Valley—the Little Hocking Water Association—took other routes than the class action suit to address the problem of widespread PFOA contamination (see Figure 5-5).

Figure 5-5. Timeline of key events.

1999-2000 West Virginian cattle farmers bring suit against DuPont for death of entire herd; case settled out of court, but discovery produced thousands of documents about PFOA contamination throughout the Mid-Ohio Valley and detected in the blood of workers. Trial
lawyer submits documents to the Environmental Protection Agency public docket.

2001-2002  Discovery of PFOA in six water systems of Mid-Ohio Valley.

2001  Citizens pursue class action lawsuit (Leach et al. v DuPont).

2002  Little Hocking Water Association learns its wells have highest levels of PFOA found yet in public drinking water; attempts to find independent lab to conduct blood analysis sample of customers.

2003  Little Hocking Water Association struggles to find independent source of information about blood levels. Learns only private lab to conduct analysis is under contract with DuPont. Appeals to EPA for biomonitoring, but is ultimately turned down.

Little Hocking Water Association is approached by researchers and physicians from the University of Pennsylvania about serving as a community-based partner in an exposure and epidemiologic study of PFOA among residents that drink Little Hocking water. Little Hocking Water eventually declines partnership. University of Pennsylvania scientists go in search of other community-based organizations to partner with, ultimately working with the Decatur Community Association.

2004  University of Pennsylvania secures a community-based, environmental justice research grant from the National Institutes of Environmental Health Sciences to begin study of Little Hocking.

2005  Plaintiffs in Leach et al., class action suit settle out of court with DuPont. Following arbitration arrive at “science-based settlement.” DuPont to pay for installation of filters on regional, public drinking water systems affected by PFOA and the establishment of a 3-member Science Panel to investigate the link between exposure and human disease. Plaintiffs allocate settlement money to pay for biomonitoring and health study of the class, which is carried out by a local firm, Brookmar, Inc.

Little Hocking Water Association published blood data of its own as part of demand for bottled water from DuPont. DuPont does not extend offer for water.

University of Pennsylvania study released blood results to community; DuPont agrees to supply alternative drinking water source to those serviced by Little Hocking Water Association.

Broomkar, Inc., begins biomonitoring project; returns data to participants, on average, within ten days of receipt. By late 2006,
Brookmar, Inc., had overseen sample collection and analysis of 70,000 area residents.

2006

DuPont continues to construct filtration systems.

Science Panel carries out research projects and collection of evidence on PFOA toxicology and epidemiology.

Second class action lawsuit filed against DuPont on behalf of Parkersburg, West Virginia residents, initially excluded from first suit.

2007

DuPont completes last filtration system for the Little Hocking Water Association system. PFOA still found in the system. Little Hocking Water Association negotiates for continued bottled water delivery. Little Hocking Water Association files suit against DuPont, requesting pristine water source and infrastructure to convey it to the Little Hocking distribution system.

In Search of Independent Science

As described in the introduction to this chapter, the well fields for the Little Hocking Water Association, which services drinking water to 12,000 customers in four townships in Ohio sits directly across from DuPont’s Washington Works plant (see Figure 5-3). Little Hocking’s wells contained some of the highest levels of PFOA detected in any of the region’s water systems.

In June 2003, the general manager of Little Hocking Water Association, Bob Griffin, traveled to the EPA headquarters in Washington DC to testify before the US EPA. At the time of his testimony, the water association already had clear and convincing evidence that the Little Hocking Water Supply contained “the highest level of PFOA contamination of any public water supply in the United States, if not the world” (Griffin 2003a). Yet, the implications of human consumption of PFOA were uncertain. On behalf of the consumers of the most contaminated water supply, Little Hocking Water Association officials submitted both written and oral
testimony requesting EPA to examine blood levels in the community, noting a protracted struggle for them to obtain lab analyses independent from DuPont.

In their EPA appeal, the Little Hocking Water Association noted that their initial response to news of well contamination was to find an independent lab to test their water customers’ blood for exposure. However, the Little Hocking Water Association faced significant roadblocks in their quest to contract with a laboratory. According to Griffin’s testimony, only one lab was capable of running the desired analysis and that lab had an exclusive contract with DuPont, who kept tight control over the analytic methods they had developed. Initially, the lab refused to provide services to outsiders. Frustrated that the Association could not find a laboratory capable of, or willing, to help them assess the level of PFOA in water customers’ blood, Griffin requested that the EPA provide independent blood analyses in the interim. EPA, which at the time was concerned about PFOA levels in the general population, and was in the process of negotiating with DuPont and the other global manufacturers of PFOA to phase out production, ultimately declined to conduct the analysis as part of their broader investigation into population-wide PFOA production. In response to EPA’s position, Griffin responded:

It is my understanding that the EPA will not pursue human biomonitoring through the ECA’s [Enforced Consent Agreement] that we are discussing today. Even so, the EPA recognizes that the population living near the industrial sites have not been sampled and that these people may PFOA blood serum levels that are higher than the general population… I recommend that our community should be a targeted sampling group [in EPA’s investigation.] Not only are we exposed through the same products that the general population uses nationwide, we are also exposed through our air, soil, and water. Unfortunately, we are a ready-made study group… Because of the controversy surrounding this issue, there is a need for a study of the problem that is truly independent of industries that have a vested interested in the outcome… Therefore, we are requesting that we not be forgotten in this investigate process that the EPA is undertaking. People in our community and other communities along the Ohio River are drinking water everyday that has C-8 [PFOA] in it, without truly knowing the long-term health effects to them, or their children and grandchildren. PLEASE DO NOT
FORGET US. Please give us data and information that we can have confidence in (Griffin 2003a).

EPA, however, rejected Griffin’s request on behalf of Little Hocking Water on the grounds that it was “beyond the scope of this ECA discussion” (US EPA, 2003).

Three years later, in May 2005, Little Hocking Water eventually did have a small number of blood samples drawn from its customers (N=25) and analyzed for a suite of perfluorinated compounds, although little is known about how the association was able to get this analytical work done.26 The only information about the study released by the water association through their lawyer was that the analyses were conducted by “an independent medical group out of Columbus (Ohio)” (McIntosh 2005). According to the general manager of the water association, Robert Griffin, who was quoted by the Marietta Times, The Little Hocking Water Association conducted the study to appeal to DuPont to provide customers with an alternative source of drinking water until more is known about the implications of PFOA on human health, particularly at this level of exposure (McIntosh 2005). DuPont did not supply an alternative water source until several months later, after results were released from another blood study—a community-based study conducted with University of Pennsylvania researchers.

### Outside Researchers Seek to Address “Information Disparities” in Little Hocking

Though the Little Hocking Water Association was able to obtain blood analyses, three years passed between when Little Hocking Water learned about the contamination and they were able to make headway in getting either blood results or DuPont to provide an alternative drinking water supply. This interim period was described as one where distrust and skepticism pervaded the communities who drank water from the Little Hocking water system. There were notable

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26 The Little Hocking Water Association, and their lawyer, refused my requests for an interview, I believe, because of the possibility of future legal action. What is known about their pilot analysis can be gleaned from the Little Hocking Water Association website and from a limited discussion of the results reported in the media by the Association’s lawyer, who kept the lab and scientists confidential.
“information disparities” because so much information about PFOA had originated from the company charged with producing the exposures in the first place. As one interviewee noted:

There was a lot of hostility. And people were generally frightened about the whole issues. There was a large amount of distrust, of course, because of what I previously mentioned is people finding out how after the fact that this chemical was known to have been in the water for years. No one was told about it, and there were all these numbers floating around as to safe levels, and they were changing from one day to the next, it seemed like, and all of those types of things made people really suspicious about the information they were receiving.

As news of the contamination and mounting class-action suit increasingly headlined area newspapers, Dr. Hong Zhang, a physician at the Grand Central Family Medicine Clinic in nearby Parkersburg, West Virginia, also began fielding questions from patients about the health effects of PFOA exposure. Zhang, enrolled in a unique practicum residency for physicians in occupational and environmental medicine at the University of Pennsylvania, brought the issue to Dr. Ted Emmett, a compassionate, yet temperate Australian-born doctor who directs the residency program and was affiliated with the university’s federally funded Center of Excellence in Environmental Toxicology (CEET). Emmett immediately recognized the immense research needs about exposures to a chemical that lacked epidemiological or exposure data in non-occupationally exposed populations existed. Emmett, as the Deputy Director of CEET, was unique in both qualifications and access to the institutional resources to tackle the formidable questions posed by PFOA exposure analysis and epidemiology. More interestingly, however, was his other position as the center’s Community Outreach and Education Core director, a position that reflected and encouraged a firm commitment to conducting such a novel

epidemiological investigation with the utmost transparency and in partnership with the affected community.

CEET joined with both the Grand Central Family Medicine Clinic, and with the Decatur (Ohio) Community Association, whose members live within the communities affected by PFOA contamination. Together, the partnership designed a research plan to address not only the lingering community questions regarding PFOA exposure, but to also conduct the research in a way that would begin healing the community from the secondary and deeply social impacts of widespread contamination. The National Institutes of Environmental Health Sciences funded the project in late 2003 through a unique funding mechanism that supports community-based partnerships among scientists, community organizations, and health care providers specifically to address problems of environmental injustice.

The University of Pennsylvania and Decatur Community Association team convened a Community Advisory Committee, often referred to as the CAC. Over the course of the study, the CAC involved residents from each of the townships serviced with drinking water by the Little Hocking Water Association as well as representatives from the regional school district, health officials, Ohio EPA, and the US EPA. The scientists and CAC would meet quarterly to discuss the study and its progress, often with involvement from the public and representatives from area health clinics, and public health and regulatory agencies, most notably the Washington County Health Department and Ohio EPA. CAC meetings, whose minutes are posted on the study website (http://www.lhwPFOAstudy.org), and in its regular newsletter, became one of the few community resources where residents could learn about PFOA exposure and its health implications.

Sampling commenced the following year, with all partners involved in recruiting participants, data collection, and communication of the results. The initial scientific goals included: (1) to better characterize the extent of community exposures to PFOA; (2) to parse out the most significant routes of exposure; and finally, (3) to assess whether PFOA exposures could be
associated with early indicators of particular health outcomes, based on existing evidence from animal and occupational research on other exposed groups.

The scientific team measured blood levels of PFOA of approximately 370 community members who drew drinking water from the Little Hocking Water system. They assayed the participants’ blood for biomarkers, of liver, thyroid, and renal function, and they analyzed cholesterol blood count. Following this first round of sampling, the researchers were unable to find an association between the health endpoints under investigation and PFOA exposure.

Environmental Working Group, in its press release of community study findings, noted that the sample size of Emmett’s preliminary study precluded an assessment of more sensitive health endpoints that develop over longer time periods, principally cancer and developmental effects (Koop and Houlihan 2005).

Emmett and the study team remained ardently committed to providing each participant with his or her blood levels of PFOA, even though the study had yet to determine an association between exposure levels and any clear indication of disease processes. As part of their overall commitment to counter-balance the significant “information disparities” that characterized the region’s experience with PFOA, Emmett provided each participant with individual and aggregate results that offered as much context for interpretation as possible. These results were reported first to participants by mail, and those people were later offered opportunities to meet with Dr. Emmet to discuss them. As one community advisory committee member noted:

We provided a letter which simply was able to state “How did your number compare to the population as a whole?” but we weren't really able to tell folks what that meant yet either because at that point, it was still to be determined what it means.

This community-based approach to reporting differed significantly from how the Brookmar, Inc., Health Project results were reported—devoid of any indication of how a participant’s results compared to others in the Mid-Ohio Valley or the country. As noted by other researchers who
have addressed the unique communication dilemmas raised by reporting such uncertain scientific information, even when researchers cannot offer information about health implications, they can nevertheless support participants’ right to draw meaning from their results by offering information about others’ exposures as a point of reference (Brody et al. 2007).

Emmett also reported the results to the residents from the affected communities at a forum held on a steamy August evening at a regional high school. Over 400 people filled the auditorium’s worn, wood-backed chairs—mostly residents, but representatives from DuPont, the media, state and federal regulatory agencies, as well as from Little Hocking Water were also present. Concerned about the potential for the information to upset community members, the Community Advisory Committee had hired local security guards to attend as well, though their presence turned out to be unwarranted.

Emmett, in consultation with the CAC, crafted a carefully orchestrated Power Point presentation that highlighted the main conclusions from the blood sampling, but that would not generate alarm among the residents on the Little Hocking water service. In a meeting that exceeded two hours in length, community members learned that consumers of Little Hocking water had 60–75 times higher levels of PFOA in their blood than the general U.S. population (Emmett 2005). Emmett later recounted that these levels were higher than expected, so much so that the readings initially delayed analysis. Emmet also reported that blood concentrations of PFOA were detected in samples drawn from the youngest (under 6 years) and oldest (over 60 years). Curiously, and still unexplained, is the finding that serum levels were also the highest among those who ate more home-grown vegetables or fruits, and not among those who regularly consume local fish or game, as might be expected from other chemicals that exhibit such tendencies to bioaccumulate and persist. Emmett posits this differential may result from how residents use water to clean, cook, and preserve what comes from their gardens—a difficult prospect for communities where many families still grow vegetables in their backyards.
Emmett recommended residents use an alternative source of water for drinking and mixing formula, as well as for preparing foods and hot drinks. Hours before Emmett presented these findings to the community, DuPont however, after years of refusing to do so, unexpectedly announced that the company would offer bottled water to any Little Hocking Water customer who requested it. Some 70% of eligible residents took DuPont’s offer. An anonymous resident summed the significance of these findings: “There was a large fine from EPA. There was a lawsuit, and a lot of money changed hands. But it’s [the CEET] study that has changed the water I drink” (Tillett 2007). It is unclear how DuPont arrived at this offer, since the research team purposefully did not release their findings publicly until the community had been briefed first, and Little Hocking Water had been negotiating for alternative water for years. The timing of DuPont’s offer—within hours of the first community forum—reasonably suggests that the findings, somehow, spurred DuPont to act where it previously had been languishing.

Furthermore, even as DuPont initiated a bottled water program, following release of the community-based study results, DuPont maintained its stance that the blood levels reported by such studies were meaningless for human health. The company asserts that PFOA in human blood is not linked to any demonstrable health effects, a position DuPont maintains. DuPont’s Washington Works website concludes:

Based on health and toxicological studies, DuPont believes the weight of evidence indicates that PFOA exposure does not pose a health risk to the general public. To date, there are no human health effects known to be caused by PFOA, although study of the chemical continues (DuPont 2008b).

Yet, the results from Emmet’s study prompted area regulators to lower the drinking water standard, while also prompting other states, including Minnesota and New Jersey, to lower drinking water standards, again showing the significance of events in the Mid-Ohio Valley for regulatory decisions outside the region. In January 2007, Sarah Wallace of the Ohio EPA, who often attended the study’s community advisory board meeting, used the forum to announce that
the US EPA and DuPont had reached a consent agreement that lowered the allowable level of PFOA in drinking water from 150 ppb to 0.5 ppb. This study's finding that the level of PFOA in the body is about 100 times that of PFOA in the water had a major impact on that standard being reduced so significantly. In the meantime, the community at-large awaits results from the follow-up study of blood levels after consistent use of an alternative drinking water supply.

Even so, the community-based study released these results into a numbers-saturated context. Some community residents reflected confusion over which study they participated in, some distinguished between the two by noting that one paid you for your blood sample, the other did not. When residents on the Little Hocking Water service participated in both the community-based study and the Brookmar Health Project, the results did not always agree, further confusing some participants. This confusion preceded news that came out two years later, which reported that mistakes had been made in the analysis of at least 20,000 samples collected by Brookmar.

**Community-Based Science and Social Relations within the Mid-Ohio Valley**

This federally-funded epidemiologic study, as required by the ethical standpoint of the National Institutes of Environmental Health Science community-based research grant, partnered with community organizations. Though the impetus for the study came directly from community concerns expressed to a physician working in community health centers, it was a challenge for the researchers to find a community-based partner to fulfill the requirements for this unique grant opportunity. The presence of few community-based organizations suggests that capacity issues were also an important characteristic of the affected communities of the Little Hocking service district. The University of Pennsylvania researchers first approached The Little Hocking Water Association to serve as the researchers’ community partner, but after much consideration, Little Hocking Water declined. One speculation is that by maintaining separation from the study, Little Hocking Water could later, more effectively pursue legal action against DuPont, since unlike other area water associations, they were not party to the larger, class action suit. Not officially
joining as community research partners seemed like the best course of action to protect Little Hocking Water’s ability to secure the cleanest possible water source for its customers.

When Little Hocking opted not to serve as the community organization for the epidemiological study, the researchers were hard pressed to find other community-based organizations that represented people living in towns serviced by the Little Hocking Water Association. As a result of the contamination, water service districts became new forms of association. Rather than political jurisdictions, such as a township or county, people became identified according to the water district in which they lived. In some instances, the area serviced by Little Hocking Water crossed county lines, or split the town of Belpre in two, since another water association serviced half the town. Residents of Little Hocking Water became unique within the region, since the Association deliberately had not entered the class action suit (though individual customers did), was one of two area water associations that had taken on a public role as a de facto PFOA informational clearinghouse, and pushed the issue of PFOA contamination at the state and federal level.

An alliance between the researchers and the Little Hocking Water Association, in many ways, was a logical and potentially fruitful alliance for the community because of the role the Association had already in providing community members with information when few other organizations could. However, with Little Hocking Water no longer a willing research partner, the researchers reportedly approached local firefighters, and eventually formed an alliance with the Decatur Community Association. Participating in a scientific study was far outside the former experience of the Community Association, which until then, managed space to house community events such as the Neighborhood Crime Watch association and 4-H gatherings. Yet, its members took on the role and became experts on the PFOA issue, helped maintain an informational website about the study and PFOA, as well as often addressed the media with updates on the study. Where there may have been limited community capacity to begin with, members of the Decatur Community Association helped to develop the capacity of area residents,
including those that lived on other water services, to understand the nature of PFOA body burdens.

At the same time, however, this study also reinforced divisions already existent within the community, in particular creating boundaries between those community members who involved themselves in the study and those who advisory board members felt adopted a more activist stance against PFOA contamination, though, because an organized, sustained grassroots response never materialized, it was unclear to me who these individuals were. Community Advisory Committee members from the Emmett community-based study, nevertheless felt it important to maintain distance between more activist factions within the community. Members of the community-based team maintained clear boundaries between those involved in their epidemiologic study and those groups involved in blood sampling and research conducted in conjunction with the class action lawsuit. When the trial lawyers approach Emmett’s research team about the sampling design for the community-based Little Hocking study, University of Pennsylvania’s lawyers had to step in to ensure the research design was unencumbered.

Other divisions that emerged or were reinforced by the biomonitoring projects were over the relationship between the community and DuPont. In some instances, as was suggested in interviews, some residents worried that by consenting to blood monitoring, their participation was seen as being disloyal to DuPont. The primary concern was that participation in the study would contribute to negative publicity for DuPont, who would, in turn, leave the Mid-Ohio Valley. As one of the area’s most significant employers, many feared any activity suspected to threaten DuPont’s long-term prospect in the region. Defending industry in the face of widespread contamination is not uncommon in this region, as twenty years earlier, a sizable faction of workers and residents in nearby Institute, West Virginia staged a street march in favor of Union Carbide following the infamous 1984 chemical explosion there (Chemical Valley 1991). As high as participation rates were in both biomonitoring projects, non-participation was still an act of support for DuPont.
IMPLICATIONS OF BIOMONITORING FOR NATIONAL ADVOCACY AND COMMUNITY QUIESCENCE

In conversations I shared with community members, in public testimony submitted to the EPA, and in interviews reported through the media, I learned that in the Mid-Ohio Valley there is both a deep concern about PFOA contamination and profound resignation that there is little their community can, or is willing, to do to address it. Consider the following reflections:

I think the current status is that people probably don't think a whole lot about it unless something happens to show up in the paper.

You can't maintain—maybe that’s another community’s thing—but it's like you cannot maintain over years and years and years this outrage.

Don Poole, manager of the Tuppers Plains-Chester Water District in Meigs County, said the discovery of PFOA in local drinking water has prompted some of his 5,000 customers to resort to dark humor to express their frustration. Three years ago, the district placed second in a taste test sponsored by the National Rural Water Association. “My friends joke that it must have been the PFOA,” Poole said. “To me, this PFOA contamination is a trespass, and they (DuPont) should be treated as trespassers,” he said. “But unless the U.S. EPA steps in, there is not much we can do about it.” (Hawthorne 2003)

And what does this [blood] test mean to the people that gave the test, and what's this test mean to DuPont? What's it mean to the EPA? Really, it probably has no meaning whatsoever... how can we not do anything about it? ...I think, I think the only meaning that it may have is... How can DuPont continue making more product? How can the local politicians and government and city officials keep DuPont supporting this community? DuPont's contribution to government, and government ties...

Organized community activism against about PFOA contamination has been sporadic and at times divisive. Over the course of the past eight years, several women have stepped forward in an attempt to organize public concern, but never were able to rally an organized response from within the community. These women each served as the public face for the issue, then dropped from public view altogether (Lyons 2007a). Even as data poured in about PFOA levels, an
organized response never emerged from the community; yet, it may be the case that dissent and
protest is expressed in other ways than through formal organizations such as social movement or
non-profit organizations (Anglin 2002), a topic better analyzed through more extensive interviews
with community members (see research conducted by ethnographer Mary Hufford). One future
line of questioning would assess whether the act of donating blood samples and participating in
one of the various biomonitoring studies constitutes an act of resistance.

The diminished organized response must be understood within the broader context of
historical industry-community relations in the Appalachian region, where polluted populations
were also, in many cases, employed by polluting industries that were among the few employers in
the region. In a similar vein, interviews with key informants suggested the community
experienced fatigue from the omnipresence of pollution in their midst, as one person noted: “you
cannot maintain over years and years and years this outrage. People go back to their lives and try
to incorporate whatever this awful information is into their lives, and try not to think about it.”
The large class action suit, too, could have diminished organized response, in part, because it
moderated or prevented the most radical of class members from pursuing activist or advocacy
strategies, so as not to affect the course of the trial.

Another contributing factor may be that the mid-Ohio Valley often has been isolated from
other regions of the United States. Some within the mid-Ohio Valley, and in Appalachia more
generally, suggest that living there is like living in a bubble—there are often huge cultural and
social disconnects between life there and life in the rest of the county. This sentiment was very
much portrayed in a recent Steven Soderberg film, “Bubble” (2005), which was set in and drew
its cast from the mid-Ohio Valley to tell a story about the lives of employees from one of the
region’s manufacturing plants.

The cultural and social barriers, in turn, have played a poorly understood role in preventing
community members from forming strong connections with potential allies in sites where PFOA
contamination from local industries also has been discovered. Such isolation is striking,
especially since the Mid-Ohio Valley led to the discovery of PFOA in other communities, and to extensive media and scientific attention. My sense from key informant interviews is that, in general, community members do not realize the domino effect of scientific, regulatory, and legal attention that has occurred as a result of events in the Mid-Ohio Valley.

In Gaventa’s (1980) study of quiescence and power, quiescence is not a characteristic of a community, but a product of history and contemporary power arrangements that frame the nature of the problem and possible responses. In a similar vein, this led me to consider how biomonitoring science helped shape the framing of the PFOA problem. The largest, highest-profile biomonitoring in the region, the settlement-funded Health Project, clearly designated the interpretation of PFOA body burdens as an issue to be understood and remediated only by experts. The organization of this study assigned interpretation of the results to the court-appointed scientific panel, which would make their final determination about the health implications of PFOA burdens five to six years after the community learned about their blood levels. As well, the Brookmar project presented blood levels devoid of interpretive benchmarks to help community members understand their larger significance, including statistics about community and national averages. Without active community involvement in the scientific process, and without a data reporting strategy that facilitated participants’ interpretation of the admittedly hard-to-interpret results, there were substantial barriers to participants developing a collective understanding of the results. Lacking such an understanding, community members would have a hard time developing a politicized response (Brown et al. 2003). Conversations with community members and key informant observers of Mid-Ohio Valley contamination note that the public is waiting for their data “to mean something”—for experts or the courts to make a final determination of what their blood levels mean. It may be that this removed the issue from the realm of mass politics, and relegated it to the realm of technoscience.

Instead, body burdens of Mid-Ohio Valley people contributed to coalition building and advocacy among advocacy organizations not rooted in the region, though groups like the
Washington DC-based Environmental Working Group were involved intermittently in the Mid-Ohio Valley. Extra-local advocacy groups took the issue of PFOA and PFC-body burdens in a new direction by highlighting consumer products as a key route of exposure for people far from sites of production. In some instances, as I learned while conducting fieldwork outside the region, state-level advocacy organizations concerned about PFOA and PFC-exposures through consumer products knew nothing about the local contamination or pending lawsuits in the Mid-Ohio Valley, even though the experiences of residents there helped break PFCs into the public spotlight. In turn, the alternative focus of these groups, which commanded the attention of regulators and the media, left some in the Mid-Ohio Valley to feel “left behind,” even though their experiences had been the initial touchstone.

Environmental Working Group (2003) played a key role in securing coverage of the Mid-Ohio Valley situation by the TV news magazine show “20/20.” The program described the water contamination in the Mid-Ohio Valley, and how the community’s experience helped spark a broader investigation into both DuPont and PFOA. “20/20” had interviewed several community members about their experiences with water contamination, including the son of a DuPont worker who experienced birth defects potentially linked to PFOA exposure while in utero. Yet, the story quickly shifted from the Mid-Ohio, and instead featured interviews with two staff members from EWG who reported on how PFOA is detectable in the blood of all Americans as a result of its use in the production of common consumer goods like water-repellent sportswear or stain-repellent carpeting. What began as a story about how those living on the fenceline of industry in the Mid-Ohio Valley, during a time when residents had no information about whether PFOA was in their blood and what the exposures might mean for the long-term health, ended as a commentary on the potential dangers of non-stick cookware. The show concluded with the following summation by Barbara Walters, which signifies how quickly the Mid-Ohio Valley fell from view:

So the big question is, should you throw out your Teflon and other nonstick cookware? At this point, the Federal government
is saying no, you shouldn't. It's conducting a major investigation right now. The results are expected in the coming months and we'll be staying on top of that story. In the meantime, some suggestions. Don't let your Teflon pots burn or the liquid in them boil away. And don't leave an empty Teflon pot on high heat.

As this example shows, the presence of PFOA in Mid-Ohio Valley water and blood inspired state and national environmental health groups not based in the Mid-Ohio Valley to raise awareness about ubiquitous exposures to perfluorinated compounds like PFOA. Events unfolding in West Virginia and Ohio Valley fueled broader activist campaigns to raise awareness about consumer dangers posed by PFOA and played into the groundswell of mainstream concern over consumer-based exposures (Murphy 2006; Szasz 2007). Such consumer-based activism is aimed at changing chemicals policy more broadly in CA and federally, but in this case only marginally involved the communities who are disparately affected by PFOA. The Steelworkers, Environmental Working Group, and Ohio Citizen Action, all built campaigns around PFOA and perfluorinated chemicals. Ohio Citizen Action, though working on air pollution issues in the Mid-Ohio Valley and publishing news accounts of local PFOA contamination on its website, otherwise was involved tangentially in local activism around this issue. Rather, Ohio Citizen Action coordinated a strategic action to uncover which fast food restaurants’ supply chains furnished them with PFOA-coated food wrappers. Consumer-based exposures to PFOA have become an activist focus elsewhere, including in California and Maine.

Moreover, though the issue did not prompt coalition building at the local level, PFOA body burdens did catalyze the formation of coalitions elsewhere, for example to pressure the state of California to add PFOA to its Proposition 65 chemicals list, which would require labeling of all consumer products made with the chemical. In March of 2006, a coalition of seven environmental and labor advocacy groups, including the United Steelworkers, Sierra Club, and EWG, asked the attorney general of California, Bill Lockyer, to include PFOA among those that should be labeled under the 1986 consumer product protection law, Proposition 65 (Fischer
This action followed on the heels of an EPA Scientific Advisory panel on PFOA that upgraded its designation from a “suspected carcinogen” to a “likely” one. Proposition 65 requires the labeling of all consumer products that contain known carcinogens or reproductive toxicants. EWG representative Richard Wiles went on record in the same story, arguing, “citizens should have the right to shop their way around this chemical and make decisions to reduce exposure” (2006). Subsequently, EWG has backed a California legislative campaign to ban the use of similar, perfluorinated chemicals in the use of food packing.

**CONCLUSION: A COMMUNITY IN WAITING, A FALSE SENSE OF CLOSURE**

During the spring of 2007, it is business as usual for the employees of White Crystal Springs water. Each day, they criss-cross the Little Hocking community in white vans to distribute water to over 70% of residents on the Little Hocking Water system. On a regular basis, and at DuPont’s expense, the vans drop off a fresh supply of jugs to area homes, restaurants, and schools, and cart away empties for refilling. Empty Crystal Springs bottles line the porches of middle-class homes and double-wide trailers, and the hallways of the elementary and school officials have covered water fountains in plastic or stacked them with paper cups and empty bottles to discourage students from using them (see Figure 5-6). Now, between classes or during basketball practice, students drink from bottled water dispensers that are regularly replenished by DuPont.

Provision of alternative drinking water has “taken the edge” off the problem, perhaps also playing a role in the level of quiescence observed in recent years. However, bottled water delivery cannot go on indefinitely, nor will it, as DuPont has given word that delivery will cease once the filtration units required by the class action settlement to build are effective. Moreover, while drinking bottled water has contributed to a reduction in exposure over time, one of the most interesting, and for the community, disturbing realizations, has been that the bottled water, though bottled north of Marietta, Ohio, was found to contain trace levels of PFOA (Bauer 2006).
As agreed upon in the terms of the Wood County class action settlement, DuPont installed activated carbon filtration systems in four of the six affected water systems, with construction plans underway to install the final two. These filters rely on granular activated carbon designed for use in municipal filtration systems, and have been helpful in filtering out the gas additive, MTBE, from public drinking water supplies (Calgon Carbon Corporation 2007). These carbon filters, each costing on average $80,000, arrive by flatbed trucks to the cinderblock garages that now house the filtration systems (Lyons 2007b).

Even as the filters came on-line, within the community and among local water officials, concerns remained. How often would the filters need to be changed out, and would affected water systems, such as Little Hocking, need the filters changed more frequently to handle the higher concentration of PFOA? In addition, how long would filtration units be needed, given the persistence of PFOA? And, with the safe levels ever-changing, having fluctuated over the past six year period between 0.5 pbb and 150 pbb, at what level should these filters be working? Moreover, with the final verdict of the PFOA class action lawsuit hanging in the balance of the PFOA Science Panel, many systems worry about who will assume the long-term fiscal responsibility for maintain the filtration systems. Some water systems have installed bypass
valves, in anticipation that one day DuPont may no longer be responsible for maintenance. If no link between exposure and human disease is detected, there is great potential for the Science Panel to absolve DuPont's responsibility and shift the long-term burden of maintenance costs to the water districts, which would devastate rural, non-profit water systems.

The Little Hocking Water Association has been the last to be retrofitted with filters, in part because the answers to the above questions have not been answered satisfactorily. According to public releases and newsletters from the water association, the filtration units and alternative water supply have never been more than “an interim measure.” Little Hocking Water Association officials have, from the outset, been steadfast in their request for a well field free of contaminants, not tap water filtered for PFOA to an “acceptable” concentration. Unlike other water systems, Little Hocking Water Association was not party to the class action lawsuit against DuPont, a strategic decision to ensure the water association could negotiate independently with DuPont and, if need be, bring legal action against DuPont to keep statute of limitations open.

Furthermore, compared to other water systems, Little Hocking Water Association delayed construction of DuPont’s carbon filtration until it understood whether the filtration units could handle the levels of PFOA uniquely found in the Little Hocking system. Officials wanted to understand whether they would require more frequent filtration changes, at what expense, and who will assume long-term fiscal responsibility for maintaining the filtration systems for the duration of PFOA’s presence in the water supply. Emmet’s research helped confirm that water was a major route of exposure. It also played a role in DuPont finally providing an alternative drinking water supply to reduce exposures. However, the long-term management of Little Hocking water has been far more challenging and has revealed how elusive a grasp scientists and regulators truly have on the implications of human exposure to this substance.

Little Hocking’s concerns came true in the fall of 2007. After the filtration unit was completed, tests revealed that the water still harbored PFOA. Little Hocking pushed for DuPont to continue funding alternative drinking water until the issue was resolved.
According to DuPont’s quarterly Securities Exchange Commission filing (DuPont 2007), Little Hocking Water Association filed a suit against DuPont in September 2007. They are now asking for a pristine water source and infrastructure for delivering it to the Little Hocking system.

Community inquiry into what happens with spent filtration units, a question pursued by the Community Advisory Committee to the epidemiologic study, revealed that when PFOA, once filtered from the water supply and sequestered in the carbon filters, was taken by the manufacture to Pittsburgh in the used filters, incinerated, and potentially some portion re-released into the air.28 My attempts to contact the manufacturer to understand the final fate of Mid-Ohio Valley PFOA did not reveal whether incineration released the sequestered PFOA into the air. I was left wondering: who else, then, becomes implicated in this narrative that began in the Mid-Ohio Valley?

"Please Don’t Forget Us"

Narratives of environmental and justice struggles in the United States weave together many threads that begin in Appalachia, a critical, though often underappreciated region in sociological accounts of environmental health problems. A string of events, rarely connected by social scientists, has taken place in Appalachia that have had national, even international significance: the silicosis deaths at Gauley Bridge/Hawk’s Nest Tunnel in the 1930s (Cherniak 1986), the “coal wars” of the mid-twentieth century (Boyer and Morais 1955), asbestos workers’ lawsuits (Brodeur 1985), and the 1972 mining community disaster at Buffalo Creek (Erikson 1976). Further down the Kanawha River at Institute, West Virginia, the 1984 release from Union Carbide occurred, the American second cousin of India’s Bhopal Chemical Valley 1991). The

28 This question was raised during one of the community advisory board meetings for the Little Hocking Water System study. One of the community members inquired to DuPont how the spent carbon filters used the filter the water systems were handled once replaced. According to community minutes: “Water filtration is in effect for the districts of Tuppers Plains, Pomeroy and Belpre. In the latter, there have been two changes of the charcoal filtering medium. There was a question about the disposal of contaminated charcoal. A call to a DuPont official after this meeting elicited the information that the charcoal is taken to Calgon in Pittsburgh and is incinerated there.” (http://lhwPFOAstudy.org/CACMinutes.htm, accessed 12 July 2007).
accidents at Bhopal and Institute, and the intentional withholding of information about what these accidents released, spurred the U.S. Right-to-Know laws that now require regulated industries to report specific chemical releases to the EPA. Once again, the environmental health of Appalachian communities has been thrust onto the national, even global stage, now that scientists in Asia and other continents are measuring blood for PFOA. This case, and the rapid succession of PFOA exposures identified in its wake, has spurred scientific and regulatory attention to PFOA and its sibling compounds.

The role of this region in the history of environmental health science and activism is somewhat blurred, as the lessons it teaches take root elsewhere. The Mid-Ohio Valley pulled back the curtain on an entire class of chemicals that slipped past the regulatory gaze when the Toxic Substances Control Act was signed in the late 1970s. It is true that the experiences of this community helped identify other contaminated places and to detect general background levels in communities far from the factories and the fenceline. This was significant in prompting regulatory attention and new scientific research. Yet those on the fenceline of the Washington Works plant are still drinking from bottled water and the long-term responsibility for supplying an alternative or filtered water hangs in the balance of the PFOA Science Panel. The difference between what regulators and national advocacy groups are concerned about, and the lived experience on the fenceline, led the Little Hocking Water Association general manager to remind EPA to not forget those on the fenceline who bore disproportionate burdens of PFOA exposure. Those on the fenceline, who face PFOA through multiple exposure pathways, feel left behind as regulatory and scientific concern has prioritized figuring out most how non-occupationally exposed individuals living far from production sites like the Mid-Ohio Valley carry the same chemical in their blood.

Waiting for Science

Though scientists poorly understand the link between human health and chemical exposure, in specific instances where industry has compiled health-relevant information, lawsuits and lawyers
play a critical role in making industry knowledge public, in ways that federal regulations do not, and arguably, cannot. The trilogy of lawsuits in the Mid-Ohio Valley cracked decades of DuPont’s research files, revealing much to scientists and regulators. In the Mid-Ohio Valley, the discovery process helped bring to light data about human exposure to a largely unknown, unstudied, and unregulated persistent, bioaccumulative chemical. Affected citizens enlisted the services of lawyers, who in turn, helped put PFOA on scientists’ and regulators’ radar. This in turn led to passage of state level regulation, for example for water in New Jersey and air in Ohio (see Clapp et al. 2006). It also led to federal monitoring of PFOA in the American population, as well as EPA and Department of Justice investigations. Discovery of other PFOA-contaminated communities soon followed, resulting in lawsuits filed in Minnesota and New Jersey.

Furthermore, the science that resulted from the settlement of the 2001 class action suit produced a vast amount of new knowledge about the chemical, and yet, for all the information brought to light, the struggle for understanding is as pressing as it ever was.

For sites of production—where chemicals are first used and synthesized—and especially in cases where “new” contaminants are discovered closest to their source, chemical exposures are often the hardest for communities to address. There are pre-defined channels that often confine affected communities to a narrowed set of options for seeking redress, including filing lawsuits or seeking the help of regulators. In large measure, these options, and what they can and cannot achieve for affected communities, is shaped by the long-standing relationship between producer/polluters and the regional economy and governments, who often align to define the problem in the narrowest of terms—a technical problem solved through filtration. Bureaucratic, regulatory processes circumscribed and delimited citizen input into regulatory decisions. Knowledge politics were also in play. In the Mid-Ohio Valley, for decades, the polluter controlled the technology and capacity to analyze blood for the key chemicals used in manufacturing processes.
In addition to seeking redress through regulators, lawsuits are another means for citizen redress in fenceline communities. In the Mid-Ohio Valley, a succession of lawsuits uncovered reams of scientific data about community and worker exposures, and were critical in bringing this issue to light. As well, the trials became a significant driver for new scientific research. In this instance, a class action settlement generated the cash to monitor the blood of thousands and to convene a team of world-renown epidemiologists to wade through the quagmire of toxicological and epidemiologic evidence regarding PFOA exposure. At the same time, the trial’s “science-based settlement” set up a relationship between the community and science whereby blood concentrations were presented as individualized “health data,” no more or less significant than a person’s blood pressure or cholesterol, and interpretable only by experts. Blood concentrations provided by the Brookmar Health Project were presented without any interpretative benchmarks with which to draw meaning. Though this presentation of the results generated much conversation within the affected communities, it also impeded the realization that PFOA levels in the region—even if their health significance was unknown—were still truly remarkable in light of the national average. Rather, the interpretation was left to the court-appointed jury of experts who had until 2011 to reach a verdict on whether PFOA reasonably can be associated with human health effects.

Even after gallons of blood were drawn, and talk of PFOA levels became street corner conversation, whether and how water-based exposures can or should be mitigated over the long term remained largely open, ungraspable, and as slippery as the surface-coatings PFOA is used to make. For all the research that has been done, and the gallons of blood analyzed, the Mid-Ohio Valley community awaits the verdict from the jury of scientists, while a growing disaffection with interim measures blooms within pockets of the community who anticipate what will happen if the PFOA Science Panel works against the limitations of epidemiology. It is unclear what outcome community members might want. The prospects of the Science Panel finding a positive association between PFOA and human disease processes are potentially as disturbing as a finding
of “no association.” If no association is found, then DuPont is immediately absolved of any further responsibility to the community, including the exorbitant costs to maintain the water filtration systems it built per order of the settlement agreement. In this situation, residents are likely to still harbor concerns about the PFOA that they know is flowing through their veins and from their kitchen tap. There is also the difficult possibility that the Panel cannot find an association because the data are too inconclusive or the association too difficult to research. All three scenarios present the community with a difficult reality.

Scientific and regulatory inquiry into PFCs continues, even as the team of international scientists that comprises the PFOA Science Panel labor to make a determination for the courts whether a link to human disease is discernable in the ever-growing body of evidence. But, given what is known about the bluntness of epidemiological tools (Davis 2001), how little is known about the health implications of long-term PFOA exposure at this time, the ubiquity of exposure that makes a non-exposed, “control” population non-existent, and the myriad of other exposures experienced by the people of the Mid-Ohio Valley, perhaps too much has been asked of science.

Importantly, the trial and the settlement study set the key terms of the debate, which was to define a safe level of chemical burden and how to ensure that filtration achieved public safety. This framing masked other, equally viable questions from taking center stage, namely: should PFOA be in the body at all? Moreover, the Mid-Ohio Valley is dealing with more than PFOA exposure—some we know, some we do not yet know about. For example, the public, legal, and scientific focus on PFOA masked the presence of other chemicals in the same family of PFCs. The focus on PFCs, in turn, conceals that this chemical is but one chemical found in the air, water, and bodies of the Mid-Ohio Valley (EPA Toxics Release Inventory 2005).

The legal community and the court system were important for bringing the issue to light, and ensuring public and regulatory access to scientific information about PFOA contamination and hazards that DuPont was not reporting. As well, the settlement-funded Science Panel, and the plaintiffs’ decision to use the settlement money to fund biomonitoring for over 70,000
individuals, are both doing an important public service in providing scientists and regulators with reams of data about human exposure to a chemical that has since been found in the blood of most Americans, and people and animals from across the globe, including in the bloodstream of polar bears in the Arctic. The contribution these lawsuits made to pushing science and regulation cannot be overstated (McGarity 2008), but it must be qualified, for perhaps the settlement arrangements ask too much of science.

Whether the people of the Mid-Ohio Valley should be compensated for any harms brought against them as a result from PFOA exposure, and whether rural, non-profit water systems will have to take over the exorbitant costs of managing the filtration systems to control PFOA levels in drinking water, are practical decisions that rest, ultimately, in the hands of three court-appointed scientists. But, there are more than these practical decisions resting on their final verdict. There are broader questions about the relationship between a multinational industry and the communities in which they are located, about the responsibility such industries have to the public to inform them of the hazardous materials they use and emit into these communities. Ultimately, this case raises questions over industrial use of chemicals that build-up in the environment and the human body and will stay, in some quantity, for a yet unknowable length of time.

The questions placed before the, and for which the community awaits answers, are arguably beyond their capacity to answer—beyond the capacity of any scientist to answer. As novel a solution as this “science-based settlement” was, science has been asked to answer questions that are beyond the ability of science to answer, what Weinberg (1972) refers to as “transcientific.”

Yet, it was good that these questions were not pursued in the courtroom. Given the context of mass tort law today discussed in the introduction, the courtroom has become a difficult arena for citizens to raise concerns about the safety of industrial practices for community health (Cranor 2007). As Cranor (2007: 1) notes, “A significant, unseen revolution in the tort law is in progress.” Recent changes in tort law have followed from a series of decisions that have changed
how scientific evidence and expert testimony is reviewed and admitted by the courts. Because tort cases raise scientific questions about the health significance of chemical exposures, the court system is placed in the position to consider, and often reach decisions based on, scientific questions for which there is little evidence, or that are on the frontier of scientific investigation. These changes, in turn, as Cranor argues, undermine the ability of courts—which have been a critical safety net for citizens to raise concerns when the regulatory system has failed to protect them—to ensure public health, and moreover, justice following exposure or harm from toxic chemicals (Cranor 2007).

Given this, on the one hand, settling the lawsuit and moving the debate over whether PFOA causes human harm out of the courtroom was a positive outcome, since it is uncertain how well the court system would have handled what scientific evidence there is about PFOA. This adds to the significant public contribution that the settlement yield both human biomonitoring and health studies that will contribute much needed and, more importantly, publicly-accessible exposure and epidemiological evidence data on PFOA. On the other hand, turning the data over to the Science Panel, and not communicating the data to the people of Mid-Ohio Valley in an accessible way, served only to cut them off from another route for bringing some resolution to the lingering questions raised in the previous paragraph. Furthermore, the trial never went to jury; although it may have been prohibitively expensive to get the trial to that stage, nevertheless this would have been another means through which the public could have a say in the ultimate outcome. As Raffensperger and Myers (2006) argue that “democratic participation in court cases involving uncertain science demands that juries… make these [toxic tort] decisions” (p. 297)

Even as DuPont’s total releases into air, water, and land have decreased in recent years, nowhere do the numbers reveal the story of PFOA, which was and remains an unregulated substance. Companies that release PFOA into the air, water, and ground are not yet required to

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report releases to the Toxic Release Inventory. EPA’s Office of Prevention, Pesticides, and Toxics Substances is moving toward adding PFOA to the list of TRI chemicals, and plans to include PFOA among other chemicals that have the lowest reporting threshold—persistent bioaccumulative toxicants. Just as a decade ago, PFOA releases slipped past both regulatory and public scrutiny, so, too, are other substances, the ones that will fill the pages of tomorrow’s Toxics Release Inventory registers, newspapers, and research journals.

In the Mid-Ohio Valley, there was significant public pressure to initiate widespread blood monitoring for PFOA. However, this pressure to collect data did not translate into a collective effort to use biomonitoring results to support collective action or a united advocacy strategy for exposure reduction and a form of regulatory transformation. In short, a sustained, grassroots struggle never materialized once community biomonitoring revealed that Ohio Valley residents had significantly higher blood burdens of PFOA than later found in a representative sample of Americans. This important point, distinctly contrasts with how events unfolded in the other two cases discussed in Chapters Six and Seven.

Even if science is conducted for the benefit of the public, science that is conducted without the steering role of an informed community or community advisory board can disempower an already marginalized community from acting on its own behalf. When questions are of a transscientific nature it is all the more important that the public be given the information and opportunity to determine what constitutes a “risk” and how that risk should be addressed.
Chapter 6

“HOME IS WHERE THE HARM IS:”
BODY BURDEN, CONSUMER PRODUCTS, AND GREEN PRODUCTION IN MAINE

INTRODUCTION

During the Fall of 2007, just as Maine’s foliage peaked, an unlikely mix of 150 environmental health activists, scientists, Maine potato farmers and starch manufacturers, government officials, including Governor John Baldacci, scholars, industry representatives, and students converged on The University of Southern Maine’s community education center in Portland. They came to attend the conference, “Growing Maine’s Green Economy: Better Living through Green Chemistry,” where they would learn about proposed solutions to environmental health problems that “expand [the] economy by replacing hazardous materials in consumer products with safer alternatives.” The conference organizers introduced a new vision of Maine, one in which the state—whose economy and research and development expenditures lag behind other states—could become a national center for green chemistry, engineering, and production. At the center of this vision was the humble Maine potato—a long-time workhorse of the Maine economy that on this day became a symbolic beacon of hope, both for revitalizing the Maine economy and for proactively addressing what had become a broad-based, multi-sector effort to reduce chemical exposures through everyday consumer products. Images of brown and purple speckled potatoes adorned the podium, appeared in PowerPoint slides, and made their way into conference materials, along with the taglines, “brown is the new green” or “who knew that potatoes could build a better future?” Workshop participants collaboratively sought to define next steps for raising capital so that Maine researchers could develop and commercialize technology to convert Aroostook County’s potatoes into polylactic acid, or PLA, a bio-based plastic. The broad-based coalition behind The Potatoes-to-Plastics Consortium also envisions a new production facility

located in Maine’s potato-growing county that would churn out PLA for consumer-products industries in Maine to replace conventional, or petroleum-based plastics that rely on a litany of synthetic materials in their production.

Life-long environmental health and justice activist, Michael Belliveau, now Executive Director of Maine’s Environmental Health Strategy Center (EHSC) and founding member of the state-wide advocacy coalition, the Alliance for a Clean and Healthy Maine, opened the day’s events. He took to the podium in jacket and tie and, with a wide grin, surveyed the group that had assembled that morning. “There is a harmonic convergence going on in the state of Maine,” he mused, a line that would be repeated by subsequent presenters throughout the day. Indeed, the striking assortment of organizational and institutional affiliations of the attendees signals that the gathering was, if not harmonic, then at least a unique convergence. The list of co-sponsors also highlights the diversity of organizations supporting this project, which included the Maine Departments of Environmental Protection and Economic and Community Development, Tom’s of Maine, Interface Fabrics, The Environmental Health Strategy Center, and the Maine Conservation Voters Education Fund. The list of presenters and panelists was equally diverse, including the Governor, the Commissioner of the Department of Environmental Protection, nationally-recognized scholars in green chemistry and sustainable development, representatives from venture capital firms and environmental foundations, as well as from local economic development agencies, research shops, businesses, farm associations, and from public and environmental health advocacy organizations.

I was intrigued by the level of involvement that Maine’s environmental health advocacy network had in this state- and industry-backed economic development initiative. The Alliance for a Clean and Healthy Maine, and its founding organization, the Environmental Health Strategy Center, were relatively new organizations in the Maine advocacy community. I had followed the activities of these organizations for nearly two years. During that time, they had advocated for policy to regulate the use of bioaccumulative chemicals in electronics or upholstery sold in
Maine; they also had advocated for the passage of an Executive Order (2006) spurring Maine agencies toward the use and investigation of safer chemicals. Finally, they participated as invited members of a task force convened by that Executive Order to recommend policy reforms to the Governor’s office to address use in consumer products. Together, these groups both conducted and leveraged body burden science to push a new advocacy agenda that worked to shift the legislature, non-profit community, and state environmental agency from a narrow focus on industrial pollution and waste stream issues, to chemical exposures in consumer products. As a result of their efforts, Maine has become a strategic arena where local groups converge around issues of chemical body burden, chemical safety, and policy reform. Of particular interest to me was that these environmental health advocates, in addition to co-sponsoring and coordinating this rather unexpected gathering, also had coordinated the first exposure study of seventy-one chemicals in a sample of Maine people (Alliance for a Clean and Healthy Tomorrow 2007a).

The Environmental Health Strategy Center and the Alliance were started to address the presence of chemicals in human bodies. Both strive to eliminate chemical body burden within a single generation. Their founding marks a significant shift in environmental activism within Maine, which has found common cause with public health groups concerned about the rising incidence and prevalence of learning disorders and diseases with suspected environmental links. Long-time activists involved in state environmental coalitions say the strength and character of the environmental health coalition is unique because it is far less contentious than partnerships occurring during previous eras of activism, which fought pitched and seemingly endless battles over the industrial pollution of Maine’s rivers. However, more than just spurring the development of new coalitions within the public sector, common concern over human chemical burdens has forged unique relationships between the advocacy community and state officials, including legislators, the governor’s office, and with the Department of Environmental Protection, business leaders, and researchers.
I studied how body burden science in Maine was part of a new trend in environmentalism, where advocacy groups addressed the problem of human chemical exposure by shifting the focus from toxic chemicals found in pollution to toxic chemicals found in consumer products. Because historically the chemical content of consumer products has been unregulated, highlighting everyday exposures through household and consumer goods has become a new channel through which environmental health advocacy groups address what they see as the failures of the federal government to protect the populace from potentially harmful chemicals. Biomonitoring has been an important strategy for publicizing concerns about chemical exposures because it reveals how the same chemicals that are in consumer products are also found in people who do not live anywhere near centers of production. There is a certain “shock-value” to this news – that chemicals are in bodies and, moreover, that products are not regulated – and advocacy organizations capitalize on that to draw attention to the need for policy reform.

At the turn of the 21st century, biomonitoring for consumer-based exposures by environmental health organizations has became a significant trend in the United States. Beginning with Environmental Working Group’s biomonitoring-based campaigns, many other advocacy groups have sought to replicate these efforts as one component of a multi-pronged strategy to highlight how everyday exposures continue to happen to Americans otherwise not expected to be exposed, given their location or occupation. Alongside these other groups, Maine’s advocacy community uses body burden science in ways that shift environmental activism from a predominantly defensive and reactive stance, to a proactive strategy to build alliances and shift policy and debate.

I analyzed these events by considering Maine as a site of consumption. Importantly, while chemical exposures from consumer products could happen anywhere, sites of consumption like Maine, as I define the concept, are politically rather than geographically defined places. These are
sites where groups involve themselves in research and advocacy around exposures through consumer products, not just where consumer-based exposures occur.

Second, studying the science and policy advocacy around product-based exposures in Maine also offers an opportunity to glimpse at how biomonitoring science has played out in a region where grassroots and professional environmental activists are well established and well connected, following a long history of environmental policy and regulatory struggles (Judd and Beach 2003; Ranco 2000). Both mainstream environmentalism and environmental justice struggles by Maine tribes have led to policy reforms that have set Maine apart from other states. Activists and tribes have helped push policy and environmental regulations that built Maine an identity as a national policy leader.31 Both policy-makers and activists are quick to note that “as the state of Maine goes, so goes the nation.” For example, Maine was the first state to pass legislation regulating the dumping of industrial waste in rivers prior to the federal Clean Water Act of 1972. In the mid-1990s, The Penobscot Indian Nation worked with EPA to get the agency to issue the most stringent dioxin permit in the US to limit releases from the Lincoln Pulp and Paper Mill (Ranco 2000). Maine was among the few states to pass a Toxics Use Reduction Bill in 1990, Maine’s Toxic and Hazardous Waste Reduction law. Only five other states – Massachusetts, New Jersey, Oregon, Minnesota, and Washington – have passed similar bills that prevent pollution by encouraging a reduced toxics use (Geiser 2001). Since its passage, the state has engaged in various efforts to ensure that the state procures environmentally preferable products and moves toward a statewide integrated pest management system. Bills passed in the

31 According to activists and policy-makers interviewed for this dissertation, Maine is able to be a national policy leader because of its unique, political culture, which sets the state apart from the rest of the nation. Maine’s progressive political culture is evident in other policy areas. Every bill gets a full public hearing, which is not the case in all states. (A Citizen’s Guide to the 123rd Maine Legislature, 2007-2008. Maine People’s Resource Center. Portland, ME.) Second, as one member of a state-wide NGO noted, “there are a lot of things that are already law, policy, or practice in Maine that are probably fifteen or twenty or twenty-five years away in most other states—like public financing of elections. Second, Maine is a small population state. Activists and policy-makers need to reach a critical mass rather than a majority vote to move legislation. This, in turn, means that the state legislature can be swayed by just a few key people and organizations. As a result, as one activist noted, there is a lot that public activism can achieve in Maine that is much harder in many other states.”
legislature work to reduce both dioxin and mercury stemming from the household, medical, commercial, and industrial Maine waste streams and, in many cases, Maine is among the few states to pass such legislation. As part of Maine’s innovative zero mercury campaigns, the state legislature passed the first legislation to require auto manufacturers to fund collection of mercury from car switches. Six other states have similar legislation to address the mercury content of products: Rhode Island, Minnesota, California, Connecticut, Michigan, and Maryland.

Beginning in 2003, the state acted to address two concomitant issues around consumer products where policy language explicitly states the goal is to eliminate body burden via exposures—first, by legislating that industry provide more information to the public about chemical hazards in everyday consumer and household products; and second, where an alternative is feasible, restricting the market for specific chemicals in certain consumer goods. In 2003, LD1309 banned the sale of arsenic-treated wood within Maine, while also instituting a homebuyer right-to-know about arsenic hazards. During that same legislative session, the state house also required that a safer alternative replace the mercury-content for most consumer products to be sold in the state. Beginning in 2004, Maine become one of the first states to require the use of safer alternatives to two formulations of brominated flame retardants used in televisions, computers, and furniture (see LD 1790), and set the goal of considering the implications and alternatives to a third, more commonly used formulation of brominated flame retardant in the coming years. Today, state officials, policymakers, and activists express that the state’s role as national environmental policy leader is a source of identity and pride, a sentiment many express when advocating for the next generation of environmental health initiatives through the policy process.

In this chapter, my focus is on organizations and coalitions that challenge human body burden through a variety of means, including conducting science, policy advocacy, and coalition-

building. Maine has a professionalized and experienced network of non-profits and social movement organizations, and this experience means that they have been able to strategically frame the problem of body burden in a way that was compelling to state policy-makers, elected officials, and even local business interests. With body burden framed as a significant environmental and public health problem, they also presented it as economic, political, and scientific opportunity. Human body burden became a way not just to move policy, but also to shift consumer markets toward less toxic materials, even in the absence of complete toxicity data. They were able to reframe body burden as an opportunity for cooperation, rather than antagonism, and for supporting, rather than threatening, economic and business development.

When these groups discussed body burden, they explicitly highlighted problems in production systems that present opportunities for scientific innovation and business development. Involved parties framed body burden as a technological failing to be resolved through scientific innovation that would “design around” or “design away” the tendencies for certain chemicals to biomagnify (i.e., build up in the highest levels of the food chain) or bioaccumulate (i.e., to build up in the body over time). Throughout these policy and economic advocacy campaigns, chemical body burden was framed as an issue to be designed around and resolved with science. That is, body burden could be solved through scientific innovation that would redesign the materials used in production. Most importantly, green chemists were seen as the visionaries who would create chemicals that would not biopersist or bioaccumulate, and yet keep the economy moving forward. As such, chemical body burden operated as an opportunity to reinvigorate Maine’s economy through development of Maine’s research, development, and production infrastructure and capacity to support a green bio-economy. Bond measures and coalitions to build Maine’s green science infrastructure and entice green production to Maine were coupled with policy initiatives that would purge the marketplace of the most egregious materials. Importantly, the proposed policies defined the worst chemical offenders based on their potential to bioaccumulate and biopersist. The overarching goal is to keep the materials economy moving forward, but by
relying on materials that are designed not to build up in the human body. In turn, these political, scientific, and economic opportunities have captured the attention of a broad-base of support. * * *

This chapter begins by exploring the context from which the Environmental Health Strategy Center, and the Alliance for a Clean and Healthy Maine emerged. I lay out how, for most of the 20th century, Maine’s environmental struggles resembled those in other sites of production. Community groups, tribes, and advocacy organizations fought long, often protracted battles against local business interests and state regulators. However, in 2000, activists worked to open a new political space in Maine by addressing the problem of toxic chemicals not through pollution, but through their presence in consumer products and in human bodies. I describe how economic shifts and broader trends in environmental policy-making create opportunities for activists to redefine Maine’s political arena as a site of consumption—that is, how activists formed a state-wide coalition to shift mainstream environmental politics from an exclusive focus on regulating industrial wastes to regulating industrial chemicals that are readily detectable in consumer products, and in human blood and urine.

After describing the historical context of environmental organizing in Maine, I report how a coalition founded expressly to deal with the problem of human body burden conducted the first pilot study of chemicals in Maine people. I briefly detail how they conducted the study, and then focus on the implications the study had for the Alliance’s ongoing chemical policy initiatives and coalition-building to support economic development and green production.

I conclude by considering the relationship between the Alliance’s publicly successful efforts to reform Maine’s chemical policy and economy and the now less visible, lingering environmental health struggles faced by those who have not yet been brought into the Alliance’s campaigns—Maine’s tribes and migrant farm worker populations.
ENVIRONMENTAL ORGANIZING IN MAINE: HISTORICAL AND POLITICAL ECONOMIC CONTEXT

Maine has a long history of grassroots initiatives to address the consequences of industrial practices on human health and quality of life. These campaigns have important consequences for environmental health organizing in Maine for three reasons. First, a long-standing struggle against industrial pollution established a strong non-profit and social movement advocacy community in the state of Maine, as well as a committed core of environmental justice and tribal sovereignty activists among Maine’s indigenous communities. Second, struggles against in-state polluters yielded environmental policies that set Maine apart from many other states and helped build its identity as an environmental policy leader. These successes would become significant later, as activists could appeal to policymakers’ and regulators’ identities as environmental leaders when introducing and pushing subsequent bills that addressed chemicals in consumer products through the legislative process. Finally, while some of these environmental campaigns against local polluters led to policy successes, they were nevertheless difficult, often drawn out regulatory battles. These trying experiences formed the backdrop against which a subset of environmental activists proposed to take environmental organizing in a different direction. After years of struggling against local polluting industries, this group of activists proposed to address persistent and bioaccumulative chemicals in a way that avoided head-on battles with entrenched state interests.

From industrialization forward, industry in Maine has been dispersed across the state’s vast land mass. Save for Portland and its concentration of oil infrastructure, big industry never clustered in any one region of the state. The lack of spatial concentration lent itself to the maintenance of Maine’s image as a pastoral landscape, which in turn, served as a deterrent for the presumed in-migration of additional heavy industry that might have otherwise been compelled there (Judd and Beach 2003: 15). While this did not attract the nation’s big firms to the area, it attracted their benefactors. The Rockefellers and DuPonts, among other major capitalists, owned
vacation homes along the coastal communities of southern Maine. As noted by Judd and Beach (2003) in a recent history of mid-20th century environmentalism, the nation’s elite families became wealthy by polluting other places, but sought escape in Maine’s seemingly unadulterated wilds (p. 17).

Yet, the industry that did establish itself in Maine, most especially paper and textile industries, dammed and significantly polluted the state’s rivers. Early initiatives against mill pollution grew from the communities along the many watersheds that functioned as de facto sewers for the textile and paper mills situated along the state’s riverbanks. Grassroots protests against industrial pollution have been recorded as early as 1929, when widespread outrage following typhoid outbreaks along the watersheds of the Kennebec and Penobscot Rivers forced Governor William Gardiner to request that paper manufacturers investigate river pollution from mill waste. During the 1940s, communities along the Androscoggin River voiced strong opposition to the then entrenched notion that the paper and textile industry controlled the state’s rivers. Polluted watersheds, as an environmental, social, and political issue, fostered coalition-building among merchants and community organizations, and among communities, because the shared uses of the river linked many interests and many communities. Though initially the complexity of the issue, particularly the dual existence of the mills as pollution-source and major employer, divided citizens and communities, and citizen protest was muted by the post-World War II pro-business climate within the state, throughout the 1940s and 1950s, and the problem expanded to proportions no longer possible to ignore. New social groups joined the fold – sports enthusiasts, parents and teachers organizations, and women’s clubs (Judd and Beach 2003).

By 1953, these groups organized themselves into the first statewide organization with an environmental focus, Citizens for Conservation and Pollution Control (CCPC). Through letters in the local papers and testimony given at the state house, the coalition grew in reach and political savvy. CCPC was joined by the end of the 1950s by the National Resources Council Maine (NRCM), a statewide umbrella organization for conservation groups. NRCM would become a
major voice on industrial pollution during for its first couple of decades. NRCM worked strictly on resource and conservation issues in the North Woods, the Allegash, and other Maine rivers. NRCM continues to work on issues of industrial pollution, though with some internal debate over how many organizational resources should be allocated to challenging industrial pollution as a public health issue. Subsequent public struggles to curtail development in the North Woods and oil development along the Maine coast helped further develop these statewide organizations. As environmentalism shifted toward a focus on the implications of pollution for the public, two NRCM staff left the organization to found the Environmental Health Strategy Center and the Alliance for a Clean and Healthy Maine.

Maine’s tribes also have challenged industrial pollution, particularly from the pulp and paper mills located along Maine’s major rivers (Judd and Beach 2003; Ranco 2000). One of the most significant historic and contemporary environmental struggles has been the release of dioxin from the Lincoln Pulp and Paper Mill, some 35 miles upstream from Indian Island, home to many in the Penobscot Indian Nation (see Ranco 2000). Tribes battle not only with industrial pollution, but also with the long-term implications of dioxin pollution that pulp and paper pollution have for subsistence foods harvested from the same rivers. Dioxins, even though an unintended byproduct, are among the most persistent substances ever produced (Thornton 2000). Thus, for tribes, the struggle is twofold. They find themselves embroiled in the politics associated with sites of production – local industry with political clout dumping pollutants into the immediate environment – while also addressing threats to subsistence and culture, alongside challenges to their traditional knowledge systems and political sovereignty to oversee management of their natural resources (Ranco 2000; Rolde 2004). In this latter instance, their struggles more resemble the experience of other communities in sites of persistence, where historic releases of persistent chemicals bioaccumulate in subsistence foods.

Some tribes in Maine have worked in alliance with mainstream environmental groups, for example during the 1990s Campaign for a Dioxin-Free Maine, as well as on mercury pollution
from another industrial facility that manufactured chlorine for the pulp and paper mills. Yet, there are also instances where Maine tribes and mainstream environmental groups pursue issues independent from one another. This divergence is observable more recently, as many of Maine’s mainstream public health and environmental groups push chemical policy reform through campaigns to address chemicals found in consumer products, while, for example, the Penobscot Nation continues to battle industrial effluent from the mills, a point I address later in the chapter.

Maine’s advocacy groups and tribes have spent years battling entrenched local industries, in particular, the pulp and paper industry and their industrial allies. Many of these battles were over persistent, bioaccumulative substances, including mercury and dioxins, which activists found particularly difficult to challenge, as they were byproducts of production. Moreover, these were difficult, trying campaigns, as noted by activists who participated in the statewide coalition Dioxin Free Maine, which urged the state’s pulp and paper mills to reduce dioxin emissions by eliminating the use of chlorine. Ultimately, in this case, the Dioxin-Free Maine Coalition was unsuccessful in getting the mills to change their production processes.

Grassroots efforts to reign in local polluters have also been battles over the rights of tribes and citizens to challenge environmental regulations. For example, the Maine People’s Alliance, with support from the Natural Resources Defense Council, filed a lawsuit on behalf of the people of Maine to hold the current owner of a chlor-alkali plant accountable for its significant ecological and human health impacts from mercury pollution, including far downriver from the plant itself. Since 1967, the HoltraChem plant, nestled along the banks of the Penobscot River in Orrington, Maine, supplied the region’s pulp and paper industry with chlorine, which was extracted from seawater using mercury. Between 1967 and 2000, when the plant closed, significant levels of mercury were discharged into the Penobscot and onto on-site landfills. Though several courts ruled in favor of Maine People’s Alliance, the parent company appealed the decision all the way to the Supreme Court, where it argued that the citizens’ groups had no basis for pursuing the lawsuit. The Supreme Court eventually turned down the appeal, upholding the appellate court
decision that appellate citizens have the right to question EPA policy and enforcement decisions (Harrison 2007).

Though these were difficult struggles, they were not without policy and regulatory successes along the way. It was through these struggles that Maine passed policy and developed regulations that, as noted in the introduction, define Maine as a national environmental leader. These efforts provided opportunities in the 1960s and 1970s to professionalize state-level environmental advocacy and to hone activists’ skills in negotiating with both the state and industry about policy, and to understand the complexity of environmental issues and their relationship to the state’s economy. Through these various struggles, the Maine non-profit and environmental advocacy community grew increasingly well-established and professionalized over time. Activists honed their connections and strategies, becoming especially savvy at political lobbying at the State House in Augusta (Judd and Beach 2003). By the late 1990s, the environmental advocacy community continued to gain strength, particularly in its capacity to leverage science, and later to produce science for strategic purposes.

Throughout most of the 20th century, as this history suggests, Maine was a site of production, and activism was directed both toward the state and toward local industries. From these, the advocacy community not only amassed important political capital and experience, but also they devised new organizing tactics, which were borne from hard fought struggles against entrenched business interests. These new tactics were designed to challenge the root problem – that industries could use whatever chemicals they saw fit, with no public input and little oversight from government. If activists could change what chemicals industry uses – make them less toxic – then they could also alleviate the problem of toxic emissions and effluent flowing from the end-of-the-pipe. In this context a new organization and a coalition of public health and environmental organizations emerged to build on these policy wins, and to open a new political space for addressing chemical exposures that steered clear of entrenched debates over end-of-the-pipe regulation.
Maine’s Lifeblood, Revisited

There is very little manufacturing left in the state of Maine, and that’s a sad story. But the manufacturing that we have… NRCM has partnered with state agencies and partnered with business to really do our best to clean up the industries that are still here in Maine. Part of what we’re working on now is to make sure that the products from out of state that those products are made with safe chemicals so that they are not getting got into our homes and poisoning our kids, poisoning our wildlife (Prindiville 2006).

Over the past eight years, as indicated by the quote above, there has been a notable shift in how some environmental activists in Maine talk about and organize around environmental problems. Activists traditionally have emphasized threats to natural resources, but a new contingent of activists now focuses on threats to public health. The emergent focus on human health implications of industrial pollution did not just develop in isolation, rather it grew out of the state’s long standing focus on the implications of pollution for natural resources. The key actors who advanced the public health frame in Maine were former employees of the state’s largest natural resource-focused environmental advocacy organization, the Natural Resources Council of Maine (NRCM).

Previously, activists addressed the industrial pollution of Maine’s rivers by calling out how industry was poisoning the state’s “lifeblood,” a metaphor that figured prominently in the 1958 polemical exposé against the cozy relationship between the state and the pulp and paper industries (Daviau 1958). By the early 2000s, however, activists and state officials have aligned themselves in campaigns to address chemical pollution in the blood of Maine people. Even with the shift in focus from rivers to veins, the legacy of a historical focus on natural resources remains evident in the sentiment of one state employee, who questioned (paraphrased) “when will breast milk and blood be seen as natural resources to be protected?”

At the same time as some within the environmental community realized there was an opportunity to reframe and address chemical exposures, Maine also was reaching the end of a
long period of slow decline and economic transition. Many of the states’ historically most significant point sources for industrial pollution had closed and left the state, some in response to global and economic forces, others, like the HoltraChem Chlor-Alkali plant, in response to prolonged advocacy and state pressure. Fenceline struggles over industrial pollution did not end; rather, the struggle over chemicals in industrial run-off continues today, and in the closing section of this chapter, I revisit this issue. Maine remains a site of production-based exposures, even though the Alliance and its allies have constructed Maine as site of consumption. However, plant closings and a net out-migration of polluting facilities were part of the bigger picture of the period in which Maine created a major shift in organizing and policy priorities.

A New Focus on Chemical Body Burden

In response to increasing data about chemicals in human bodies from the Centers for Disease Control’s National Exposure Reports (2001; 2003; 2005), and from advocacy biomonitoring studies, activists in Maine founded a new organization and advocacy coalition. The John Merck Fund, which supports environmental health organizing, approached advocates in the Maine environmental community about funding a statewide campaign that would follow the lead of Washington State, where activists had begun campaigns to support a broad-based phase-out of persistent bioaccumulative toxicants. In 2002, Michael Belliveau and Amanda Sears, two staff members of the Natural Resources Council of Maine, left the organization to found the Environmental Health Strategy Center, an organization that exclusively addresses environmental public health problems, in particular, the accumulation of chemicals in human bodies.

Belliveau had a history of building coalitions and informing advocacy campaigns by conducting science. Before relocated to Maine, he was the director of Communities for a Better Environment (CBE), an environmental justice organization that focuses on the convergence of environmental, social, and economic injustices in northern California communities such as Oakland and Richmond. These communities face a host of problems resulting from area
industries, transportation corridors, and oil refineries. The organization focuses on health issues as well. While at CBE, Belliveau helped in the development of affordable air monitoring devices that citizens used to challenge local industries. Citizen air monitoring — called “bucket brigades” — relied on materials readily available at local hardware stores. Belliveau brought to Maine a long history of site of production struggles, and experience using science in an advocacy context.

Reducing body burden would be at the heart of EHSC’s organizational mission:

We believe that government and corporations must be held accountable to halt the trespass of our bodies, workplaces and communities with toxic pollutants… The Environmental Health Strategy Center aims to phase out the persistent toxic chemicals in Maine within a single generation. We will know we have succeeded when freshwater fish are safe to eat again, when drinking water from wells no longer presents harm and when dioxin and other toxic residues are absent once more from our food supply. Our mission will be accomplished when the greatest lifetime exposure to persistent toxic chemicals no longer occurs during the breast-feeding of our babies (Environmental Health Strategy Center 2002).

Once established, EHSC’s first task was to ally the state’s environmental, public health, health professional, religious, and patient organizations, in order to bring public health framing to environmental issues in Maine. EHSC organized eleven statewide groups33 into a diverse, statewide coalition called the Alliance for a Clean and Healthy Maine, whose central organizing principles have been endorsed by an additional forty state groups.34 By uniting the environmental community with the public health community, coalition leaders argued they could sidestep many of the stereotypes weighing down environmental action in other arenas where decades of resource- and conservation-based efforts, as one area advocate suggested, had been pigeon-holed

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33 Member organizations of the Alliance for a Clean and Healthy Maine include: Environmental Health Strategy Center; Learning Disabilities Association of Maine; Maine Conservation Voters Education Fund; Maine Council of Churches; Maine Labor Group on Health; Maine Organic Farmers and Gardeners Association; Maine People’s Resource Center; Maine Women’s Policy Center; Natural Resources Council of Maine; Physicians for Social Responsibility/Maine Chapter; Toxics Action Center.

34 For a list of endorsements, see: http://www.cleanandhealthyme.org/Home/AbouttheAlliance/Endorsers/tabid/63/Default.aspx).
as “tree-huggers” unable to negotiate effectively with those in power. As is the case with the Strategy Center, chemical body burden figures prominently in the central mission of the Alliance:

The Alliance for a Clean and Healthy Maine is a diverse coalition of Maine-based organizations engaged in a public health campaign to phase out the long-lived toxic chemicals that build up in the food web and our bodies. Through a series of strategic issue campaigns, The Alliance is targeting sources of persistent toxic chemicals to be replaced with safer alternatives. Over time, we will seek government and business commitments to phase out the entire class of persistent toxics in favor of clean production (The Alliance for a Clean and Healthy Maine 2007b).

EHSC and the Alliance, in order to address the problem of chemical body burden, focused on a particular class of chemicals that were known to persist and accumulate in the environment, in foods, and in the human body: persistent bioaccumulative toxicants, commonly referred to as PBTs. EHSC and the Alliance would later focus their attention on a wider class of substances that could be measured inside the human body through biomonitoring, even though those substances were not bioaccumulative in nature, such as phthalates. At the outset, however, their initial focus on both persistent and bioaccumulative toxicants, such as mercury and later brominated flame retardants, also signaled another important shift. These groups were part of a broader trend in which environmental organizing addressed an entire class of substances that share common characteristics or properties, rather than organizing against a single polluter or pollutant.

“Home is Where the Harm Is:”35 Emergence of Product-Focused Environmentalism in Maine

During the summer of 2006, in advance of the state legislative elections, the Maine People’s Resource Center, a member of the Alliance for a Clean and Healthy Maine, organized a multi-faceted campaign to raise public awareness about chemical exposures through everyday products. The reach of their message, spread primarily through door-knocking and petition-signing, was

35 Title borrowed from Belliveau et al 2006.
furthered by a print and radio campaign that challenged the notion of the “all-natural Maine,” a creative play on the “Welcome to Maine: The Way Life Should Be” signs posted along highways that mark the state-line. The ad, which pictures a bright-eyed infant, reads: “Natural ingredients: love, hope, potential. Additives: mercury, lead, and dioxin. Wouldn’t it be wonderful if all children could begin life as healthy as possible – Isn’t that the way life should be?” (Maine People’s Alliance 2006). An accompanying one-minute radio ad, which aired in early summer 2006, began with the sound of a crying infant:

Doctor: Here she is mom, the newest member of your family.  
Mom: She’s beautiful. Just perfect.  
Doctor: Beautiful. All natural and made in Maine.  
Voiceover: A new baby is a beautiful thing. But the chances that a baby born in Maine today is really all-natural are actually very slim. Research has shown that almost all of us Americans, including mothers and their newborn babies, have very unnatural chemicals in our blood streams. That’s why we have to tell our legislators that Maine has to do more to eliminate toxins like mercury, lead, and dioxin from the products we use and the environment we, and our children, live in. To find out what you can do go to www.mainepeoplesalliance.org. Today. For the next generation, tomorrow may be too late.”

Organizers launched these campaigns in anticipation of the 2007 legislative elections. In their print-media, the Maine People’s Alliance (MPA) acknowledged that Maine leads the way in addressing chemical exposures at the state level, but that despite recent progress, more needs to be done. As MPA warned its constituents, “big, out-of-state chemical companies are taking notice and spending millions of dollars to influence legislative votes in our state” (2006). On the organization’s website, The Maine People’s Alliance notes, “the makeup of the legislature in 2007 and 2008 will largely determine whether or not we can pass meaningful legislation addressing this issue. By showing public support for our environmental work we will be able to

make sure that candidates for office know how Mainers feel about toxics in the products we buy” (2006). In combination with the large Alliance for a Clean and Healthy Maine, their petition was three-pronged: to push legislators to establish a chemicals policy that (1) mandates corporate accountability for health and safety testing of all chemicals used in consumer products; (2) requires replacement of unnecessary chemicals with safer, affordable alternatives; and (3) ensures that all consumers have the right-to-know about chemical ingredients in common products.

The focus of the Alliance organizations on chemicals in consumer products, as indicated in the above print and radio advertisements, was not born from an initial concern about what consumers were exposed to through the products they buy, bring into their homes, or use on their bodies. Rather than an end goal, the focus on chemical exposures through consumer products was a strategic emphasis and a new entry point into a broader conversation about how chemicals are used and regulated.

Nor were these tactical shifts inevitable or born from a single moment. Rather, there was, as one activist noted, an evolution over a span of two to three decades of environmental organizing. These shifts developed over time, as activists in Maine, and nationally, increasingly recognized that there were converging economic and political opportunities that enabled them to push chemical policy reform through the consumer product issue.37 The focus on chemicals in consumer products was a strategic choice that activists arrived at over time through their early campaigns against PBTs, and, in particular, mercury. As EHSC and the Alliance launched their first campaign against PBTs, activists realized that new, more comprehensive approaches were

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37 The ability of Maine activists to capitalize on these opportunities was supported by the dense networks of activists and scholars to which EHSC and the Alliance are connected. EHSC is a well-connected organization, with personal and organizational ties to several regional, national, and international networks of professional environmental health NGOs, for example, the international coalition, Health Care Without Harm. Likewise, EHSC maintains and develops additional connections through the foundations that support its work and daily operations. EHSC’s everyday operations are funded by an umbrella organization, the Tides Center, that supports NGOs with select missions; it is also supported by another foundation-supported network of NGOs and individuals who do chemicals policy work. Some of the connections are reflected in the organization’s board of directors, others in the reach and depth of collaborations, for example, with a network of activists and scholars working to push chemical policy reform. Their collective vision for reform, for example, is articulated through the Louisville Charter for Safer Chemicals, of which EHSC was both a participant and signatory member. For more about the Louisville Charter, see: http://www.louisvillecharter.org.
necessary, especially considering that traditional methods of appealing to regulators had never been effective. Challenging chemical residues and additives in consumer products became a way to highlight gaps in both the state and federal regulation of chemicals.

In Maine, the focus on consumer products developed through the Alliance’s early efforts to address mercury exposures, which were, previous to the Alliance’s formation, a priority concern in Maine due to large-scale contamination downriver from a former chlor-alkali plant, and fish contamination resulting from long-range transport and deposition of mercury in Maine’s interior rivers and lakes. As the Alliance launched their first campaign against mercury, they realized two important political opportunities to challenge how mercury is used and regulated.

First, the Alliance realized that key decision-makers in Maine were concerned about the constituents of downstream-user and commercial waste. EHSC and the Alliance used this concern to establish a focus on regulating the purchasing and disposal of mercury-containing products. One Alliance member offered the following insight into the realization that consumer products were a powerful way to move an otherwise stagnant issue:

There’s no corresponding state program for Toxic Substances Control Act [as there is with other federal legislation, such as the Clean Water Act]. And so what’s happened instead is the state agency interest in regulating products--first of all, historically, it’s an orphan. There’s no – has been no role for the state to do that. But where we’re able to encourage the state… is on the waste side. Because states do deal with solid waste, they do deal with hazardous waste, that is delegated from the federal government… Products become waste. Products are a waste at the end of their useful life. It’s a volume problem; it’s also a toxic problem.

So, states get that… How Maine got into mercury products, was on the basis of… yes, mercury got into the air, and it got into the water, and it got into the fish, but they could deal with the products in the waste stream, people throwing products in the trash. And so, one of the powerful mechanisms in that mercury products law was a disposal ban, which said that it shall be illegal for anybody, including you and, I, and individual residents to throw any mercury-containing product in the trash. Now, naturally, how can we enforce a law on every individual? But the point was that – to say that – the use of – the very us – of
these chemicals results in them being dispersed into the environment, in significant parts for disposal….

And so it was the disposal side that gave the state agency the opening, the encouragement to say, "Oh, yeah, I guess we can regulate these products, because these products are causing a toxicity problem in our waste stream."

As suggested in the previous extract, advocates leveraged the most pressing concerns and regulatory capacity of the state – contaminants in the waste stream – as a touchstone. This opened up the possibility for states to extend their jurisdiction and their definition of environmental pollutants to consumer products.

Second, when raising concerns about mercury in products, activists found that the legislature was willing to not rely on traditional methods of risk assessment for weighing the potential hazards such products posed. During public hearings on mercury-products legislation, industry and industry-hired experts argued that the state should not regulate mercury in thermometers, for example, until the state could first quantify, through risk assessment, how much risk mercury thermometers pose to the environment and public health. Once risk was quantified, they argued, then, and only then, the state could determine whether or not mercury thermometers pose enough of a risk to warrant regulation. However, in a surprising shift, the legislature decided that risk assessment was not the best process for determining action. One activist recounted:

The state committee rejected [t]his argument, and the bill passed, and related bills passed after that. And that was a break in business as usual, because… in a major new substantive way, the state – the policy makers were saying “No, risk assessment is not the tool that we’re going to rely upon. Instead, we’re going to say, “Does the chemical pose a serious hazard?” Is the chemical inherently hazardous, and do we have enough evidence of exposure, and enough evidence of the type of harm it might pose? We’re not going to use quantitative risk assessment. Instead, the debate was shifted to not whether the risk was acceptable, but is there a safer alternative? And once that question was answered, that yes, in fact, there were many mercury-free alternatives to thermometers and thermostats and other mercury products, it was straightforward then for them to
say okay, let’s make certain that those products can no longer be sold in the state of Maine if they contain mercury.

This marked a significant political opening for the Maine environmental health advocacy community. However, the shift from making policy decisions based on calculating risks versus considering whether there are reasonable, less harmful alternatives is not new, just uncommon. Increasingly, however, alternatives assessment is gaining traction especially in state level policies as a decision-making framework that guides weighing a range of alternatives to chemical use, including not using them at all (O’Brien 2000).

Thus, as the mercury products campaigns moved forward, over time EHSC and the Alliance’s focus on PBTs narrowed further – to an exclusive focus on consumer and household products that contained or harbored residues of PBTs. Activists found themselves on new ground; by challenging chemical exposures through campaigns focused on consumer products, activists were no longer engaging in traditional defensive, reactive style environmentalism. Since the policy victories of the 1970s, the environmental health and justice advocacy network has largely been on the defensive, fighting for enforcement of federal and state laws and regulations, or against deregulation, weakening enforcement, and lax oversight. Now, they could engage the problem of chemical exposures strategically. The opportunities afforded by the focus on consumer products, thus, was multifold:

With a broader chemical focus, fewer industrial opportunities [to challenge them], and also a strategic decision to avoid picking political fights with powerful in state business interests, like the pulp and paper industry, where a bitter campaign had been fought in the 1990s to try to reach totally chlorine-free bleaching paper had fallen short of its goals… we saw that by focusing on consumer products, there would be many benefits. All kinds of chemicals of concern would be addressed that increasingly there was very strong evidence of lots of exposure being in the home.

Instead, through their experience challenging mercury by focusing on its use in select consumer products, the Alliance saw how they could build momentum, consensus, and political
resolve to address mercury more comprehensively. As well, through the mercury product campaigns, the Alliance learned that they could build coalitions and consensus by framing mercury as a public health problem, rather than exclusively a problem relevant to wildlife. One activist noted that this “put a human face” on what was previously seen in Maine as pertaining to only wildlife, and thus a more abstract or distant concern for people. The Alliance’s reframing of environmentalism as concerned principally about human health draws from a long-standing, but often less visible thread of environmentalism that dates at least to the Industrial Revolution, and to Progressive Era health activism by Jane Adams and Alice Hamilton (Gottlieb 2005).

Professionalization of public health and conservation led to the bifurcation of these two fields. Conservationism and natural resource protection, that is, nature and wildlife-oriented environmentalism, was better funded and more visible in the United States until the 1970s, when the hazardous waste and environmental justice movements gained in size and national presence. These movements moved the human-populated environment and health concerns front and center, and for the first time since the Progressive Era, health and environmental concerns merged once again. As these human health-focused groups blossomed across the country, their concerns merged with major, health-focused movements, such as the US environmental breast cancer movement, who adopted an environmental perspective by seeking more research on and recognition of what role environmental chemicals played in disease etiology. From these, emerged a broader, environmental health movement (Brown 2007). Thus, what played out in Maine between the environmental and public health communities reflected a trend that was happening nationally.

Once the Alliance was able to establish allies and consensus around acting on mercury, they did so again, by addressing the presence of arsenic in pressure-treated wood commonly used in parks and children’s play structures. The arsenic campaign allowed the Alliance to reaffirm the main messages first established during the mercury campaigns, and to recruit new allies. As summarized by an Alliance member:
[We organized] a series of short term winnable issue campaigns that motivate[d] people and promote[d] the concept of the problem and the solution and the success. We’ve been building towards pushing for comprehensive chemical policy reform, and it’s definitely within reach now… [We’re] building a consensus around this and moving forward.

Political opportunities within the state made a focus on chemicals in consumer products both compelling and successful. Activists designed campaigns to politicize the broadest possible base of constituents to support policy changes that would restrict chemicals that posed a bioaccumulative risk, particularly for women and children. These campaigns played well within Maine, given policy-makers’ and residents’ strong commitment, regardless of political background, to environmental issues and preserving Maine’s ample natural resources. As well, the campaigns were designed to restrict specific uses of select chemicals and were winnable, given local political opportunities. For example, campaigns focused on products and chemicals used or produced by industries with a minimal political or economic presence in the state. This helped make public campaigns over product-focused policy initiatives a public relations battle between Mainers (i.e., insiders) and outside lobbyists. For example, this was the case both in 2004 and 2007, when the legislature considered – and enacted – two bills to restrict the sale of electronics and furniture in Maine if these products contain a particular class of flame retardants, polybrominated diphenyl ethers, or PBDEs, which are not produced in Maine, nor intensively used by industries located in Maine. The PBDE campaigns also succeeded because they moved on chemicals for which market shifts were already compelling industry laggards who had not previously made the move. As a result, manufacturers of televisions, for example, that once used brominated flame retardants but were willing – or had already switched – to use other flame retardant formulations, did not challenge the bill.
BODIES AS EVIDENCE: THE FIRST STUDY OF POLLUTION IN MAINE PEOPLE

Science has been a critical component of the Alliance’s organizing against unregulated chemical use in consumer products. During its earliest campaigns, the Alliance and its member organizations relied on biomonitoring data from the CDC and other advocacy organizations, like the Environmental Working Group, to define their mission and focus their organizing. For example, in 2004, public testimony submitted by EHSC and NRCM staffers presented data regarding the rising level of brominated flame retardants in US women’s breast milk to support proposed state legislation to restrict the sale of household goods containing two commercial formulations. For these early campaigns, the Alliance did not have specific data on Maine body burdens, but instead relied on national body burden data reported by the Centers for Disease Control’s National Exposure Report (2001; 2003; 2005).

More than relying on data others collected and analyzed, the Alliance and EHSC also have carried out research projects, including participating in a multi-state study of chemicals in house dust (Costner et al. 2005). As well, EHSC staff used dust wipe kits, provided by the Environmental Working Group, to test for arsenic on playground equipment, decks, and other structures made with pressure-treated woods. It was not, therefore, a huge leap for the Alliance to follow in the footsteps of so many other environmental health advocacy groups in the U.S. by conducting its own pilot survey of chemicals in Maine people.

In 2004, the nine steering committee members of the Alliance for a Clean and Healthy Maine decided to coordinate a small pilot project whereby a diverse group of Mainers would have their blood and tissue samples tested for a given set of chemicals prevalent in the consumer economy. The Alliance was hoping to contract with a project manager, initially and ideally, outside of the Alliance, but they could not find someone with the background in science, organizing, and policy. In August 2005, EHSC took on the project management, and recruited help from three research assistants from Physicians for Social Responsibility, NRCM, and the University of Maine. The Alliance also convened a biomonitoring steering committee comprised of representatives from its
member organizations. The Alliance steering committee consulted with three additional advocacy organizations with expertise in conducting biomonitoring and public communication of the results: The Environmental Working Group (Washington, D.C.), The Commonweal Biomonitoring Resource Center (California), and Washington Toxics Coalition (Washington), that latter of which had recently conducted a state-level biomonitoring pilot project.

The Alliance, as one project member explained, orchestrated the project, and contracted or consulted with scientists, phlebotomists, and private laboratories to assist with data collection and analysis. The Steering Committee and project managers recruited additional expertise and scientific oversight from local networks to identify the technical support and consultants they needed, as a secondary goal of the study was to highlight the scientific and medical expertise and infrastructure within Maine. They invited a long-time practicing family physician in Maine with ties to the Harvard School of Public Health to serve as the principal investigator. A scientist from the Center for Integrated and Applied Toxicology at the University of Southern Maine was also recruited to consult on the project and to help usher the project through ethical review by the University of Southern Maine’s Institutional Review Board and Office of Research Compliance. Together, they also oversaw chemical selection, data collection, selection of and communications with laboratories, and conducted and translated data analysis for the project team and study participants.

The University of Southern Maine’s Institutional Review Board oversaw ethical review of the study, which presented the IRB with a novel proposition. The study participants, after receiving results about what the analysis found in their blood, hair, and urine, would be invited to speak publicly about their experiences in the study and the final report would release individual results alongside biographies and photographs of each participant. In order for the IRB to approve a situation where participants would give up their confidentiality voluntarily, the Board requested a two-staged informed consent process. The Alliance gained each participant’s consent before drawing biological samples, understanding that they would receive personal results and an
opportunity to speak one on one with the principle investigator, a family physician, who would help them interpret their findings based on the environmental health survey they completed. Then, once the results were reported to the participants, and participants had an opportunity to consider the meaning of the results in consultation with the PI, the research team approached the participants for a second round of informed consent. All participants eventually consented to the public release of their information, though one participant reportedly took a bit longer to make that decision.

With their Body of Evidence project, which was released in June of 2007, the Alliance wanted to contribute the first-ever snapshot of chemical exposure and accumulation in Maine people as a way to contribute more knowledge to the growing understanding between “our relationship with the chemicals in the world around us” (Alliance for a Clean and Healthy Maine 2007a: 8). Though one staff member noted that the study was designed as a “research project with a public education component” rather than an “advocacy study,” the study had clear implications for advocacy. This was an explicit attempt to conduct compelling science for the purposes of moving public debate and building a wide network of committed constituencies who would help push environmental health policy and chemical policy reform in Maine. The Alliance, as noted in the final report, chose to release the results to “elevate public discussion about pollution in Maine people and promote action to fix our broken safety system that allows chemicals to build up in our bodies” (Alliance for a Clean and Healthy Maine 2007a: 8).

Yet, among those collaborating on the project, there was a contrast “push and pull” between the scientific and political aims of this study. This manifested itself in the Alliance’s difficulty to find staff with both the political and scientific experience to oversee the project from data collection through report-writing. Those with more advocacy and organizing experience found themselves in new territory, as they wrote research protocols, ushered studies through ethical review, and maintained the strict chain-of-command necessary for handling biological samples for chemical analysis. Those more familiar with science invested an inordinate amount of time
devising effective strategies to convey the results to participants in a meaningful way. The most significant tension between science and advocacy occurred around the project timetable, since data collection and analysis were far more trying and drawn-out than anyone on the team had suspected. There were many unanticipated hiccups along the way, such as the samples getting held up at the border, where they had to undergo inspections before being sent on to the Canadian lab for chemical analyses. There, three samples defrosted and subsequently had to be recollected, which pushed back the timetable and made it hard to coordinate the release with other events in the political arena.

The chemical selection process also involved a careful weighing of funds available, how much similar studies had cost, and the political import of various categories of chemicals. After much deliberation among Steering Committee members, in consultation with the PIs and other consultants, the project tested blood, urine, and hair samples for the following categories of chemicals: the flame retardant, polybrominated diphenyl ethers; perfluorinated chemicals, which are used in the production of stain-, water-, and grease-resistant surface coatings; heavy metals, including lead, methylmercury, and arsenic; and several plastics additives or their metabolites, including phthalates and bisphenol A. In all, the project screened the donated samples for seventy one chemicals, finding forty-six different substances, thirty-six on average in each participant’s samples (Alliance for a Clean and Healthy Maine 2007a). The Alliance selected this suite of chemicals if they fell under one of the following three categories. They were either (a) considered “emerging contaminants”38 that is, not necessarily a new chemical, but understood more recently as potentially problematic for human health; (b) because they persist or bioaccumulate; or (c) because they may pose a threat to human health at extremely low or trace

38 Emerging contaminants, broadly defined, are synthetic chemicals that have entered the human or natural environment, but that have not previously been regulated or monitored (environmental or biological). “Emerging” signifies that the chemical only recently has been recognized as potentially concerning or deserving of regulatory and/or policy attention. In some instances, emerging chemicals may have been used for a long period, but their consequences were unstudied and thus unknown. New evidence of human exposure or toxicity could flag the attention of scientists, policy-makers, and regulators attention. In other instances, new synthetic molecules are created or new processes initiated that create new contaminants never-before released into the environment.
levels. Furthermore, these chemicals were selected because they were “politically in play” or had “policy relevance,” according to the Alliance. These were compounds recently added to the list of chemicals monitored through the National Exposure Study, conducted by the US Centers for Disease Control, or else they were under regulatory and policy scrutiny at either the state or federal level. Most importantly, the “chemicals were chosen because they are found in common products that are part of our modern lifestyle… Only in the last decade have scientists and doctors discovered that some chemicals, like brominated flame retardants and fluorinated stain-resistant coatings, move from the products in which they are used into the environment and into humans.” (The Alliance for a Clean and Health Maine 2007a: 9). As a result, the study’s focus fit well with the Alliance’s strategic priority to highlight that the chemicals found in human bodies are also those used without regulatory oversight in consumer products.

It is also important that by the time the study was completed, in mid-2007, the state had enacted policies or regulations addressing many of the chemicals included in the Body of Evidence study, including arsenic, lead, mercury, and brominated flame retardants. This fact may seem surprising, given that many studies by advocacy organizations, like the one conducted by the Commonweal Biomonitoring Resource Center (2005), were conducted to move policy, in this case, to spur along a state-wide biomonitoring surveillance program. However, in this case, the study fit within the Alliance’s overall strategic plans a bit differently. Thus, when the report finally came out, the Alliance was able to highlight that comprehensive policy reform is the next step to address body burden. That is, although Maine acted on some substances in some products, it did not act on all substances in all products. The study, then, could challenge the chemical-by-chemical policy approach, since Mainers’ bodies were still harboring traces of mercury and the brominated flame retardant formulations, penta and octa. The Alliance presented the presence of chemicals for which Maine already acted, albeit in a limited fashion, as necessitating the need for more sweeping reforms to remove the substances from the marketplace altogether. The study also noted that while Maine has acted on a handful of chemicals, there are
hundreds more, like perfluorinated compounds, that Maine has not considered. Finally, and perhaps most significantly, by featuring chemicals for which Maine was already an established leader, the report appealed to the pride of policy-makers and citizens in Maine’s initiative and leadership to motivate future action.

These chemicals were tested in samples donated by thirteen volunteers from throughout the state, all long-time residents of Maine. Participants were selected to achieve diversity in gender, age, occupation, and geographic region, with the final sample included an urban high school student, a nurse, an organic farmer, and two state legislators (a Democratic member of the House, and a Republican Senator), along with eight others. The goal was never to collect a sample large enough to achieve statistical significance; rather, as noted to me by one project team member, the goal was to collect a sample that allowed for the results to be “emotionally significant” and salient to Maine, since no such analysis had been conducted before. As this collaborator noted, even still, a small-scale study stood to contribute much to science, since at least in the context of medicine, single case studies have long been used to signal where researchers should next focus their attention.

In early summer of 2006, the research assistants helped participants donate a lock of hair, a urine sample, and several vials of blood, which were collected by a licensed phlebotomist. Each participant also completed an extensive health and environmental health survey designed by the PI, Dr. Donahue, who later used the surveys to help interpret each participant’s results to the fullest extent possible.

Nearly a year following sample collection, participants were given an elaborately compiled binder with their personal results, plus information about the chemicals and the study more generally. To ease participants’ understanding of the data, each chemical family was color-coded and all supporting materials with information about that chemical appeared with the same color print. For example, all materials about burdens of lead appeared in green, all materials about flame retardants in brown. Each participant’s results also were presented in comparison to others
in the study, a strategy to help the participants interpret their results in the absence of health or toxicity information (see Figure 6-1). After receiving their results and speaking at length with Dr. Donahue about them, all thirteen participants consented to speak publicly about their results.

| Chemical Pollutants in Maine People: A Pilot Survey |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| YOUR RESULT | Maine Median | Maine Max | Maine Min | CDC-NHANES | COMMENTS |
| PBDE’s (ng/g lipid) | YOUR RESULT | Maine Median | Max | Min | COMMENTS |
| #15 (IUPAC#) | 0.439 | 0.144 | 0.6 | 0.06 | Source: Flame retardants in furniture cloth, foam, TV’s, computers and carpeting. |
| 17 | 0.154 | 0.08 | 0.5 | 0.037 |
| 28 | 0.9 | 0.694 | 2.2 | 0.35 |
| 35 | 0.102 | 0.07 | 0.48 | <DL |
| *47 Flame Retardants | 8.38 | 8.38 | 33.5 | 2.9 | (34) (US sample median study 2001) |
| 48,49 | 0.136 | 0.1 | 0.275 | 0.05 |
| 60 | 0.122 | 0.122 | 0.506 | 0.05 | Your blood had all 14 PBDEs tested. |
| 85 | 0.177 | 0.148 | 0.745 | 0.05 | Overall your levels were average for Maine sample. |
| 99 | 2.21 | 1.87 | 9.28 | 0.99 | However, your fat soluble PBDE’s were higher, suggesting high previous exposure in the past but lower exposure now. |
| 100 | 1.55 | 1.55 | 7.23 | 0.454 |
| *153 | 4.84 | 4.06 | 15.3 | 1.4 |
| 154 | 0.2 | 0.2 | 0.746 | 0.1 | Note: There are no national levels available yet for PBDEs. |
| *183 | 0.297 | 0.328 | 1.4 | 0.147 |
| 203 | 0.19 | 0.134 | 0.3 | 0.1 |
| Total PBDE’s | 19.697 | 19.7 | 59 | 6.8 |

**Figure 6-1.** One section of the results tables presented to each of the thirteen participants in the Body of Evidence project. Results like these were accompanied by a binder of information instructing participants how to read their results as well as information about each chemical for which the study tested. Prepared by the Principle Investigator, Dr. Rick Donahue (2007).

The final report, *Body of Evidence: A Study of Pollution in Maine People* (2007a), and the accompanying website (www.cleanandhealthyme.org) pictured each participant alongside basic biographical information and the levels of each chemical found in their bodies. For example:
Dana Dow, 56, is a Republican state senator who represents his hometown of Waldoboro and 20 other towns in midcoast Maine. He is serving his second legislative term and sits on the Marine Resources and Labor committees. Married with four children, Dana also owns a furniture store. Dana had the highest levels, and most different types, of perfluorinated chemicals (PFCs), the Teflon chemicals. Senator Dow’s levels were more than twice the national average for PFOA and several other PFCs (The Alliance for a Clean and Healthy Maine 2007a: 5).

Participants’ involvement went beyond putting a face on the exposure data; the majority of participants also spoke publicly about their results, adding their own interpretations of what the results, and participating in the study, meant to them. Participants spoke to the local print and television news media at a press event held at the State House. A subset of participants also gave presentations during a policy teach-in, which took place at one of Maine’s most significant, annual cultural events, The Common Ground Fair. For consenting to be a part of such a novel study, and for sharing their results publicly, the final report heralded the participants as “environmental health heroes” (The Alliance for a Clean and Healthy Maine 2007a: 2).

In June 2007, the Alliance, along with many of the study participants, presented the results and final report, Body of Evidence, to a standing-room-only press event at the State House. That morning, the Kennebec Journal featured a full-page, color ad announcing the study. The Alliance’s ad depicted three study participants as chemical-soaked sponges to symbolize how bodies – unknowingly and involuntarily – soak up chemicals from their ambient home environments (see Figure 6-2). The Alliance also extended the analogy to highlight how the public bears not only the burden of chemicals in their bodies, but the fiscal burdens of their environmental and public health consequences. The ad read: “The costs of toxic chemicals aren’t absorbed by the companies that made them, they are absorbed by you.” (The Alliance for a Clean and Healthy Maine 2007c). To further play on the Alliance’s main message, at the press release, the Alliance distributed sponges (see Figure 6-3) printed with the slogan: “ring your legislators”
to “wring out dangerous toxic chemicals in Maine,” along with copies of the 60-page, color report (see Figure 6-4).

**Figure 6-2.** Advertisement placed by the Alliance for a Clean and Healthy Maine, which appeared in color in the June 12th 2007 edition of the Kennebec Journal, a daily newspaper that services Augusta, the state capitol, and surrounding regions. The ad appeared on the same day the Alliance released the results from their Body of Evidence project.
Figure 6-3. The Alliance for a Clean and Healthy Maine distributed these sponges during the June 2007 press conference to release the results of their Body of Evidence project. The event was held at the State House in Augusta, Maine.

Activists reported that the level of news coverage was unprecedented, given previous experience working on environmental health issues and policy in the state. One activist described the coverage as “the most effective media event [she] ever worked on.” Results were also conveyed to the public through front-page news articles in all of the state’s daily papers, many
above-the-fold and featuring large, color photographs of the participants. The news media covered the study for nearly a week after the report’s release. A sampling of headlines read:

- Measuring our Toxicity: Study Shows Everyday Items Expose All of Us to Pollutants (Hickey 2007a).
- Pollution Gets Personal: Study in Maine Finds Modern Living Carries a Toxic Price (Hickey 2007b).
- Many Products May Pose a Risk: Study Finds 36 Toxic Chemicals in Bodies of Mainers Tested (Huang 2007).
- Chemical Trespass in Our Bodies (Editorial Board, Kennebec Journal and Morning Sentinel 2007).

Radio and television news programs also picked up the story, some several months after the data release (e.g., “Body of Evidence,” Radio Program, Maine Center for Economic Policy, “State of the State,” aired October 2, 2007). All featured the participants, who offered scientific and political narratives about their experiences. In particular, the news media tended to focus on participants whose body burdens were perhaps the most unexpected, including: Hannah Pingree, the 30-year old House Majority Leader, Russell Libbey, the head of Maine’s organic farming association, and Dana Dow, the Republic Senator/furniture store owner.

More astonishingly, given the level of public debate over the significance of biomonitoring data and the public criticism industry has made against studies conducted by other environmental groups who conduct such projects, there was little challenge or critique from the chemical

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39 For example, the Environmental Health Research Foundation received support from the American Chemistry Council, the and national trade association for the US-based chemical and plastics industries, to develop a web-based information clearinghouse on biomonitoring (see: http://www.biomonitortinfo.org/aboutSAC.html). On that site, EHRF has posted several commissioned commentaries and rejoinders to studies conducted by environmental health organizations like the Natural Resources Defense Council and the Environmental Working Group. For example, Dr. Elizabeth L. Anderson of Sciences International, Inc., a consulting firm for
industry in the Maine press coverage. Some in the advocacy community suspected industry
groups, who do not have a significant financial or political presence in the state, were caught off
guard by the Alliance study, and therefore did not have a coordinated public response. However,
the study likely put Maine on the chemical industry’s radar; a representative of the American
Chemistry Council flew from New York to Maine to attend each subsequent meeting of a blue
ribbon panel convened by Governor Baldacci to think about chemical policy and consumer
products.

The Body of Evidence project was completed during a critical policy window, when statewide
and broad-based support for the coalition’s activities stretched from the governor’s office to the
state’s non-profit, public health advocacy organizations, and perhaps most interestingly, to locally
based industries. Both the personal product manufacturer, Tom’s of Maine, once a locally owned
company, now a subsidiary of multi-national Colgate-Palmolive, and InterfaceFABRIC, which
manufactures synthetic fabric from bio-based plastics, were represented on the Governor’s Task
Force on Safer Chemicals, as was the Environmental and Energy Technology Council of Maine, a
Maine business association. Representatives employed by these companies and associations were
present during the deliberations of the Task Force and helped formulate a set of policy
recommendations for the Governor’s office for proposing state-level comprehensive chemical
policy reforms (described in a subsequent section). Thus, the study reinforced the direction the
coalition was moving in already, and due to how the Alliance framed the issue of Mainers’ body
burdens, which is described next section, the project served as a catalyst for additional coalition-
building and policy advocacy.

industry, law firms, and the government sectors specializing in environmental health sciences, who serves on the website’s Science
Advisory Council, authored “Limitations and Uncertainties of Biomonitoring Surveys Conducted With Small Populations,” which
refutes the scientific merits and public health implications of small scale, pilot projects conducted by advocacy groups, such as the
Environmental Defence Canada (Note: EDC purposely spells defense with a “c”.) The site also published a commentary responding
to Environmental Working Group’s 2005 study of cord blood that was written Dr. Charles A. McKay (University of Connecticut
School of Medicine), another member of the site’s Science Advisory Council. (Both of these responses, and others, are available at:
http://www.biomonitoringinfo.org/new/index.html. Last accessed on 11 March 2008.) Dr. Charles A. McKay was one of two
“experts” who appeared in the Maine media to offer alternative interpretations of the Alliance’s report.
IMPLICATIONS: MAINERS’ BODY BURDENS AS BOTH PROBLEM AND OPPORTUNITY

In the final report, and in interviews and public events, the Alliance framed the results as inherently problematic, regardless of the level of chemicals detected in the samples. Their interpretation underscored that, in many instances, it was not possible for scientists to know what specific levels of each chemical might mean for participants’ health. That uncertainty was leveraged as reason to act immediately to restrict the use of these substances and reduce population exposures. Second, rather than focusing on the possible significance of the concentrations or levels detected, the Alliance problematized that chemicals were detected at any level and moreover, and highlighted the number of different chemicals found. Finally, though it is not yet known whether the results might indicate a current or future health problem, the Alliance argued that the results were nevertheless interpretable, meaningful, and most importantly, immediately actionable.

Body burden was, in their framing, a problem that results from a failed policy and regulatory system, a lack of sufficient data, and a production system that relied on questionable or harmful substances without pursuing alternatives. To put it in the language of the Alliance, which draws from the conclusions of a policy report written by Dr. Michael Wilson (University of California at Berkeley), the body burdens borne by these Mainers signal the presence of a safety, technology and information gap (Wilson et al. 2006) that results from a broken “safety system for industrial chemicals.” (The Alliance for a Clean and Healthy Maine 2007a: 4). First, there is a “safety gap” because under current chemical policy “industry is not required to demonstrate the safety of chemicals before adding them to consumer products, nor are they required to use safer alternatives to chemicals known to be hazardous” (The Alliance for a Clean and Healthy Maine 2007a: 4). Second, absent testing or labeling requirements, a “data gap” prevents the public and commercial end-users from the right-to-know what chemicals are in consumer products. Finally, without policy incentives and adequate fiscal backing from government, the Alliance argues there is also a “technology gap;” there is little incentive for industry to move away from business as
usual and switch to, or invent, safer alternatives of chemical feedstocks and additives. Close these three gaps, the Alliance argued, and Maine can take a major step toward resolving the problem.

The Alliance framed Mainers’ body burdens as a problem that requires Maine politicians to act, and Maine citizens to spur them to action. This is an important point, especially since the Alliance’s campaigns could be mistaken as geared toward altering what products consumers buy and use. Yet, the Alliance still had to engage consumers and address concerns about reducing personal exposures to chemicals. Encouraging people to act collectively often requires a first stage of addressing their concerns as individual consumers. Subsequently, advocates then can “help them take the next step.” As one Alliance member reflected:

I don’t consider what we do to be consumer advocacy… Our purpose is not to educate consumers, although we do that anyway, but, we always try to educate so as to organize people… so the education work is just tactical, to move issues and people, and to move people into action. So, it’s not about… green living, green purchasing – which typically requires you to be more educated and more affluent to even participate in that approach. That’s not the answer at all. Any concerned person, who may or may not be politically active – the first thing they want to know is, “I’m really concerned about that, what can I buy instead?” or “how can I go, what can I do to reduce?” And so we do provide that information, but that’s not the purpose at all. The purpose is to get the chemicals out of commerce and to hold the chemical industry accountable. That we find these in people’s bodies, that gives us a very powerful position to work from.

Once the Alliance flags the attention of consumers, they can begin to help them transform themselves into active citizens. As noted by EHSC’s Michael Belliveau during the Teach-In at the Common Ground Fair, “we can’t lifestyle our way out of the problem. We need to fix the system, and that requires changing policy, which requires taking political action” (quoted in English 2007). He urged the audience to join the Alliance, by questioning what’s in their products, and to phone their state representatives:
Tell them you heard about the study at the Teach-In, and you’re very concerned about chemicals and their effects on children’s health. Ask: “What are you going to do about this?” Tell them you also heard that Rep. Hannah Pingree is going to introduce legislation in January to request that children’s products have no toxic chemicals in them, and ask, “Will you support this legislation?” (see English 2007)

The Alliance’s message went beyond defining Mainers’ body burdens as problematic or requiring solely a political response. They argued that the results point to a series of interconnected scientific, political, and economic opportunities that Maine could capitalize on through strengthening existing alliances, building new coalitions that reach across the public and private sectors, and most importantly, through funding and carrying out innovative science to design new chemical feedstocks that are safer and will not accumulate in bodies.

This section describes how the Alliance used their results and construed the public and environmental problem of chemical body burden as a political, scientific, and economic opportunity for the state of Maine. More specifically, I describe how The Alliance employed the results in three ways, in each instance to build connections between individuals, organizations, and sectors to take advantage of these perceived opportunities. The biomonitoring project was part of an overall strategy: (a) build support behind specific legislative initiatives to phase out select biopersistent chemicals from the Maine marketplace; (b) then to move toward proposal of more comprehensive, state-level chemical policy reform; and, finally (c) to spur a public-private initiative to back green economic development initiatives that would foster green chemistry, engineering, and production in Maine. In all of these initiatives, the issue of chemical body burden, and specifically, the results of the Alliance biomonitoring project, brought together – then reinforced – a unique coalition of groups and organizations.
Biomonitoring Supports Passage of Novel Chemical Policy

In 2004, the Maine legislature, by a large margin, enacted LD 1790, an Act to Reduce Contamination of Breast Milk in the Environment from the Release of Bromine Chemicals in Consumer Products. This was one of the first restrictions on the sale of consumer goods treated with two commercial mixtures of the polybrominated diphenyl ether flame retardants, commonly referred to as “penta” and “octa,” referring to the number of bromine atoms contained in each formulation. Furthermore, the law stated the legislature would again revisit the topic of bromine flame retardants. As stated in the 2004 legislation, should the state Department of Environmental Protection identify a safer and readily available substitute, the legislature would extend the restriction to a third, and more widely used, deca formulation. In 2007, after the DEP confirmed the plausibility of alternative, phosphorus-based flame retardants, the same legislator to co-sponsor the 2004 bill, House Majority Leader Hannah Pingree (Democrat, House District 36), introduced a second bill with two aims. First, it would phase out the use of deca in television sets sold within Maine by 2010, and it would restrict the sale of mattresses and furniture treated with deca. Pingree’s goal was to reduce exposures to deca by restricting its use in household products most commonly treated with the flame retardant.

After passage of the penta and octa restrictions, but before introducing the follow-up legislation on deca, Pingree had been one of the thirteen Maine residents to donate hair, urine, and blood samples for analysis. The final results, however, were not ready for public release by the scheduled date of the bill’s public hearing. Just days before the hearing, however, Pingree helped the Natural Resources Council of Maine release a three minute, flash video over the Internet, through which she revealed her participation in the study and acknowledged its forthcoming release. The video, titled “You’re In Jeopardy” (Natural Resources Council Maine 2007a) parodied the popular television game show using both cartoon animation and a brief video segment. The short film sought to educate the public about the answers to the following three questions:
1. What percentage of chemicals used in everyday consumer products have been adequately tested to make sure they do not harm people?
2. What toxic chemicals added to many household products have been found in breast milk, polar bears, and many people?
3. What can Maine people do to help stop the increase of toxic chemicals in our bodies and environment? (Natural Resources Council Maine 2007b).

In the video, Pingree revealed that the same class of chemicals the proposed policy addressed – polybrominated diphenyl ethers – were also, to her surprise, found in her body. She offered the following:

I was recently tested for toxic chemicals in my body along with twelve other Mainers. The results were shocking and scary. Thirty-five of the sixty-seven chemicals were found in my body, including mercury, lead, Teflon chemicals, and toxic flame retardants, known as PBDEs. These chemicals don’t belong in anyone’s body. They can cause learning and memory problems; thyroid-hormone conditions, reproductive problems, and even cancer. These chemicals are found in common household items, such as televisions, furniture, and even toys. These chemicals are putting us all in jeopardy. But it doesn’t need to be this way. There are safer alternatives already in use. We can stop corporations from using untested and dangerous chemicals in the products we buy and use here in Maine. We need your help. Please help keep toxic chemicals out of our bodies, our children, and our environment by clicking the button on your screen…. I urge you to vote to phase out Deca from consumer electronics and prohibit its use in mattresses and home furniture in Maine, by passing LD 1658 into law.

Following Pingree’s appeal, the video provided links to additional information about the upcoming hearing and to an electronic form to enable viewers to contact their legislators directly. The early release of Pingree’s results was not planned. In fact, the Alliance had hoped to release the full results months earlier, but had been delayed by the inevitable hiccups that occur when non-profit organizations take on the enormous challenge of conducting and writing up such complex studies. Yet, the trickled release of Pingree’s results to coincide with the public hearing, and her later submitting her body burden as public testimony in support of the bill, may well have tipped-off the media and influenced the eventual torrent of press coverage that occurred after the
full report was released. Following release of the video, the *Lewiston Sun Journal* followed with an article, “So Young, So Toxic” (Alaimo 2007).

A few days later, at that hearing, Pingree spoke about her results again, this time in a passionate appeal to her colleagues during the public hearing:

> Recently, I was part of a statewide toxic body burden study that you’ll hear a lot more about next month. I was tested for a variety of toxic chemicals. When the results came back from the lab, I was shocked by what the test found in my body. They found 17 different PBDE compounds, all of which are known breakdown products from deca. These chemicals don’t belong in my body or anyone else’s. If and when I have a child, the PBDEs in my body will get passed on to my child through breast milk and could impact their development.

By the end of the hearing, the Natural Resources Committee had heard dozens of testimonies. Had it not snowed heavily that day, making travel to the State House less feasible for some, more people would have testified. The Committee also received in excess of a hundred pages of public testimony and supporting information. Maine groups, including the Maine People’s Alliance, The Maine Parents and Teachers’ Association, EHSC, NRCM, The Learning Disabilities Association, pediatricians, and most significantly, The Maine State Federation of Fire Fighters and Maine Fire Chiefs Association, all submitted testimony in favor of the bill. That the Alliance forged a connection with Maine’s firefighters, who in their public testimony expressed concern about their collective body burdens of flame retardants from breathing burning consumer goods, is particularly striking. Firefighters have been a significant, and often persuasive advocate for the passage of similar flame retardant bills, including in Washington and California. One activist noted that in states considering restrictions of specific formulations of flame retardants, their support has tipped the balance in favor of passage. With Maine’s fire safety community, including unionized fire fighters, in support of the deca ban, the only opposition came from the industry association that lobbies on behalf of the global manufacturers of brominated flame retardants, Bromine Science and Environmental Forum (BSEF), and two others, Dr. Mildred
Christian, a toxicologist, and David Borowski, a burn victim, who both admitted that BSEF had supported their travel to Maine that day.

Of the testimonies received, the most salient were those offered by Pingree and Borowski, whose bodies offered symbolic testimony—Pingree’s chemically-burdened body in support of the bill, Borowski’s burned body in opposition. Borowski, citing the physical, emotional, and social turmoil resulting from a childhood burn accident, implored the Committee not to challenge deca, or any other flame retardant, in fear such a policy would diminish the use of flame retardants generally. Yet, it was Pingree’s testimony that resonated in subsequent questions and comments offered by Committee members. When trying to understand the significance of deca, they referred not to abstract data about chemical body burdens, but instead grounded their discussion in Pingree’s results. For example, one committee member who wanted to understand how long a substance like deca would stay in the human body, posed the followed question to pediatrician Dr. Syd Sewell, after his testimony on the public health significance of deca:

I’ll use Representative Pingree as the example, since she threw herself out here earlier as having been tested… Accumulation in breast tissue—will [the chemicals] remain in her body? I guess the question is… does it only come out through the breast milk? If she accumulates deca into the fatty tissue… that’s the only way? It’s never out of the body?

In similar fashion, Pingree’s body burdens entered public testimony throughout the hearing.

Opponents never challenged the results Pingree reported, nor did they critique the study, or the Alliance for coordinating it. Rather than attack the credibility or validity of the science, opponents, such Dr. Ray Dawson from the Bromine Science and Environmental Forum, the primary trade group representing the four global manufacturers of “deca,” downplayed the implications of human body burden for policy-making. Though not referencing Pingree’s testimony explicitly, Dawson’s comments refuted the health significance of Pingree’s reported burdens of brominated flame retardants. His testimony raised two issues. First, he refuted that
body burdens of deca have health significance. Instead the presence of deca in the body reflects the natural state of human bodies living in an industrial society and “a salute to today’s analytic chemistry.” Second, he argued that deca does not merit restricted use because it is not bioaccumulating in people, nor is it breaking down and contributing to human accumulation of concerns, or chemical compounds with a different molecular composition, that have fewer bromine molecules. Rather, as Dawson argued, studies were showing that when PBDEs were showing up in people, they were not breakdown products of deca, but already phased-out formulations that are similar in structure, though other expert testimony and published studies refute this point (Benedict et al. 2007; also see review in Stapleton 2006).

However, after nearly a four-hour public hearing, the Dece bill, formally, “An Act to Protect Pregnant Women and Children from Toxic Chemicals Released into the Home,” moved easily through Committee and was signed into law shortly thereafter.

Alternative Factors that Led to Bill Enactment

There is no absolute certainty that Pingree’s testimony was the deciding factor. Likely it was not. Pingree’s testimony was but one component among many that tipped the balance in favor of passage. While her testimony was powerful, it was joined by many others, including mothers and others concerned about children’s development, all of whom referenced the rising tide of chemicals detectable in breast milk and blood. Other issues were at play as well, which are worth mentioning, since they are part of the broader political context in which body burden becomes salient to policy change.

First, there was a strong insider-outsider political dynamic that solidified the coalitions assembled by the Alliance. Not only were outsiders transporting harmful chemicals across state lines, but also outsiders were trying to dictate how Maine should govern itself. The bill had been opposed by “outsiders,” including chemical industry lobbyists and others who flew to Augusta, the state’s capital, to testify, rather than local interests. Industry did not read the cultural and
political terrain. Their strong opposition to the bill was a direct affront to Maine’s strong cultural identity as a state that prides itself on policy leadership and self-reliance, despite its population size. Industry lobbyists also misread the political terrain. Since local firms, and thus, local lobbyists were unaffected by the proposed reforms, when BSEF argued that the bill should go after flame retardants more unilaterally rather than singling out deca, their counter-proposal would affect Maine businesses. As a result, they isolated, and lost what could have been support from local lobbyists, for example those advocating on behalf of Maine retailers that sell other products treated with brominated flame retardants (e.g., automobiles), and thus would be affected by a wider set of restrictions. Finally, the money the Bromine Science and Environmental Forum poured into their anti-bill ad campaigns upset the public and policy-makers alike, further galvanizing local commitments to pass the legislation. Because the bill had overwhelming public support from within Maine, that an outsider industry was challenging what appeared as the “will of the people,” the ads appeared paternalistic and patronizing. One activist noted that industry was lobbying against similar bills in several states at once and, because overwhelmed, was ill prepared to defend against the bill in a way that responded specifically to Maine’s political culture. Thus, they made several key mistakes that worked to reinforce the commitments and support of Maine people and policy-makers behind the bill.

Second, as an issue and a strategy, one advocate explained, consumer products and body burden is uniting. It links issues and draws many policy-makers into the fold. As such, “addressing chemicals through consumer products is really where the opportunity is these days.” S[he] explained: Historically, one of the primary challenges posed by addressing chemicals one polluted site at a time is that such struggles too easily remain isolated from one another. Localized campaigns only implicate a handful of elected legislators, if that. Chemicals in consumer products, however, put all legislators “on the hook.” Second, when dealing with one site at a time, the organizer continued, it is easier to lose sight of how pollution stems from a systemic and institutional problem. By linking chemical body burden and consumer products,
the intertwined issues are cross-cutting. Such a framing implicates many chemicals, and by extension, many products and market sectors. As a result, the public and policy-makers come to realize that this is an institutional problem that requires a comprehensive policy solution. Under such conditions, as one advocate noted, even a campaign to address a single chemical used in a wide array of consumer products can signify all of the harmful chemicals used in an industry.

**Biomonitoring Supports Transition to Comprehensive Reform Initiatives**

The Body of Evidence report was released as the Alliance transitioned from supporting a series of single-chemical bills to the introduction of more comprehensive initiatives. Though Pingree’s used her personal experience to support the deca bill, more generally in the Alliance’s report, public testimony, speeches, and press releases, the Alliance did not single out any one substance, or class of substances, from those they had tested. Rather, the Alliance implicated the safety system charged with overseeing the use of chemicals in production and in consumer products.

The study results have been part of a move toward thinking across classes of chemicals, rather than single chemicals, and more importantly, to revising the system that regulates them. From the outset, The Alliance leveraged the findings to begin shifting the focus of the state toward more comprehensive reforms. At the close of the June 2007 press event where the Alliance released their findings, Belliveau mentioned the ongoing work of The Governor’s Task Force on Safe Chemicals, 40 which would offer what the Alliance hoped would be the policy response to the Body of Evidence report. Indeed, at the opening of the 2008 legislative session, the Governor

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40 In February of 2006, following much effort on behalf of the Alliance, Governor John Baldacci issued a precedent-setting Executive Order, “An Order Promoting Safer Chemicals in Consumer Products and Services.” Citing concern over the “data demonstrating ongoing and substantial increases in human breast milk and blood of chemicals known to occur in consumer product” (Baldacci 2006), the Governor, among several tasks, convened a 13-member panel to survey current chemical policy reform efforts and to offer the Governor “recommendations for a more comprehensive chemicals policy that requires safer substitutes to priority chemicals in consumer products,” (Exec Order, p. 5) where priority was defined, in part (though not exclusively) on whether substances or their breakdown were bioaccumulative (p. 6).
introduced a new bill that incorporated many of the recommendations the Task Force made following over a year and half of monthly meetings (*An Act to Promote the Use of Safer Chemicals in Consumer Products*, LD 2210/HP 1577).

More than a policy-response however, the Task Force functioned as a microcosm of Maine’s public and private sectors, where a diverse assortment of organizational and institutional interests deliberated and converged on a set of mutually-agreed upon recommendations about how states could address the unregulated presence of bioaccumulative and/or toxic chemicals in consumer products. The Task Force included representatives from the DEP, as well as representatives from Maine businesses such as Tom’s of Maine, InterfaceFABRIC, and the Environmental and Energy Technology Council of Maine. One proposed policy change endorsed by the Task Force was to require product manufacturers to provide consumers and users with information about the chemical content of products. Another was to regulate the sale of additional consumer products if they contain chemicals the Task Force listed as of high or moderate concern based partially on whether the chemical was either persistent, toxic, or bioaccumulative.41 Perhaps even more significant was that these public and private entities participated in articulating a vision for broader policy reforms, which included shifting the burden of proving chemicals hazardous onto manufactures, replacing uses of hazardous chemicals with already available, safer alternatives, and enacting policies that protect the most vulnerable populations (Maine Governor’s Task Force on Safer Chemicals 2007).

More subtly, however, the study contributed to a deepened, more personal commitment among key decision-makers to enact policy change. The study strengthened Pingree’s resolve as policy advocate to take on the bigger challenge of pushing through more comprehensive reforms (versus

41 To make this determination, the Task Force reviewed government-compiled and/or peer-reviewed lists of chemicals categorized by inherent chemical properties, such as PBTs (those that are persistent, bioaccumulative or toxicants), EDCs (those that are known or suspected to disrupt the endocrine system), or CMRs (those that are carcinogenic, mutagenic, or reproductive toxicants.) The Task Force listed what it thought were the most comprehensive and sound “chemical lists” and referred policymakers to these for final classification of priority chemicals. For further information see the Governor’s Task Force of Safer Chemicals Final Report, available at: [http://mainegov-images.informe.org/dep/oc/safechem/me-safer_chem_full_rpt.pdf](http://mainegov-images.informe.org/dep/oc/safechem/me-safer_chem_full_rpt.pdf).
the single chemical class bills, i.e., brominated flame retardants) that she introduced in earlier legislative sessions). As Pingree noted in a public speech given at the Common Ground Fair, learning of her own body burdens increased her personal commitment to reducing the accumulation of chemicals in human bodies through policy reform:

On a Sunday night in January I talked with Doctor Donahue for more than two hours. It was fascinating, frightening and after I hung up the phone, I was no longer just going to be a casual political supporter… I was now a convert who couldn’t stop talking about my results. Today, partially because I know now what is in my own body, I believe that toxic chemicals are one of the most significant environmental and health issues facing us today (Pingree 2007).

Members of the Alliance, who had worked with Pingree on both brominated flame retardant bills, noted a difference, too, between her work on the first bill, compared with the ferocity and drive with which she pursued the second, after learning that the very chemicals under scrutiny were also found inside her. As one interviewee reflected, “a policymaker with personal experience… is way more effective.”

Similarly, as a result of his participation in the study, Republican State Senator Dana Dow, a former chemistry teacher who runs a furniture store when the legislature was not in session, was transformed into one of the most outspoken champions of the “comprehensive reform” message. Through his participation in the Body of Evidence study, Dow learned that the very same stain-repellant chemicals his business had applied to furniture were showing up in his blood at levels in excess of others in the study:

I own a furniture business. And we do use some chemicals in the form of Stainguard in that business. I wanted to see how that was going to show up and to learn some new things about it… We spray that on. That doesn’t come in the fabrics, normally… Causes me to think. Because out of the thirteen people, I was the high. In that particular category, there were, I think, seven different chemicals. I was the high in six out of seven, and almost the high in the seventh one… That type of chemical, originally, when I first bought the business, you used to have to
wear a gas-mask until they changed the formula somewhat. But I’m still not convinced that it’s safe. There isn’t enough research yet on how it affects the body (Dow, interviewed by Maine Center for Economic Policy 2007).

For Dow, who was the lead sponsor of the deca bill in the Senate, the study also helped him move from an advocate of a single bill about a single chemical to a champion of more comprehensive action. During a public radio interview, Dow described this shift:

I came out of the study reflecting on an overall viewpoint, knowing we got 30,000 man-made chemicals in the environment and adding probably hundreds more each year… that our way of taking one out per year just isn’t working. Things are going to have to change on a national, even global level… We just have to keep [the issue] in the forefront, in people’s minds through news or stories like this. We’re going to have to come up with some kind of policy. It’s going to have to be more than just state policy on how we are going to attack new chemicals. We’ve got to have some new way, new philosophy of how we put chemicals into use (Dow, interviewed by Maine Center for Economic Policy 2007).

By the time the deca bill moved to the Senate floor for a vote, Dow urged his colleagues to support the bill, but also to go one step further:

We must take a new approach to how we look at the things that we put into society and so this gives me my grandstand stage today to say so. I support this bill. I know it’s just one chemical. To me it’s an easy one. We’ve got to take a new approach as environmentalists, as conservationists… (Dow, interviewed by Maine Center for Economic Policy 2007).

**Body Burden as Scientific and Economic Opportunity**

Though the Alliance clearly framed body burden as a problem, the solutions they proposed were not only political, but also scientific. Chemical body burden was framed as a problem to be “designed away” and resolved through science. That is, to address the problem of body burden of chemicals, particularly those that are found in consumer products, required creating incentives for
an emerging area of science – green chemistry and engineering – that could redesign new materials to be used in production. At the time many of these substances were synthesized, chemists were not trained to think about toxicity. Nor were they aware that when they designed substances to be fat-loving, or lipophilic, a property that made such chemicals useful in many industrial and commercial applications, they were also creating substances that could build up in the fatty tissues of the human body. Green chemistry, however, involves the design of chemicals that are non- or less-hazardous (Anastas and Warner 2000). Green engineering is the next phase, where new materials are developed into commercial products. Green chemists and engineers are heralded as the visionaries who could create needed materials that would not biopersist or bioaccumulate, and yet keep the economy moving forward.

Thus, in Maine, more science was not necessary to interpret biomonitoring studies, as was the case in the Mid-Ohio Valley; that chemicals were in bodies was enough to act. Rather, scientific innovation is touted as a necessary adjunct to policy. While policy could restrict or remove the worst chemicals from commerce, science creates new materials to replace them. Developing replacements to toxic and bioaccumulative chemicals was especially important, since many state-level legislative efforts to restrict the use of chemicals in consumer products, as was the case with Maine’s deca bill, would do so if and when safer and feasible alternatives were available (see final report of Maine Governor’s Task Force on Safer Chemicals 2007).

The Alliance, along with their allies in industry and the Governor’s office, argued that herein lay an economic opportunity for Maine—to support the development of Maine’s “innovation and bio-economy” through investment in research infrastructure and new green production facilities. The Governor, in his Executive Order for Safer Chemicals (2006), charged the Task Force to provide guidance for how Maine could create incentives for the development of safer chemicals through increased investment in Maine-based green chemistry research, development, and production. In following their charge, the Task Force concluded:
Growing markets for safer products will encourage innovation and provide economic opportunity for Maine: Technological innovation is one of the keys to both the development of safer alternatives to toxic chemicals and to allowing our companies to maximize the value of Maine’s rich natural resource base. Green Chemistry, including the development of bio-based products from Maine agricultural and forest resources, offers the potential for substantial economic growth and job expansion in this state. This innovative technology will supply a demand that already exists on the part of successful Maine businesses committed to sustainable materials, processes, and products. Becoming preeminent in the field of Green Chemistry is a natural for this state and its businesses (Maine Governor’s Task Force on Safer Chemicals 2007).

In this case, body burden highlights problems in production systems that present opportunities for economic and business development. The Alliance, as well as the Task Force, argues that chemical body burden is an opportunity to reinvigorate Maine’s economy through development of Maine’s production infrastructure and capacity to support a green, bio-economy. The Alliance also has backed bond initiatives that would set aside funds to establish the state’s scientific infrastructure and to attract highly-trained human capital to Maine’s universities. With these resources in place, the Alliance envisions Maine as a national center for green chemistry and green engineering.42

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42 The Alliance encourages the University of Maine system to become a competitor to the University of Massachusetts’s Lowell Center for Sustainable Production, which has built itself into an internationally renowned storehouse of expertise, resources, and infrastructure in the fields of green chemistry.
Figure 6-5. Flyer for the Growing Maine’s Green Economy workshop held at the University of Southern Maine’s Portland Campus. Though the flyer lists Tom’s of Maine, InterfaceFABRIC, Inc., and the Environmental Health Strategy Center as sponsors, others include the Maine Department of Environmental Protection and the Maine Department of Economic and Community Development.

Here we return to the opening of this chapter, where the Alliance was participating in the Growing Maine’s Green Economy workshop to support the development of the Potatoes-to-Plastics Initiatives (see Figure 6-5). This initiatives seeks to attract federal research and development grants and private venture capital to support the development of a bio-based plastics plant to make plastic from Aroostook County’s potato industry. Such a proposal, as was argued during the day-long workshop the Alliance co-sponsored about the initiative, would increase manufacturing jobs in Maine, present new opportunities for Maine farmers, and would boost the Maine economy by meeting the rising market demand for sustainable plastics. The Alliance,
alongside representatives from Maine’s potato industry and firms who are down-stream users of bio-based plastics (e.g., InterfaceFABRIC) funded the Margaret Chase Smith Policy Center to conduct a feasibility study (Dickerson et al. 2006). The study authors concluded, as summarized by the Alliance that:

The bio-based plastics industry can benefit Maine by attracting grants and venture capital; creating jobs; creating opportunities for the potato industry while reducing costs of disposing of waste potatoes; meeting demands of Maine companies for locally made, petroleum-free, compostable, bio-based plastic; protecting environmental and public health; and reducing waste and conserving landfill space, since bio-based plastics can be composted. Also, oil consumption can be reduced and climate change slowed: PLA produced from corn requires 35% less fossil fuel than making an equal amount of petrochemical-based PET plastic and results in 52% fewer net greenhouse gas emissions than the manufacture of an equal amount of PET (The Alliance for a Clean and Healthy Maine 2007d).

Most importantly to the Alliance, however, is that bio-based plastics avoid use of many of chemical additives against which they have campaigned, including, phthalates and parabens, “pseudo-persistent chemicals” that the Alliance also analyzed in their Body of Evidence project.

What is striking is the degree to which the Alliance has teamed with the state economic development agencies and local industries (including potato farmers and product manufactures who use bio-plastics plastics) in what was hailed by the Economic Development and Green Chemistry coordinator for the Alliance, Stan Eller, as the first stakeholder group in the nation to develop green economic development proposals from the ground-up, involving active participation from the advocacy community. The Alliance backed potatoes-to-plastics initiative was presented as part of a broader movement to link the environmental advocacy community with industry and capital through in public-private coalitions. These coalitions seek to become the new owners of the bioeconomy—to capture a corner of the burgeoning market for sustainable materials and prevent the “new economy” from being owned by the same handful of multinational companies that have dominated the petroleum-based chemical and plastics industry.
over the past half century. In particular, the collaborative approach to ownership that was
presented during the workshop would be among the down-stream users of bio-based plastics.
Environmental health foundations would have a role as well. Previously, private foundations
supported grassroots organizing and environmental health organizations to push chemicals policy
and shift markets toward safer alternatives. Now these same foundations realize that the
advocacy campaigns they supported opened up new opportunities for them to grow their assets –
and ensure the possibility of future funds to support environmental health initiatives – through
values-driven investment in green production ventures.

These initiatives seek, in part, to transform public oversight of industry, not necessarily just
the materials or chemicals industries use. That is, while the Alliance and their allies want to
change the materials – the chemicals – the industries use to manufacture goods, they also want to
change the relationship between the groups that own production and some of the groups who
historically have dealt with the externalities of chemically-intensive production in the past. In
Maine, these initiatives merge the interests of environmental health advocates who want to end
the problem of human body burden to chemicals within the span of a single generation with those
concerned about economic development and proponents of “clean and green production.” In
doing so, the Alliance is using biomonitoring and the economic opportunities it presents to merge
markets with movements, advocacy with economics.

However, though key leaders in this initiative speak about the need for a stakeholder model of
open, democratic deliberations of concerned parties, important constituencies have yet to be
brought into these deliberations. To shift the relations of production in this new bioeconomy
substantially, these initiatives must reach out more deliberately to labor groups and to the
communities that will share a fenceline, or live down stream, from the proposed green production
plants. Yet, many questions remain over the degree of sustainability that is achievable for bio-
based plastics production.
Deliberations over the bio-based plastics initiatives in Maine include both great idealism and great realism. On the one hand, stakeholders strive to create a manufacturing process that is a complete loop and contributes zero waste. The goal is to ensure that the wastes and byproducts of production are not toxic, and have alternative uses to support some other aspect of the economy. For example, the state has contracted with the University of Maine to research how the waste stream of the state’s pulp and paper mills can be reused as feedstock materials for the chemical industry. But, proponents of this initiative also argue that to reach this endpoint requires a series of incremental shifts away from chemically intensive production methods. This likely means that as these initiatives go forward, while making important headway in shifting what materials are used in production systems, there will be tradeoffs and compromises along the way. One of the potential tradeoffs under consideration is the extent to which potentially toxic inputs (e.g., synthetic fertilizers, fungicides, and pesticides) are needed to ensure Maine can grow enough potatoes to meet market demand for this initiative. To grow potatoes in Maine – a much wetter climate than other potato-growing regions such as Idaho – requires use of fungicides to ensure a vital crop. Yet, there has not be a significant enough demand to drive the development of a greener fungicide. The Initiative, as it conducts its feasibility studies, is considering whether Maine’s scientists might be able to develop just such a fungicide.

Conspicuously absent from the October 2007 Growing Maine’s Green Economy workshop was representation of the farm workers whose labor will grow the potatoes necessary for plastics production. An estimated ten to twelve thousand migrant and seasonal workers play a significant, though often unrecognized role in harvesting Maine’s principle crops – blueberries, apples, eggs, and potatoes – often at significant cost to their own health and with few opportunities for political representation (Adams 2008). While the Maine Labor Group on Health is a coalition member in the Alliance, it is not clear the extent to which they have, or will in the future, represent the concerns of Maine’s migrant workers in these discussions, or of workers who these new green production facilities will employ. Bringing workers into these discussions would add much to
these discussions so that green production is not just about creating more jobs in Maine, but also about creating more jobs that ensure safe working conditions and fair wages. As the new “clean and green economy” takes off, now that it is buzzword among political candidates and multinational industries, Maine could once again establish itself as a leader by demonstrating how clean production is not just a green-washed façade over business as usual, but can also represent a fundamental shift in the relations of production. Green production should be sustainable for the environment and sustainable for workers.

While this initiative has touted the economic advantages of green production for the state, there is a tremendous opportunity for the Alliance and their economic and state allies, by bringing labor and farm workers into the conversation, to make this initiative also about improving the economic well-being and health of all people who live and work in Maine.

CONCLUSIONS

With the start of the 2008 Legislative session, Hannah Pingree, the House Majority Leader has already introduced a bill that proposes comprehensive chemical policy reform, and in particular is targeting chemicals known to pose bioaccumulative and biopersistent risks for women and children. As well, the Governor, having just released the final report from his Task Force on Safer Chemicals at the close of 2007, is now taking steps to move on recommended chemical policy agenda with his own bill. These initiatives pose a prime opportunity to start bridging the gap between pollution and chemical issues throughout the chemical lifecycle.

Advocacy around consumer exposures and campaigns to “clean and green the marketplace” have taken off across the country, but in each place where such campaigns have been significant for shifting public and policy debates, there are important parallels. California, Washington, and Massachusetts, all states with advocacy groups addressing chemical exposures from consumer products, share a similar political and environmental history to Maine. These are states with a well-established, professionalized environmental and non-profit community, which
have developed the network to fund, conduct, and then leverage exposure science as a significant component of their advocacy work. As well, as one activist explained, there are unique political opportunities in states where the chemical industry is not well-established, and where the state has undergone deindustrialization in which many chemically intensive industries have left the state.

One consequence of deindustrialization for states like Maine has been a major economic downturn, another has been the presence of fewer big polluters lobbying at the State House, though in Maine, the pulp and paper industry has survived the economic turbulence and remains a significant polluter. Deindustrialization, however, enabled activists to redefine political jurisdictions as *sites of consumption*. In so doing, activists have more leeway to select issues strategically, rather than have the issues under debate solely defined by industry. While industry opposition still challenges activists, and activists must respond to industry lobbying and public relations, relative to previous environmental health campaigns, they have more leeway to select which issues are up for discussion, rather than have the issues solely defined by industry. In sites of consumption, activists can act first, and leave industry to respond. This is far different from the environmental health activism of the previous three decades, where industry acts, and citizens and activists scramble to respond. In Maine, however, when activists proposed a new policy initiative to restrict use of brominated flame retardants, the trade association for the affected industry, not located in Maine, scurried to respond.

Given the economic needs of the state, and the experienced, professionalized advocacy community in Maine, once activists redefined the state as a political site of consumption, they also were able to redefine environmental problems as economic opportunities and have that proposal be compelling to groups traditionally pitted against each other in site-of-production struggles. Documenting body burdens of Mainers, though perhaps not essential to the Alliance’s overall campaigns, nevertheless reinforced their message that body burden was an issue relevant to Maine. It also provided further evidence to support ongoing initiatives to reinvigorate Maine’s
economy through the development of green science shops and green production facilities. The study also helped cement alliances and relationships because it played into and built on a strong cultural pride in Maine as a self-reliant state, despite the significant economic problems faced by the state. One key factor to the study’s widespread acceptance by these groups was that it was conducted by and about Mainers. This appealed to the strong, palpable local pride and self-identification as environmental policy leaders. By ensuring that much of the project was “home grown,” the Alliance built on and reinforced the perception among policy-makers, state officials, citizens, and activists of Maine as leading the nation in its efforts to address environmental health.

But importantly, Maine has not always been a *site of consumption*. It has a long history as a *site of production*. As activism has focused further down the lifecycle, that is, to exposures that happen through use of consumer products, often the most pressing site of production issues have been pushed to the margins of public concern and debate. In working to move debates over chemicals exposures from the end-of-the-pipe exposures to the industry’s use of chemicals in products, the Alliance shifted some advocacy and political focus away from ongoing battles with regulators and industry over chemical exposures on the fenceline. Though a good number of polluting industries and manufacturers have left the state, pollution struggles remain significant, particularly for Maine tribes living along the Penobscot and other major rivers. These have not only been struggles over industrial pollution, but also over the right of citizens to challenge industry and regulatory permits, and over tribes’ sovereignty to protect their land from industrial polluters who are, from the perspective of tribes, “outsiders” not unlike the bromine-based flame retardant makers who were scorned by Maine policy makers and advocates for imposing their chemicals on Maine people.

Even as body burden in general, and body burdens of Mainers in particular made for historic coalitions between the state, activists, and industry, there were missed opportunities to link site-of-production struggles with advocacy over persistent, bioaccumulative chemicals in consumer products. There were missed opportunities as well to ally with farm workers and align the call for
green production with the need for fair and safe work environments through the Potatoes-to-
Plastics initiatives. This is not to say that the chief activists pushing this new discussion about
chemicals and the material economy were unsympathetic to these struggles. On the contrary, the
Environmental Health Strategy Center, and the Alliance more generally, were lead by activists
who had devoted several decades to fenceline struggles with industrial and military pollution, and
who were national leaders on environmental justice struggles. The chief architects of the body
burden campaigns were on the forefront of national activist networks attempting new, offensive
strategies and sought to move away from defensive, regulatory battles and reactionary
environmentalism (a theme that I will revisit again in Alaska, where activists have made a similar
shift but through different tactics.) Yet, as one activist noted, there was a missed opportunity, not
ensuring a representation from and involvement with the tribes on the Alliance study. As the
Alliance pursues more comprehensive policy initiatives in the coming legislative sessions, and as
the Potatoes-to-Plastics initiative moves from studying the prospect of the proposal to making it
happen, the Alliance might realize the lesson embedded in their recent successes—that diverse
coalitions move issues and that biomonitoring science can help with constituency building and
coalition formation. As such, they would do well to invite active participation from farm
workers, labor groups, and Maine tribes, too.
Chapter 7

PERSISTENCE AND SUBSISTENCE:
TRANSBOUNDARY LEGACY CONTAMINANTS IN ALASKA

INTRODUCTION

As October chilled the migration of tourists from the lower forty-eight, I departed on my second visit to Alaska to observe and work among a small, but ardent cast of environmental justice activists, who many in the environmental advocacy community consider experts at implementing community-based biomonitoring science. A year earlier, I attended an environmental health and justice conference held at the base of the majestic Alaskan Range. There, through the narratives of Alaska Natives challenging the disproportionate contaminant burdens borne in the circumpolar region, I learned how contaminants threaten subsistence food production and cultural well-being of Alaska Natives. Against the golden-hued background of a fiery, Alaskan autumn, my image of Alaska was remade—recast as a global crossroads for the byproducts of a half-century of militarism and expansion of industrial production. To better understand the unique environmental justice dilemmas occurring in indigenous communities in Alaska, I spent the interim year reading Alaskan political and environmental history. However, my education in Alaskan political economy truly began on my connecting flight to Anchorage.

My fellow passengers represented a slice of the Alaskan economy: uniformed infantry returning from training exercises and contract laborers for extractive industries, like the plaid-shirted oil worker who sat beside me. His day began in Missouri, and would end the following evening, when he would roll into Prudhoe Bay. For three weeks, he would fix oil machinery, then return home to coax crops from his family-run farm.

Historically, the potential to extract Alaskan resources has lured steady waves of Outsiders, so much so, that the term “outsider” routinely appears capitalized. Outsiders came first to harvest whale oil and furs, then seafood and pulp, followed by metals, coal, then oil. The booms have
been volatile, driven by resource depletion and destruction, price-setting market forces, extensive federal oversight, and by Outsider investments (Haycox 2002). A recent New York Times article reviewed rising concerns about what industry will dominate the Alaskan economy next, once the oil stops flowing southward from Prudhoe Bay. Today, new projects are in various stages of development—a natural gas pipeline, initiatives to extract and gasify coal—to eek out ever more from the Earth’s crust. To these extractive enterprises, more Outsiders flock, and from these more contaminants will surely flow.

As the number of mines and other extractive industries in Alaska increases, contemporary sources of exposure cause new debates in Alaska, yet the extent to which historical sources of pollution remain is also significant. Chemicals used in previous decades by industry have migrated through air and ocean currents, and moved through the terrestrial and marine food webs that sustain a significant portion of Alaska Native communities, who for centuries have subsisted on what the land offers. These chemicals represent another category of Outsiders that flood Alaska and the circumpolar North,43 except they do not arrive by airplane. Once in-state these Outsiders—molecules of persistent pollutants—do not leave. Trapped by the cooler air temperatures, they settle into the landscape, the food web, and into the people that depend on these for cultural and physical survival. More recently, as researchers further document the effects of global warming on circumpolar ecosystems, scientists are just beginning to understand how melting permafrost and ice unleash past generations of contaminants once contained and now released through thawing (Intergovernmental Panel on Climate Change 2007). Industrial operations continue to release other categories of persistent chemicals, which are also finding their way north. Though many chemically intensive industries are not located in this region,

43 The circumpolar North refers to the eight countries that border the Arctic Ocean, including the US (Alaska), Canada, Denmark/Greenland, Norway, Sweden, Finland, Iceland and Russia. According to the Arctic Council, the international body comprised of all circumpolar nations, some 4 million people—including over thirty different indigenous groups—live in this region (Arctic Council 2007).
nevertheless, as one activist noted to me, “the reach of industry extends thousands of miles into
the Arctic.”

As suggested by infantry aboard my flight, Alaska also has been a strategic staging area for the
US to engage in global politics. Throughout the 20th century, the U.S. military brought an
unparalleled wave of development and migration of Outsiders to Alaska. During the World War
II era, the military constructed bases along the southern coastal regions and on the Aleutian
Chain, where the US engaged Japan and guarded ports so that coal from the interior could fuel the
Pacific fleet. Airfields stretched across Alaska’s girth so planes from the Lower 48 could refuel
before skipping across the Bering Sea and onward to the eastern front (Garfield 1996). Nuclear
bombs were tested underground (Kohlhoff 2002); Alaska was also, selected for developing non-
military applications, including a never-materialized plan to use nuclear bombs to gouge new
harbors in the Alaskan coastline (O’Neill 1995). During the Cold War, Alaska maintained its
status as a tactical outpost for observing Russian operations and detecting missile launches.

Today, there are between 600 and 700 formerly used defense sites (FUDS, as they are
commonly called here) in Alaska (see Figure 7-1). Through the Defense Environmental
Restoration Program (DERP), in 1983, Congress assigned the Army Corps of Engineers to
address contamination at sites formerly under control by the Department of Defense. The
government has spent millions to address contamination at formerly-used defense sites in the US
and abroad (US General Accountability Office 2001), over $535 million in Alaska alone, with a
projected $1 billion more needed to address all sites (Alaska Division, Army Corps of Engineers
2003). The Corps also manages the Native American Lands Environmental Mitigation Program,
through which it has entered into approximately two dozen Cooperative Agreements with
federally recognized tribes whose land and resources have been compromised by military

44 The Corp recognizes approximately 600 sites eligible for clean-up under the Defense Environmental Restoration Program. Alaska
Community Action on Toxics, in its accounting, estimates the number of formerly used defense sites closer to 700. For Corps
accounting of sites, see: www.poa.usace.army.mil/hm/about/a_files/AKDistrictHistory.doc
activity. This program provides tribes with access to additional federal funding and more local control over mitigation. However, hundreds of sites need clean-up, and the Corp faces a backlog of unaddressed or partially remediated sites (US General Accountability Office 2002). Many have been forsaken, mere ghost operations strewn with detritus. As tribes push for clean-up of historic sources, several bases and weapons testing ranges remain active\textsuperscript{45} that anchor a substantial portion of the Alaskan economy, as the military continues to test new generations of weapons. Five Alaskan military sites have been listed on the National Priorities List as “Superfund” sites. All were active-duty sites upon designation; four remain active (Button 2003). Currently, no formerly used defense sites have been prioritized on the NPL list, though some villages have requested that designation.\textsuperscript{46} Alaska Natives, like many Native American communities in the United States, bear the largest burden of the legacy of militarism, which is as significant a contributor of chemical contamination and environmental injustices as economic and industrial activities (Hooks and Smith 2004).

Historic military and globally circulating contaminants from industrial sources, often dubbed “legacy contaminants,” impose a particularly heavy burden on Alaska and the circumpolar region, where many people, particularly from indigenous communities, eat from the land and sea. I was told in some villages, like those on Saint Lawrence Island, that 70-80\% of the population relies on subsistence foods. Traditional foods remain as significant, though many Alaska villages are now mixed subsistence-market economies. Subsistence activities like hunting, fishing, and gathering berries, greens, and eggs comprise a substantial portion of community members’ time, though village markets do supplement traditional foods. Given the remoteness of most Alaska Native

\textsuperscript{45} In the late 1990s, the Air Force dropped a bombs containing depleted uranium in an interior region southeast of Fairbanks, Tanana Flats to test ground-penetrating properties (Sherwonit 2003).

\textsuperscript{46} The Comprehensive Environmental Response, Compensation, and Liability Act, or CERCLA (1980), in theory, provides EPA with the authority and funds to clean up what are deemed the most significantly contaminated sites in the country. Funds are limited, and clean-up stalled to the extent that sites are no longer being regularly added to the list. Eighty percent of the sites listed on the NPL list were once Department of Defense sites (Military Toxics Project and Environmental Health Coalition 2001). Community members from St. Lawrence Island requested that the Northeast Cape site be considered for addition to the NPL (Waghiyi 2004). The site was never added; I am told that listing would slow down the clean-up already in progress under the Corp’s management.
villages—there are no roads in a significant portion of the state—market foods must be flown in from great distances and at significant cost, which in turn is reflected in the exorbitant price. In cash-poor communities, where year-round jobs that furnish cash income are scarce, market foods are largely inaccessible to many families. Eating traditional foods, thus, is an economic necessity. Traditional foods, and all the activities that surround their harvest, preparation, and consumption, are also integral to social and cultural survival of rural Alaska Native life. Yet, these nutrient-dense foods often transmit heavy loads of persistent chemicals and heavy metals, and thus set up an impossible dilemma and a great injustice. As one organization that addresses these problems, Alaska Community Action on Toxics, notes, there are:

Serious risks associated with the consumption of traditional foods as a result of the introduction of contaminants into the northern environment over the last fifty years from a number of sources. This, in turn, has created a significant public health dilemma for residents… and other indigenous people of the circumpolar North, that is, whether to continue consuming a traditional diet in the face of the growing threat of contamination, or to deal with the myriad of health and social problems that stem from abandoning their traditional diet.

Contamination of traditional foods threatens the economic vitality, and ultimate survival of Alaska Native villages and an entire way of life that has been passed on through generations since time immemorial. It also threatens the physical well-being of residents. Communities of the Circumpolar North face a significant public health dilemma regarding continued consumption of traditional foods, even as science continues to uncover the extent and threats of both legacy and current-use persistent pollutants in the Arctic environment. Yet, forging traditional foods is not an option. Studies have found that decreasing consumption of traditional foods can lead to increases in a range of mental and health outcomes, including depression and diabetes, given the complex relationship between the nutrient-rich content of subsistence foods, and the cultural and social salience of their consumption (Jolle 2002; McGrath-Hanna et al. 2003). Nor, however, is
continued consumption, when exposures may pose harms, particularly to vulnerable populations and to developing infants and children.

In the face of this impossible dilemma—this double bind, where either course of action is intolerable—indigenous communities from across the circumpolar regions have paved a different course. These groups have begun challenging contamination of foods as an unconscionable violation of their rights (Downe and Fenge 2003).

Compared to other Arctic nations, including Canada, Sweden, Norway, Finland, and Denmark, that are also parties to an international agreement to participate in Arctic contaminants monitoring programs, there is a relative lack of data about persistent pollutants in Alaskan food systems and people (US Department of the Interior et al. 2000), a data gap that stands in violation of the United State’s agreement with the other countries and indigenous communities of this region.47 As government researchers, universities, and non-profit organizations work to address these research gaps, Alaska is still a battleground in the struggle for contaminant-free foods and bodies. Human biomonitoring here thus takes place in the context of limited state policies that address local uses of persistent, bioaccumulative substances, and federal policy that has only marginally participated in international action to eliminate persistent pollutants from global use (Center for International Environmental Law 2004).

* * *

Between the abandoned military outposts and the northern migration of persistent chemicals from lower latitudes, the legacy of chemicals on Alaska has been multi-fold. I came to Alaska to understand the meaning of biomonitoring and human blood concentrations when the exposure

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47 Beginning in 1989, the countries that rim the Arctic Ocean began outlining a collective strategy to address rising concern about development in and the environmental health of the circumpolar region. These meetings resulted in the passage of the Arctic Environmental Protection Strategy of 1991. In 1996, the eight countries of the circumpolar North, with involvement from indigenous communities of the region, constituted the Arctic Council as a multi-national body to oversee the development and environmental health of the Arctic region. The Council oversees the functioning of six workgroups, each with a specific mandate to research and address pressing issues facing the Arctic. Two of these workgroups specifically address the problem of contaminants (e.g., the Arctic Contaminants Action Programme and the Arctic Monitoring and Assessment Programme).
originates from an often unidentifiable number of sources, some local, but most “historical” and global in origin. When temporal or geographic distances separate the exposure source and the affected population, I wanted to understand how that separation shapes the conduct and meaning of biomonitoring science, and how it is incorporated into advocacy and decision-making.

My focus is on a small, non-profit organization, Alaska Community Action on Toxics (ACAT, pronounced A-CAT), which brokered a research relationship between two Alaska Native villages and researchers at the State University of New York at Albany. At the behest of the community, ACAT and SUNY researchers analyzed the blood of Saint Lawrence Island residents for an industrial solvent, PCBs, and a suite of chlorinated pesticides. While the research has helped the military prioritize the St. Lawrence Island clean-up, for ACAT, it also sparked a maelstrom of controversy with the Alaska Department of Public Health, and to a lesser extent, with the Army Corp of Engineers, which oversees the cleanup of St. Lawrence Island defense sites. These challenges pulled the organization and its scientific collaborators into technocratic debates over how the study was carried out, the significance of its findings, and the details of their interpretation of both the significance of the problem and what should be done. These debates, in turn, masked the broader, structural issues underlying the problem that ACAT, by conducting the research, sought to highlight—the long-term consequences of militarism and chemically intense industrialization on the health and well-being of Alaska and other communities of the circumpolar north. The challenges that followed on the heels of their first biomonitoring project strained ACAT’s relationships with other organizations and agencies in the state, in some cases with lasting impact on potential allies and supporters. These challenges followed from sharp criticism by the state, scientific debate that drove a wedge between ACAT and important organizational allies, and, when science requires ever more science in order to act, what some activists refer to as paralysis from unending analysis.

Yet, despite these challenges, ACAT expanded into new areas of human biomonitoring to complement its advocacy work and gained a national reputation for its work. ACAT went on to
provide technical assistance to other communities, assisting with blood lead monitoring for communities near Red Dog mine in 2006 and receiving additional federal support in 2005 to establish a breast milk monitoring program for a dozen Nome-area communities rimming Norton Sound. Communities from throughout the United States have appealed to ACAT for guidance. In addition, in 2007 ACAT helped coordinate a multi-organization biomonitoring study—entitled *Is It in Us?*—which drew blood and urine samples from approximately 40 volunteers residing in seven states. This study follows in the tradition of similar public biomonitoring studies conducted by Environmental Working Group and the Commonweal Biomonitoring Research Center, which have played a significant role in educating the public about the implications the current chemical policy system has for people regardless of where they live or work. It also points to the tremendous scientific and organizational capacity of ACAT, which, though small, helped to coordinate the intricate, often daunting tasks required by sample collection of this magnitude.

As I highlight in this chapter, even as ACAT began more biomonitoring, among other scientific projects, the organization also grew increasingly critical of the role of science in its campaigns. They began challenging why measuring contaminants at ever-smaller levels was necessary in the first place, and how the call for more monitoring, in the absence of other actions, was as much an injustice as those brought about by the disproportionate burdens of military and global contaminants. They increasingly found ways to work toward their goals, while bypassing the regulatory system, which they saw as keeping them on a treadmill of science and technocratic debate. They referenced scientific results, and the political conditions that necessitated science in the first place, while shifting to arguments based on ethical principles, rather than technocratic evidence. They framed both human body burden—and the political and scientific quagmires that delay action—as a violation of human rights. As ACAT argues, the more that molecules build up in human bodies at longer time and geographical distance from the point of release, the greater the need for action—not more science—and the greater the imperative to involve affected citizens
in decision-making over chemicals in commerce. This suggests that in places that are the farthest
in space and furthest in time from points of production, the greater there may be the potential for
exposed groups to use body burden science in ways that challenge the relationship between
industry and society, and how science is entangled within those power relations.

ACAT also began to rely on science in a different way, to forge new constituencies and new
alliances between Alaska tribes and with other organizations working to stem the global tide of
persistent pollutants. Biomonitoring science was at its most powerful when translated into deeply
personal narratives about chemical burden that help link together people and organizations from
across the life cycle of chemicals and from across productions systems. Rather than using
scientific findings to convey legitimacy, ACAT pursued relationships that science helped
reveal—that people in the Arctic bear burdens of the same chemicals as those who live and work
in closer proximity to their use and production. From these experiences, a new model of
organizing emerges that “puts science in its place,” as one activist noted.

In this chapter, I trace the evolution of ACAT from its reliance on a science-based organizing
strategy, to the emergence of a more rights-based organizing framework. This new framework
relies on body burden science to build constituency as well as alliances with other advocacy
groups, in an effort to eliminate the production and use of persistent chemicals and to ensure that,
going forward, the people most affected by the decisions made by companies and national
governments are able to restrict their power and influence. Before getting into these issues, I first
describe the events that led ACAT to become a scientific leader among advocacy organizations,
and a proponent for the view that advocacy for environmental change must involve more than
making science-based appeals and technocratic arguments.

Organizational Response to Environmental Injustices

For two decades, Annie Alowa, a Siberian Yu’pik elder and community health aide from St.
Lawrence Island, bore witness to rising rates of illness and infertility. In a population with
historically low rates of chronic disease and fertility problems, Alowa observed cancers, miscarriages, pre-term births, low birth weights, and a range of conditions linked to the endocrine system. She noticed fertility problems and cancers, particularly among those families who, every summer, spent several weeks hunting and harvesting foods at Northeast Cape. For centuries, the coastal region at the eastern tip of the island served as a traditional subsistence camp for many families that live the rest of the year fifty-miles away, in the village of Savoonga, located in the middle of the northern coast. From the 1950s until the 1980s, Northeast Cape also served as a Cold War radar installation, where, huddled in a cluster of low-lying buildings, the U.S. Air Force listened for Russian air strikes (see Figure 7-1). From that same post, the Navy later eavesdropped on Russian submarine maneuvers (ACAT 2006; Alaska Department of Environmental Conservation 2007; Army Corps of Engineers Alaska Division 2007).

**Figure 7-1.** Map depicting the location of formerly used defense sites on St. Lawrence Island at Gambell and Northeast Cape (denoted by squares). The area where Savoonga families establish summer subsistence camps (Northeast Cape) is circled.
(ACAT 2002). When the military left the island, they abandoned or buried everything they had brought with them, as was recounted to me:

When the military and Air Force left [Gambell], they dug big pits and buried everything, their Quonset huts, their heavy equipment, their machinery, their food, everything. They punctured holes in thousands and thousands and thousands of barrels of fuel that they had brought—when they came they had everything for 15 years, when they left, all they had was their backpack and rifle. And we have elders in Gambell that witnessed this.

I have seen two photographs of Annie Alowa; both remain vivid images in my memory. In one, she wears a red, down vest and black rubber boots pulled high over her pants, her silver hair tucked behind a red and white checkered kerchief, her expression somber. Behind her lies an assortment of debris—55-gallon drums, wooden pallets, wire spools, and cooper wire tangled like ragweed. In the second photo, a wider-angle captures the full scene. Annie Alowa is dwarfed by Kangukhsam Mountain in the background, and in the foreground, a meandering mound of 55-gallon drums and assorted detritus, which rise from the expanse of low-lying tundra and tributaries of the once fecund Suqitughneg, or Suqi, River. I have seen drum counts as high as 29,000 (Kaniqsirugu News 1999). From such distance, this many industrial-strength drums, that once contained a variety of petroleum-based oils and lubricants, resemble crumpled soda cans. Upon closer inspection, many are so brittle with rust that the sides have worn off, with only their cylindrical skeletons remaining. Elsewhere, not seen in these photographs, sat abandoned buildings, heavy equipment, power generators that have since been demolished and removed.

Less visible and far harder to remove, are contaminants like heavy metals, pesticides, an array of other persistent organic pollutants, and polychlorinated biphenyls, or PCBs, a particularly troubling legacy of the former military operations (ACAT 2002; Alaska Division, Army Corps of Engineers 2007). According to the Arctic Monitoring and Assessment Programme, a research program established to help implement the eight state Arctic Environmental Protection Strategy,
the Distant Early Warning (DEW) Line stations that stretched along the 66th parallel from Alaska, beginning at St. Lawrence Island, and ending at Greenland, used some 30 tonnes of PCBs in their operations (AMAP 1998).

June Gologergen Martin, who was raised on the Island and later worked at Alaska Community Action on Toxics recalled the following about the defense site at Northeast Cape:

As a Siberian Yupik native, I grew up going to North East Cape during the summer months in the mid-1960s…We live a subsistence lifestyle. We are rich in our culture; our Siberian Yupik language is very strong. Our families still hunt walrus, seals, bowhead whales, halibut, crabs, different species of seabirds and fish in the Bering sea, lakes, and rivers, like the Suqi River in North East Cape… We also gather edible plants, roots, seabird eggs, marine plants and seaweed. During the earlier years of my life, there were talks of not consuming fish and wildlife and edible plants around the North East Cape military site. These warnings came from our elders and leaders. We were told not to subsistence fish in the Suqi River at North East Cape. We were confused and alarmed about this warning from our elders and leaders. If we cannot consume our subsistence fish, marine mammals and other plants due to contamination by military debris left behind, our spirit slowly dies within us (2001)!

As a result of these concerns, Alowa approached every state and federal agency that might listen, though few did. As explained to me:

She had gone around all the different agencies and nobody was taking her seriously. And here she is, an elder, very respected, very traditional—didn't smoke, didn't drink—lived a traditional lifestyle with her husband, Nelson. [She was] a very astute observer of what was going on with the health of people because she'd been a health aide for many years in her community. And yet the regulatory agencies, the Department of Health, the federal agencies did not take her seriously.

In 1997, Alowa finally met someone who listened, and more than that, who heard her worried plea.
Alowa had caught the ear of Pam Miller, a research scientist, then with Greenpeace. While in Alaska, Miller realized the need for a locally based organization to address the myriad of environmental health and justice problems experienced by Alaska Native communities. These problems often remained masked by the state’s erroneous self-image as a virgin, unspoiled “last frontier” or the state’s interest in maintaining this image to promote tourism and its fisheries. While the environmental justice activists critique state agencies for evading responsibility to protect the health of Alaska Native communities, often, national environmental groups are also complicit in overlooking the specific environmental needs and injustices of Alaska Native communities. National environmental organizations also share a tenuous history with Alaska Native communities, who clashed over Greenpeace’s anti-whaling campaigns because for some Alaska Native communities, whales remain essential as subsistence foods and their harvesting central to cultural survival.

Pam founded Alaska Community Action on Toxics (ACAT) to respond to the many environmental justice issues unique to Alaska. Today, ACAT is one of the few non-profit organizations to address the twin insults of environmental and social injustice in partnership with communities and tribes. Since 1997, despite a limited budget and small staff, this diverse group has taken on a daunting portfolio of environmental and health campaigns at all levels of jurisdiction. It operates out of a nondescript, two-story building, among nail parlors, banks, and take-out restaurants that line the four-lane strip of mid-town Anchorage’s Northern Lights Boulevard. Since its founding ACAT has been staffed by more than 50% Alaska Natives, several originally from, or still living on St. Lawrence Island. Alaska natives occupy six out of ACAT’s eight board seats, one an elder from St. Lawrence Island. (Alaska Community Action on Toxics 2005).

* * *

After meeting Alowa at an ACAT-sponsored environmental health conference, Miller accompanied her to Saint Lawrence Island to document Alowa’s observations with photographs,
video, and environmental samples. Then, Alowa, with Miller at her side, began asking for
meetings with high-level officials, which continued until late-stage liver cancer overtook Alowa’s
body. Before returning to Saint Lawrence Island to live out her remaining days among friends,
family, and familiarity, Annie gave one last, impassioned appeal, this time memorialized on a
video Miller created with the help of Alaskan filmmaker, Jean Riordan:

Northeast Cape was a very clean place. We used to hunt and
pick the greens and everything there…Now we’re even scared to
pick up one little piece because we don’t know if it’s healthy to
pick it up, or an enemy to us… People that stay there are
catching this cancer, including me. But I am going to fight this
until the last day of my breath… I never used to hear about
cancer or anything like that before—until they built that site… I
think about this when I’m throwing up, and sitting up at night—I
say to myself, I will fight until I melt… We are not dumb
Eskimos, No, I am not. On my last day someone could take it
over. I would say to the Colonel and to the people that messed
up the village at Northeast Cape… Would you please, if you are
not our enemies, please come over and clean it up before more
people die of cancer. I will be very thankful. I don’t want any
of you guys to point at each other but to work together and clean
it up for our sake… (2000).

As her death grew imminent, Alowa beseeched her community and Pam to press on. After
issuing a permission to distribute the video, Miller distributed several hundred copies of the
documentary, including to decision-makers at the Pentagon, the Agency for Toxic Substances and
Disease Registry, the US EPA Headquarters, as well as state agencies, including the Alaska
Department of Environmental Conservation. Touched by the tape, staff from these agencies
further distributed the tape through their professional networks. Both the content of the video,
and its wide distribution, reportedly angered the chief of the Alaska Division of the Army Corps
of Engineers (Corps), Colonel Sheldon Jahn. In response, Jahn issued blanket and often
condescending assurances that the Corps was handling the problem. The community48, however,

48 In this case, community is defined as the people living in the villages of Savoonga and Gambell, both located on the northern coast
of Sivuqaq, or in English, St. Lawrence Island. The people of Savoonga and Gambell are Yupik, and have ancestors from the Siberian
wanted more than Corps had done over the previous decade and half, and more than assurances. They wanted to be brought into the decision-making process regarding the further assessment and clean-up of the site. Communities and ACAT made three requests. First, they asked the Corps to recognize and cooperate with their tribal government as a sovereign, self-governing entity. Second, they wanted the Corps to respect community knowledge about the location of buried wastes. Accordingly, they wanted to be included in decisions over how and where environmental samples were collected and how cleanup would proceed. Finally, they requested a “timely and responsible investigation and cleanup that would be protective of both the environment and human health” (Alowa 2000).

In 2000, a community advisory board was convened to update and incorporate the community into future decisions regarding clean-up. In 2002, Colonel Jahn left his post at the Corp; his replacement, Colonel Steven Perrenot, moved remediation efforts on St. Lawrence Island to the top of the Corps’ list for clean-up.

Community-Based Biomonitoring

The documentary, *I Will Fight Until I Melt*, was but the first of an ongoing partnership between the communities of Saint Lawrence Island and the small, though indomitable Alaska Community Action on Toxics. The video had been instrumental in drawing the attention of the public and key decision-makers to the formerly used defense sites on Saint Lawrence Island. Soon thereafter ACAT and the community sought to use science to help further their collective struggle. Pam Miller, though an organizer by heart, is a scientist by training, which had

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peninsula of Russia. Many speak Siberian Yu’pik as their first language. The community is represented by Native Council as well as by a restoration advisory board that participates in oversight of the Army Corps of Engineers clean-up of formerly used defense sites on the Island.

49 The Department of Defense offers the opportunity for community members to join a Restoration Advisory Board, which includes representatives from the Department of Defense, or federal agency, the AK Department of Environmental Conservation, and local and tribal governments. (Source: Department of Defense 2007. Restoration Advisory Board Rule Handbook. Available at: http://dec.state.ak.us/spar/csp/docs/rab_rule_handbook_Jan07-v2.pdf Accessed 8 March 2008).
comprised much of her work with Greenpeace. Though she and the community never set out explicitly to conduct analysis of contaminants in blood, the organization was set up to provide technical assistance and environmental sampling as one of the means through which it supported communities’ capacity as decision-makers.

To help hold the military accountable and to better understand the pattern of illnesses observed by Annie Alowa, the community first wanted to characterize current exposures. Though the military had been on the Island numerous times over the past decade to collect samples and characterize the contaminant, many in the community felt the scientists were not looking in places elders knew, or had observed, the most contaminated spots were likely to be. Plus, given site characterizations of defense sites elsewhere in the country, or of DEW Line sites in Canada, ACAT also had concerns about whether samples were analyzed for the full suite of chemicals likely present at these sites.

Through a mutual contact, Miller connected with Dr. Ron Scrudato, a researcher at the State University of New York at Albany with extensive experience conducting environmental sampling for PCBs. Scrudato, in turn, linked Miller and ACAT with one of his collaborators, Dr. David Carpenter, also from SUNY Albany. Not only was Carpenter a recognized expert in the health effects of PCBs, but he had worked alongside Scrudato with Mohawk communities in New York, partnering on several community-based participatory research projects that examined the consequences of extensive PCB-contamination of the Saint Lawrence River and traditional foods. With the full endorsement of the tribal governments of the Villages of Savoonga and Gambell, who passed resolutions in support of the research project, Miller and ACAT, along with Carpenter, Scrudato, and health care providers from the Norton Sound Regional Health Center, put together a proposal for grant money. In 2000 they received a research grant from the National Institutes of Environmental Health Sciences. The grant mechanism, which incidentally also funded the community-based epidemiologic study of PFOA described in Chapter Five, supports environmental justice research that actively involves members of the affected community in the
research process. Once awarded, Miller used the funds to hire several community members from Saint Lawrence Island onto ACAT’s staff to implement the project (ACAT 2003).

The project’s objectives were multi-fold: to identify the source of contaminants that affected the communities living at Savoonga and Gamble; to characterize health problems experienced by residents; to address local contamination and prevent new sources of exposure; and finally, since they were contending with difficult to manage or regulate substances like persistent organic pollutants, to help train health care providers to recognize, prevent, and treat problems potentially associated with chemicals to which the people of St. Lawrence Island are exposed (ACAT 2005a).

ACAT never set out to conduct biomonitoring on St. Lawrence Island. Rather, they became involved by direct request of St. Lawrence Island community members. As explained to me:

> The [grant] proposal [to NIEHS] itself was kept very open ended. Purposefully. We wanted the people of the island to design whatever was done from the ground up. We didn't want to make a lot of presumptions about it. So, while we included the possibility of body burden testing in the proposal, it was not first and foremost on our agenda.

Though the team had planned biomonitoring to be one component of an exposure study, when presented with a range of research options, the community opted to prioritize having their blood analyzed first, rather than analyzing food and environmental samples first:

> [ACAT] met with the community several times, with the leadership, and [we] realized also the complexity of doing environmental testing in order to prove anything—it's just a huge environment that—we're surrounded by the Bering Sea. We don't have the oceanographic capabilities to do large scale environmental monitoring. It would be extremely difficult. And so we were talking about the most direct ways to really understand whether people had been exposed is to do body burden testing. So, it did come up in the conversations with the leadership, but I think they were much more forceful about wanting it done sooner rather than later. And so I think that's really how— they basically said, “We want to know what we
have been exposed to.” And they understood that was the most direct way to do it.

During the August of 2001, community field aides collected preliminary blood samples from 60 residents. The sample was not randomly selected; rather, participants volunteered for the study, upon invitation to participate by the field researchers, themselves members of the Gambell and Savoonga communities. The sample was stratified according to who lived in or frequented areas near each of the two former defense sites (N=40, twenty in each site), compared with those who did not (N=20).

Typically, while biomonitoring documents exposures from all sources, it cannot indicate the source of the exposure. Here, however, the study team, grounded in the community’s demands for understanding changes in cancer and infertility rates, took on the challenge of source apportionment, or “fingerprinting,” the predominant source of exposure. That is, they sought to parse out the relative contribution of historical military PCB use from PCBs that migrated to the circumpolar North, bioaccumulated through the marine or terrestrial foods chains, and then were ingested. Initially, they planned to do this through their sampling strategy, by measuring blood serum concentrations in sub-populations based on whether they frequented, or ate foods from Northeast Cape. Later, the scientists documented which of the 209 different types of PCBs were detected in blood serum, and then looked for patterns in which types were showing up in which subpopulations. Blood samples were also analyzed for three persistent, organochlorine pesticides, including mirex, and a breakdown product of DDT.

**Blood Results**

ACAT presented every study participant with an envelope detailing each person’s results. They also presented the community with a 100-page bound report that detailed what the study team had done (see Figure 7-2), what they learned, and provided background information about what the results potentially might mean (Zamzow 2002). The report detailed not just results for
the blood sampling, but also for soil and water samples, as well as analyses of PCBs, oil, pesticides, and metals in significant food sources, such as iqallug/kayut (fish), nunivagseghat (greens), quyngiq (reindeer), alpa manik (murre eggs), ayveq (walrus), and neghsat/maklaget (seal). ACAT provided additional information on how contaminants collect in northern climates, and move through terrestrial and marine food webs. The report summarized information on health effects associated with PCB exposures based on studies done on other indigenous populations of the circumpolar North. ACAT also compiled information about the history of contamination and clean-up efforts at both sites.

In the summer of 2002, the research team met with community leadership, which included the city governments in Savoonga and Gambell, tribal leaders, and the village corporation. Afterwards ACAT staff and the field researchers convened two community forums to present the results to the Savoonga and Gamble communities. A translator and mental health professional also attended, the latter to ensure community members had sufficient support should the results be upsetting. Following the forum, Dr. Carpenter made himself available for one-on-one sessions with any participant who wanted more information about his or her results. Carpenter returned again in the summer of 2004 to visit with community members after finishing the analysis of an additional eighty samples. Throughout, the goal of the oral and written presentations, which were planned with community input and oversight, was to help “inform the decision-making processes toward healing and protecting the health of future generations,” as noted in a subsequent grant application.
The study team delivered three main findings to the community based on their preliminary analysis of blood serum. First, they reported that the level of PCBs and some chlorinated pesticides found in blood were “significant.” Second, the most immediate exposure source was attributed to consumption of marine mammal fat, which has accumulated and bioconcentrated contaminants over time. However, though these foods may be a significant exposure source, atmospheric transport also has introduced a significant amount of persistent chemicals into the circumpolar ecosystems and food chain. Third, though the study concluded that the global circulation of industrial chemicals was by far the largest contributor to food chain contaminants.
and thus blood levels, residents who harvested foods from subsistence camps near the former
defense site at Northeast Cape had “somewhat higher levels of PCBs, which may reflect a local
source of exposure” (Carpenter date unknown).

I was not present the summer day the results were reported to the people of St. Lawrence
Island, which happened before I began this project. However, based on follow-up interviews
with members of the project team, I learned that participants, rather than expressing fear,
expressed relief that the study confirmed their lived experience. As I was told:

My sense was that people felt bolstered up by the results. It was like, again, confirmation for what they had already suspected. And things really changed after that as far as we had established the Restoration Advisory Board for the cleanup. People were more wiling to stand up to the military after that.

I think what I remember most is that when they were presented with their results, especially elders, a couple of elders, just wept with relief. It wasn't sadness, it wasn't, “my God, I'm contaminated.” It was, “what we suspected is true. We have elevated levels of these chemicals and this confirms what we've already known.” And that was a relief for people to realize that. That was the sense that I got, and I think everybody felt that in that community meeting and in the meetings individually... people were just grateful to know what was going on.

The Contemporary Legacy of Legacy Contaminants

Carpenter’s presentation reported that, based on their preliminary analysis, local
contamination was a likely exposure source. Those who camped at Northeast Cape had higher
blood concentrations of PCBs compared with populations who lived year-round in either
Savoonga or Gambell, but did not frequent or eat foods harvested there, even though their diets
were comparable. People who lived in Savoonga ate the same types of foods as people from
Gambell, suggesting the difference resulted not from what foods community members ate, but
where those foods were harvested. As a result, the scientists preliminarily concluded that the
discrepancy in levels between these groups suggests that at least some exposure results from
historical use of PCBs near food gathering sites at Northeast Cape. These same discrepancies in levels were confirmed with additional blood samples collected during the summer and fall of 2003 (Carpenter et al. 2005).

In a follow-up study, subsequent analyses parsed out the chemical composition of the PCBs detected in blood. By doing so, the scientists were able to observe an indication of recent exposures: they compared the chemical structures of the range of PCBs detected in bodies of elders versus younger members of the community. Compared with the profile of PCBs found in older community members, the scientists found more “transient” congeners (types) of PCBs, with fewer chlorine molecules, and more persistent, higher-chlorinated molecules among older members whose bodies had accumulated PCBs over a longer period (Carpenter et al. 2005).

Sediment cores taken by boring down into the soil also corroborated the historical presence of PCBs. To rule out the possibility that exposures were resulting solely from global transport, the scientists used a radio-metric analysis to date when particular strata of soil were contaminated. They found that the time period in which PCB-enriched soil was found corresponded to dates when the military was known to have been present (ACAT 2005a).

Though the results suggested that local sources were likely responsible for some portion of exposures, the analysis also brought attention to global sources of these same contaminants. Though residents were concerned initially with contaminants from the two former military sites, through their partnership with ACAT, they came to realize their traditional foods, and their bodies, were double-burdened—not only from chemicals emanating from these former defense sites, but also from atmospheric transport of PCBs to the Arctic regions. For the pilot study, the SUNY analysis found that the average PCB concentrations in the (non-lipid adjusted) blood samples were between six and nine times greater than levels carried by the average person living in the lower forty-eight (Zamzow 2002). In addition to PCBs, the study also detected several organochlorine pesticides, including a breakdown product of DDT and mirex, with global transport determined to be the most significant contributor to human exposures.
While the final report of the study team to the people of Savoonga and Gambell described the implications for remediation of the two military sites, the report also made the case for community members to join the Arctic Council and other international organizations that represent indigenous communities in international treaty negotiations that seek complete elimination of persistent chemicals. Zamzow and ACAT argued that the production and use of persistent chemicals needs to stop” worldwide, and that only full elimination will address the problem of arctic food chain contamination effectively (Zamzow 2002: 7). The report included among its many appendices the text of the recently signed UN Stockholm Convention on Persistent Organic Pollutants, which banned the use of twelve persistent chemicals or industrial byproducts (including PCBs) once ratified by fifty nations. At the time, ACAT was part of an international effort to push ratification, particularly by the United States. The report encouraged the people of St. Lawrence Island to write letters to the Alaskan Congressional delegation to support US ratification and implementation of the treaty.

**IMPLICATIONS**

**State Offers Different Interpretation of Results**

ACAT did not present the results to the media or state agencies until several months following report-back to the communities. Thinking that the results might be of benefit to other communities, community leaders on St. Lawrence Island decided to release the data to the media. On their behalf, ACAT distributed information packets to the Governor, the Alaskan Congressional delegation, the state Department of Environmental Conservation, the US EPA, and the Alaska Office of the US Army Corps of Engineers, who oversaw the St. Lawrence Island military clean-up. They also planned a press release event in early October of 2002 that lead to coverage on the front page of the state’s most influential paper, The Anchorage Daily News (Kizzia 2002). Alaskan television and radio (Alaska Public Radio Network, KNBA, KNOM, KTUU, and Independent Native News) also reported on the findings.
Following the press release, the Alaska Native Health Board, the Alaska Native Medical Center, the Alaska Native Science Commission, and the Department of Health and Social Services Division on Epidemiology all requested meetings and copies of ACAT’s results and report. The Alaska Department of Public Health’s Division of Epidemiology took particular exception to the study and ACAT’s interpretation.

According to publicly available documents, the state disagreed with four elements of ACAT’s interpretation (ADPH 2003). The Division of Epidemiology first disagreed that the levels found in blood serum were “elevated,” arguing rather that they were normal and within range for populations that share similar dietary habits. Second, though the state supported the continued cleanup of the military sites on the island, they disagreed that the military site was a significant contributor to the PCB levels measured in blood serum. The state also argued that the PCB levels were too low to warrant concerns over possible human health implications. Most importantly, the state argued that, given that the results were neither unusual nor harmful to human health: No further medical evaluation or follow-up associated with PCB exposure is warranted for any of the persons tested. Residents should continue consumption of traditional foods, since the benefits of their consumption unilaterally outweigh “the controversial potential adverse health effects from contaminants at the concentrations found in those foods” (Alaska Division of Public Health 2003a: 5), and finally, the agency noted that women should continue to breastfeed their babies, since, again, they argued the benefits “outweigh the theoretical risks associated with exposure to trace contaminants in breast milk” (Alaska Division of Public Health 2003a: 5).

To arrive at these conclusions, ADPH had requested a copy of the report, which ACAT supplied. SUNY researchers also shared the blood data for reanalysis. The Division of Epidemiology then convened toxicologists and medical epidemiologists to review the data. From that, the director, John Middaugh and his staff drafted a bulletin that reviewed the study and arrived at the conclusions outlined in the previous paragraph (Alaska Division of Public Health 2003a).
I next elaborate on the differences between the study and the state’s interpretation as presented in public documents such as state agency reports, ACAT newsletters, and news accounts.

**Perception of Normal Varies by Comparison Group**

The Division of Epidemiology (DoE) disagreed that the blood serum concentrations of PCBs were significant, noting instead that they were within the normal range, given the population’s subsistence practices. Conversely, the community study noted the levels were problematic because they were between six and nine times higher than the US Centers for Disease Control had found in samples taken from randomly selected Americans (Zamzow 2002). The key difference between whether the numbers appeared normal or problematic stems from the identity of the comparison or reference group. The DoE countered that these were “dissimilar populations” (p. 1) and not comparable. ADPH argued that, because the CDC “did not include groups that rely on subsistence foods” there was no basis on which to compare the St. Lawrence Island levels. In a subsequent report on PCBs and persistent organic pollutants (Verbrugge and Middaugh 2004), issued a year later, DoE again, made the same argument—a comparison cannot be drawn between Alaska Native populations that eat subsistence-based diets, and the general American populations (included in CDC’s National Exposure data) that does not. In this instance, DoE noted that, in addition to the different diets eaten by these populations, the specific contaminants found in Alaskan samples were not detected in samples drawn from average Americans. The DoE concluded that:

The CDC has recently published national reference data for individual PCB, dioxin and furan congeners. In 1999-2000, the serum of over 1200-randomly selected American adults was collected and analyzed. These NHANES results are challenging to compare with many studies, because they are only presented as selected percentiles for individual congeners on a lipid-adjusted basis. Many PCB, dioxin and furan congeners were not detected in the national NHANES sample, so no numbers are available for them with which to perform comparative calculations (Verbrugge and Middaugh 2004: 28).
In contrast, ACAT and their partners argued that not only is such a comparison valid, but it is also vital, since it highlights the disproportionate burdens Alaska Native populations bear because they rely on subsistence foods contaminated with persistent chemicals. As Carpenter noted, “there is no question but that the Alaska Native population has serum PCB levels above the national average, and it is very likely that the major source is food” (Carpenter 2003).

Nowhere in the Alaska Department of Public Health Division of Epidemiology documents reviewed for this study did the Department acknowledge that food chain contamination poses a disproportionate burden for populations that rely on subsistence foods. Instead, they normalized that burden by saying it was similar to burdens borne by others. Instead, the DoE drew comparisons between data drawn from Alaska Native populations with other populations that eat subsistence diets and comparable levels of foods from the marine food chain (Verbrugge and Middaugh 2004). Because of the different reference populations, their review of the St. Lawrence data led ADPH to disagree with ACAT and their partners:

Polychlorinated biphenyl (PCB) concentrations detected in St. Lawrence Island village residents are similar to other Alaska Native populations that have been assessed, as well as to other Arctic populations studied under the Arctic Monitoring and Assessment Programme (2003a: 1).

They also compared the levels found on St. Lawrence Island to populations that draw their food primarily from the Great Lakes region. The report argues that Alaskan body burdens are on par with those found among people who eat from the Great Lakes. By doing so, the report likens the issue of persistent organic pollutants (POPs) in Alaska to that of a region where POPs have been the cause of major concern and policy-action. Importantly, fish from the Great Lakes regions have captured much attention for the content of persistent organic pollutants they harbor. Persistent pollution in this region has been the subject of international debate and cooperative policy-making since at least the 1970s, including the very radical recommendation for the sunset of all chlorine-containing chemicals, including PCBs, as well as many chlorine-based pesticides.
addressed by the UN Stockholm Convention on Persistent Organic Pollutants, such as DDT (Howard 2005; Thorton 2000).

The Relative Contribution of Local versus Global Sources

In addition, the DoE took issue with ACAT’s conclusion that local (i.e. military) sources were at least partially responsible for the PCB blood levels detected on St. Lawrence Island. To make this point, the DoE plotted the St. Lawrence Island blood data against data gathered from two other Alaska-based biomonitoring studies to argue that the ranges of PCB concentrations found in St. Lawrence Island “fall within the range of values measure in Aleutian/Pribilof Island residents” (Alaska Division of Public Health 2003a: 2) studied by the Alaska Division of Public Health (2001). The DoE also noted that PCB concentrations detected in St. Lawrence Island women were similar to the mean PCB concentration reported for 131 Alaska Native women of comparable age through the state,” as found by a study involving the CDC, the National Cancer Institute, The Indian Health Service, and the Alaska Area Native Health Service.

In a response to Middaugh, which was then reprinted in an ACAT newsletter, Carpenter (2003) agreed:

Serum PCB levels at St. Lawrence Island are not significantly elevated in relation to other Alaska Native populations… [since] most of the exposure to PCBs and persistent pesticides comes from atmospheric transport to the polar regions from temperate regions.

However, Carpenter disagreed with the state’s assessment of the relative contribution from the historic military sites, noting that there was a pattern of different exposures found among the people living on St. Lawrence Island. Those eating foods harvested from near the former defense site at Northeast Cape had higher blood levels and different types of PCBs than those who never visited or ate foods from that region. Carpenter asserted that the preliminary results did support their working hypothesis that “individuals with close contact with the Northeast Cape would have
higher serum PCB levels than those who did not,” but that the study team planned additional blood testing, in addition to environmental sampling, to confirm and characterize this pattern (2003).

The Health Implications of Low-Dose Exposures through Subsistence Foods

Another difference between interpretations was the health significance of low-dose PCB exposures. Carpenter’s research and ACAT’s report acknowledge that low-dose exposures, at levels at or below those recorded on St. Lawrence Island, have been associated with a range of health effects, most especially to fertility, reproduction, and other effects mediated by the hormone system (Zamzow 2002). In contrast, the state acknowledged only a “theoretical risk of subtle health effects” (Verbrugge and Middaugh 2004: 1). Tracy Lynn, from the Alaska Department of Public Health, went on record with the Anchorage Daily News stating that evidence supporting subtle effects from low-dose PCB exposures, such as those found by ACAT and partners, is “theoretical and highly controversial” (Kizzia 2003). The DoE response to the St. Lawrence Island study concluded:

> After reviewing the available information, the ADPH has determined that the PCB concentrations measure in St. Lawrence Island residents are unlikely to cause adverse health effects. While clear toxic effects have been demonstrated at high PCB doses, scientific controversy remains regarding possible subtle effects at low doses. However, the overall weight of evidence support the conclusion that no adverse health effects would be expect at the PCB concentrations measured in this study. These concentrations are in the expected range for a population with a healthy northern subsistence lifestyle centered on fish and marine mammal consumption [cited by the Arctic Monitoring Assessment Program, 1998]. No further medical evaluation or follow-up associated with PCB exposure is warranted for any of the persons tested” (Alaska Division of Public Health 2003a: 5).

Carpenter’s reply disagreed with these conclusions, noting:
This statement flies in the face of enormous evidence, and the position taken by both ATSDR [The Agency Toxic Substances and Disease Registry] and EPA [the Environmental Protection Agency]. The evidence that there are health hazards from exposures to PCBs in the range of 6-9 ppb is very strong, with disease outcomes ranging from cancer to neurobehavioral effects to endocrine disruption and immune suppression. (Carpenter 2003).

In DoE’s subsequent report on PCB exposure (Verbrugge and Middaugh 2004), published a year later, ADPH maintains their position that low dose exposures, such as levels founds in subsistence foods, are not expected to be relevant to adverse health outcomes, that there is “a lack of any clear evidence” (p. 3). This sixty page report on PCBs does not cite Dr. Carpenter’s research, even though he is considered a leader in the study of PCBs, particularly among subsistence populations such as the Mohawk Nation along the St. Lawrence River.50

That these two camps disputed the relative significance of low-level exposures to PCBs reflects a broader pattern of debate in the field, which has become more contentious as biomonitoring studies continue to find trace and “ultra-trace” levels of contaminants in most people sampled. This is especially true in instances where persistent chemicals potentially pose low-level exposures over long periods of time, such as through the food supply.

Environmental health scientists have long-debated the relative effect of low-dose exposures, and these are debates that play out in both scientific meetings and regulatory panels. The realization that chemicals can mimic or interfere with the hormone, or endocrine, system at very low levels sparked what has been termed a paradigmatic shift in the field of toxicology (Krimsky 2002). For centuries, environmental health scientists worked from the assumption that “the dose makes the poison.” This adage dates to the father of toxicology, Paracelsus, and states that larger

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50 Carpenter has over two hundred publications to his credit including literature reviews and studies on PCBs published by top journals in the environmental health sciences (e.g., Carpenter 1998). Importantly, Carpenter and colleagues at the State University of New York at Albany have pushed the field of environmental health sciences forward by studying complex chemical mixtures, which better approximate real world exposures. From this work, he and his colleagues at SUNY-Albany, funded through the Superfund Basic Research Program and other federal funding streams through the National Institutes of Health, are starting to piece together how chemicals like PCBs act differently in combination, even at low doses (Carpenter et al. 2002; Denham et al. 2005).
doses ingested, the greater the effect. Under this assumption there exists a level of exposure at which scientists assumed no effect would follow. Guided by this assumption, scientists focused on identifying the effects that high, acute exposures chemicals have on the human body, at the exclusion of looking for more subtle effects from lower, though often more frequent exposure. However, in the 1980s, scientist Theo Colburn pieced together evidence from hundreds of studies that showed chemicals were all having effects on systems regulated by the endocrine system. Hormones were found to behave differently—sometimes a stronger effect was seen at lower, not higher, doses. As well, historically, environmental health research has focused on whether and how exposures lead to the onset or exacerbation of cancers, with less attention paid to more subtle, and harder to measure, effects on human physiology, such as immune function, fertility, and neurodevelopment, which in many cases is mediated by hormones (Krimsky 2002; Colburn et al. 1996). In the years since this discovery, evidence continues to mount about the low-dose toxicity of well-researched chemicals such as PCBs. The lingering debate over the scientific evidence of low-dose exposures for many chemicals remains largely perpetuated by political questions over how to deal with this knowledge (Krimsky 2002). The debates stemming from the St. Lawrence Island study must be understood in light of this history of politics and science policy debates.

**Disagreement over Implications**

The DoE’s interpretation led to a different assessment of the public health implications of the St. Lawrence Island blood results. DoE expressed concerned that ACAT and partners’ interpretation, in additional to media coverage associated with ACAT’s report, had provoked St. Lawrence Island residents and other Alaska residents to fear that their traditional foods are contaminated and unsafe to eat (Alaska Division of Public Health 2003a: 1). Even though the DoE notes that fish can carry contaminants, the report argues that this should not affect their consumption:
Traditional foods are an important and healthful component of the diet of Native Alaskans. The Division of Public Health strongly endorses the consumption of subsistence foods. PCB concentrations in Alaskan fish are far lower than in most fish from the Lower 48, reflecting the relatively remote, nearly industry-free environment of many regions of Alaska (Verbrugge and Middaugh 2004: 30).

DoE noted that the benefits of traditional foods exceed any possible threat they may pose. This guidance is based on the DoE’s assessment that, of those species tested, there are low levels of contaminants in wild Alaskan foods, and an assertion that low level exposures to PCBs pose a “theoretical,” and at best, “controversial potential for adverse health effects” (Alaska Division of Public Health 2003a: 1). The DoE chided the ACAT study for unjustifiably discouraging the consumption of traditional foods on St. Lawrence Island, or in other Alaska Native communities.

Neither Carpenter, nor ACAT, had endorsed a recommendation that people from St. Lawrence Island stop eating traditional foods, though the DoE report implied that was the implicit message conveyed by their report and press release. Rather, as Carpenter notes on behalf of the study team and community:

What we do endorse strongly is providing individuals from whatever community with the current information on both benefits and risks…. The government of Alaska, particularly the DPH, has consistently taken the position that indigenous foods are good no matter what is in them… to ignore the problem of contaminants in traditional foods is, in my judgment, condescending, paternalistic, and poor practice of public health. Native communities have the right-to-know what is in their traditional foods. Neither you nor I has any right to tell them what to eat, or not eat, but we should not deny any community the information they need upon which to base their own decisions. The Yu’pik community on St. Lawrence Island is concerned about their health and the contaminants in their bodies. They asked us to help them determine what the contaminants were in their bodies and where they come from… Such information empowers the community to make its own decisions…. The only logical way to proceed to sort out relative risks versus relative benefits is to determine levels of consumption and levels of contaminants, and provide objective
information to the communities so that they can make their own decisions (Carpenter 2003).

Moreover, ACAT and their scientific and community partners, argue that the benefits of traditional foods do not unilaterally outweigh the risks. The risks, as Carpenter and ACAT note, are substantial.

At the same time, the St. Lawrence Island study group acknowledged that forgoing traditional foods is not an option either. As one ACAT staff person noted, “it is not a choice to not eat our traditional foods.” Rather, ACAT asserts that systemic actions are necessary to restrict persistent contaminants from entering the food chain. One interviewee explained: it is not enough to say global contaminants are affecting traditional foods; these need to be tracked and then stopped at their source. Though exposure reduction from global elimination may be as much as a generation off, in the interim, ACAT notes that more immediate exposure reduction strategies are critical. This, for ACAT, includes full remediation of military sites that exacerbate exposures resulting from the influx of contaminants to the circumpolar region. From that perspective, ACAT argued that food chain contamination is a violation to human rights.

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Typically, debates over biomonitoring results occur when they involve established public health practices with known health benefits. This has been the case breast milk monitoring, which reveals how breast milk is often a route of transfer of persistent pollutants from mother to child (Boswell-Penc 2005). The implications biomonitoring has for breast-feeding led to extended debates in California, where efforts to launch a state-wide biomonitoring surveillance program were stalled by organized challenges against proposed monitoring of breast milk. Some activist groups, for example breast cancer advocacy organizations or lactation groups, expressed strong reservation that a breast milk monitoring program might lead some mothers to forgo breastfeeding their babies (e.g., Brenner 2003). To allay these concerns, environmental health advocacy organizations that study, or advocate reducing contaminants in breast milk, are quick to
point to corollary research that “breast is best,” despite the contaminants found in human breast milk. Concerns over whether reporting exposures faced by subsistence communities would decrease consumption of traditional foods also surfaced in Canada, where some of the first research on body burdens of persistent pollutants was first completed. Scientists and communities, through the Canadian National Contaminants Program and the Arctic Monitoring Assessment Programme have been working through effective strategies to convey risks and benefits posed by food chain contaminants (Cone 2006; Inuit Tapiriit Kanatami 1995; Northern Contaminants Program 2003).

The debates that followed the release of the St. Lawrence Island data also must be placed into the broader context in which the DoE works. It is not merely that the DoE arrived at different public health implications because the agency disagreed with the comparison group or about ACAT’s conclusions on the low-dose toxicity of PCBs; the DoE also subscribed to a different opinion about the role of contaminant monitoring and public health advice. One of ADPH’s principle roles is to use human and/or fish biomonitoring data to develop dietary and public health advice for Alaskans. However, though many other state Departments of Public Health have issued fish advisories in response to the presence of contaminants in foods and people, ADPH has been reluctant to do so until recently. Rather, historically, the Alaska Department of Public Health has challenged consumption advisories, and has not issued its own warnings because, according to a more recent report, the agency believes that in doing so, they honor “the principle of nonmaleficence (i.e., first do no harm). In this case, nonmaleficence refers to the potential harm that could occur by encouraging people to reduce their fish consumption and

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51 For example, the Toxics Free Legacy Coalition, which is comprised of environmental health organizations from Washington State, monitored breast milk contaminants in 2005. In the final report, however, they were clear about the implications the report had for breast-feeding. For example, see one example fact sheet “The Benefits of Breastfeeding” published by a member organization that accompanies the report, which addresses these issues. Available at: http://www.sightline.org/research/pollution/res_pubs/breastfeeding. Accessed 17 March 2008.

thereby not receive the beneficial health effects of this nourishing food” (Verbrugge 2007). In ADPH’s logic, fish consumption advice would constitute a breach of professional ethics. To prevent this from happening, for example, DoE argues that information about food contaminants must be presented along with, and perhaps privileging, information about the benefits of their consumption. Similarly, when ADPH describes body burdens of persistent pollutants, particularly in women, this information is accompanied by statements about the public health benefits of breastfeeding. This position reflects general advice issued by the Northern Contaminants Program, which advises scientists and public health agencies to convey information about contaminants in foods that is balanced by information about their sustained benefits (2003). This is also the position adopted by advocacy organizations, like ACAT. The focus on balancing risk information results from the earliest studies of contaminants in circumpolar people and food chains, which reportedly did catalyze grave concern among communities particularly in Nunavut and the Canadian Arctic (Colborn et al. 1996; Cone 2006).

However, DoE has a history of challenging consumption advice and food contaminant or body burden studies that examine food contaminants and human body burden in which they are not involved. The DoE has challenged generic fish advisories from FDA and EPA, which they argued do not account for the nutritional benefits of fish- and marine-based subsistence diets (Arnold et al. 2005). As the DoE has summarized, Alaska Native communities who eat market-based foods instead of their traditional, subsistence diets face significant costs to individual and community health and social well-being (Nobmann, et al. 1998; 1999; Alaska Division of Public Health 2003b). They also have challenged federal fish warnings on the grounds that they do not account for the relatively lower levels of mercury in fish from Alaskan waters. In addition to challenging the St. Lawrence Island study for calling into question traditional foods harvested from Alaska, the Alaska Division of Public Health has challenged other studies and even federal agencies that have raised similar concerns. For example, the DoE has challenged other studies
finding PCBs in Alaskan fish populations, including one published by the journal, Nature (Alaska Division of Public Health 2003c).

The DoE also critiqued consumption advice that a federally funded agency planned on issuing to the people of St. Lawrence Island. Though the DoE criticized the ACAT study for stirring what they saw as public concern over the safety of traditional foods, in fact, the Agency for Toxic Substances and Disease Control had already issued a site-specific fish consumption warning for fish pulled from near the Northeast Cape formerly used defense site. In September of 2000, ATSDR shared with the Department of Environmental Conservation a draft report the agency prepared about PCBs in fish sampled from Northeast Cape, the results from a health consultation they began in 1999. In the report, ATSDR recommend that residents of St. Lawrence Island not consume fish from the Suqi River and its drainages at or near the Northeast Cape site, because some of the fish collected from the river exceeded EPA recommended consumption guidelines for PCBs. According to an entry posted by DEC staff person in the Northeast Cape database, maintained on the DEC website:

> The State Division of Epidemiology didn’t agree with the level of warning (as approaching a fish advisory) and commented to ATSDR to soften the language, which they did in a subsequent draft. The HC [Health Consultation Report] recommends that more sampling and evaluation be done at the site. (Brownless 2000).

Over the subsequent five days, Middaugh from the Department of Epidemiology met with the DEC to “coordinate State opinion on the approach to the ATSDR Health Consultation for Northeast Cape.” The DoE and DEC came to the decision that “a fish advisory is premature until further data is gathered” (Alaska Division of Public Health 2003). Meanwhile, community members, who learned about the PCB levels and consumption advice from ATSDR’s draft report, expressed concerned about fish drawn from a second river, the Tapisak, near the Suqi. By 2005, the ATSDR had released an updated report based on subsequent sampling. PCBs were found in
all fish sampled, but when compared to fish sampled in other regions, levels were found to be comparable and therefore no site-specific consumption warnings were warranted. ATSDR did offer blanket recommendations to vary the species of fish eaten and harvesting locations, as well as to skin the fish, peel the fat, and not eat fat drippings released during cooking (ATSDR 2005).

The extent to which the DoE has challenged any study that implicated Alaskan fish, coupled with their tendency to focus exclusively on species of interest to commercial or recreational industries (rather than the all species that comprise the full diet of coastal, Alaska Native communities), points to the broader context in which state officials interpret and translate science for public health practice. Their actions raise the possibility that state public health agencies must walk a fine line to protect public health, but without implicating key economic sectors. To acknowledge the risks posed by food chain contaminants in traditional foods, would by association implicate the health of Alaska’s rivers and fisheries, a charge that would affect Alaskan sport fishing as well as the commercial seafood industry, which collectively account for nearly $2 billion of Alaska’s economy. At the same time, studies like the one ACAT and their community partners conducted challenge the illusion of “pristine Alaska”—unspoiled by either local or global industrial practices, or a legacy of military activities—to which throngs of tourists visit each year. Such circumstances point to the importance of future inquiry into state-level agencies, and the unique political and economic contexts in which individuals working within such agencies interpret science, issue science-based advice, and practice public health. Previous studies of science advice at the federal level has done much to increase sociologists’


54 According to the Alaska Travel Industry Association, in 2006 the “travel and visitor industry” contributed $1.6 billion dollars to the Alaskan economy (Alaska Travel Industry Association 2007).
understanding of how political-economic factors shape scientific interpretation and translation into advice (Hilgartner 2000; Jananoff 1990); these debates suggest that more indepth inquiry of state agencies would reveal much about the challenges and pressures faced by agencies and their staffmembers.

Different Solutions

The DoE proposed three responses to the problem of legacy contaminants in the food chain. First, they issued voluntary guidance that individuals could eat species lower on the marine food chain, or leaner, less fatty flesh, to minimize exposure, a practice referred to as “rotating your poisons” (Hightower 2007); they also called for more research on which species contribute most significantly to human burdens (Verbrugge and Middaugh 2004: 30). Second, for the people of St. Lawrence Island, the DoE supported continued clean-up of military sites (DoE 2003), and third, they recommended expanded biomonitoring and monitoring of contaminants in subsistence foods to inform future public health guidance (Vebrugge and Middaugh 2004).

To the Alaska Department of Public Health’s credit, in recent years and following a shift in leadership, it continues to document the health, economic, and sociocultural benefits of subsistence diets in Alaska, and moreover have attempted to use a multi-stakeholder and consensus process to arrive at the limited fish consumption advisories issued by the state in 2007 (see Verbrugge 2007). DoE advisories were restricted to concerns about five species of Alaskan fish found by the state’s fish monitoring program to harbor elevated mercury levels. However, ACAT and their community partners have pushed for other responses as vital to address human body burdens and food chain contamination.

ACAT has continued to help the people of St. Lawrence Island advocate for removal of local contamination by the military. By removing contaminated soil and other sources of local contamination, such as buried wastes, ACAT hopes that the level of PCBs in plants and in foods would diminish over time, and in turn, lower the total amount of PCBs ingested by area residents.
They also argued for more careful cleanup measures to avoid remobilization of contaminants once sequestered in the ground.

Second, ACAT demanded that the “production and use of harmful chemicals needs to stop all over the world.” (Zamzow 2002: 7). As the report concluded:

> It is unconscionable that people who have never made, used, or were in any way involved with these chemicals need to fear them and deal with them on a daily, personal level. All northern people need to work together to eliminate the sources of POPs so no one has to fear traditional foods… Stopping countries from making or using a chemical has real effects (Zamzow 2002: 88).

To do this, they noted that the issue must be addressed on the international stage through advocacy for the UN Stockholm Convention of Persistent Organic Pollutants. By 2002, when the St. Lawrence Island report was released, the United States had signed, but not ratified, the convention, meaning that the US had not brought its federal regulations in line with the treaty in order for its provisions to take effect. Thus, the report urged the people of St. Lawrence Island to urge Senators Stevens and Murkowski to move towards ratification. As well, ACAT urged that representatives from St. Lawrence Island become involved in the Arctic Council (discussed above), noting “the voice of arctic people have been drowned out by the huge chemical corporations.” (Zamzow 2002: 7).

In addition to limiting the release of persistent chemicals locally and globally, ACAT also argues that, as communities continue their traditional food practices, current harms that result from environmental exposures must be addressed. The third prong to their proposed solution is to educate health care providers to recognize symptoms of conditions associated with environmental exposures, since many of whom are unaware of the unique exposures affecting populations living in the circumpolar region. ACAT is working to develop and environmental health care curricula meeting standards for Continuing Medical Education credits. Reaching more broadly, ACAT also works to develop information exchanges for health care providers to discuss the diagnosis
and treatment of health issues associated with exposures to environmental contaminants. ACAT has distributed newsletters aimed at physicians, and sponsored grand rounds and seminars.55

Finally, ACAT and their partners challenge the state’s call for more biomonitoring science in the absence of decisive, longer-term action to mitigate and reduce exposures than fish consumption advisories. The ADPH has noted that more biomonitoring in Alaska is needed in order to issue specific guidance on fish consumption in Alaska, particularly among people living in potential pollution hot spots (Alaska Division of Public Health 2003a). As well, the Division of Epidemiology hopes to expand its technical capacity to conduct biomonitoring in years to come. For example, the a recent newsletter, the DoE notes that (2004):

A long-term human biomonitoring program in Alaska is critical to assess trends in contaminant exposure and nutrient intake, and to continually verify that our consumption advice is optimally protective of human health. The Section of Epidemiology and the Alaska Public Health Laboratory within the Alaska Division of Public Health are currently collaborating to establish such a biomonitoring program. The Alaska Public Health Laboratory is developing the capacity to measure persistent organic pollutants, including PCBs, dioxins, furans, and PBDEs, in human serum. This analytical support will enable the Section of Epidemiology’s Environmental Public Health Program to offer blood testing to Alaskans who are concerned about potential POP exposures. This will be a valuable extension to the Division’s biomonitoring efforts, which include the statewide Maternal Hair Mercury Biomonitoring Program. The Maternal Hair Mercury program was reviewed by the Alaska Area Institutional Review Board and was determined to be standard public health practice, not research (p. 30)

55 According to ACAT’s overview of research activities submitted to the National Institutes of Environmental Health Sciences, seminars have included children’s environmental health (Dr. Ruth Etzel, Research Director, Southcentral Foundation and Alaska Native Medical Center), Diabetes and Environmental Factors (Dr. David Carpenter, Director, Institute for Health and the Environment, SUNY Albany), and Special Vulnerabilities in Pregnancy and Early Development Concerning Environmental Exposure (Aimee Boulanger, Program Director, Institute for Children’s Environmental Health). As well, ACAT has organized twelve teleseminars with active participation by health care professionals on topics ranging from diabetes, reproductive health, learning and development disabilities and breast cancer.
Though increased state capacity may be an important tool for public health promotion, it is yet to be seen for what purposes such biomonitoring will be used. There is a discernable pattern that chemicals disproportionately are bioaccumulating in people from subsistence-based indigenous communities. What biomonitoring has been done in Alaska and in the circumpolar North more generally repeatedly converge around a similar pattern: PCBs and many chlorine-based pesticides are elevated in populations living in circumpolar populations compared with those living at lower latitudes (AMAP 2004). Scientists continue to find this pattern true for other persistent pollutants, including the bromine-based flame retardants discussed in Chapter Six (see Ikonomou et al. 2002) and the perfluorinated compounds discussed in Chapter Five (see Stock et al. 2007). While Alaska and the US must uphold their agreement to monitor the presence of contaminants in the Arctic, at the same time, ACAT raises the important point that biomonitoring without also acting to reduce known bioaccumulating chemicals is also a problem.

A Cascade of Conflict, On a Treadmill of Science

The Alaska Division of Public Health recruited other organizations to endorse its critique of and response to ACAT’s blood results. When the state, and several other key organizations, such as the Alaska Tribal Health Consortium, publicly disagreed with ACAT’s findings, it initiated a cascade of conflict between ACAT and other organizations in the state. Early on, the dispute between ACAT and the DoE played out through letters as well as in meetings. However, as the Division on Epidemiology was concluding their re-analysis and critique, they disseminated draft conclusions to state agencies and other organizations that work on issues of Alaska Native health and the environment, in each instance seeking endorsement of the state’s position. Before release of the critique, the DoE solicited feedback and endorsement from other organizations, including ACAT allies or collaborators. For example, in January of 2003, representatives from the Division of Epidemiology met with the Department of Environmental Conservation to discuss the report
The dispute between ACAT and DoE affected ACAT’s relationship with the Norton Sound Health Corporation, partners on the St. Lawrence Island study, as well as the Aleutian and Pribilof Islands Association, a non-profit, community-based organization that addresses similar social, economic, and environmental issues faced by the Aleut people.

The dispute about the relative significance of PCB levels on St. Lawrence Island spread over a wide network of organizations and agencies such that Anchorage Daily News reporter, Tom Kizzia (2003), eventually described the disagreement as both “unusual” and “unusually high profile.” The University of Alaska at Fairbanks and the Alaska Native Tribal Health Consortium both went on record critiquing the study, alongside the Alaska Department of Public Health (Kizzia 2003). The report and its implications were debated in meetings with Norton Sound Health Corporation, which provides health care to residents of St. Lawrence Island and was a collaborator on the study, during the April 2003 St. Lawrence Island Restoration Advisory Board meeting, the committee that oversees the Corps’ clean-up efforts there (Alaska Department of Environmental Conservation Contaminated Sites Database 2003).

Not only did this send ACAT scrambling to repair these relationships through individual meetings, phone calls, and letters that clarified ACAT’s misunderstood position and intentions, but also drew ACAT and their partners into ever-more technocratic arguments about how to conduct and interpret their biomonitoring study (e.g., whether to draw blood for PCB analysis only after participants have fasted for 12 hours). To address environmental destruction on St. Lawrence Island, and global contaminants more generally, ACAT stepped onto what I term a “treadmill of science,” a metaphor that builds from an oft-used concept in the field of environmental sociology, the treadmill of production (Schnaiberg 1980; Schnaiberg and Gould 1994). This concept refers to how economic and political systems keep societies in an ever-escalating, self-reinforcing pattern of growth and environmental destruction. Here, these same systems that drive economic growth and result in environmental destruction also ensnare community organizations, who in order to challenge this system, often get weighed down in a
never-ending cycle of doing and defending science while the production-destruction cycle repeats.

Yet, even as ACAT spent much time and energy responding to public scrutiny and criticism, it also continued to pursue science as a core-part of their overall strategy to help communities address the twin injustices of legacy contaminants from military and global sources. ACAT coordinated the collection of additional blood samples from St. Lawrence Island the following year, and also extended their soil and food sampling projects. Then, to further legitimate their findings, they worked with the people of St. Lawrence Island and SUNY to publish the results from this larger study, which they did in the International Journal of Circumpolar Health (Carpenter et al. 2005). They also used the science to keep the issue in the public sphere by presenting to audiences of scientists, policy-makers, and other advocacy organizations. By 2006, ACAT and their community partners had presented findings from their St. Lawrence Island study at numerous scientific conferences, including those convened by the National Institute of Environmental Health Science, the Arctic Monitoring and Assessment Programme conference, the Alaska Public Health Association, American Public Health Association, Alaska Chapter of the American Academy of Pediatrics, National Environmental Justice Advisory Council, Polar research Board, the Alaska Native Health Board Statewide Conference, the US Environmental Protection Agency, the Agency for Toxic Substances and Disease Registry, the National Academy of Sciences Polar Research Board, the US Department of Defense, the Alaska Department of Environmental Conservation, the First National Conference on Precaution, the Military Toxics Conference, and others.

At the same time, ACAT initiated new biomonitoring projects, at one point juggling three projects simultaneously. In 2005, the National Institute of Environmental Health Sciences awarded ACAT, SUNY Albany, and Norton Sound Health Corporation another four years of funding to extend the work done with St. Lawrence Island communities to additional rural communities in the Norton Sound region. Among the proposed work, ACAT, in conjunction
with its partners as well as a community advisory board and health care providers, is designing a pilot study of contaminants in breast milk of new mothers in the region. ACAT also conducted a public health study using biomonitoring as a health assessment tool to monitor blood lead levels in communities living near Red Dog Mine, a zinc mine northwest of Kotzebue, listed by the EPA as Alaska’s top polluting industry (Dobbyn 2004). Finally, beginning in 2006, Miller served as co-leader, alongside Sharyle Patton, of the Commonweal Biomonitoring Resource Center, of a national biomonitoring study released in 2007 (Commonweal Biomonitoring Resource Center and the Coming Clean Body Burden Work Group 2007). The study examined blood and urine samples donated by 35 volunteers, five from each of seven states across the country. The participants were analyzed for a suite of 20 chemicals, including several each of the following classes: the flame retardant, polybrominated diphenyl ethers; and the plastics additives, bisphenol A and phthalates. The Alaskan volunteers included two Congressional candidates, a public radio reporter, a Native Movement activist, and a commercial fisherman.

ACAT also used blood results to further campaigns that address both local contaminants resulting from the military sites and to push for national and international policies to eliminate use of persistent chemicals globally. ACAT and residents from St. Lawrence Island used the results to request that EPA list Northeast Cape as a Superfund site and to push the Corps for more comprehensive risk assessment and site characterizations. For example, community members had expressed concern that the Corp’s site characterization was not sufficiently comprehensive, testing neither the full complement of relevant contaminants nor sampling in all areas they knew to be impacted, based on community members’ observations or previous employment at the military outposts. Sediment analysis and blood sampling detected mirex, a chlorine-based and persistent pesticide used to treat for fire ants that and also used as a flame retardant, that was not included in the Corp’s initial site characterizations. The Corp’s initial site characterizations did not include mirex. The study helped prove to the Corps that they needed to be testing for a wider array of contaminants, including mirex (ACAT 2005).
Meanwhile, ACAT and community members used the science to build relationships with allies who, in turn, helped them generate momentum to move in a different direction. ACAT realized that their science helped them build networks of support, which would eventually enable them to bypass the regulatory juggernaut and seek change by using science to make moral claims, rather than technocratic ones. They became active in advocacy networks concerned about POPs elimination and chemical policy reform, which in turn would build toward global elimination, and alliances with other exposed groups in other regions of the country and world. These experiences, combined with the legacy of struggles over tribal recognition and sovereignty, set the stage for ACAT, around the time of its 10th anniversary, to move in a new direction. ACAT increasingly started to critique the notion that they must use science to pursue remediation and environmental change, even as it continued to produce more science.

A New Relationship with Science

Vi Waghiyi, ACAT coordinator for the St. Lawrence Island research project and relative of Annie Alowa, has traveled extensively to present findings from the St. Lawrence Island research and to request additional support. She twice testified before the National Environmental Justice Advisory Council to the EPA Administrator regarding EPA’s minimal response to requests for federal assistance. In response to her powerful, second testimony (see Waghiyi 2004), one attendee of the annual meeting observed that:

Alaskan Natives are the.. “new Mossville” [Louisiana, known for extensive dioxin contamination]. …Eight representatives from Alaskan Native Communities were on the agenda to present testimony. [One attendee] questioned when something would be done to assist Alaskan Natives. She stated that it is heartbreaking to listen to all their testimony, and she pointed out that the burden is always on the communities to travel to the NEJAC meeting and to perform their own research (National Environmental Justice Advisory Council transcript 2004: 2-10).
This quote captures the double burden of contamination and science that increasingly ACAT has come to critique.

For ACAT, what started out as science-based advocacy has grown to be an advocacy style that both critiques and transcends science. Over time, the relationship between ACAT’s mission and strategies to fulfill that mission has shifted from a reliance on scientific information to given their concerns legitimacy, to conducting independent science to move debate and empower communities, to challenging the unethical political circumstances that make communities and their allies rely on science in the first place. A second shift, which occurred in relation to the first, is that ACAT has changed the forums in which it uses biomonitoring science. They use science to engage potential allies in advocacy organizations or networks of those committed to international policies to eliminate persistent chemicals. They are choosing to not use science in the regulatory arena, which, as they argue, functions like a “cattle chute,” that funnels their concerns into a single issue—at what level do persistent chemicals pose an actionable risk to human health? These were subtle shifts that evolved with time, and partially in response to ten years of science-based advocacy, and the challenges, long delays, and technocratic debates that followed from them. In this section, I recount this shift—which remains a transition still in progress—as well as point out some of the conditions that spur ACAT to make this organizing shift.

At the time Miller founded ACAT to address persistent pollutants in Alaska, there was little, if any, scientific documentation about persistent pollutants in the US Arctic, relative to work ongoing in the Canadian or Russian Arctic (AMAP 2004). Thus, the context in which they began organizing around these issues necessitated that ACAT conduct environmental and biological monitoring as a way to fill gaps created by a lack of state or federally-funded research and to convince funders, state agencies, and the military that persistent pollutants posed a grave problem for Alaska. Within Alaska, there was also little tracking of contamination at FUDS or progress in remediation efforts. In particular, community members referenced their biomonitoring data, as
described in the previous section, to convince the military that the contamination at St. Lawrence Island was more than just a historic problem. These sites, though they harbor contaminants from a previous generation, pose a contemporary and urgent problem.

Over the past three years, I have had occasion to hear ACAT Environmental Justice coordinator, Shawna Larson, speak about environmental justice issues in Alaska (2006). In each instance, she elevated the dialogue, wresting the discussion free from the burden of technical arguments, and returning to a broader vision of the relationship among people, chemicals, and industry. For example, during a 2006 teleconference call hosted by ACAT and the Collaborative on Health and the Environment-Alaska, Larson noted how appeals to policy-makers and regulators quickly get reduced to a technocratic discussion in the language of parts per million or parts per trillion (Larson 2006a). She noted how issues that are political, economic, cultural, historic, and social far too often are whittled down into a single issue in the risk assessment paradigm, spoken about only in the language of parts per million, parts per billion. During another dialogue about effective strategies for communicating with communities about contaminants in fish and in people, she changed the questions under debate, instead raising structural questions about the root problem. For example, when scientists dispute whether communicating the risks posed by food chain contaminants will lead indigenous communities to abandon traditional diets, she asked: Why are contaminants present in foods and where is it that tribal people get to have a say about what’s in their food and breast milk? Where is the justice in that? When state agencies call for more biomonitoring before acting to mitigate current exposures, she added (paraphrased): Are [more] studies the only way to stop contamination? If so, why is that? Where is the justice in that? When policy-makers debate the relative meaning of biomonitoring results for proposed elimination of persistent chemicals, a dispute that pits parts per million against marketplace feasibility, she questions: why are health decisions weighed through the lens and logic of economics? Where is the justice in that?

ACAT has gone to extensive lengths to document the parts per billion of PCBs in the food
webs and blood serum of people living on St. Lawrence island, and works to develop a breast milk monitoring program in the Norton Sound region to keep the pressure on state, federal, and international decision-makers. Yet Larson emphasizes that communications with agencies and policy-makers often overlook the most salient, pressing questions: why are contaminants in foods? Why are they in breast milk? And, when will indigenous communities have a say in this issue that affects them so deeply? Her questions cut to the root problem of why indigenous communities, to be heard, must speak through science, and not through their own experiences and voice. This same problem is echoed by ACAT’s struggles to have indigenous people and traditional knowledge invited onto the roster of “experts” that make decisions over what contaminants to add next to the UN treaty on Persistent Organic Pollutants. Moreover, Larson points to an even more fundamental issue: “Are studies the only way to get contaminants stopped. If so, why is that?” Once the science is laid bare, she quickly raises the double-injustice perpetrated on Alaska Natives, first by the contaminants, then by the technocratic ways in science reveals serious health and ethical issues that are weighed through the lens, language, and logic of economics.

Critiquing Science While Doing Science

Despite ACAT’s increasingly sharp critiques of science, it is important to acknowledge that ACAT has not abandoned their scientific work altogether. On the contrary, conducting analysis of both environmental and biological samples remains an important component of ACAT’s core advocacy work. As noted in Chapter Two, conducting science even while participating in scientific research is a salient feature of many environmental and health social movements (Brown 2007; Morello-Frosch et al. 2006a).

The addition of a strong critique while continuing to conduct research coincides with a period in the organization’s history in which it has garnered significant experience and expertise in conducting studies, and in which it launched a new breast milk biomonitoring project through a
regional health care facility. The use of science remains one component of their efforts to limit or outright eliminate the release of persistent pollutants, enabling them to pressure the United States to participate on the international stage to eliminate uses of persistent pollutants. Science is also key in helping ACAT educate health care professionals, particularly those working in Alaska Native villages, to recognize and treat the health implications of exposures; and finally, science is central to their efforts to push for and oversee remediation of locally-contaminated sites.

Specific examples of these uses of science abound. ACAT staffers compiled scientific research and developed briefing papers for a delegation of governor-appointed staffers to attend negotiations of the UN negotiations on the Stockholm Treaty on Persistent Organic Pollutants. Internal grant reports have documented to funders that ACAT’s “independent” blood analyses, coupled with analysis of environmental samples, empowered communities to “participate fully in decisions about the clean-up of formerly-used defense sites” (ACAT 2007). The research they conducted helped community members who served on the Restoration Advisory Board make decisions about the military’s proposed plans to remediate contamination on St. Lawrence Island, including a decision to reject proposed landfill for debris and waste once strewn across these sites.

However, as ACAT moves away from a regulatory to a rights-based organizing paradigm, it is shifting its vision of how to navigate through the political economic context, and rethinking the role science plays in its efforts. The underlying premise of a rights-based paradigm relinquishes haggling with regulatory agencies and policy-makers over the definition of acceptable risks. These are technocratic exchanges through which scientific data are presented and debated. Instead, under this new organizing paradigm, ACAT seeks to “drive rights into local laws”, such as local ordinances, and to incorporate an explicit rights-based framing of their work that supersedes framing the imperative to act on global and military contaminants through the language of science and parts per million. Rather than expressly using science to meet the burden of proof, as some communities do, or using it to promote policy reform that would flip the burden
of proof, ACAT’s work challenges how the rights of people have been trumped by the rights afforded corporations, and overlooked by the military. For example, ACAT has expanded its work with tribes to establish local and tribal ordinances to prevent deleterious development or land uses within their jurisdiction and to create the legal foundation on which corporations cannot challenge local rule by appealing, through the court system, to constitutional rights, as many corporations have become accustomed to doing.

ACAT’s turn to a different style of organizing is an extension of their experience and that of individual organizers among them. As noted by one ACAT staff member:

Initially, we worked to quantify issues. We drew blood. Tested it for chemicals. Found chemicals. Took that information to the agencies. But, we didn’t get to the root of the problem. The root issues remained…

This directional change also comes from the experience of ACAT organizers. Those experiences led organizers to lose faith in the pre-established grievance, remediation, and regulatory processes. For example, military clean-up on St. Lawrence Island and throughout the state has been a protracted struggle at every step in the remediation process. These experiences led ACAT organizers to rethink what had become their standard organizing and advocacy strategies—collect data, write reports, take the data public, make appeals to officials, and file the necessary paper work requesting remediation of existing problems and regulation to stave off the northern flow of chemicals.

ACAT’s turn toward a more explicit rights-based organizing framework was born out of the necessity of environmental health and justice problems that are unique to the circumpolar north. The kinds of problems ACAT was addressing—problems posed by legacy contaminants that are the hallmark of sites of persistence—were already outside the purview of local, state, federal and even international regulation. The accumulation of chemicals in the circumpolar north has happened both despite, and arguably, because of current regulations and policies, which never
accounted for, or protected against, the potential for synthetic chemicals to persist, travel, and bioaccumulate. Moreover, the military has long been exempted from what few regulations oversee industrial use and disposal of synthetic materials and heavy metals. ACAT’s experience made plain that the regulatory paradigm was not just inefficient, it was obsolete. US federal and state regulations only manage pollutants by controlling or limiting their release, but persistent pollutants are, by virtue of their physical properties, virtually impossible to manage.

In addition, ACAT organizers drew parallels between their experiences pushing the state on environmental justice issues and pushing the state to recognize tribal sovereignty. Though there are approximately 230 federally-recognized tribes in Alaska, for decades, Alaska Native tribes have appealed to and been met by government inaction on issues of environmental and public health, particularly from state agencies that have also, for many years, not recognized or cooperated with Alaska tribes as self-governing bodies (Haycox 2002). President Clinton extended federal recognition to Alaska Native tribes (Native American Rights Fund 1994) and directed agencies to cooperate with tribes on a government-to-government basis (Executive Order No. 13084, May 14, 1998; Executive Order No. 13175, Nov. 6, 2000). Though federal recognition was itself late in coming it was not until 2000 that the Alaskan Government, via administrative order from Governor Tony Knowles, officially recognized the tribes as partners of the Alaskan government. Despite this measure of good faith, the relationship between the state and many tribes remains tenuous (Haycox 2002), particularly over subsistence rights of Alaska Natives (see further discussion on this point in the conclusion).56

Moreover, Alaska Native communities have been harmed by the actions—and inactions—of the state and federal government, many harms of which have been perpetrated with and through scientific research and experimentation. Biomonitoring served as a surveillance tool to track the

56 Another important component of this historical context, is the legacy of struggle over land claims and the government efforts to settle land claims around the time of the oil pipeline was constructed from Prudhoe Bay to the southern Alaskan coast. For more on this, see Berger (1985).
implications of nuclear weapons testing. During the 1950s and 1960s, the Public Health Service’s Radiation Surveillance Center in the Division of Radiological health monitored bone, urine, and blood for strontium 90, cesium 137, and other blast products in Alaska Natives (unknown 1965; Snow 1965). Though these and other scientists found disproportionately higher levels in people from Alaska relative to other populations (Schulert 1962; Palmer et al. 1964; Wilimovsky and Wolfe 1966), Alaska continued to be a site for nuclear experimentation (Kohlhoff 2002). The US military conducted radiological experiments with residents from six Alaska Native villages, who were injected with radioactive iodine and monitored for physiological responses to arctic climates (O’Neill 2007). Thus, given this history of political marginalization and scientific exploitation, as noted by Shawna Larson (2006b), Alaska tribes place less faith in the ability of government to help them resolve and protect environmental health and justice, and are wary of how science was complicit in their subjugation.

These experiences primed ACAT to be receptive when a non-profit consultant introduced them to a group promoting a different model of organizing that side-stepped traditional institutional channels for seeking redress and remediation. The Community Environmental Legal Defense Fund (CELDF) and Advocates for Community Empowerment, two small organizations, run by lawyers and located in rural Pennsylvania, argue that the US environmental movement is ineffective at addressing the structural issues driving environmental problems and injustices. Rather, as they note, most community struggles, deal with single issues that are quickly channeled into the regulatory system, which reduces their scope, conceals the structural roots of the problem, and reframes the debate in terms of permissible levels of harm and pollution. After hearing a presentation from the groups, ACAT decided to bring them to Alaska to conduct training.

Through workshops and trainings, CELDF provides grassroots groups across the country with new tools for organizing that encourage the avoidance of regulatory proceedings. In particular, they work to help municipalities and local governments challenge corporate control of local and
environmental decision-making, and to drive democratic principles into local ordinances and bylaws that, in turn, help the communities hold corporate influence over localities at bay. Though initially they worked to help communities prevent locally unwanted and noxious land uses, over time the local ordinances they develop have expanded in scope.

For example, in 2006, CELDF helped a small township in rural, conservative Pennsylvania to outlaw the “trespass” of chemicals into the human body. Liberty Township’s “Corporate Chemical Trespass Ordinance” reads:

The Board recognizes that sufficient data and experience exist for a reasonable person to conclude that a significant percentage of both currently used and newly manufactured chemicals are harmful to humans, animals, and ecosystems. The purpose of this Ordinance is to recognize that it is an inviolate, fundamental, and inalienable right of each person residing within the Township of Liberty to be free from involuntary invasions of their bodies by corporate chemicals. The Board of Supervisors of Liberty Township declares that persons owning and managing corporations that manufacture chemicals and chemical compounds trespassing on the bodies of residents of the Township must be held liable for those trespasses. The Board of Supervisors also declares that the failure and refusal of the United States government and the government of the Commonwealth of Pennsylvania to ensure that corporate chemicals do not trespass on the residents of Liberty Township makes them jointly and severally liable for those trespasses (CELDF 2006).

Such ordinances comprise a new political strategy communities are using to counteract the effects of industry on their health and well-being. It has yet to be seen whether such ordinances can hold up in a court of law, but even still, the development of such ordinances can have far reaching implications for the communities that pass them. The process of drafting and passing ordinances such as these is more important than the final product. Establishing local ordinances builds community capacity to exercise self-determination over land use and local economics. Moreover, communities are doing more than saying what they do not want in their backyards, but they are laying down a progressive vision that builds and defines community.
ACAT staff and organizational board members have undergone at least one (and some multiple) sessions of Democracy School. Two staff members have gone on to become certified instructors of the Democracy School curriculum, which they revised and adapted to the unique experiences of Alaska Native and indigenous communities in the United States, which the original curriculum had overlooked.

From this training, ACAT plans to incorporate the construction of local ordinances as a new strategy to build community power and tribal sovereignty. Through such measures, they seek to address environmental justice struggles as multi-faceted issues that are rooted in relationships between the public and industry, and the government and military that support or rely on them, who together co-opt the sovereignty of local communities and tribes. While ACAT may continue to collect blood samples or provide communities with technical assistance, ACAT also argues that:

It doesn’t help if we only do blood tests. We only help if we help [communities] make laws of their own construction.

While chemical trespass ordinances are a relatively new organizational focus, and ACAT is just now starting campaigns to develop them, the organization has recent experience working with nearly fifty tribes in Alaska to draft resolutions that support the US ratification and implementation of the U.N. Stockholm Convention on Persistent Organic Pollutants. As noted by Larson, resolutions have been an important instrument for Alaska tribes to:

call upon the US State Department and the Environmental Protection Agency to negotiate a strong treaty that protects our way of life and future generations from the harmful effects of toxic chemicals that accumulate in the north… Tribes recognize that the POPs Treaty [The U.N. Stockholm Convention of Persistent Organic Pollutants] is an important way to stop the northward flow of chemicals at the source. The tribes have also express concern [through such resolutions] that the State Department and EPA have not consulted them on a government-to-government basis about the treaty (2000: 1,9).
With assistance from ACAT, resolutions in support of the Treaty were drafted and passed by dozens of tribal councils, including the Chenega Bay Indian Reorganization Act Council, Bill Morre’s Slough Elder’s Council, Chickaloon Village Traditional Council, Clarks Point Village Council, and the Native Village of Savoonga IRA Council, among many others. Such resolutions have led to the former Alaskan Governor, Tony Knowles, to write a letter in 2000 to President Clinton urging full US support behind ratification of a UN Stockholm Convention that has the goal of:

eliminating the most serious 12 persistent organic pollutants…
[and it] should also advance and include provisions detailing scientifically based criteria to evaluate other chemicals for inclusion in the treaty in the future (Larson 2000: 9).

Yet, importantly, advocating for a new organizing strategy not rooted in regulatory and science-based debates, is also not without consequence. ACAT has proposed a new organizing paradigm that challenges what has become conventional, even institutionalized, strategies for seeking social change. This traditional model, what ACAT calls the regulatory paradigm of environmental organizing, rests on three tactics: do research, work through the media, and appeal to the public, regulators, and policy-makers using scientific information. Many of the major environmental organizations, such as the national and state Public Interest Research Groups (PIRGs), have adopted this model of organizing. There is also a network of US organizations that train fledging organizations and community groups in this school of environmental organizing. For example, this is the model the Toxics Action Center has used to assist and train hundreds of communities and grassroots groups across New England. Some professionalized environmental advocacy organizations, however, have expressed reluctance that the organizing model proposed by the Democracy School and extended by ACAT will work and that it will not hold up to legal challenges from industry. Others organizations voice reticence about shifting away from model centered on changing regulatory policies and practices, rather than avoiding the regulatory arena altogether.
**Across Two Paradigms**

ACAT staff now straddles these two paradigms of science and organizing. They have garnered federal funding and national respect for their scientific research, particularly for their biomonitoring work around persistent organic pollutants among Alaska Native communities. They continue to provide important research about contaminants in Alaska that academic, state, and federal researchers have only just begun to address (CDC is now working in sites in Alaska through the Arctic Monitoring and Assessment Programme). But beyond that, ACAT sees a limit in what science can achieve in terms of addressing the fundamental causes of contamination. They see a critical point at which the call for more biomonitoring in the absence of immediate political action is both unnecessary and unethical.

When regulators and government agencies did not respond to communities’ concerns about contamination, a fledging environmental justice organization did. ACAT, through their connections to scientists, helped the communities of St. Lawrence Island quantify their concerns about the formerly used defense site there, after nearly two decades of appealing to regulators and state and federal agencies had failed to produce much response. Though quantifying blood levels of PCBs and chlorinated pesticides brought attention to St. Lawrence Island, and helped bring national attention from scientists and activists to the community and ACAT, successes from their science brought challenges for ACAT in the forum of criticism and disrupted relationships with important potential allies and collaborators in Alaska.

When ACAT helped the communities of St. Lawrence Island connect to scientists and conduct research, science brought important victories, but also came with tradeoffs for ACAT and the communities they were supporting. It led ACAT into complicated scientific debates, and to face public criticism from the state. They realized that science has its limits as a tool for prompting action or change, particularly when science is used to work through traditional, positivist forums, like regulatory agencies. The interpretation of the results and their public health implications tie into broader political-economic debates already going on within the state over the regulation and
remediation of local point sources of pollution; over the implications of contaminants in marine life vital to the economy; over Alaska Natives’ access to subsistence foods; and over the political relationship between tribes and the state government. ACAT found it difficult to use science in their advocacy work when: (1) science does not lead to clear policy or advocacy goals, or when it leads to conflicting advocacy or policy responses, such as the case of food contaminants and dietary advisories; (2) science and risk communication becomes the debate, and the main issue of reducing toxic contamination slips from focus; and (3) when calls for more science delay decisive political or regulatory action.

These three issues all converge in discussions about how to deal with legacy contaminants in the food chain. Some public health officials assume that reporting exposures to persistent, bioaccumulative substances will, by default, push communities to opt out of subsistence traditions, or breastfeeding. However, when public health agencies limit communication of exposure data, or adopt the position that they should provide balanced risk messages or place risks in the perspectives of benefits, they also implicitly deny a community’s right-to-know and right-to-act on their own behalf. As ACAT concluded:

> With community-based participatory research, the people of St. Lawrence Island have the information from the Department of Defense and other state/federal agencies, sources they believe are biased and in consistent denial of their problems… [the study] creates a base of information for them to make informed decisions about the military site clean-up and health-related concerns” (ACAT 2004).

Even more, when debate only focuses on the relative harms of reporting contaminants in foods and bodies, and not the underlying source of contaminants, this poses another form of injustice. Both ACAT and the SUNY scientists argue that if communities want this information—and the St. Lawrence Island communities did—then they have the right to have that data as well as full access to the scientific resources they need to understand what is in their foods and bodies. To withhold this information when communities want it, and moreover to delimit or restrict research
that explores questions important to community concerns due to fears that communities will respond in ways that violate accepted public health practices, is viewed as paternalistic and unjust. Biomonitoring information holds meaning beyond individuals choosing between eating subsistence foods or not. Such a dualism enables inaction, where a range of responses is possible. St. Lawrence Islanders did not give up their traditional foods because of the study. Community members alone, and staff members of ACAT, took the study results and campaigned with them to spur local clean-up and to push for federal and international action on the main contaminants of concern.

ACAT realized that working with science sometimes means working within entrenched systems that allow the continued production and use of persistent chemicals. They also realize that science can be transcendent and used outside the institutional channels through which activities have conventionally used science. No longer satisfied to make only scientific arguments, ACAT now also makes ethical arguments, by pointing out how those who are least involved in creating harmful substances are often the most harmed. Through their connections to the International Indian Treaty Council (IITC), ACAT supports efforts for the United Nations to uphold treaties already in existence that create the foundation on which to challenge the continued use of persistent, bioaccumulative chemicals. These include the Convention on the Rights of Children and the International Convention on Civil and Political Rights, which state that no people should be denied the rights to subsistence.

Thus, they are finding ways to use scientific research to inform activities and appeals for action made outside the regulatory system. They conduct research, but transcend science by appealing not to scientific authority or logic, but to the moral and ethical sensibilities of policy-makers, regulators, and the public. As a result, they are moving in a new direction, and finding new ways to apply the knowledge biomonitoring studies produce. They thus reframe the problem not in scientific terms, but in terms of how the science reveals the conduct and perpetuation of a human rights violation. Importantly, when science begets more science, and when more science
stalls further action, ACAT organizers are quick to note that such an outcome, too, is unethical. They can speak in terms of the parts per million of contaminants harbored in the bodies of Alaska Natives, and in the next sentence, ask why regulators need to know that information in order to act? They recognize that the results of body burden studies can function as both evidence and validation one the one hand, and on the other, as an indicator that current efforts to document (rather than stop) the northward tide of contaminants are insufficient. Thus, as noted earlier in this section, their use of science often comes with a strong critique of why they are forced to conduct science in the first place.

Over time, ACAT shifted how they interpreted and described the significance of biomonitoring data in terms of how they framed the solution. Body burden cannot be fixed through technological change. Nor can body burden be prevented only through policy change. Body burden can only be addressed through elimination of the chemicals at their source, which in turn requires a shift in the relationship between affected populations and polluters. To do this, ACAT works at the international level, where the United Nations has recognized the special vulnerability of Arctic communities to persistent organic pollutants in the preamble to the Stockholm Convention on Persistent Organic Pollutants (UN Stockholm Convention 2001). In fact, ACAT has been an instrumental participant in helping to ratify and now implement the United Nations Stockholm Convention on Persistence Organic Pollutants. ACAT works to push for federal overhaul of chemicals policy system, which is necessary in order for the US to ratify the POPS treaty. While the US signed the initial treaty to ban or severely restrict global use of twelve substances, the US has yet to implement the treaty because its federal laws are not in compliance with the treaties provisions for adding new chemicals for global action. The Center of International Environmental Law, based in Washington DC, argues that it was advantageous for the US to support the treaty initially because the US had already acted on the twelve substances under consideration, and because, it had certain economic implications for US industries. If countries that still use these banned substances (such as PCBs and DDT) are forced
to find alternatives, this would create market demand for new generations of pesticides, flame-
retardants, and other chemicals made by US manufactures. In order for the US to officially join
the other parties to the Convention, Congress and the President must enact amendments to two
pieces of federal legislation relevant to chemicals, including the Toxic Substances Control Act
(TSCA) and the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

**Persistent Pollutants: The Next Generation in the Struggle for Subsistence Rights and
Recognition of Indigenous Knowledge Systems**

When put into a broader context, the struggle over toxic-free foods in Alaska is the next
frontier of a long-term struggle that Alaska Natives have waged to protect their traditional
practices and diet. For several decades, subsistence has been “a highly charged, highly visible,
and strongly emotional issue in Alaska. It [has] dominated much of the political discourse.”
(Haycox 2002, 152). Alaska Natives, since the passage of the Alaska Native Claims Settlement
Act in 1971, have struggled over land and rights to harvest subsistence foods (Berger 1985). The
Alaska National Interest Lands Conservation Act (1980) safeguarded traditional subsistence
practices on federal lands, including conservation lands, and afforded “rural Alaskans” full access
to federal lands for subsistence as well. The Act also required the state government to
acknowledge the subsistence needs of “rural Alaskans.” At issue is the language “rural
Alaskans.” The spirit of this phrase, as explained by Haycox (2002) was to recognize and
enforce the subsistence rights of Alaska Natives, who comprise the majority of rural Alaskan
population. Yet, many white residents also claim cultural attachment to hunting and fishing, and
independence from government oversight or intervention (Haycox 2002: 152). Furthermore,
ANILCA’s special recognition of the subsistence practices of “rural Alaskans” directly conflicts
with the state constitution, which includes a specific provision that all citizens of the state equally
own its natural resources, including fish and game. A series of state laws attempted to override
ANILCA and extend subsistence rights to all, but the Supreme Court struck these down in the 1970s. Subsequently, because the state was out of compliance with subsistence as set out in ANILCA, the federal government assumed control over regulation of subsistence practices on federal lands, and later waters, from the state. The state has refused to pass a constitutional amendment to bring it in line with the federal law, and until it does, the federal government will continue oversight. Thus, issues over the oversight of subsistence practices have become a battleground for the state to continually invoke and defend state’s rights over federal oversight (Haycox 2002).

Alaska Native’s battle for subsistence rights continues today. At the annual Alaska Federation of Natives (AFN) conference held in October 2006, subsistence rights were again among the most significant issues on the agenda. It was also a salient issue raised during the 2006 gubernatorial campaign, with only two of the three major candidates supporting further subsistence rights (deMarban 2006; Hopkins 2006). However, the struggle over contaminants in subsistence foods is the next generation of these on-going battles for subsistence rights and, ultimately, survival.

In the introduction to this dissertation, I reviewed the long arc of science and policy in the United States and I emphasized the role of scientists in documenting the global spread of chemicals. However, before these studies, indigenous communities of the circumpolar regions, and in other regions affected by the legacies of persistent organic pollutants, observed changes in the foods they hunted, fished or gathered; and they repeatedly conveyed these concerns to scientists and policy-makers. As Andrea Carmen, Executive Director of the International Indian Treaty Council, said at an ACAT sponsored conference, indigenous people open the fish and see sickness. They share this knowledge with the scientists and politicians, who in turn, tally the observations of indigenous people. These tallies may bring legitimacy to claims made by

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57 Subsistence practices on federal lands and waters are overseen by the Office of Subsistence Management, which in turn, is governed by the Federal Subsistence Board. The Board includes representatives appointed by the U.S. Secretary of Interior, and drawn from the following federal agencies: U.S. Fish and Wildlife Service, Bureau of Land Management, National Park Service, Bureau of Indian Affairs and U.S.D.A. Forest Service.
indigenous communities, but the underlying issue is why indigenous knowledge and experience are not valued as expertise in their own right, and why science is necessary at all.

**CONCLUSION: SCIENCE IN THE FACE OF PERSISTENCE**

The basic notion of “sites of persistence” is that there is a temporal and spatial gap between when the chemical was used and released, and when it is detected and poses a problem. A key issue for ACAT is to prove that historic chemical uses pose contemporary concerns. Biomonitoring has helped them prove that their bodies are affected so that they can flag the attention of regulators, policy-makers, and the public. Yet showing exposures in sites of persistence often does not satisfy public health officials and environmental regulators, who are unfamiliar with low-dose, chronic exposures or worry about the implications of this evidence for key industrial and agricultural sectors that are engines of economic growth. This results in adversarial relationships between advocacy groups like ACAT requesting exposure reduction and state and federal agencies responsible for taking action against industry. ACAT found themselves embroiled in technocratic arguments over the relative significance of these low-dose, yet chronic exposures, when in fact they started from a position that these chemicals simply did not belong in people’s bodies—regardless of the level at which they are present.

Because biomonitoring information is a relatively new addition to the policy arena, scientists and policy-makers are trying to figure out how to incorporate this information into decision-making, regulations, and policies. There are few institutional channels to deal with this problem, and hence more opportunities for interpretative flexibility in how activists interpret and use the results. For example, they can use body burden results to make rights-based and moral arguments, rather than technocratic arguments, to move public and policy debate and to create pressure on regulators/decision-makers to act. Because the trend of chemicals concentrating in the North is already well documented, when groups have to reconfirm the problem or document the presence of new contaminants, they argue this constitutes a second layer of injustice.
They also could use science symbolically to help link bodies/groups harboring the same chemicals in their bodies. Body burden became a unifier for indigenous people of the circumpolar North, and for communities that harbor the same chemicals whether because they apply them to crops in Central America or because those same chemicals have accumulated in Arctic food chains. For example, ACAT found that biomonitoring science enables connections with other advocacy organizations. As a result of using biomonitoring to understand chemical burdens of various groups in Alaska, ACAT also became involved in networks of advocacy organizations linked by what biomonitoring science makes visible. Biomonitoring science detects chemicals in bodies that live and work in places where chemicals are produced, used, and disposed. ACAT forged new relationships through the International Indian Treaty Council’s North-South Pesticide Project; that is one of several ways in which ACAT is now part of a group pioneering a new model of life-cycle advocacy. ACAT now connects their work on human body burden to advocacy occurring in other places which deal with the same chemicals. For example, the North-South Pesticide Project focuses on how Indigenous peoples of the Arctic are on the receiving end of contaminants transported from lower latitudes, where they are applied, often by workers from indigenous communities in the southern hemisphere. As relayed to me, “we know that people in the lower latitudes where pesticides are used and produced are also at risk.” ACAT works to connect workers with people of the Arctic who ultimately receive these pesticides in traditional foods. In 2006, staff from ACAT attended a conference sponsored by the International Indian Treaty Council and hosted by the Yaki Nation in northern Mexico. ACAT was invited to attend to discuss issues of global transport and to learn about workers’ exposures. The goal was to share and develop a strategy for action that relies on international conventions and governance bodies, including the United Nations, and the North American Commission for Environmental Cooperation established through the North American Free Trade Agreement. ACAT sees this work as a natural complement to their advocacy for the Stockholm Convention where they make
linkages with other communities across the globe that are dealing with persistent pollutants at different stages in the lifecycle.

It is clear that sites of persistence are also indigenous communities, both in the circumpolar North and in Native American communities in the lower forty-eight that live near nuclear/weapons testing sites/storage facilities. Though many indigenous communities are also sites of production and face exposures from contemporary industry and military activities, these communities also face the legacy of historic industry and military uses. In this case, there is a temporal distance between use and exposure. Herein lie two important implications for the meaning and political value of body burden science.

First, the observation that former uses pose problems even decades later adds weight to moral arguments against the continued and future use of other materials that will similarly persist. When environmental justice claims are centered on the point of production or locus of disposal, official inaction often occurs over the idea of intentional harm. Officials and potentially responsible parties may debate whether affected communities moved near industry, or whether industry located near an already marginalized community. Defenders of the status quo can argue that pollution didn’t seek out poor or minority neighborhoods, and can even challenge aggrieved parties to prove in court that there was intentional harm. But when chemicals are showing up and affecting marginalized communities far from industry, traditional rationalizations that minimize disproportionate impacts fall apart. Theoretically, it becomes easier for affected groups to appeal for action based on moral and not just scientific arguments. Yet even in that situation, official challenges can be made. In Alaska, we see new efforts to minimize the appearance of disproportionate impacts through scientific debates over who are “appropriate” comparison groups used for the purposes of interpreting biomonitoring results. Simply by switching the comparison groups, body burdens on St. Lawrence Island can appear normal or problematic.

A second implication for the meaning and political value of body burden science deals with the polity of indigenous communities. In the US, tribes have a government-to-government
relationship with the federal government. Because of this arrangement, and because of the sovereignty movement, tribes are reasserting their political power and are using their unique position to push environmental issues using different political processes. They can pass local ordinances that legislate a new balance between citizens’ rights and corporate rights within tribal jurisdiction. They can appeal directly to federal agencies and elected officials to make reforms. They can bypass the federal government and go to the UN to negotiate with other countries to pass strong persistent chemical elimination policies, even though the US has lagged behind other nations in joining these efforts.

In this second implication, we see that spatial distance matters because no one firm is implicated: the chemicals accumulating in bodies originate from potentially hundreds of uses, market sectors, and industries. As a result, it is easier to argue that it is not just one malevolent industry spewing pollutants into a river, but rather, a system-wide problem with roots in how production decisions are made and how production is regulated. This may seem to let individual firms or industries off the hook, but on further examination, it offers the possibility for a more universal approach to chemical regulation as an alternative to individual liability and/or responsibility. This also enables activists to challenge chemicals in international forums.

Most importantly, this chapter raises what Morello-Frosch noted is “usual irony” (personal communication, April 12, 2008)—ACAT’s strategy is notably forward-looking, despite grim circumstances. In this chapter, I highlighted the struggle against PCBs, a class of chemicals in which most uses have been banned both domestically and internationally. Given that PCBs are largely out-of-commerce and use, there are few remaining options for redress. In such a context, debates quickly shift from the production of exposures to whether and how to issue dietary advice or communicate risk to affected communities. While they engage state agencies about these backward-looking, downstream issues, at the same time, they work to ensure that sites of persistence do not multiply due to the proliferation of other bioaccumulative pollutants that are building up in the circumpolar North. Indeed, scientists have already detected, and ACAT has
already expressed concerns about, brominated flame retardants (discussed in Chapter Six) and perfluorinated compounds (discussed in Chapter Five) in Arctic ecosystems (see Betts 2007; Ikonomou et al. 2002; Renner 2006). These are two chemicals under intense regulatory scrutiny that, even once regulated in the US and abroad, will become the “next generation” of northern contaminants. ACAT will continue to use science to document their persistence and bioaccumulation, while also using a rights-based framework to outlaw and prevent the future production of other persistent chemicals. In this way, despite the gravity of the situation faced by communities who live at the end of the chemical lifecycle, ACAT and their community allies fight to ensure that the same mistakes are not repeated. They work to ensure that the lesson taught by PCBs and other chlorinated substances are translated into new ways to produce, use, and oversee chemical materials in the future.
Chapter 8

THE LIFECYCLE OF LEGACY CHEMICALS
AND THE LEGACY OF BIOMONITORING

OVERVIEW OF DISSERTATION

For decades, contaminated communities and the environmental health movement have used science to move policy debate or push for pollution prevention and remediation. I examine biomonitoring within this historical tradition of public involvement in environmental science. For communities and social movement organizations concerned about chemicals, biomonitoring presents implications and opportunities that few sociologists have considered. This dissertation seeks to close this gap through a study of the relationship between biomonitoring science and environmental advocacy, policy, and politics.

Rather than explore these issues in a single case study, as is common in the sociologies of science, social movements, and the environment, this study considers the meaning and implications biomonitoring science has in three places using the methodology of multi-sited ethnography that is organized by a chemical lifecycle framework. This final chapter contrasts these cases to show how exogenous conditions shape the conduct and implications of biomonitoring for social and environmental change; my broader goal is to demonstrate the value of a more systemic approach to studying where science and politics meet. Each case represents a stage or moment in the lifecycle of where people encounter pollutants. Borrowing from two metaphors, “follow the molecule” and “cradle-to-grave,” my analysis begins where chemicals are in their infancy, follows them through their productive lives in consumer goods and industrial uses, and tracks them to their metaphorical graves. In following the tradition of multi-sited ethnography, the three cases studies highlight common ways in which the underlying political economic conditions structure the meaning and political potential of body burden.
Each case is unique and could stand alone. Yet, my aim is to uncover the underlying systems that structure the lifecycle stage in which science and chemical contestation occur. There are two principle points of distinction across each lifecycle stage. First, each case is characterized by the different orientation between the source of chemical exposures (i.e., polluter, product, or practice that leads to human chemical exposures) and the exposed populations who pursue biomonitoring to address this problem. The second key distinction across sites is how political and socioeconomic relationships in each site enable and constrain public access to, involvement in, and interpretation of biomonitoring science.

In Chapter Five, I presented three concurrent biomonitoring projects conducted in a lesser known corridor of chemical and industrial production found in the US, the Mid-Ohio Valley region of Appalachia. There, a factory used a persistent chemical to manufacture consumer and industrial goods, then dumped the waste into the region’s water supply, leaving thousands wondering about their extensive exposure to a poorly understood chemical. In chapter 6, I defined Maine as a site of consumption, where environmental health activists formed an advocacy coalition to challenge human exposure to persistent and “pseudo-persistent” chemicals through consumer products and household goods. They also conducted a study of chemicals in thirteen Maine residents, including two policymakers, to push chemical policy reforms that regulate the industrial use of persistent chemicals. Finally, in Chapter Seven, I portray an organization that partners with the communities who serve as the unwitting terminus for the northern migration of persistent chemicals—those in commerce today and those used decades ago by industry and the military.

Had my focus been exclusively on either the Mid-Ohio Valley, Maine, or Alaska, I would have missed identifying the different ways in which biomonitoring (science) and political-
economic factors (social order) operate together to enable and constrain affected groups from challenging the structural conditions that produce chemical exposures. As well, a focus on just one moment in the chemical lifecycle would preclude an understanding of an emergent reality for environmental health and justice organizing—how advocacy, policy, and science that occur in one stage of the lifecycle bears implications for others.

**CROSS-CUTTING THEMES AND POINTS OF COMPARISON**

While biomonitoring science is not a new addition to the environmental health sciences, recent technological development has availed science with the capacity to detect more synthetic chemicals in the human body with increasing ease, accuracy, and at levels that almost defy comprehension. As a result, biomonitoring has expanded to an unprecedented scale. Of particular interest is how, over the past ten years, biomonitoring has become a public science. Communities, social movement organizations, even rural water associations that manage municipal drinking water supplies have pursued biomonitoring. No longer sequestered in industry-run laboratories, or in only the most well-funded university or government research facilities, social movement organizations and communities (with the connections to sympathetic scientists and/or funding) now coordinate biomonitoring studies of their own. In each of my three cases, biomonitoring was used to infuse ongoing struggles with new information about human exposures. Thus, while the technique biomonitoring is not new, its introduction and implications for chemical contestation in place-based environmental health and justice struggles is. This dissertation considers what happens when new knowledge about chemicals in bodies enters into established (i.e., sites of production) or emergent political (i.e., sites of consumption and persistence) arenas of environmental contestation.
Science and the Structuring of “Scientific Opportunities”

The social relations in each site contributed to how biomonitoring was interpreted and what solutions to human body burden were proposed. While previous research on science and advocacy characterizes the relationships through which community groups produce science, I examine how social relationships are a key contextual factor in how public groups participate in and parlay the results of biomonitoring research to support their claims for remediation, prevention, or policy change. I point out how in each site of contact and contestation there are different “scientific opportunities.” By scientific opportunities, I refer to the potential for public participation in knowledge production, interpretation, or translation that builds toward structural transformation in political and industrial systems. Here, I call upon Gidden’s (1979) concept of structuration to define scientific opportunities as created both by activists and communities as well as by political, economic, and social conditions in each locale. In this section, I discuss how scientific opportunities were different across the three sites, since each site posed a unique set of potentials and opportunities for public groups to use biomonitoring to further progressive social, political, and environmental change. This demonstrates how biomonitoring and social relations mutually influence one another – that the field of action includes how social relations affect biomonitoring, and its obverse, how biomonitoring affects social relations, a finding that fits within and adds to the literature on co-production (Jasanoff 2005).

The Political Potential for Biomonitoring in Sites of Production

Many of the classic ethnographies and sociological case studies about environmental crises emphasize the politics, economics, and social dimensions that characterize contestation over exposures in sites of production. As described in Chapter Three, sites of production are well-established political arenas where there are institutional rules, norms, and procedures through which communities and social movement organizations seek redress or to prevent future chemical exposures. Often, in sites of production, communities and activists turn to science to help make
claims and seek concessions from regulators, policy-makers, or industrial polluters. Citizens appeal to regulators to institute or enforce pollution permits to stop, or at least slow, the flow of chemicals. However, they must work within a defined set of norms and assumptions about science—what Jasanoff characterizes as the unique civic epistemology of regulatory science in the United States (2004).

Given that science is often a prerequisite for public participation in environmental regulatory and policy discussions (Fisher 2000), communities’ pursuit of redress through regulatory channels requires that they have either scientific capacity, or organizational capacity with which to partner with scientists. Yet, diminished community capacity is often a defining characteristic of the organizational terrain in sites of production. Problems of community capacity are exacerbated further when sites of production, like the Mid-Ohio Valley, are also rural, economically-marginalized areas.

As was seen the Mid-Ohio Valley, sites of production have a history of industrial occupation that, while providing key jobs, also can preclude forms of community association, organization, and the expression of dissent. Communities without these important associational ties and organizations experience an added burden to address contamination like the Ohio and West Virginia communities neighboring DuPont’s Washington Works plant. There were limited organizations through which to pursue scientific information about water or blood contamination, or to push for interim and long-term exposure reduction. Consider, for example, what organizations took on public roles of redressing contamination in the Mid-Ohio Valley. One of the strongest public voices came from a small, non-profit water association. Another example is how University of Pennsylvania scientists, who endeavored to provide critical information to communities they saw as having few outlets for information or redress, were hard-pressed to find a community-based organization with which to partner. Without such a partner, the scientists would not be eligible to apply for one of the few sources of money to fund such an investigation, the National Institute of Environmental Health Science’s Environmental Justice: Partnerships for
Communication program. The scientists eventually partnered with a rural association – The Decatur Community Association (DCA). Though representatives from the DCA became experts and public spokespersons on the issues posed by PFOA exposure, prior to their participation in the community-based study, they did little more than oversee space in which the community would gather. While on the one hand, this is a testament to how community-based science is important for community-capacity building; on the other hand, however, my broader point is illustrated by how difficult it was for scientists to find a community partner from such a small pool of organizations.

One of the other pathways through which communities in sites of production have pursued biomonitoring is by seeking compensation for biomonitoring and medical monitoring through lawsuits. While the court system has become an important arena through which biomonitoring studies could be funded, pursuing redress via biomonitoring within the court system is controversial and has its limitations for communities. Science conducted in and through the courts offers fewer opportunities for active public engagement. Cranor (2007) has argued that courts operate under the assumption that science can arbitrate and thus rise above political disputes, even though questions raised by tort cases are either on the extreme leading edges of scientific investigation where scientific uncertainty is often most pronounced, or deal with what Weinberg (1972) calls “trans-scientific” moral and political dilemmas for which science is not equipped to resolve. This in turn has implications for whether science builds a community’s capacity to speak on their own behalf or to push for regulations, policy, or a change in industrial practices that address the underlying structures that produce community contamination in the first place.

In the Mid-Ohio Valley, the biomonitoring and health survey conducted by Brookmar, Inc., which was funded with the settlement funds DuPont paid to class members, offered Mid-Ohio Valley communities no point of reference with which to interpret, and therefore, act on the assessment of blood PFOA levels. That project was oriented around a different definition of how
science can serve a “public good.” The Brookmar, Inc., project, sought to (1) provide valuable health screening information to individual members of the Mid-Ohio Valley (i.e., cholesterol or blood sugar levels) and (2) contribute data that would enable scientists, regulators, and policy-makers a better understanding of PFOA exposure and its health implications.

As well, through the process of bringing suit against an industry, the community’s end goal of reducing or eliminating exposure can be overshadowed by the more immediate goal of using the suit to secure funds for biomonitoring. Here the pursuit of biomonitoring quickly becomes the end goal, rather than the means through which another end is achieved. Again, in the Mid-Ohio Valley, the trial, as of 2008, produced (1) an interim, technical solution in the form of filtration systems for drinking water and (2) exposure and health data, and a panel of scientists funded to interpret them. Without minimizing the importance of both these outcomes, the trial was never a mechanism through which the Mid-Ohio Valley could challenge the underlying, structures that produced the problem in the first place or to prevent such a disaster from occurring in the future.

Moreover, torts often must narrow the scope of the problem, for example, to a single polluter, pollutant, or health outcome, in order to be a successful channel for communities to obtain any compensation for biomonitoring or remedy to body burden. The legal system, though designed as a way to balance the inefficiencies or gaps in the regulatory system, under current conditions, may not be the most effective means through which communities address the underlying root structures that produce chemical exposures, unless the tort system and regulatory systems undergo parallel reforms (Cranor 2007). Regulatory reforms would need to increase the amount of scientific evidence about the health and safety of current-use chemicals, and require pre-market safety testing. At the same time, as Cranor (2007) argues that another possibility is to push reform to switch the burden of proof from plaintiffs proving harm, to defendants proving they sufficiently supplied scientific evidence to demonstrate product or chemical safety. Neither of these reforms will be easy to make, as both are politically charged and face significant political barriers to their implementation (Cranor 2007).
Finally, when communities pursue remediation or redress through class actions, that path can have implications for whether the community can pursue alternative pathways, such as through mass politics or mobilization. Often suits can discourage or dampen the expression of dissent among class members, even when mass politics and social movements may be one of the few avenues through which a community could pursue more systemic and structural changes to the twin systems of regulation and production that activists were making in both Maine and Alaska.

The Political Potential for Biomonitoring in Sites of Consumption

The Maine case both extends and contradicts current theory about environmental politics and consumption. I highlight the factors that allowed Maine activists to address consumer goods as a problem, without making green consumption the solution. That is, Maine activists were able to reach and politicize consumers through biomonitoring, to push for regulation of consumer products, and to support production of green products, without also supporting lifestyle-based solutions, despite cultural and economic pressures that tout green purchasing as the answer (Murphy 2006; Szasz 2007). The study of Maine as a site of consumption adds a different take on the power of social movements speaking to and mobilizing consumers. Changing consumer awareness and preferences is not an end, but a means toward an altogether different end: a broad-based coalition that demands chemical policy reform and a transformation in the materials economy.

I point to how sites of consumption are typically locales with a unique constellation of political-economic characteristics. These characteristics, in turn, make the introduction of biomonitoring data a powerful component of policy, economic, and social change occurring there. Sites of consumption are also defined by a de-industrialized (or de-industrializing political economy), which changes the political balance of power at the state house when activists use biomonitoring to rally citizens and policy-makers around chemical policy reforms and other initiatives. This means that activists can more readily challenge industrial processes and products
that have no direct bearing on the state economy. Similarly, activist proposals for chemical policy reforms to minimize human exposures are more feasible when the state house is less dominated by local business interests.

The shifting economics in states like Maine, but also in Washington and Massachusetts, enable activists to engage environmental and public health problems caused by the industrial production and use of chemicals through a different pathway. By addressing their presence in consumer products, and making the problem relevant to a wider segment of the population through measuring body burdens of “average” citizens, activists have opened a new way to push for more systematic reforms to policy and production than previously achievable by contesting single polluters or a single industry in sites of production.

Maine also had a well-developed social movement sector, with a professionalized network of activists. These activists have the experience, scientific capacity, and the network ties to other scientists and professionals to fund, carry out, and then persuasively communicate biomonitoring science to the public. Thus, public groups are pursuing biomonitoring through different channels that allow for more public control over the production, interpretation, and translation of knowledge than in sites of production where public capacity and scientific access is more limited. The Alliances’ biomonitoring pilot project was part of a two-pronged campaign to pass bills that would purge the market of specific chemicals and to spur policy-makers, state regulators, industry, and others in Maine to support green production as a solution to body burden that would also boost the state’s sagging economy. There are many reasons why biomonitoring was a successful component of their overall strategy; here I highlight the significance of the political-economic context in creating the opportunities for these biomonitoring to describe and solidify the platform on which the Alliance built its policy and economic campaigns. Maine activists issued specific demands that did not challenge local political-economic arrangements. Their campaigns targeted specific chemicals (e.g., PBDEs) used by specific industries (i.e., electronics and furniture manufacturers), or proposed specific economic and green production opportunities
(e.g., making plastics from potatoes) of interest to local industries (e.g., InterFACE and Tom’s of Maine). This strategy contrasts markedly from the situation in Alaska and the Mid-Ohio Valley, where demands were equally specific, (i.e., sunset use of all persistent pollutants, or stop the release or use of PFOA), but ultimately antagonistic to local economic and political interests. Thus, Maine activists were in a unique position to make such demands and to such alternative economic opportunities as a way to meet their demands for reducing chemical body burden.

Previous research on consumer-based environmental politics notes the potential to mobilize consumers who demonstrate environmental sensibilities and who are willing to exercise their politics through green purchasing. Previous research also characterized how power is moving “down” the production chain such that retailers, and through them, consumers, have more say over what chemicals producers use in the production of commodity goods. This theory would predict that there is a sizable potential to move chemical policy, debate, and even alter production practices through activism in sites of consumption that move retailers or inspire consumers to back policy with implications for what products are offered in the marketplace.

Prior research also pointed to the persuasive potential of public relations-style advocacy campaigns that use images, symbols, and other marketing techniques to persuade consumers to either vote with their wallets, or become active citizens in policy reform campaigns. This suggested that body burden science could be translated into such symbols for constituency building. Indeed, this was seen in Maine, where biomonitoring was used to generate public awareness about the issue of body burden. These campaigns relied on strong images—a Republican senator as “toxic sponge”—and clever phrasing—“ring your legislators to wring out toxics.” Web-based movies, radio segments, and full-color political advertisements placed in newspapers exemplify how the Alliance translated body burden science for public consumption. As well, the Alliance translated biomonitoring through the narratives of people selected to be, as was noted to me, “qualitatively significantly.” That is, people whose body burdens impart a shock value, for example, the head of a state-wide organic farming association or the 30-year old
house majority leader. Study participants became the public spokesperson for the Alliance to carry the coalition’s main messages about the problem of human body burden and its policy and economic solutions.

As well, sites of consumption afford more flexibility in terms of how biomonitoring science is interpreted and used. Regulatory oversight of chemicals in consumer products is far less developed than regulatory oversight of industrial release and long-term management of chemical waste. As a result, rules and procedures for incorporating biomonitoring into policy and regulatory decisions about chemical products is less routinized and codified. Furthermore, this is an active area of policy formation, with cities, states, and more recently the federal government just beginning to pass legislation to address the chemical content of products, most especially children’s toys. One of the open discussions is how biomonitoring – and the attendant uncertainties in its interpretation— can or should figure into policy and regulatory action against consumer products. In this context, social movements capitalize on the inherent uncertainty of biomonitoring science as part of the problem, rather than allowing scientific uncertainty to stall action. They also capitalize on the fact that exposures from consumer products tend to be ubiquitous, as compared to the specific, yet disparate effects on specific communities that are seen in sites of production and persistence.

However, though these campaigns targeted consumers, the primary point of these campaigns was not to shift consumer behavior. Rather consumer product and body burden campaigns were used to mobilize consumers into citizens. Though there is a strong, cultural tendency to see a problem like body burden as resolvable through “self-quarantine” or lifestyle changes (Murphy 2006; Szasz 2007), the Alliance capitalized on this cultural tendency to capture public attention through the issue of consumer products, and then argued the futility of lifestyle changes to protect people. They drew attention to how, in the current market, the range of options consumers have to reduce exposure to chemical compounds like plastic additives or flame retardants is quite limited. Often the chemical additives and residues in consumer products are unknown, unlabeled,
and unregulated, making it hard to identify products to avoid or choose. Until more substantial shifts in production of consumer goods occur, people have the personal responsibility option to purchase products without the addition of certain chemicals. Yet economic constraints pose a barrier to exposure reduction, since many environmentally-preferable products are not physically or financially accessible to all. Moreover, these chemicals are ubiquitous and often impossible to avoid.

Using biomonitoring to move policy and build coalitions around green production takes advantage of several broader political economic changes. The rise of green chemistry and materials science is part of the broader story of why biomonitoring in sites of consumption can be used effectively to critique and potentially alter production systems. These fields are working to synthesize new non-toxic molecules that will not bioaccumulate. Over the past decade, the field of green chemistry has become institutionalized within universities as a legitimate discipline and field of study (Roberts 2005). These trends follow what ecological modernization (Mol 2001) theory has suggested—that there is both the possibility as well as the necessary interest for industry to shift the materials used in production by taking the toxicity, persistence, even potential for bioaccumulation into account. Governments back these changes, too, since policy initiatives grow the economy and maintain (and perhaps will grow) revenue for state uses.

Second, broader market shifts enable activists to pursue alliance with industry. Massive chemical policy reform in the European Union, and other countries that have followed the EU’s lead, have created new markets for consumer goods such as electronics and cosmetics made without the use of certain chemicals. This, in turn, has created economic opportunities for US firms to manufacture goods for this significant market. Given the market potentials for green materials and green production, the Alliance highlights these as an opportunity for Maine that would dovetail with their broader agenda of phasing out the problem of human body burden. To do this, the Alliance—as well as private foundations that have financially supported environmental health and justice organizations for decades—are partnering with industries to
develop, for example, bio-based plastics and new production facilities to make them. Thus, body burden in sites of production are a part of significant shifts in advocacy, where movements and markets are entering into alliance to take advantage of mutual opportunities—economic opportunities (for industry) and opportunities for environmental/public health improvements (for movement groups) created by such market shifts.

*The Political Potential for Biomonitoring in Sites of Persistence*

Body burdens in sites of persistence, especially in the Arctic, have been significant arenas of international scientific and policy concern. The eight member nations that border on the Arctic Ocean all contribute to an international contaminants monitoring program, the Arctic Monitoring and Assessment Programme, of which biological monitoring of subsistence communities has been a significant component. As well, international concern about the body burdens of people living in the circumpolar North lead to the UN Stockholm Convention of Persistent Organic Pollutants. In fact, the preamble to the treaty draws attention to the unique exposures and special vulnerabilities of people living in the Arctic and sub-Arctic regions. The policy and scientific responses grew from the rising prevalence of chronic diseases in northern communities, as observed by community health aides, and by scientists’ shock upon discovering that populations they expected to be unexposed, were actually higher than the urban populations they initially set out to investigate.

As a result of these concerns, there has been an incredible volume of science about northern contaminants and human chemical burdens. This body of research repeatedly has documented a clear set of trends: successive waves of persistent pollutants are produced, released, and ultimately settle in colder climates. PFOA, PBDEs, and PCBs, the three chemical antagonists featured in each case chapter, are pinnacles of WWII chemistry and of 20th century innovation and enterprise. Their lifecycles each follow a common arc, and each eventually winds its way to Arctic subsistence communities. The narrative histories of these chemicals are also parallel:
scientists discover that a chemical molecule has wandered beyond the factory and relentlessly follow the molecule to measure the bounds of its migration. Scientists search for these chemicals everywhere, meanwhile also searching for populations—human, avian, marine, and mammalian alike—to serve as a ‘clean’ control population against which to compare levels. However, everywhere scientists looked, they found molecules of these synthetic, persistent chemicals. No matter where they look, they never found their clean, comparison population, but instead that people of the circumpolar North bear some of the highest burdens.

Chlorinated-compounds, like PCBs, captured public attention during the 1960s, and have stayed in the public eye ever since, despite being banned in the 1970s. Rachel Caron’s Silent Spring issued the most resounding early warning about chlorinated-compounds, particularly those used as pesticides such as DDT, dieldrin and eldrin. Twenty-years later the question of whether to sunset all chlorine-based compounds is still on the table. Yet, despite chlorine chemistry’s sordid history, and the many early indicators chlorinated compounds offered about the implications of a chemical’s legacy, there has been a wide-spread failure to incorporate the early warnings of chemical persistence, dispersion, and accumulation into domestic policy.

Subsequently, there has been successive waves of (re)discovery of similar properties in other substances. Brominated-compounds, especially those used as flame retardants, were the next organic (i.e., carbon-based) compounds to be called into question. The issue of brominated flame retardants in infant sleepwear brought bromine-chemistry to the fore during the 1970s (Blum 2006). A different class of brominated flame retardants returned both bromine chemistry and persistent chemicals to the public attention, after Swedish researchers detected exponential growth of these compounds in human breast milk, followed by a swift reaction by Swedish lawmakers (Hooper and McDonald 2000.) As a result, new science poured in on human exposure and toxicity, leading to several EU nations taking regulatory action to phase out their use. Meanwhile, while EU body burdens dropped in parallel to decreased use, US use skyrocketed, as did levels in US women’s breast milk, leading some scientists (Hooper and McDonald 2000) to
conclude that US women and children bore some of the highest levels of this contaminant. At the
time, brominated flame retardants, specifically a class of them known as polybrominated diphenyl
ethers, or PBDEs, were hailed an emerging contaminant and the new PCBs. A wave of research
and regulatory attention washed over the United States. The principle manufacturers of two
commercial formulations have announced voluntary phase outs, while individual states such as
Washington, Maine (discussed in Chapter Five) and California have regulated consumer product
uses of a third, higher volume formulation, deca-BDE, at the state level. On the heels of PBDEs,
came attention to perfluorinated, or fluorine-based molecules, the next generation of “emerging
contaminants” used since the late 1940s but discovered as problematic in the 1990s, particularly
following the discovery of widespread contamination in the Mid-Ohio Valley.

The lifecycle of each of these chemical molecules ends in the Arctic communities, and herein
lies the unique scientific opportunities found in sites of persistence. This clear pattern, in turn,
sets up the possibility for biomonitoring science, when conducted in sites of persistence, to
support the strongest critique of production systems. When groups like Alaska Community
Action on Toxics and their community partners from St. Lawrence Island analyze blood samples
for PCBs, the results can be contextualized within the long history of biomonitoring that has
demonstrated a clear pattern of disproportionate exposures and the successive waves of chemicals
eventually reaching, and affecting, northern communities. They point to the injustice of more
releases and more measure of exposures when this trend is so well-characterized.

In terms of the existing body of evidence about disproportionate exposures, other sites of
persistence are similar to communities of the circumpolar North in this regard. There is ample
science documenting the presence of radioactive materials in communities facing the legacy of
nuclear waste as a result of weapons testing or storage. These communities have been among the
first communities on which the government conducted biomonitoring surveillance programs,
dating to the 1950s through 1970s, when nuclear bombs were tested in the Marshall Islands,
Alaska, and the US Midwest.
Another key characteristic in sites of persistence is that affected communities more effectively can point to exposures as resulting both despite and because of the regulatory system. The reach of these chemicals that have penetrated into the Arctic—thousands of miles from their point of origin—powerfully conveys how problematic the assumptions of current US chemical policy are. Together, these twin issues—that communities of the circumpolar North face the greatest burden of production systems thousands of miles away, and that their body burdens resulted both because and despite current regulatory systems—have made biomonitoring a powerful component of structural and systemic critiques of production systems that have afforded Alaska Natives and other indigenous communities special considerations at the United Nations.

Yet, though biomonitoring may be an effective tool for engaging internationally about the problems faced in sites of persistence, as highlighted in the experience of St. Lawrence Island and ACAT, there are limited opportunities for biomonitoring science to support change domestically. Such challenges spurred ACAT to shift gradually from an emphasis on traditional, science-based advocacy toward a rights-based approach that frames chemical body burden as a violation of human rights and the result of corporate infringement on sovereign localities.

**Redefining Environmental Problems: When Old Problems Encounter New Knowledge**

Across the three sites, biomonitoring science and its introduction into an existing contestation over chemical exposures transformed how the central environmental problem was framed and understood, and changed perceptions about what solutions are both necessary and possible. Further, a reshaped understanding of environmental problems reconfigured the terrain or organizational field in terms of who the stakeholders are, which parties are responsible to act, and which have the authority, imperative, or the right to respond.

For example, through the West Virginia court system, water contamination was reframed as an invasion of blood and bodies without permission or authority. Yet, as the lawsuit moved forward, the court system served to recast the central issue as a problem with insufficient toxicologic and
epidemiologic research on PFOA. In response, the negotiated “science-based” settlement created funds to generate data about human exposures and PFOA toxicity that would address how little scientists and regulators knew about the chemical. That there was so little public information about PFOA, however, reflects its status as an unregulated chemical. PFOA was one of many chemicals that was “grandfathered in” when Congress passed TSCA in the 1970s and therefore industry was never required to test or submit data regarding emissions or toxicity to the EPA. PFOA exposure was both a regulatory problem and a problem rooted in systems of production. Now further redress through the court system—and the ultimate fiscal responsibility for medical monitoring and maintenance of filtration systems for public drinking water—hinges upon whether the court-appointed Science Panel finds any relationship between PFOA exposure and human health. That scientific uncertainty became the central issue reflects how the court system can serve as another arena where industry can use scientific uncertainty arguments to displace their responsibility and delay more decision remedies (Cranor 2007). This reframing was produced as the case moved through the tort system, rather than reflecting on the plaintiffs’ lawyers, who had the odds stacked against proving cause of action for either punitive damages or medical monitoring relief.

As well, though PFOA has implications for people living in other sites of production and across PFOA’s lifecycle, Mid-Ohio Valley residents understood PFOA body burdens as primarily a local problem. Several historical and social factors account for this, including regional isolation and a lack of community organizations with ties to national and international environmental health and justice advocacy networks. However, science played a role in reinforcing this isolation and disconnect between individuals within the Mid-Ohio Valley communities, and between the Mid-Ohio Valley and other PFOA-affected regions. Brookmar, Inc.’s landmark data collection and blood analyses provided 70,000 people with information about PFOA blood levels, but did so on an individual-basis and without additional contextual information about PFOA levels found within the community or the US population more generally. Furthermore, while
national environmental groups highlighted the significance of Mid-Ohio Valley blood levels to support their own campaigns for regulatory oversight, they did not foster long-term community connections that could have informed the Mid-Ohio Valley communities that PFOA contamination was a more widespread phenomenon.

In contrast, how Maine activists talk about human body burden enabled two shifts in how environmental problems were understood and addressed. The Alliance’s publication of Mainer’s body burdens transformed environmental politics as pitting the advocacy community against industrial insiders (i.e., local business interests) to a problem where Maine activists and industries ally to address chemical exposures caused by outside business interests. That is, the Alliance used biomonitoring science to highlight how the same chemicals found in commonly used consumer products also were found in the bodies of long-time Maine residents, including two of the state’s elected officials. A significant part of the Alliance’s message was that these chemicals were not produced in Maine, but nevertheless exposed Maine people without their knowledge and against their will, because the chemicals were unregulated in everyday commodities. By reframing the central problem of industrial production as about the materials industries use to produce goods, and moreover, by going after industrial activities taking place outside state borders, the Alliance was able to rally a powerful coalition of non-profit organizations, professional associations, government officials, and even local industries to support their policy reforms and other initiatives. The Alliance’s framing meant that key state-level environmental groups could move away from battling local interests in order to reform the regulatory system.

In Alaska, however, ACAT made a similar argument against the influx of contaminants from “outside” the state, but with different outcomes. When they raised this issue on the international stage, the problem of outside contamination was quite compelling. That pollution was affecting the Arctic has been an important catalyst for international policy action (Downie and Fenge 2003). Yet, locally, ACAT was not able parlay the framing of pollutants as “encroaching outsiders” to spur state action or coalition-building, despite the cultural salience of anti-
“Outsider” sentiment that is prevalent in Alaska (Haycox 2003). In part, this is attributable to the fact that global pollutants were affecting food sources central to the Alaskan economy. As well, drawing attention to food chain contamination may have alienated potential allies who have fought fiercely to protect subsistence rights and were worried such news might lead to state intervention or encroachment upon subsistence.

The Alliance also used biomonitoring science to shift the definition of body burden from posing an environmental and public health problem to posing Maine with unique political, economic, and scientific opportunities. Maine activists framed body burden as a technological problem to be resolved through scientific innovation. When these groups discussed body burden, they highlighted problems in production systems that occasion scientific innovation and business development. That is, body burden could be solved through scientific innovation that would redesign the materials used in production. Green chemists were seen as the visionaries who would create chemicals that would not biopersist or bioaccumulate, and yet keep the economy moving forward.

As such, chemical body burden was defined as an opportunity to reinvigorate Maine’s economy through development of Maine’s research and production infrastructure and capacity to support a green economy. Bond-measures and coalitions to build Maine’s green science infrastructure and entice green production to Maine were coupled with policy initiatives that would purge the marketplace of the most egregious materials. The overarching goal was to keep the materials economy moving forward, but by relying on materials designed not to build up in the human body. In turn, these political, scientific, and economic opportunities have captured the attention of a broad-base of support. What once created tension between industry, state, and advocacy groups became points of convergence and cooperation. Thus, in both cases, the Alliance used biomonitoring to reframe environmental health problems as opportunities for cooperation, rather than antagonism, and for supporting, rather than threatening, economic and business development.
In Alaska, ACAT and the communities of St. Lawrence Island used biomonitoring to shift what was seen as an historic problem with little significance to public health, to a contemporary problem requiring immediate action and careful remediation. The results of ACAT’s Environmental Justice for St. Lawrence Island exposure monitoring project helped empower the community to pressure the military and state for more effective clean-up of formerly used defense sites on the island, even if the results themselves were contested by the military, state agencies, and at times, by allies. ACAT further challenged the state for its willingness to define “global fate and transport” as the primary source for the body burdens experienced by Alaska Natives and other indigenous nations of the circumpolar North. Rather, ACAT points to how this frame too easily displaces the focus off of global and local producers that release persistent chemicals into the environment.

Most importantly, the role of science in resolving chemical body burden stand in sharp contrast. In the Mid-Ohio Valley, scientists, media, lawyers, and community representatives, as I note, called for more science to interpret what the data mean. However, in Maine and Alaska, which typify relatively newer arenas of environmental advocacy and contestation, advocates proposed alternatives for what role science plays in policy and institutional change. In Maine, the advocacy coalition was adamant that more science is not needed to interpret the meaning of biomonitoring; however, they argue that the results call for new science, apart from biomonitoring science, to catalyze action and response. Body burden creates the political demand and market potential for chemists and engineers to develop “green” molecules that will not pose toxicity threats, or accumulate in human systems, and to re-engineer the systems of production that keep the consumer economy moving. In other words, more science is not needed to interpret the results, but rather to act on the results. However, in Alaska, activists argued against the call for more science as necessary to interpret biomonitoring results (as seen in the Mid-Ohio Valley), nor is more science needed to act on existing studies (as seen in Maine). Rather, ACAT raised
the limits of science and instead put forth a rights-based framework that challenges the implications of an over-reliance on both chemicals and science.

Furthermore, in Maine and the Mid-Ohio Valley, science was an essential component of the solution to human body burden. Without detracting from the importance the Mid-Ohio Valley law suits had in availing the public, regulators, and the scientific community with vital information about human exposure and PFOA toxicity, nevertheless, much faith was placed in the ability of pollution control and abatement technologies, and in environmental health sciences, to mitigate the problem and redress harm. In Maine, activists, state legislators, even the governor hail green chemistry and materials science as a major component of the solution to human body burden. Science, in Maine, could resolve the problem of chemical toxicity while contributing to economic growth in the process. ACAT’s framing of body burden issues suggest that the root problem lies not in what industries use and produce, but in their relationship to civil society. As ACAT argues, body burden is not a technological issue to be resolved through technical fixes or inventing new materials, but through rights-based international treaties and local “toxic trespass” ordinances that shift the relationships between civil society and production systems through increased public oversight over firm’s production decisions.

In Alaska, environmental justice activists do not define science as the only transformative pathway. Science, instead, was part of the problem, even if necessary and valuable because it validates community wisdom. ACAT views the need for biomonitoring science to challenge human exposures as symptomatic of a regulatory system that relies on science and technocratic debate to maintain status quo economic and political relations. They make this critique while still conducting biomonitoring, because it remains necessary to move regulatory agencies and policy-makers to act. In Alaska, tribes and environmental justice organizers argue that the more that chemicals build up in human bodies at greater temporal and geographical distance from the point of release, the greater the need for action—not more science—and the greater the imperative that affected citizens must be involved in decision-making over chemicals in commerce. Thus, in
places that are the farthest in space and furthest in time from points of production, the greater the potential that exposed groups understand body burden as challenging power relations and how science is entangled within them.

**MAKING THE CONNECTION: WHEN SCIENCE ENABLES AND CONSTRAINS LIFECYCLE ORGANIZING**

One way for science to lead to structural changes regarding chemical exposure is through bringing affected people and communities into conversation with other national and international social movement organizations and relevant professionals. Here I address the enabling features of such networking, as well as the factors that constrain the creation of such linkages.

This project was undertaken during a time in which life-cycle activism is a new advocacy strategy in environmental health and justice organizing, as actors in each site of chemical contestation build connections and encounter resistance to drawing such linkages. Industry has worked to make production systems and the myriad supply, distribution, and waste chains these systems encompass, largely invisible—producers separated from end-users, and both producers and end-users separated from those who handle or suffer the material wastes and byproducts produced earlier in the system (Here again, I refer to the idea of “distanciation” (Princen 2002). However, body burden science in sites of persistence, particularly those in the circumpolar north, are strikingly powerful because they reveal the entire, complex system that contributed to these exposures. Second, concerns expressed by those in sites of persistence reveal a new understanding of environmental justice that accounts not just for the location and geographic distribution of production, but also for the massive movement and redistribution of materials through waste export, goods movement, and global fate/transport of persistent chemicals.

As different social groups interpret, translate, and act on biomonitoring science, I paid particular attention to new social relationships and arrangements that result. I found that biomonitoring and the scale at which it is interpreted can help build new relationships, or
conversely, drive wedges between affected communities and differentially affected advocacy groups. Within and across sites of contestation, biomonitoring science can alienate and atomize in some cases, while in others it can be channeled into opportunities for alliances that, in turn, enable and build toward political, social, and environmental change. This finding builds from Jasanoff and colleagues’ work on the co-production of science and society, which examines how science and social relations mutually constitute one another.

New relationships result from place-based biomonitoring, as new groups and alliance are brought into conversation about body burden and potential solutions. For example, in Maine, the issue of body burden has been used to forge new coalitions of industry, state, private philanthropists, and activists to support policy change and to move production away from a reliance on persistent chemicals. Alliances also were made across different places that all occupy the same position in the chemical life-cycle. In Alaska, environmental justice activists talk about body burden as a way to build alliances between Alaska tribes, and between Alaska tribes and other indigenous communities through the Indigenous Environmental Network and the International POPs Elimination Network.

Advocacy campaigns also symbolically make linkages across the chemical life-cycle by drawing parallels among common chemical exposures throughout product systems, a strategy now popularly referred to as “life cycle advocacy.” People affected by the same chemicals but in different locations along that chemical’s life course have begun to ally in unique and strategic ways, forming coalitions that address human exposure. In 2005, Massachusetts’ Alliance for a Healthy Tomorrow held a forum on phasing out polyvinyl chloride (PVC) plastics in consumer products and building materials. They invited residents from Mossville, Louisiana, where PVC is manufactured, to share the experience of living among PVC manufacturing plants and bearing body burdens of dioxin, one byproduct of PVC production. In 2006, the burdens born by polar bears in the circumpolar north were cited during hearings over a proposed bill to restrict the use of brominated flame retardants in Maine consumer goods. Alaska Community Action on Toxics
also has forged a North-South Alliance, which connects in sites of production most affected by
the spraying and application of persistent pesticides with the communities of Alaska and the
circumpolar north that are the ultimate end-recipients of those very same pesticides. Finally,
ACAT also has been instrumental in forging relationships with other environmental health
organizations in the Lower Forty-Eight around issues of human body burden through their
participation in the Coming Clean Network. For example, they participated in a coordinated body
burden study and related advocacy and policy campaigns that make linkages across production
cycles.

In making alliances across the chemical life-cycle people transmit alternative interpretations of
body burden that challenge the notion that science is only interpretable by experts. By linking
sites of production to other sites along the chemical life cycle, community groups and social
movement organizations lift concerns about chemical exposure out of the regulatory quagmire,
and into a new, unorganized policy space, where the regulatory apparatus and institutional
mechanisms that interpret exposure science for policy-making are less defined, and are rapidly
reorganizing. This, in turn, creates new political and institutional opportunities further down the
production chain to transform the materials economy and the relationship between industry and
civil society. For example, making connections to people and places remote from sites of
production, in some instances, more effectively can challenge the power relations that
traditionally define sites of production. Documenting burdens in sites of consumption, and
linking those to burdens elsewhere in the chemical lifecycle, has been another strategy that has
led to city- and state-level policies that activists hope will tip the balance toward federal reform.
Though policy is most rapidly shifting consumer-based exposures by changing or regulating the
means (i.e., materials) of production for everyday consumer products, the groups that straddle the
far ends of the chemical chain—those in sites of production and those in receptor communities—
continue to bear the highest burdens. Here, affected community groups argue that more needs to
be done than shifting just the chemicals used in production or monitoring human exposures.
Environmental justice activists suggest that the solution involves challenging the relationship between society and the firms and industrial practices that produce chemicals and exposures. The further chemicals and their consequences extend along the chemical lifecycle, and the more chemical pollution transcends distance and time, the greater the imperative to act and the more involvement the public should have in industrial and governmental decision-making. Thus, when linkages are made to groups in sites of persistence, there is a more immediate imperative to act.

We see a contrasting outcome in sites of production like the Mid-Ohio Valley, where community-based alliances are constrained by historical and political-economic relations, leaving public groups with a far narrower range of opportunities in which to translate blood results into political action. Few within the community had sustained ties to regional or national advocacy networks to assist with building community capacity to organize around the results or to link together communities and organizations addressing concerns over similar chemicals.

Historic patterns of social relations in some locales render these connections latent and unrealized, even when science reveals common chemical exposures. In sites of production, affected communities often feel cut off from other locales dealing with similar chemicals. On the fenceline, biomonitoring and body burden research is often conducted in the least participatory forums (i.e., by courts and by agencies). This isolates exposed populations, rather than bringing them into a network of association and/or alliance with other groups. Though life-cycle advocacy is becoming an increasingly prevalent strategy within the environmental health movement, many national environmental health advocacy networks prioritize household exposures and chemical policy reform are not attuned to body burden issues in those fenceline communities. As a result, many fenceline communities are not drawn into broader struggles over the same chemicals to which consumers far from the fencelines are exposed. For example, results of elevated body burdens in the Mid-Ohio Valley acted as a critical catalyst whereby the Washington D.C.-based, Environmental Working Group spurred a global investigation of and advocacy around PFOA in “average” populations due to its use the production of hundreds of consumer goods. Advocacy
around exposures happening elsewhere along the chemical life cycle, principally among consumers, have since been given priority status by researchers and policy-makers. However, many advocates that address perflourinated compounds through state, regional, national, even international actions know very little about the Mid-Ohio Valley, though it played a significant role in making this class of compounds a policy target. As some in the Valley have noted, while chemical policy initiatives around PFOA began at the fenceline, they have largely left the fenceline behind.

**SCIENCE-BASED ADVOCACY WHEN BODIES ARE ON THE LINE**

In Chapter Two, I briefly reviewed the political conditions that led the environmental movement to rely on science-based advocacy. Following World War II, in step with the rising production of synthetic chemicals, public intellectuals who saw themselves as part of the scientific-information movement began providing the public with technical assistance and information about the hazards of synthetic materials and new technologies (Egan 2007). The public-minded work of Barry Commoner and Rachel Carson, who presented the public with information about the dangers of nuclear fallout and DDT respectively, represent one way the public and the environmental movement gained access to scientific information about hazards during an era when information about environmental hazards was kept from the public. In particular, Commoner practiced a brand of public intellectualism whereby he not only supplied the public with needed information, but he also gave them the authority to determine its ultimate significance (Egan 2007). He argued that the public and not experts should define what constituted and “acceptable risk.” Commoner’s and Carson’s efforts to inform the public, combined with other community and labor organizing campaigns, galvanized public momentum behind initiatives to terminate above ground nuclear weapons testing, ban DDT, and push Congress to pass a wave of environmental legislation in the 1970s.
Importantly, publics do more than engage with data and results. How social movements and community groups engage in science all-the-while challenging it has been the focus of a growing field of sociologists studying the intersection of science and social movements. Phil Brown and colleagues have defined science-based advocacy and targeting science as the signature feature of contemporary, US-based social movements that engage environment- and/or health-related issues (Brown et al. 2004b; McCormick 2007; Morello-Frosch et al. 2006a; Zavestoski et al. 2004). As this research highlights, even as public groups engage in and with science, many also contest the very conditions that render science critical to organizing in the first place. For environmental health activism especially, the relationship to science and technology is complex, due to the role of science in producing the conditions that necessitate action, by creating the materials that pollute rivers and blood streams (Beck 1992) and for its role as “an explicit means for corporate interests to exert influence over state decision-making” (McCormick 2007: 610). These scholars also challenge the norms and practices of scientific method and practice, particularly the underlying assumptions about who has the authority and credibility to engage science (Brown 2007; Epstein 1996; McCormick 2005). By doing so, publics and movements seek to shift the conduct and practice of science from one end of the spectrum to the other through a critique of the underlying assumptions about expertise. For example, McCormick (2005; 2006) documents how the Brazilian anti-dam movement critiqued science for a variety of reasons. In her study, activists challenge the scientific process, discredit its conclusions, and expose the political underbelly of impact assessment science to thwart dam construction that would flood their communities. Importantly, as McCormick (2005; 2006) demonstrates, public groups do not just engage science from outside it—as public critics— but also by allying with various members within the institution and profession of science.

However, a less explored question is, now that communities and advocacy groups have become significant producers and critics of science, what are the consequences and implications that follow from this? Biomonitoring and human body burden has become a central priority
driving environmental health and justice organizing in the United States, and an important arena for debate among advocates, scientists, industry, and policy-makers and regulators. Yet, the promises and perils of biomonitoring science as an advocacy and policy tool have yet to be analyzed adequately. What compels me to investigate how public groups involve themselves in biomonitoring science, and what happens when they do, is that, in some instances, biomonitoring affords new political openings through which to pursue change and opportunities for powerful alliances to make those changes happen. At the same time, biomonitoring poses additional burdens, often to those communities facing disproportionate exposures and effects of chemical exposures.

In large measure, such complexities and possibilities stem from the current state of biomonitoring science. Biomonitoring is a fast developing, but largely unsettled scientific practice. Commonly accepted practices for sampling, chemical analyses, and, of particular interest here, for communication, interpretation, and translation into policy. In many instances, the ability to detect a chemical has outpaced scientists’ ability to interpret what a specific chemical at a specific concentration means for human health. Furthermore, biomonitoring reveals that chemical exposures occur in combination, which adds another layer of complexity to interpreting its meaning, since data on the health effects posed by complex mixtures is even more scant. Countless research studies and government reports detail why such vast knowledge gaps in basic toxicity and health screens persist for the 80,000 to 100,000 chemicals in commercial use. What is most important to understand is that, unlike pharmaceuticals or pesticides, presumed biologically-active agents, basic toxicity and health screening for industrial chemicals has never been a top research priority in the United States because regulations do not require it.

Community groups and social movement organizations concerned about chemical exposures have long been involved in science-intensive debates over whether exposures happen and whether they are harmful. While biomonitoring science presents public groups with new opportunities to document exposures, a key component of citizen efforts to advocate for regulatory or policy
change, it also opens up another, difficult to resolve debate: whether the internal presence of chemicals is hazardous or elevates the risk for future harm. Thus, as described in Chapter 2, while community groups are able to clear what was once a significant hurdle in addressing chemical exposures, they also can find themselves involved in even more protracted technical debates.

This dilemma follows a classic observation from the sociology of science—when uncertain science has potential policy and political applications, science is debated *ad infinitum*, often to the detriment of action altogether (Epstein 1996). In addition, the greater the degree of scientific uncertainty, the more controversy science generates, the more technocratic subsequent science becomes (Latour 1987). Moreover, conducting additional science often fuels, rather than placates such technical debates, despite the relentless call for—ever-more research to better translate uncertain science into policy (Jasanoff 1990). These circumstances affect public groups who conduct or participate in biomonitoring studies, and find themselves ensnared in ever-more complicated, technocratic debates far removed from the arena of mass politics.

After waves of scientific development, human biomonitoring science has advanced our understanding of human chemical burdens and chemical policy reform has reemerged on the national agenda. Since 2000, we have witnessed the introduction of several versions of the Kid Safe Chemical Act, the first federal efforts to revise the Toxics Substances Control Act; numerous bills to implement the UN Stockholm Convention on Persistent Organic Pollutants; and state-level policy that would control chemical exposures not just at the end-of-the-pipe, but much earlier in the production process—at the moment synthetic molecules are first synthesized. Central to these policy deliberations is human body burden—that science can read the history of chemistry in the human body, just as it might read ecological and geological history in the rings of a tree or strata of ice borings. Throughout these deliberations, human body burden slices to the quick of social organization, revealing unexamined assumptions about progress, power, and chemical-human relations. A maelstrom of political conflict and scientific debate has ensued.
Given the data gaps and degree of contested health information, both the National Research Council (2006) and the Centers for Disease Control (2005) argue that the technical capacity to use biomonitoring to assess exposure has outpaced development of the scientific and health data with which to interpret its significance. Both state that the presence of a chemical does not necessarily indicate the potential for risk or harm. The broader question of what the presence of chemicals in bodies does mean remains open.

In the U.S. context, unlike in the European Union, these advances have also outpaced the development of interpretative social and policy frameworks. Even as biomonitoring science reveals much about human exposure to chemicals, it raises many more difficult questions that are both ethical and political. Human body burden challenges the contemporary legal, moral, social, and policy frames in which both professional bodies and the body politic rely on to think about chemicals that have crossed into human bodies. Interpreting what human body burden means interpreting not just for health but also for society. The proliferation of biomonitoring data pushes numerous social sectors and institutions to wrestle with how to interpret the mounting body of evidence about human chemical burdens. Is body burden problematic? Even so, is it tolerable, or should something be done? If so, what can and should be done, and by whom? Industry, social movements, medicine, scientists and other researchers, regulators, and policymakers are all gathering to coordinate their perspectives and positions on conduct, interpretation, and communication of biomonitoring science.

Stakeholders’ approaches toward settling these disputes can shape what regulatory and policy interventions are enacted and implemented. While biomonitoring science could translate into policies that address the social production of disease, biomonitoring science also could be used to augment current risk-factor approaches to chemical regulation, which have borne significant, often disproportionate impacts on some communities more than others have. Environmental justice activists rightfully worry that policy applications of biomonitoring science may divert attention from the social and political-economic factors that underlie exposure and health
inequalities. Biomonitoring could be used to individualize the problem of chemical exposures, allocate limited resources to educating consumers about lifestyle and purchasing choices, and channel regulatory attention away from strengthening standards, enforcement, and toxics use prevention. This likelihood is based on the explosion in the number and availability of “green” consumer products, such as cleaning products or cosmetics.

Though communities and advocacy organizations increasingly participate in the conduct and interpretation of biomonitoring, they also raise important concerns that center on the powerful rhetoric that can be transmitted through biomonitoring science. Many environmental health organizations and communities disproportionately affected by chemical exposures approach biomonitoring and science-based advocacy strategies with reserve. One concern is that body burden science, if not carefully conducted and overseen by the public, will reproduce status quo relations by treating human bodies as post-hoc environmental monitors, especially when science delays more immediate exposure reduction (Boswell-Penc, 2006; Markowitz and Rosner 2002; Shostak 2004; Silbergeld et al. 1997).

Environmental justice activists voice concern about investing in science when the results are interpreted only through the lens of risk assessment, when historically the risk assessment paradigm has insufficiently protected communities from environmental exposures (Shostak 2004). These concerns certainly played out during Occupational Safety and Health Administration deliberations over a lead standard, and today, are taking shape as industry (and some regulators) argue biomonitoring is only relevant for the purposes of risk assessment and standard setting. In addition, communities worry that by using body burden science, they create data that can represent environmental contamination and body burden as an individual, medical problem to be clinically treated, rather than a social problem addressed by structural change and policy (Shostak 2004). Communities also debate how to counter depoliticizing rhetoric that identifies their body burden as stemming from proximal rather than structures sources and best mitigated through behavior change. This rhetoric is at work when individuals question whether
to nurse because breast milk contains known toxicants, or when subsistence communities worry they must forego traditional, subsistence foods because they convey excessive loads of industrial solvents and heavy metals.

Two other concerns have emerged from communities grappling with chemical burdens. In October 2006, a lay panel convened on the topic noted the potential for biomonitoring data to be misappropriated or be used to further stigmatize and marginalize communities, based on previous experiences with AIDS testing (Boston University Lay Panel on Biomonitoring 2006). Second, even as communities, tribes, and environmental justice advocates push for more access to biomonitoring science and for science to fill critical data gaps, they simultaneously question the necessity of biomonitoring in the first place, by asking: Why must communities conduct science to prove post-market exposures and harm rather than have industry prove pre-market safety?

Sociological analysis of related political debates echoes these critiques, adding that the institutional and political context in which science is produced, interpreted, and acted upon historically has constrained the ability of science to mitigate or resolve both environmental conflict and prevent chemical exposures (Jasanoff 1990). Indeed, because of the relationship between power and science, social movements have had varied results using science to promote radical social change. Participation in protracted scientific debates, and the pursuit of scientific expertise can divide movements and pull them off mission (Epstein 1996).

Meanwhile, as body burden and biomarker science advances, it continues to reveal how people across the globe—from beginning to end of chemical life-cycle—are exposed to the same chemicals, though in disproportionate concentrations. As a result of development in body burden science, the relationship between the once parceled or “siloed” domains of environmental health activism is undergoing rapid change, with new alliances and social movement strategies targeted across the life-cycle of products and chemicals emerging. Shostak (2004) has noted how biomonitoring science shifts environmental politics into the body; however, biomonitoring is part of a second, significant shift. Biomonitoring science also has moved public, scientific, and policy
attention to encompass the full lifespan of synthetic chemicals because it has found chemicals in people living near and remote from where they are synthesized and used in commercial applications. At the same time that biomonitoring extends the understanding of chemical hazards to populations living remotely from industry, biomonitoring generally tells us next to nothing about the exact sources of pollutants, particularly ubiquitous ones. The messy science of identifying specific sources was evidenced in Alaska, where ACAT and their scientific and community partners faced both scientific and political hurdles in pinpointing whether abandoned military sites were at least partially to blame for body burden levels. Even still, biomonitoring has eroded the artificial boundaries that compartmentalized regulatory and advocacy efforts in the past. Blanc (2007) accurately summarizes:

We still face old hazards and many new ones too: novel toxic threats that potentially emerge with each technological twist and innovation of human industry, creating ongoing dangers on the job, in the home, and for the wider environment. These are the collective challenges before us. They do not obey artificial divisions between work outside and inside the home, between the environment inside and outside the factory door, among the makers of goods, the supplier of services, and the consumer (p. 16).

Yet, while these divisions may be artificial and of human creation, they nevertheless bear real consequences and shape human experience. They organize and structure human exposures and the available channels to seek redress, even as activists within these locales work to make connections among them.

**RISING STAKES OF BIOMONITORING**

Not only has biomonitoring and body burden undergone a resurgence of public attention, but also there is a renewed vigor in the degree to which public groups, scientists, and policy-makers debate strategies for incorporating biomonitoring into policy. Historically, biomonitoring has been incorporated into policy debates to drive regulation. Typically, such efforts involved a single
chemical or heavy metal (e.g., the pesticide, DDT, is the key example). In the case of DDT, the presence of the pesticide in fat and breast milk helped drive its regulation. Similarly, data about strontium-90 in baby teeth contributed to widespread public pressure to curtail the practice of above ground nuclear testing. In both instances, biological data was an important factor in prompting government action. More recently, policymakers in Europe, Washington, and Maine leveraged rising breast milk concentrations of PBDE flame retardants used in a wide spectrum of consumer product applications from electronics to mattresses, to prompt and justify the phase out of several commercial formulations of the popular flame retardant. Biomonitoring has been used to track progress of policy or regulatory changes designed to decrease human exposures, such as monitoring how population levels of lead and cotinine respond to changes in indoor smoking and lead laws.

The central public debate has broadened to include not just the meaning of body burden (the problem) for policy, but also the meaning of biomonitoring (the science that images and measures that problem). Many stakeholder groups—community groups, national social movement organizations, regulators, policy-makers, and industry—are putting forth contrasting interpretations about what biomonitoring science means for policy. A national network of environmental health advocacy organizations is considering whether the next generation of proposed US chemical policy should rely more heavily on exposure data collected through human biomonitoring (in addition to, or separate from data collected through environmental sampling) to define regulatory priorities and to trigger regulatory action, even in the absence of complete toxicity data. (Louisville Charter 2004; also see Kid Safe Chemical Act59).

These social movement organizations propose that biomonitoring and the chemical burdens biomonitoring reveals should trigger regulatory action and drive new, more comprehensive policy. One unresolved question is whether the public and policy attention now trained on body

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burden will mean biomonitoring becomes the trigger for action and policy. When biomonitoring results trigger policy, does this constitute precautionary, progressive environmental policy or a regressive policy that fails to account for earlier warnings? Documenting DDT in breastmilk, strontium-90 in baby teeth, and dioxin in Vietnam Veterans constituted early warnings. From these chemicals, we learned chemicals behave in ways never anticipated. Documenting the accumulation of ever-more chemicals in ever-diverse populations, at some point, begs two questions. One, does the call for more biomonitoring perpetuate another layer of injustice by delaying action until new data is available? Two, as a society, have we failed to see, and respond to, a broader pattern? At what point will new biomonitoring projects cease to point out this failure, and instead, start constituting new problems that displace our collective focus? One proposed change to US chemical policy would rely on exposure data collected through human biomonitoring (versus, for example, air or water monitoring) to trigger regulatory action, even in the absence of complete toxicity data.

On the one hand, biomonitoring could be heralded as a precautionary approach to policy, because it side-steps the need for health or toxicity data. On the other hand, screening biological samples for chemicals to enact oversight could be viewed as a down-stream intervention rather than an early, precautionary warning, particularly for those already facing disproportionately higher exposures. When regulatory or policy action is triggered only after exposures have occurred and chemicals, especially those that are persistent and bioaccumulative ones, have built-up in the human system, human bodies stand in as post-hoc environmental monitors. In such instances, body burden is a late warning that perhaps air and water monitoring might have caught earlier.

As biomonitoring has become increasingly public and highlighted as policy-relevant, there has also been a parallel rise in coordinated industry responses to both delimit the interpretation and application of human biomonitoring science. Industry-funded scientists work to develop and standardize methods for translating raw biomonitoring data into biological equivalents, a
quantification of the relationship between internal dose and biological hazard. Many environmental regulators, often supported by industry, are also considering how to incorporate biomonitoring science into the current risk assessment paradigm. Their efforts suggest that evidence of biological exposure, in and of itself, is insufficient to guide regulatory action, but rather requires additional modeling of how the body metabolizes and is effected by these substances (Bahadori et al. 2007). Proposals to translate biomonitoring data into biomonitoring equivalents would, in effect, translate biomonitoring data into biological exposure standards. Such efforts would also place biomonitoring science exclusively back into the hands of experts.

Though the debates over biological equivalents are starting to heat up, they have yet to surface in a substantial way, though I suspect they will soon as the next wave of chemical reforms are introduce in Congress (e.g., the Kid Safe Chemical Act). In the meantime, historical cases suggest what is ahead for many of the public groups who work on the issue of human body burden and have a stake in how biomonitoring science is translated into policy.

**History Tells a Cautionary Tale**

During the 1970s Occupational Safety and Health Administration hearings on the occupational lead standard, industry and labor debated whether to prioritize blood or air monitoring for the standard. Organized labor, however, which involved itself in debates over how to interpret information about workers’ body burdens, expressed concerns about the value of blood levels (Markowitz and Rosner 2002; Warren 2000). Labor advocated for air monitoring of lead levels, whereas industry prioritized blood monitoring. Labor argued that industry historically made the case that body burdens resulted from poor hygiene habits at work, such as fingernail biting, not showering, resistance to hand washing, not washing clothes, rather than from excessive, ambient
lead exposures. Furthermore, labor expressed concern over the accuracy of monitoring lead levels in blood since at the time the analytic equipment was still being developed and standardized (Markowitz and Rosner 2002). Labor leaders also argued that workers’ bodies store lead in bone and other body tissues, but only slowly release lead into the bloodstream. Furthermore, they argued that industry and occupational physicians regularly administered chelating agents to workers, which would bind with lead in the blood to facilitate excretion. However, the blood would reabsorb lead from bones and tissues, and blood lead levels would only register at lower levels for a short while treatment. For these reasons, labor argued blood levels told a partial story of workers’ body burdens. They also added that prioritizing blood levels enabled industry to focus on the temporary clinical treatment of lead levels, and to not deal with the root problem—elevated levels of lead in workplace air.

The 1978 OSHA standard for lead that emerged from these hearings did reflect some of labor’s concerns about biomonitoring—air monitoring triggered blood monitoring, which in turn, triggered worker safety precautions. According to the standard, when workplaces exceeded a particular ambient air level of lead, workers’ blood would be drawn and analyzed for the lead concentration. OSHA then set the permissible blood-lead level to 50 micrograms per deciliter of blood; workers with blood lead concentrations that exceeded this standard were relocated to a different job, with a lower potential for exposure without penalty and with full pay and benefits, until blood levels fell below 40 micrograms per deciliter (Silbergeld et al. 1997; Warren 2000). During the Reagan administration, OSHA joined the steel industry, automobile makers, and paint manufacturers in a law suit to undermine this standard, though ultimately it was upheld by the Supreme Court (Markowitz and Rosner 2002). However, the enforcement of this standard, and industry responsiveness when workers blood levels surpassed 40 micrograms per deciliter was spotty, uneven, and ultimately had the consequence of denying many women, especially of child-

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60 See Post-Hearing Brief of United Steelworkers of America, AFL-CIO, CLC on Standard of Inorganic Lead” June 20, 1977), 54, Lead Docket, H 004, Exhibit 343, Department of Labor Docket Office.
bearing age, high-paying, skilled jobs to reduce industry liability based on lead exposures (Morello-Frosch 1997; Silbergeld et al. 1997).

In this case, biomonitoring—particularly when divorced from public participation or oversight—served industry by enabling it to control the terms of the debate over “problematic” ambient exposure levels (Markowitz and Rosner 2002; Warren 2000). Parallel debates over allowable or acceptable internal doses among non-occupationally exposed populations are expected to increase in the coming years. Industry and regulatory agencies are developing procedures for calculating biomonitoring equivalents (BEs), which will function much like biological limit values (BLVs) in occupational settings (Bolt and Thier 2006). This rhetoric further ushers body burden from the realm of mass politics and situates the interpretation of body burden, and whether it constitutes a risk that warrants action, within the hands of select experts.

As seen in this dissertation, biomonitoring pursued through an expert-based approach and through traditional regulatory channels undermines the potential biomonitoring science has to support efforts to reform environmental policy and production systems that create human exposures to synthetic chemicals. Indeed, the experience of chemical contamination in the Mid-Ohio Valley is grim, and it is still uncertain what biomonitoring will achieve for the people living near the DuPont factory there. The lawsuits and subsequent research in the Mid-Ohio Valley have brought to light otherwise hidden or absent information about PFOA exposures; nevertheless, biomonitoring pursued through these avenues has not yet lead to substantive changes that address the root problems that produce chemical exposures in the first place. The Brookmar Inc., study reported individual results to community members, but did not offer any benchmarks with which to interpret the results. The project deferred interpretation to scientific experts, even though it has been shown that lay people can and do understand biomonitoring results when scientists also offer supplemental information about what is and is not known about health implications (Boston University Lay Panel on Biomonitoring 2006; Brody et al. 2006). The community-based study conducted in one of the six affected water systems, however, is an
important counter example. Because of community involvement in results communication and
translation, the study increased the capacity for community associations, including the Little
Hocking Water Association even though not formally affiliated with the study, to advocate for
long-term resources to contend with the far-reaching implications PFOA will have.

As well, both Maine and Alaska, in contrast to the Mid-Ohio Valley, highlight the potential for
community groups and social movement organizations to carry out biomonitoring studies and to
use the scientific enterprise to move debate about public oversight of industrial production,
chemical policy reform, and transformation of industrial production and economic opportunities.
These groups pushed these issues and yet avoided the contentious regulatory debates Jasanoff
(2005) describes as so common in American environmental politics. As this dissertation
highlights, this is because these are newer arenas of environmental advocacy that offer activists
unique political and scientific opportunities, and because activists used science to form powerful,
cross-cutting alliances.

A LIFECYCLE APPROACH TO STUDYING CHEMICAL POLITICS

In this dissertation, I developed a lifecycle approach to studying environmental
contestation that extends the gaze of social scientists from a focus on contests about production to
contests over the content of consumer products and on the nature of chemicals themselves to
persist and/or bioaccumulate. My goal was to show how politics and the implications of science
differ in patterned or structured ways. Environmental contestation over chemicals differ
depending on the relationships between the exposure source and the exposed population, and
based upon the degree to which regulatory science is a defined, well-organized arena, as it is in
sites of production, or where regulatory science is just beginning to grapple with broader
scientific and political questions about chemical ubiquity and persistence. To examine
biomonitoring and contests over chemical exposures in only one site or stage of the lifecycle
would mean overlooking the key opportunities through which biomonitoring alters problem
definition, and how the political-economic opportunities structures opportunities for activists to use science to move debate and advocacy in new directions. A focus on the Mid-Ohio Valley alone would show how biomonitoring drives a wedge between communities and economic interests, and miss how biomonitoring also serves as opportunity for cooperation among business, government, and advocacy groups to pursue economic development initiatives. A focus on only Maine alone would show how biomonitoring is leading to new policy initiatives to purge the market of persistent chemicals and green production, and yet miss how such initiatives are enabled by—and sometimes exacerbate—conditions in sites of production. In Maine, sites of production struggle around mercury and dioxin releases laid the ground work for consumer- and product-focused initiatives. Moreover, widespread contamination in the Mid-Ohio Valley brought policy and regulatory attention to PFCs, which in turn, inspired The Alliance for a Clean and Healthy Maine to want their volunteer participants’ blood to be analyzed for those chemicals. Similarly, national advocacy organizations pursued campaigns against consumer products in which PFCs are used (e.g., non-stick cookware and stain-resistant coatings for furniture), by using the events in the Mid-Ohio Valley to keep DuPont and PFOA in the media.

Industry is voluntarily phasing out use of PFOA (as seen in the Mid-Ohio Valley) and PBDEs (as seen in Maine) over time. When their contemporary use stops and these chemicals are no longer defined as “emerging contaminants,” they will eventually join PCBs as “legacy contaminants”—regulated substances no longer in use, but that nevertheless continue to accumulate in soil, oceans, food chains and human bodies. In Alaska, body burden poses definitive threats to cultural survival, and like the Mid-Ohio Valley, body burden increasingly are understood threats to human health. Voluntary phase-out of persistent chemicals, incremental policies that purge specific market uses of chemicals, and coalitions to replace chemical use with greener chemicals in single product lines are important steps. Moreover, they serve as a foundation on which to build toward sweeping chemical policy reform, both in the US and internationally. Yet, sites of persistence lay bare the full scope of the unintended problems posed
by more than six decades of use, release, and regulatory oversight of synthetic chemicals. Alaska points to bigger questions than reforms to regulatory systems and the materials used in production, as the problem of chemical body burden is tied into broader questions about the relationship between chemical producers and users and the ultimate end-recipients of chemical wastes.

Importantly, sites of production, consumption, and persistence are typological or analytical distinctions. In actually, they co-exist and overlap. Each case study could have been analyzed through this framework, and future research might find this a fruitful approach. For example, in the Mid-Ohio Valley, which for this dissertation, I analyzed as a site of production, people are exposed to the same chemical through the same (albeit poorly understood) pathways that generate exposures for the general US population: fast food packaging, microwave popcorn bags, and potentially through a host of other stain, grease, and water-repellent applications. As well, they contend with legacy sources of PFOA, not just from more recent releases. PFOA, through yet unstudied pathways, is found in the drinking water DuPont supplied as an exposure reduction measure. Moreover, the University of Pennsylvania study found that community members who ate more preserved locally grown fruits and vegetables had higher body burdens than those who ate less. Similarly, even though I analyzed Maine as a site of consumption, Maine deals with mercury in consumer products, as well as a problem of production and persistence. As discussed in Chapter Six, mercury was a byproduct of chlorine production, a necessary material for the state’s significant pulp and paper industries. As well, Maine is contending with the long-range transport and deposition of mercury from coal-burning power plants in other parts of the county, which is contributing to mercury building up in fish from interior lakes. Yet, though these issues co-occur within the same political jurisdiction and geographical space, these issues remain siloed. There are different stakeholders raising these issues through different advocacy and policy channels, in different organizational terrain with different political opportunities. Taking a lifecycle approach to a single chemical within a single place might yield new insights into the
political, economic, and social dimensions that create boundaries among what really are common struggles.

Biomonitoring has been a key component in driving advocacy and policy to focus on the later stages of the chemical lifecycle. Biomonitoring also has become a signature component of how contests in these relatively newer political arenas (i.e., sites of consumption and sites of persistence) unfold. Finally, biomonitoring also plays a role in obviating connections between once siloed arenas of environmental organizing. Activists concerned about chemicals in consumer products, in some instances, are allying with activists in the circumpolar North and communities on the fenceline of production plants to push for comprehensive chemical policy reforms. The reforms they envision, in turn, would replace the environmental policies of the 1970s that created separate arenas of contestation in the first place; they argue for chemical policies that prioritize regulatory oversight of persistent and bioaccumulative substances, and moreover that prevent new substances that demonstrate similar characteristics from ever reaching the market. Perhaps, in years to come, the result of their efforts would obviate the need for a lifecycle approach, as the boundaries and distance between site of contact and contestation I describe cease to exist. In the interim, however, biomonitoring is likely to become more incorporated into and more significant for advocacy and policy.
REFERENCES


Alaska Community Action on Toxics. 2002. “Elevated levels of harmful PCB’s found in people of ST. Lawrence Island, Attributed to exposure at military sight—results detailed in study funded by the National Institute of Environmental Health Sciences. October 2, 2002.


Action on Toxics.

-----. 2005b. “Project Description: Environmental Health and Justice for St. Lawrence Island,
Alaska.” Published in: Environmental Justice Community-Based Participatory Research and
Tribal Research Grantee Meeting Bulletin. National Institute of Environmental Health
Sciences, National Institute for Occupational Health and Safety, and the Environmental

-----. 2007. “Project Description: Environmental Health and Justice for St. Lawrence Island,
Alaska.” Published in: Environmental Justice Community-Based Participatory Research and
Tribal Research Grantee Meeting Bulletin. National Institute of Environmental Health
Sciences, National Institute for Occupational Health and Safety, and the Environmental

Alaska Community Action on Toxics and Mimi Hogan, Sandra Christopherson, and Ann Rothe.
2006. “Formerly Used Defense Sites in the Norton Sound Region.” Anchorage, AK: Alaska
Community Action on Toxics.

Alaska Department of Environmental Conservation. 2007. “Contaminated Sites Database: Site
Report for St Lawrence Island Northeast Cape Facility.” Available at: www.dec.state.ak.us.

Alaska Division of Public Health, Section of Epidemiology. 2001. “Exposure to Persistent
Organic Pollutants (POPs) in 5 Aleutian and Pribilof Villages.” State of Alaska Epidemiology

-----. 2003a. “PCB Blood Test Results from St. Lawrence Island: Recommendations for
Consumption of Tribal Foods.” State of Alaska Epidemiology Bulletin 7 (1). February 6,
2003.


Altman, Rebecca Gasior, Rachel Morello-Frosch, Julia Green Brody, Ruthann Rudel, Phil Brown, and Mara Averick. 2007. “Pollution Comes Home and Gets Personal: Women’s Experience of Household Toxic Exposure.” Presented at the American Sociological Association Meetings, New York City.
Amenta, Edwin, and Michael P. Young. 1999. Making an Impact: Conceptual and
Methodological Implications of the Collective Goods Criterion. In How Social Movements
Matter, edited by M. G. Giugni, D. McAdam and C. Tilly. Minneapolis: University of
Minnesota Press.

UK: Oxford University Press.

Anderberg, Stefan. 1998. “Industrial Metabolism and the Linkages between Economics,

Movement and Its Legacy. Chicago, IL: University of Chicago Press.


Apelberg, Benjamin J., Frank R. Witter, Julie B. Herbstman, Antonia M. Calafat, Rolf U. Halden,
Larry L. Needham, and Lynn R. Goldman. 2007. “Cord Serum Concentrations of
Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoate (PFOA) in Relation to Weight and

Arctic Council. 2007. “About the Arctic Council.” Available at: http://arctic-
council.org/article/about. Last updated October 22, 2007.

Arctic Monitoring and Assessment Program. 2004. AMAP Assessment 2002: Persistent Organic
Pollutants in the Arctic. Oslo, Norway: Arctic Monitoring and Assessment Programme.

and Assessment Programme.

Corps of Engineers.” Available at:


Belliveau, Michael, Jenn Burns, Matthew Davis, Pete Didisheim, Susan Farady, Steve Hinchman, Bill MacDonald, Joan Saxe, and Michael Stoddard. 2006. Investing in Maine’s Future: A


Bertomeu-Sanchez, Jose Ramon and Augustin Nieto-Galan, eds. 2006. *Chemistry, Medicine, and Crime: Mateu J. B. Orfila (1787–1851) and His Times.* Sagamore Beach, Massachusetts, Science History Publications.


Brody, Julia, Phil Brown, Ruthann Rudel, Rachel Morello-Frosch, Rebecca Gasior Altman, Margaret Frye, Cheryl Osimo, Carla Perez, and Liesel Seryak. 2006. "The New Ethics for Reporting Personal Environmental and Biological Exposures to Study Participants." The American Journal of Public Health 97 (9): 1547-1554.


Brown, Phil, Rachel Morello-Frosch, Stephen Zavestoski, Laura Senier, Rebecca Altman, Elizabeth Hoover, Sabrina McCormick, Brian Mayer, and Crystal Adams. 2007. “Policy
Ethnography and Field Analysis: New Directions for Studying Health Social Movements.”
Invited for presentation at the University of Michigan Social Movements and Health Institutes
Conference, October 2007, Ann Arbor, MI.

Brown, Phil, Sabrina McCormick, Brian Mayer, Stephen Zavestoski, Rachel Morello-Frosch,
Rebecca Gasior Altman, and Laura Senier. 2006. "A Lab of Our Own: Environmental
Causation of Breast Cancer and Challenges to the Dominant Epidemiological Paradigm."

Brown, Phil and Stephen Zavestoski, eds. 2005. Social Movements in Health. Malden, MA:
Blackwell Publishing.

Brown, Phil, Stephen Zavestoski, Theo Luebke, Joshua Mandelbaum, Sabrina McCormick, and

Brown, Phil, Stephen Zavestoski, Sabrina McCormick, Brian Mayer, Rachel Morello-Frosch, and

----- 2004. "Clearing the Air and Breathing Freely: Disputes Over Air Pollution and Asthma."

Brownless, Jeff. 2000. “Site report for St. Lawrence Island Northeast Cape Facility Alaska.”
Department of Environmental Conservation Contaminated Sites Database. Available at:

----- 2003. Site report for St. Lawrence Island Northeast Cape Facility Alaska.” Department of
Environmental Conservation Contaminated Sites Database.


Bubble. 2005. DVD. Directed by Steven Soderbergh. (2929 Entertainment and Magnolia
Pictures).


----- N.d. “PCBs and Persistent Pesticides in Blood from the Residents of St. Lawrence Island.” (Power Point presentation).

Carpenter, David O., K Arcaro, DC Spink. 2002. “Understanding the Human Health Effects of
Chemical Mixtures.” *Environmental Health Perspectives* 110 (S1): 25-42.


Cohen, Maurie J. and Howard, Jeff. 2006. “Success and its Price: The Institutional and Political


*Drumbeat for Mother Earth.* 1999. DVD. Directed by Joseph Di Gangi and Amon Giebel. (Bull Frog Films.)


Environmental Health Strategy Center. 2002. “Our Vision.” Available at:


Environmental Working Group. 2003. *Body Burden: Pollution in People*. Available at:


Executive Order No. 13175. 65 FR 67249, November 9, 2000.


Stanford University Press.


8.


Mol, A.P.J. and van den Burg, S. 2004. Local Governance of Environmental Flows in Global


Morello-Frosch, Rachel, Julia Brody, Margaret Frye, Phil Brown, Rebecca Gasior Altman, Ruthann Rudel, and AJ Napolis. 2006b. "The Right to Know, the Right to Act, and the Right Not-to-Know: Ethical and Scientific Dilemmas of Reporting Data in Body Burden Research."


Rhodes et al., v. E.I. DuPont de Nemours and Company, Action No: 06-C-264. (Circuit Court, Wood County, WV).


Snow, Donald L. (Chief, Radiological Surveillance Center, Division of Radiological Health.) 1965. Memo to: Dr. Wayne C. Hanson, Battelle Memorial Institute, Pacific Northwest Laboratories. Dated June 20, 1965.


*Tolbert et al. v Monsanto/Solutioa No 2:01-CV-1407 UWC* (N.D. Alabama 2001).


----- 2006b. “Premanufacture Notification Exemption for Polymers; Amendment of Polymer Exemption Rule to Exclude Certain Perfluorinated Polymers.” *The Federal Register* 71(44):


