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GOVERNING WATERS: THE DEVELOPMENT OF WATER POLLUTION POLICY IN THE UNITED STATES, 1850-1980

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ABSTRACT

GOVERNING WATERS: THE DEVELOPMENT OF WATER POLLUTION POLICY IN THE UNITED STATES, 1850-1980

By

Jouni Juhani Paavola

This dissertation develops a governance approach to environmental problems and policy as a critical response to the traditional economic approach. It also examines the governance of water quality in the United States over the past one hundred and fifty years. The governance approach understands externalities as instances of human interdependence, recognizes positive transaction costs, and accepts the implications of value pluralism. For the governance approach, environmental problems are resource use conflicts that emerge when agents are interdependent and have incompatible interests in the use of environmental resources. Correspondingly, environmental policies are institutions that resolve these conflicts and govern resource use. The empirical research examines institutions that have governed water quality in the United States, including the 19th century riparian law and common law in general, the 19th and early 20th century state water pollution control policies, and the 20th century federal water pollution control legislation. The dissertation shows how the governance of water quality has gradually acknowledged new interests in water quality, first mainly protecting private property and water use from pollution, then extending protection to public health, and finally protecting the environment because of its recreational use and for its own sake. The dissertation demonstrates how the new uses of

water that have emerged in the 19th and 20th century have created an increasingly complex set of interdependencies, which are today governed by an equally complex set of nested governance institutions. These governance institutions are an outcome of conflict resolution and collective choices in different social arenas, in which agents have forwarded their welfarist and sometimes non-welfarist resource use goals. The dissertation shows how the institutional framework within which conflict resolution and collective choices take place influence whose interests are translated into policy. It also demonstrates how the governance outcomes are influenced by the design of governance institutions and changes in technology and resource use. The analysis demonstrates that efficiency and welfare concerns have not alone determined the course of institutional change. It also shows how the design of governance institutions is a compromise between conflicting interests, which does not necessarily deliver good environmental outcomes.

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INTRODUCTION

This dissertation has its origin in the difficulty I have had to become persuaded with the way environmental economics analyzes environmental problems, assesses environmental policies, and prescribes their choice. This dissertation seeks to outline an alternative – a governance approach – to the traditional economic approach to environmental problems and policy. The approach is also applied to water pollution policy in the United States from the early 19th century until the 1970s.

Environmental economics conceptualizes environmental problems as negative externalities or harmful physical effects an agent imposes upon others without compensating them. Externalities create a wedge between the marginal private and social costs of an activity, because marginal social costs by definition include the costs an activity imposes upon others. As an agent's maximizing behavior only accounts for private marginal costs, it results in a greater than optimal level of activity from the society's viewpoint and, therefore, reduces social welfare from its potential.

For environmental economics, the policy problem is how to achieve the socially optimal level of an environmentally harmful activity, such as pollution, and it envisions a number of ways to do so.[1] For example, the state could ration permits to the polluters

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[1] See William J. Baumol and Wallace E. Oates, *The Theory of Environmental Policy: Externalities, Public Outlays, and the Quality of Life* (Englewood Cliffs: Prentice-Hall, 1975); J. H. Dales, "Land, Water, and Ownership," *Canadian Journal of Economics* 1 (1968): 791-804; Wallace E. Oates and William J. Baumol "The Instruments of Environ-

that add up to socially optimal level of pollution. It could also pay the polluters to reduce their emissions. Alternatively, the state could establish a charge for emissions to achieve the socially optimal level of pollution. Yet another alternative is to establish and assign tradable rights to pollute up to the optimal level. Finally, polluters and their victims can be left to bargain or to litigate.

Environmental economics is mainly interested in the welfare implications of goals and instruments of environmental policy. As a group of prominent environmental economists puts it in their article, "the traditional approach consists of comparing the beneficial effects of regulation with the costs that must be borne to secure these benefits." Their conclusion is that the economic instruments of environmental policy – such as environmental fees or charges and systems of tradable pollution permits – are more desirable from a welfare standpoint than the command and control measures, such as emission and effluent limits and other environmental regulations. Economic instruments are argued to secure the attainment of a socially optimal level of pollution at a lower cost than command and control measures would.[2]

However, these judgments on the goals and instruments of environmental policy are problematic. First, a number of environmental policies have goals that are not welfare-

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mental Policy," in *Economic Analysis of Environmental Problems*, ed. Edwin S. Mills (New York: Columbia University Press, 1975), 95-128.

[2] See Karen Palmer, Wallace E. Oates, and Paul R. Portney, "Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?," *Journal of Economic Perspectives* 9 (1995): 119. See also Maureen L. Cropper and Wallace E. Oates, "Environmental Economics: A Survey," *Journal of Economic Literature* 30 (1992): 675-740; T. H. Tietenberg, "Economic Instruments for Environmental Regulation," in *Economic Policy towards the Environment*, ed. Dieter Helm (Oxford: Blackwell, 1991), 86-110.

maximizing. Yet these policy goals have often been deliberately chosen and cannot be simply swept aside. Second, the distinction between "command and control" measures and "economic instruments" of environmental policy is misleading. On one hand, the use of markets coerces those who do not become sellers. On the other hand, command and control measures often allow for negotiation and flexibility.[3] Thirdly, there is a contradiction between the economic assessment of policy instruments and the revealed preferences of policy makers: command and control measures have been favored in practice and have sometimes replaced economic instruments. For example, private property rights include rights to air and water quality, which are enforceable in the courts and are tradable like other sticks in the bundle of property rights. In the 19th century, agents enforced their rights to environmental quality in the courts, because public policies regulating environmental quality did not exist, were formulated so as to be ineffective or unenforceable, or just were not enforced.[4] Markets thus determined environmental quality as Ronald Coase has demonstrated is possible.[5] Environmental regulation has replaced

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[3] See Andrew Gouldson and Joseph Murphy, *Regulatory Realities: The Implementation and Impact of Industrial Environmental Regulation* (London: Earthscan, 1998), 42-44; Allan Schmid, "The Environment and Property Rights Issues," in *The Handbook of Environmental Economics*, ed. Daniel W. Bromley (Oxford: Blackwell, 1995), 45-60.

[4] See Carol M. Rose, *Property and Persuasion: Essays on the History, Theory, and Rhetoric of Ownership* (Boulder: Westview Press, 1994); Louise A. Halper, "Nuisance, Courts, and Markets in the New York Court of Appeals, 1850-1915," *Albany Law Review* 54 (1990): 301-357; Christine Rosen, "Differing Perceptions of the Value of Pollution Abatement across Time and Place: Balancing Doctrine in Pollution Nuisance Law, 1840-1906," *Law and History Review* 11 (1993): 303-381.

[5] See Ronald H. Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (1960): 1-44; Ronald H. Coase, "The Lighthouse in Economics," *Journal of Law and Economics* 17 (1974): 357-376.

common law as the foundation for determining environmental quality in the 20th century, although common law still plays a role.

The actual predominance and choice of allegedly inferior policy goals and instruments should be an anomaly for environmental economics because it assumes that the economy and polity are populated by rational, self-interested, perfectly informed, and maximizing agents. These agents should have chosen those goals and instruments of environmental policy that best enhance their welfare, or else there must be something wrong with our understanding of how actors choose, how policy instruments work, or both.[6] Another look at the issue seems thus warranted.

To reiterate, the traditional approach to environmental problems and policy is problematic for several reasons. First, it ignores transaction costs that in the real world contribute to the emergence of environmental problems and impede responses to them. Second, it abstracts environmental policies to mere cost or benefit effects, devoid of institutional details, which are often carefully and painstakingly crafted by the law-makers and regulators. Yet the institutional design of environmental policies importantly influences their performance in the real world. Third, the traditional approach assesses envi-

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[6] Private or social welfare maximization could explain the choice of command and control measures. On the first argument, see James M. Buchanan and Gordon Tullock, "Polluters' Profits and Political Response: Direct Control versus Taxes," *American Economic Review* 65 (1975): 139-47. See also Anne O. Krueger, "The Political Economy of the Rent-Seeking Society," *American Economic Review* 64 (1974): 291-303; Robert D. Tollison, "Rent Seeking: A Survey," *Kyklos* 35 (1982): 575-602. On the second argument, see Michael E. Porter and Claas van der Linde, "Toward a New Conception of the Environment-Competitiveness Relationship," *Journal of Economic Perspectives* 9 (1995): 97-118. Another explanation attributes command and control measures to the ignorance of policy makers, who would choose otherwise if they knew better. Finally, deliberate seeking of non-welfarist goals can explain command and control measures.

ronmental goals and policies only from the viewpoint of how they contribute to human welfare. Still, human welfare is not the only concern in the setting of environmental goals and the choice of policy instruments.

The aim of this dissertation is to overcome the above discussed weaknesses and to outline a governance approach to environmental problems and policy that understands externalities as interdependencies, admits positive transaction costs, and accepts that agents do not seek exclusively their personal welfare. This aim is sought by working toward three sub-goals. First, the dissertation works out the theoretical implications of interdependence, positive transaction costs, and value pluralism for the analysis of environmental problems and policy. Second, the dissertation develops a way to analyze environmental policies as governance institutions and to identify the implications of their institutional design. Third, the dissertation demonstrates the usefulness of governance approach by examining institutional arrangements that have governed water quality in the United States from the early 19th century until the 1970s.

The next section reviews in greater detail the theoretical foundation on which the governance approach can be based.

Theoretical Dimensions of the Research Problem

The theoretical starting point of this dissertation is the Pigovian approach to environmental economics, which conceptualizes environmental problems as externalities and identifies them with a socially non-optimal allocation of environmental resources. It understands environmental policies as instruments with which to correct resource allocation so as to achieve the optimum and to realize an improvement in social welfare. For this

approach, the goal of environmental policy is to maximize social welfare and the most important dimension of policy instruments is their cost-effectiveness in realizing the welfare-maximizing allocation of resources.[7]

Drawing from critical research on the normative basis of neoclassical economics, this dissertation argues that the unidirectional conception of externalities in environmental economics obscures the character of policy choices.[8] Government interventions to "internalize externalities" and to realize welfare improvements by correcting the allocation of resources actually redefine and assign rights to environmental resources. Therefore, government interventions should be understood as primarily distributive choices over whose interests in environmental resources should be realized when they are interdependent and incompatible with those of others.[9] This dissertation also argues with the other critics that efficiency arguments are insufficient as a normative basis for policy pre-

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[7] For an overview, see Anthony C. Fisher and Frederick M. Peterson "The Environment in Economics: A Survey," *Journal of Economic Literature* 14 (1976): 1-33; Cropper and Oates, "Environmental Economics"; William J. Baumol and Wallace E. Oates, *The Theory of Environmental Policy* (Cambridge: Cambridge University Press, 1988). See also Arthur C. Pigou, *Economics of Welfare* (London: Macmillan, 1920).

[8] See Coase, "Problem of Social Cost"; Andreas Papandreou, *Externality and Institutions* (Oxford: Oxford University Press, 1993); Warren J. Samuels, "Welfare Economics, Power, and Property," in *Perspectives of Property*, eds. Gene Wunderlich and W. L. Gibson Jr (University Park: Institute for Research on Land and Water Resources, Pennsylvania State University, 1972), 61-148; A. Allan Schmid, "Nonmarket Values and Efficiency of Public Investments in Water Resources," *American Economic Review, Papers & Proceedings* 57(1967): 158-168.

[9] See Daniel W. Bromley, *Economic Interests and Institutions: The Conceptual Foundations of Public Policy* (Oxford: Blackwell, 1989); Guido Calabresi, "The Pointlessness of Pareto: Carrying Coase Further," *Yale Law Journal* 100 (1991): 1211-37; Coase, "Problem of Social Cost"; Frank H. Knight, "Some Fallacies in the Interpretation of Social Cost," *Quarterly Journal of Economics* 37 (1924): 582-606; Samuels, "Welfare Eco-

scriptions: rights must be established and assigned before economic efficiency can be achieved.[10] This suggests that environmental problems should be seen as conflicts between interdependent agents having different interests in the use environmental resources, and environmental policies as institutions that resolve these conflicts. The "use of environmental resources" refers in this dissertation to the realization of any interests in environmental resources, including their preservation or non-use.

The neglect of transaction costs in the traditional approach has also obscured the inconclusive character of efficiency arguments. When transaction costs are taken into consideration, all resource allocations must be optimal and other than optimality or efficiency arguments must be sought to justify changes in resource allocation. Transaction costs are also important because they partly explain the emergence environmental problems, hinder the establishment of environmental policies, and influence how environmental policies perform in the real world.[11]

Research in new institutional economics pays attention to transaction costs, but it has not been interested in environmental policies. On the other hand, it has examined insti-

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nomics, Power, and Property"; A. Allan Schmid, *Property, Power, and Public Choice: An Inquiry into Law and Economics* (New York: Praeger, 1987).

[10] See Ronald C. Griffin, "The Welfare Analytics of Transaction Costs, Externalities, and Institutional Choice," *American Journal of Agricultural Economics* (August 1991): 601-614; Warren J. Samuels, "Welfare Economics, Power, and Property"; Schmid, "Nonmarket Values and Efficiency"; Arild Vatn and Daniel W. Bromley, "Externalities – A Market Model Failure," *Environmental and Resource Economics* 9 (1997): 135-151.

[11] See Calabresi, "Pointlessness of Pareto." See also Thrainn Eggertsson, *Economic Behavior and Institutions* (Cambridge: Cambridge University Press, 1990); Douglass C. North, *Institutions, Institutional Change, and Economic Performance* (Cambridge: Cambridge University Press, 1990); Oliver Williamson, *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting* (New York: Free Press, 1985).

tutions of common property that govern the use of many natural resources, such as pastures, forests, and fisheries.[12] Some works have also examined how private property and contractual arrangements govern the use of natural resources.[13] Finally, new institutional economics increasingly informs research on the governance of transboundary and global environmental resources under international environmental conventions.[14]

This dissertation argues that the approach of new institutional economics to institutions governing the use of local, transboundary, and global environmental resources is promising also for the study of national environmental policies. This approach facilitates the conceptualization of environmental problems as resource use conflicts and environmental policies as distributive resolutions of these conflicts. It also opens up a view of environmental policies as institutions that govern the use of environmental resources not

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[12] Erling Berge and Nils Christian Stenseth, eds., *Law and the Governance of Natural Resources: Studies from Northern Europe and Africa* (San Francisco: ICS Press, 1999); Fikret Berkes, ed., *Common Property Resources, Ecology and Community-Based Sustainable Development* (London: Belhaven, 1989); Daniel W. Bromley, ed., *Making the Commons Work: Theory, Practice, and Policy* (San Francisco: ICS Press, 1992); Carl J. Dahlman, *The Open Field System and Beyond: A Property Rights Analysis of an Economic Institution* (Cambridge: Cambridge University Press, 1980); Bonnie J. McCay and James M Acheson, eds., *The Question of the Commons: The Culture and Ecology of Communal Resources* (Tucson: University of Arizona Press, 1987); Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990).

[13] Terry L. Anderson and Peter J. Hill, "The Race for Property Rights," *Journal of Law and Economics* 33 (1990): 177-197; Coase, "Problem of Social Cost"; Gary D. Libecap, *Contracting for Property Rights* (Cambridge: Cambridge University Press, 1989).

[14] Susan Buck, *The Global Commons: An Introduction* (Washington: Island Press, 1998); Robert O. Keohane and Elinor Ostrom, eds., *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains* (London: Sage, 1995); David G. Victor, Kal Raustiala, and Eugene B. Skolnikoff, eds., *The Implementation and Effectiveness of International Environmental Commitments: Theory and Practice*

unlike other ownership arrangements do: environmental policies establish rights to environmental resources, assign them to certain resource users, and engender a particular allocation and distribution of resources.[15]

New institutional economics can also allow other motivations to agents in addition personal welfare. For example, research on common property sometimes identifies sustainable resource use as a goal that is either sought after or achieved by adopting certain institutional arrangements.[16] However, there has not been a systematic effort to incorporate a broader range of behavioral motivations into new institutional economics. This is no wonder: most research in the tradition has been as exclusively interested in the welfare motivations and implications of policy choice as neoclassical economics has been. Welfare emphasis surfaces in new institutional economics as concerns for the level of transaction costs generated by institutional arrangements, the value of assets under alternative institutional arrangements, or some direct notion of welfare. [17]

New institutional economics associates voluntary bargaining with low transaction costs and desirable welfare consequences. Voluntary cooperation at the local and global

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(Cambridge: MIT Press, 1998); Oran R. Young, *Global Governance: Drawing Insights from the Environmental Experience* (Cambridge: MIT Press, 1997).

[15] See Bromley, *Making the Commons Work;* Ostrom, *Governing the Commons.*

[16] See S. V. Ciriacy-Wantrup, "The Economics of Environmental Policy," *Land Economics* 47 (1971): 36-45; S. V. Ciriacy-Wantrup and Richard C. Bishop "Common Property as a Concept in Natural Resources Policy," *Natural Resources Journal* 15 (1975): 713-727. See also Ostrom, *Governing the Commons.*

[17] On normative views in new institutional economics, see Guido Calabresi, "Some Thoughts on Risk Distribution and the Law of Torts," *Yale Law Journal* 70 (1961): 499-553; Douglass C. North, *Structure and Change in Economic History* (New York: Norton, 1981); North, *Institutions, Institutional Change, and Economic Performance*; Richard A. Posner, *Economic Analysis of Law*, 4th ed. (Boston: Little, Brown, 1992).

levels is enthusiastically studied because it is thought to engender efficient institutions that reflect shared welfare goals. Complex statutory institutions such as environmental policies are in turn seen to preclude voluntary bargaining, to entail high transaction costs, and to hinder the achievement of welfare goals. This is one reason why they have not been studied seriously. Still, agents have voluntarily them to govern the use of environmental resources, which cannot be attributed solely to their ignorance.

The welfare emphasis of environmental economics and new institutional economics stems from their shared view of human behavior. They understand agents to have pre-existing and stable preferences that reflect self- and welfare-centered values. Environmental economics also assumes limitless cognitive capabilities, while new institutional economics admits that information is imperfect.[18] They also agree on how environmental policies are and should be established or changed. If choices reveal agents' preferences and what best enhances their welfare all that is must be a result of maximizing behavior and maximize the agents' welfare.[19] That is, institutions have been brought about by self-interested and welfare-centered action, and any changes in them have been, will be, and should be sought only with welfare improvements in mind.

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[18] See Geoffrey M. Hodgson, "The Approach of Institutional Economics," *Journal of Economic Literature* 36 (1998): 166-192; Herbert A. Simon, "Rationality as a Process and Product of Thought," *American Economic Review* 68 (1978): 1-16.

[19] On revealed preferences, see Paul A. Samuelson, "A note on the Pure Theory of Consumer Behavior," *Economica* 5 (1938): 61-71; Paul A. Samuelson, "Consumption Theory in Terms of Revealed Preference," *Economica* 15 (1948): 243-253. On problems with this view, see Warren J. Samuels, "The Pervasive Proposition, 'What Is, Is and Ought to Be': a Critique," in *The Megacorp and Macrodynamics: Essays in Memory of Alfred Eichner*, ed. William S. Millberg (Armonk: M. E. Sharpe, 1992), 273-285.

Without denying that concerns for personal welfare inform our everyday choices, this dissertation argues that other motivations are also important. Non-welfarist motivations may be particularly important in institutional choices, because they are about what kind of a world we want to live in. Therefore, non-welfarist motivations should be accounted for in economic analysis of environmental problems and policy. Scholarship in economics and philosophy has developed ways of understanding economic agents as more than self-interested maximizers of their personal welfare.[20] It indicates that when other moral goals, such as non-utilitarian concerns for other humans, the community, or the natural environment are allowed, institutions become means for attaining them.

Original institutional economics provides two building blocks – sensitivity to conflicts and power and social constructivism – that integrate the insights of other strands of scholarship discussed above. Conflicts over the use of environmental resources emerge because values change and agents hold different views as to how environmental resources ought to be used in the society. Agents thus seek to establish or change institutions that govern the use of environmental resources by both individual and collective action. The establishment of and change in governance institutions takes place as a re-

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[20] See Elizabeth Anderson, *Value in Ethics and Economics* (Cambridge: Harvard University Press, 1993); Daniel M. Hausman and Michael S. McPherson, *Economic Analysis and Moral Philosophy* (Cambridge: Cambridge University Press, 1996); Mark Sagoff, *The Economy of the Earth: Philosophy, Law and the Environment* (Cambridge: Cambridge University Press, 1988); Amartya K. Sen, "Utilitarianism and Welfarism," *Journal of Philosophy* 76 (1979): 463-489; Amartya K. Sen, "Rational Fools: A Critique of the Behavioral Foundations of Economic Theory," *Philosophy and Public Affairs* 6 (1977): 317-344; Amartya K. Sen, "Behavior and the Concept of Preference," *Economica* 40 (1973): 241-259.

sult of conflict resolution in social arenas.[21] The sensitivity to conflicts and power gives added meaning to transaction costs: they influence the ability of interest groups to forward their interests in conflicts or their power.[22] Thus the pursuit of values does not alone explain institutional change; arenas of collective choice and conflict resolution influence who can voice which values when collective choices are made.

Finally, social constructivism has been the hallmark of original institutional economics since Veblen and Commons adopted it in the beginning of the 20th century.[23] It means that ethical beliefs motivating agents, such as welfarism, are contextual and socially constructed rather than pre-existing and given. Therefore, preferences are changing expressions of historically contingent moral values that inform agents.[24] The same applies to knowledge informing agents: their perception of choice situations, alternatives, and outcomes is shaped by how their contemporaries and peers frame them. Thus, understanding institutional change requires analysis of agents' beliefs and knowledge.

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[21] See Jack Knight, *Institutions and Social Conflict* (Cambridge: Cambridge University Press, 1992); Warren J. Samuels, *Essays on the Economic Role of Government. Volume I: Fundamentals* (New York: New York University Press, 1992).

[22] William Dugger, "Transaction Costs and the State," in *Transaction Costs, Markets, and Hierarchies*, ed. Christos Pitelis (Oxford: Blackwell, 1993), 188-216.

[23] See John R. Commons, *Legal Foundations of Capitalism* (Madison: University of Wisconsin Press, 1959); John R. Commons, *Institutional Economics: its Place in Political Economy* (New Brunswick: Transaction Publishers, 1990); Thorstein Veblen, *The Theory of the Leisure Class: An Economic Study of Institutions* (London: Macmillan, 1899).

[24] See Geoffrey M. Hodgson, *Economics and Institutions: A Manifesto for Modern Institutional Economics* (Philadelphia: University of Pennsylvania Press, 1988); Geoffrey M. Hodgson, "Economics, Environmental Policy, and the Transcendence of Utilitarianism," in *Valuing Nature? Economics, Ethics, and Environment*, ed. John Foster (London: Routledge, 1997), 48-63; Hodgson, "Approach of Institutional Economics"; Warren J. Samuels, *Economic Role of Government I.*

Methodological and Other Remarks

The acknowledgment of socially constructed values and knowledge influences the methodological approach of this research. Jon Elster has argued that social sciences can focus either on individual action or the social structures that enable, constrain, and direct it. His delineation does not mean that a methodological approach would altogether ignore either social structures or individual action. Although methodological individualism prioritizes individual action in analysis and explanations, it enables to account for social structures such as private ownership in the form of signals generated by the price system. Similarly, although methodological collectivism emphasizes social structures in analysis and explanations, those events are still brought about by individuals.[25]

Despite their refinements, methodological individualism and collectivism remain problematic. The assumptions of Neoclassical Economics paradoxically reduce humans to stimulus-response automatons who cannot make real choices: they can only react to signals coming from their environment on the basis of their pre-existing preferences. Similarly, methodological collectivism makes it difficult to present other than functionalist or teleological explanations for social structures. An intermediary position which can accommodate individual agency and acknowledge collective phenomena such as language, knowledge, and institutions that enable, direct, and limit agency is needed.[26]

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[25] See Jon Elster, *Nuts and Bolts for the Social Sciences* (Cambridge: Cambridge University Press, 1989), 13-21.

[26] See e.g. Anthony Giddens, *Central Problems in Social Theory: Action, Structure, and Contradiction in Social Analysis* (Basingstoke: Macmillan, 1979); Geoffrey M. Hodgson, "The Ubiquity of Habits and Rules," *Cambridge Journal of Economics* 21 (1997): 663-684; Hodgson, "Approach of Institutional Economics."

This research takes such an intermediary position by recognizing that the values motivating the agents and the knowledge informing them are socially constructed while at the same time acknowledging that agents have agency.[27] Agency is possible because values and knowledge are not monolithic and universally shared: there is freedom for the individuals to creatively combine values and knowledge to make up something new. On the other hand, individual agency is limited, because social forces generate the menu of values and knowledge individuals face: they can only choose from alternatives that are available for them. Therefore, individual action and social structures are both fundamentally relevant and research cannot dismiss one or the other.[28]

This research also recognizes that the agents' cognitive capacity is limited. They may have stable preferences over alternatives they face in recurrent choices, but need to form their preferences by learning and deliberation when they confront new alternatives or choice situations. This is particularly relevant in institutional choices because they govern activities that have complex and sometimes unpredictable consequences: it may re-

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[27] See Peter L. Berger and Thomas Luckmann, *The Social Construction of Reality: A Treatise in the Sociology of Knowledge* (New York: Doubleday, 1966); Anthony Giddens, *Central Problems in Social Theory: Action, Structure, and Contradiction in Social Analysis* (Basingstoke: Macmillan, 1979); Bruno Latour, *We Have Never Been Modern* (Cambridge: Harvard University Press, 1993); Jean-Francois Lyotard, *The Postmodern Condition: A Report on Knowledge* (Minneapolis: University of Minnesota Press, 1984). See also Roy Bhaskar, *The Possibility of Naturalism: A Philosophical Critique of the Contemporary Human Sciences*, 3rd ed. (London: Routledge, 1998), 31-37.

[28] See Joseph Agassi, "Institutional Individualism," *British Journal of Sociology* 26 (1975): 144-155; Kenneth J. Arrow, "Rationality of Self and Others in an Economic System," *Journal of Business* 59 (1986): S385-S399; Kenneth J. Arrow, "Methodological Individualism and Social Knowledge," *American Economic Review* 84 (1994): 1-9; A. Allan Schmid, "Institutional Law and Economics," *European Journal of Law and Economics* 1 (1994): 33-51, 35-37.

quire a significant amount of learning before preferences can be formed over choice alternatives. What agents prefer may well reflect what the agents consider as an intrinsically valuable outcome or a virtuous thing to do.

To summarize, this research seeks to explain institutional change and performance as the result of interaction of agents motivated by particular values and informed by particular knowledge within institutions that structure their interaction and influence their power in particular ways. The research understands values and knowledge as collective phenomena discernible from historical documents, such as court decisions and legislative histories. When court decisions are analyzed, they are interpreted in the light of their social context. The judges are seen to have made their decisions on the basis of values and knowledge that were available for them as members of society. Similar standpoint is taken towards legislative and other choices.

To conclude, the methodological approach followed in this research facilitates both explanation and criticism. It also facilitates the assessment of how particular institutional arrangements can realize particular values or resource use goals based on them. Therefore, it may have instrumental use as a tool in policy analysis and design. However, as the methodological approach does not privilege any particular set of values, it does not provide a basis for substantial policy prescriptions.

Empirical Subject Area of the Research

This dissertation demonstrates the fruitfulness of governance approach by using it to analyze water pollution policy in the United States from the early 19th century until the 1970s. This period is long enough to offer a perspective on present-day water pollution

problems and responses to them. The period witnessed the emergence of new water uses for public water supply, waste disposal, and recreation, which either influenced or depended on water quality. Changes also took place in the governance institutions and in the relative importance of the courts, the legislature, and the administrative agencies as arenas of conflict resolution and collective choice. Finally, values also changed during the period. The rest of this section outlines the above-mentioned changes.

Industrialization created the first water pollution problem in the United States in the early 19th century. Early industrial establishments such as tanneries, sawmills, and textile mills were water-powered and used water in production, and were thus located at watercourses. Disposing of wastes into water was the easiest way to get rid of them, but it injured the use of water by the downstream mill owners and riparian farmers, and sometimes obstructed navigation or destroyed fisheries.[29] Conflicts over the injuries to private use of water or other property were resolved in the courts on the basis of riparian law or the law of private nuisances, while other conflicts were resolved on the basis of the law of public nuisances or fish and game statutes.[30] In practice, riparian law was the most important legal institution that governed industrial discharges in the 19th century.

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[29] See Peter N. Davis, "Theories of Water Pollution Litigation," *Wisconsin Law Review* (1971): 738-816; Halper, "Nuisance, Courts, and Markets"; Philip V. Scarpino, *Great River: An Environmental History of the Upper Mississippi, 1890-1950* (Columbia: University of Missouri Press, 1985); Theodore Steinberg, *Nature Incorporated: Industrialization and the Waters of New England* (Amherst: University of Massachusetts Press, 1991); Joel A. Tarr, *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective* (Akron: University of Akron Press, 1996).

[30] See Davis, "Water Pollution Litigation"; Anthony Scott and Georgina Coustalin, "The Evolution of Water Rights," *Natural Resources Journal* 35 (1995): 821-979.

The second water pollution problem resulted from rapid urbanization and changes in urban infrastructure in the 19th century. Living conditions worsened in the growing cities in the early 19th century in terms of noise, polluted air and water, inadequate waste disposal, and frequent epidemics of diseases.[31] Cities responded to the health crisis by constructing systems to deliver clean water to their inhabitants after the mid-19th century, and, after a few decades, sewer systems to dispose of their wastes.[32] The new sewer systems discharged untreated sewage into the watercourses and contaminated the water supplies of downstream communities. Municipalities usually had local ordinances and local boards to protect public health but they were unable to cope with inter-locality pollution problems.[33] As a response, state public health authorities and water pollution control statutes were established in the end of the 19th century.[34]

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[31] See John Duffy, *A History of Public Health in New York City, 1866-1966* (New York: Russell Sage Foundation, 1974); John Duffy, *The Sanitarians: A History of American Public Health* (Urbana: University of Illinois Press, 1990); Stuart Galishoff, *Safeguarding the Public Health: Newark, 1895-1918* (Westport: Greenwood Press, 1975); Stuart Galishoff, *Newark: The Nation's Unhealthiest City, 1832-1895* (New Brunswick: Rutgers University Press, 1988).

[32] See Tarr, *The Ultimate Sink.*

[33] Duffy, *Public Health in New York City*; Duffy, *The Sanitarians*; William J. Novak, *The People's Welfare: Law and Regulation in Nineteenth-Century America* (Chapel Hill: The University of North Carolina Press, 1996).

[34] See James Joseph Flannery, "Water Pollution Control: Development of State and National Policy" (Ph.D. Dissertation: the University of Wisconsin, 1956); Terence Kehoe, *Cleaning Up the Great Lakes: From Cooperation to Confrontation* (DeKalb: Northern Illinois University Press, 1997); Earl Finbar Murphy, *Water Purity: A Study in Legal Control of Natural Resources* (Madison: University of Wisconsin Press, 1961); Barbara Gutmann Rosenkrantz, *Public Health And The State: Changing Views in Massachusetts, 1842-1936* (Cambridge: Harvard University Press, 1972).

Two developments resulted in the third water pollution problem. The conventional pollution of water by industrial and municipal discharges had interstate effects and chemical and toxic pollution of water became common by the First World War. Both pollution problems grew worse and attracted wide public attention in the 1960s and the 1970s.[35] Legal responses to inter-state water pollution started in the early 20th century, when states litigated their conflicts over water pollution in the Supreme Court of the United States. Interstate compacts were also formed to provide a framework to resolve water pollution problems cooperatively. However, the most important response to the 20th century water pollution problems was the establishment of the federal water pollution control program in 1948 and its gradual development thereafter.[36]

The changes in water pollution problems, technology, and institutions took place in the context of changing values and knowledge. The common law response to early industrial water pollution was first informed by values that emphasized the protection of private property as an intrinsically valuable political foundation of society. These republican values were gradually replaced by utilitarian values, which viewed private property merely as an instrument to improve private and collective welfare. Similarly, values that

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[35] Rachel Carson, *Silent Spring* (Boston: Houghton & Mifflin, 1962); Frank Graham Jr, *Disaster by Default: Politics and Water Pollution* (New York: M. Evans & Co., 1966); David Zwick and Marcy Benstock, *Water Wasteland* (New York: Grossman, 1971).

[36] See Edward J. Cleary, *The ORSANCO Story: Water Quality Management in the Ohio Valley under an Interstate Compact* (Washington: Resources for the Future, 1967); Flannery, "Water Pollution Control;" N. William Hines, "Nor Any Drop to Drink: Public Regulation of Water Quality, Part II: Interstate Arrangements for Pollution Control," *Iowa Law Review* 52 (1966): 432-457; N. William Hines, "Nor Any Drop to Drink: Public Regulation of Water Quality, Part III: The Federal Effort," I*owa Law Review* 52 (1967): 799-861; Kehoe, *Cleaning Up the Great Lakes*.

considered human health as intrinsically valuable promoted the protection of public health beyond the mid-19th century, but in the Progressive Era utilitarian arguments replaced them. Utilitarian concerns also informed the establishment of federal water pollution control program, but its reform in the 1970s was based on values that viewed the environment as intrinsically valuable.[37] Amidst these value changes knowledge on the etiology of diseases and the impact of pollutants also changed.

Chapter Outline

The dissertation's first chapter critiques the notion of externalities, omission of transaction costs, and the exclusive attention to welfare motivations in the traditional approach to environmental problems and policy. The chapter also outlines a governance approach that seeks to overcome these dilemmas.

The second chapter develops the governance approach further in order to facilitate the analysis of policy problems and responses. It indicates how physical resource attributes and the attributes of resource users shape the policy problems. The chapter also demonstrates how the performance of policy responses can be assessed by analyzing

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[37] See Gregory S. Alexander, "Time and Property in the American Republican Legal Culture," *New York University Law Review* 66 (1991): 273-352; Samuel P. Hays, *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890-1920* (Cambridge: Harvard University Press, 1959); Morton J. Horwitz, *The Transformation of American Law, 1780-1860* (Cambridge: Harvard University Press, 1977); James Willard Hurst, *Law and Economic Growth: The Legal History of the Lumber Industry in Wisconsin, 1836-1915* (Cambridge: The Belknap Press, 1964); Novak, *The People's Welfare*; Rose, *Property and Persuasion.*

what kind of governance problems the attributes of the resource and its users create, and how the design of governance institutions resolves them.

The third chapter examines how riparian law governed industrial pollution of water in the 19th century. It argues that the use of courts to resolve conflicts and to make collective choices explain why riparian law changed in the mid-19th century to favor the disposal of industrial waste. The courts were open only to property interests according to their willingness and ability to pay for water use and litigation. This arrangement enabled those with a valuable water use to change governance institutions to their benefit. The chapter also analyzes the counter-reaction in the late 19th century.

The fourth chapter examines the interdependence of local communities in the face of sewage pollution that endangered public health in the 19th and early 20th century and institutional responses to it. The chapter analyzes the role of common law, statutory law, and technology in resolving conflicts over water pollution. The chapter also demonstrates how the institutionally determined administrative discretion set the course for both institutional and technological change.

The fifth chapter examines how water pollution made the states interdependent in the 20th century, and the different institutional responses that were tried to govern their interdependence. The chapter examines both the interim institutions that were used before the establishment of the federal legislation and the gradual development of federal legislation, and indicates reasons to the ineffectiveness of all of these institutions.

The conclusions reflect upon the theoretical and empirical projects undertaken in this dissertation and indicate its major achievements. They also discuss the applicability of the governance approach and indicate needs for future research.

1. DILEMMAS OF ENVIRONMENTAL ECONOMICS: EXTERNALITIES, TRANSACTION COSTS, AND BEHAVIORAL MOTIVATIONS

> "the choice among different social arrangements for the solution of economic problems should be carried out in broader terms ... problems of welfare economics must ultimately dissolve into a study of aesthetics and morals."[1]

> "different characters of the choice of institutions ('what institutions should we have?') and the choice of personal action ('how should I behave?') require different moral analyses, since these are distinct (though not independent) problems."[2]

This chapter examines three dilemmas of environmental economics – the unidirectional conception of externalities, omission of transaction costs, and exclusive attention to welfare motivations of human behavior. The chapter argues that these dilemmas weaken the ability of environmental economics to understand and analyze environmental problems and policy, and render its policy prescriptions unreflective of their ethical underpinnings and implications. The chapter also outlines a governance approach that seeks to overcome the dilemmas. The latter chapters demonstrate that the governance approach yields insights, explanations, and conclusions that would be difficult to reach in the traditional approach.

In what follows, the first section discusses the implications of conceptualizing environmental problems as unidirectional externalities or uncompensated physical effects between agents. The chapter argues that this notion obscures the interdependence of agents

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[1] Ronald H. Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (1960): 1-44, 43.

[2] Amartya K. Sen, "The Moral Standing of Market," in *The Economic Borders of the State*, ed. Dieter Helm (Oxford: Oxford University Press, 1989), 92-109, 99.

that underlies externalities: technological externalities pair with the political ones. Relieving an agent from an uncompensated physical effect burdens other agents with costs or constraints. To reject the costs or constraints leaves the first agent to suffer from the uncompensated physical effect. Therefore, environmental problems should be understood as conflicts between interdependent agents over the use of environmental resources.

The second section examines how environmental economics understands environmental policies as instruments with which to correct resource allocation without regard to the implications of transaction costs. Environmental economics welcomes government intervention when there is a promise of improved resource allocation and social welfare, and considers this view as an unproblematic one. Yet every existing allocation is optimal given the initial assignment of rights and transaction costs. The optimality of status quo rests upon a configuration of rights that is not superior to other right configurations: they would also yield optimal allocations albeit with different distributive implications.[3] The policy problem is: which optimal outcome and distribution to choose? The problem is resolved by protecting some interests in the use of environmental resources by rights that are established by environmental policies. Therefore, environmental policies should be understood as institutions that govern resource use by resolving conflicts between different interests in them and by protecting these interests in environmental resources as/with rights.

The third section examines how the welfare-centered policy prescriptions of environmental economics are based on a conception of human behavior that recognizes only welfare motivations. Yet both philosophical arguments and empirical evidence suggest that

agents may also have non-welfarist motivations and that they may be particularly important in institutional choices. Therefore, economic analysis should make space for value pluralism in the analysis of environmental problems and policy. This means that economic analysis should aim at identifying and clarifying policy goals instead of attributing them to the agents. Yet economics can retain its central role in policy analysis by indicating how well alternative goals and instruments of environmental policy are likely to realize different interests in environmental resources.

The fourth section outlines a governance approach to environmental problems and policy that seeks to overcome the above discussed three dilemmas. The governance approach recognizes that policy choices require moral judgements over whose interests in environmental resources merit protection when they are interdependent with those of others. The governance approach understands environmental policies as institutions that implement these moral judgements by defining the rights and duties of agents with respect to environmental resources. The governance approach also emphasizes that the design of environmental policies as governance institutions influences the achievement of resource use goals. Finally, it draws attention to how the overall institutional framework structures participation in collective choices and determines which values are realized.

Environmental Problems: Externalities or Resource Use Conflicts?

Since Marshall and Pigou, economics has conceptualized environmental problems such as the pollution water as externalities or uncompensated harmful physical effects between

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[3] Guido Calabresi, "The Pointlessness of Pareto: Carrying Coase Further," *Yale Law*

agents.[4] Pigou's examples of externalities included a sparking steam engine that created a fire hazard at the properties adjoining a railway and a smoking factory that dirtied a laundry's linen. Pigou's examples, and Coase's stray cows that damaged a neighbor's crops, have reinforced the conceptualization of environmental problems as unidirectional, incidental, and unintentional spillover effects.

Environmental economics has mobilized this understanding with marginal cost concepts. Marginal private cost includes the usual costs to the supplier of an additional unit, while marginal external cost includes its costs to other agents as the result of the supplier's interference with their person, property, or amenities.[5] The marginal cost to the society of the additional unit is thus the sum of marginal private and external costs. Partial equilibrium analysis indicates that profit maximization results in a greater than socially optimal level of environmentally harmful activity when a negative externality prevails. Government intervention is suggested to attain the socially optimal allocation of resources.

Journal 100 (1991): 1211-37.

[4] See Francis Bator, "The Anatomy of Market Failure," *Quarterly Journal of Economics* 72 (1958): 351-379; James M. Buchanan and William Craig Stubblebine, "Externality," *Economica* 29 (1962): 371-384; James Meade, "External Economies and Diseconomies in a Competitive Situation," *Economic Journal* 62 (1952): 54-67; E. J. Mishan, "The Postwar Literature on Externalities: An Interpretative Article," *Journal of Economic Literature* 9 (1971): 1-28; Andreas Papandreou, *Externality and Institutions* (Oxford: Oxford University Press, 1993); Tibor Scitovsky, "Two Concepts of External Economies," *Journal of Political Economy* 62 (1954): 143-151; Ralph Turvey, "On Divergences between Social Cost and Private Cost," *Economica* 30 (1963): 309-313. See also Alfred Marshall, *Principles of Economics: An Introductory Volume* (London: Macmillan, 1890); Arthur C. Pigou, *Economics of Welfare* (London: Macmillan, 1920).

[5] See Turvey, "Social Cost and Private Cost." Compare William K. Kapp, *The Social Costs of Private Enterprise* (Cambridge: Cambridge University Press, 1950).

The conceptualization of environmental problems as unidirectional externalities is problematic. First, environmental problems are conceptualized specifically as *technological* externalities, which are seen to warrant government intervention unlike pecuniary and political externalities. Pecuniary externalities include the effects visited upon others via the market system, such as the devaluation of their assets by making an innovation or by initiating competition with them. Political externalities in turn include the effects visited upon others via the political system: as a result of securing an institutional change burdening them by political action, for example.

Environmental economics has a unidirectional conception of externalities because it focuses exclusively on their physical dimension: if the government does not intervene, some agents will be burdened by a physical effect. Yet when the government intervenes, a political externality is created that burdens the agents that generated the physical effect. That is, when there is an instance of an externality situation such as an environmental problem, it means that agents are interdependent and cannot realize their incompatible interests in environmental resources simultaneously. Environmental problems should thus be understood as conflicts over the use of environmental resources between interdependent agents that have mutually incompatible interests in them.

Furthermore, externalities are not so incidental as much of the writing in economics suggests. Externalities are indeed an exception in the basic competitive model of microeconomics. However, in the real world externalities or interdependencies are ubiquitous and explain the need for institutions such as private ownership. Scarcity results in interdependence and interdependence is a manifestation of scarcity: interdependence would be an exception only in the world of abundance where there is no scarcity. Finally, the sub-

stance of externalities – such as environmental problems – is usually a predictable consequence of intentional action, not an accidental or unintentional side effect. There is just no compelling reason to change behavior that generates a harmful physical effect before a choice is made as to whose interests count.

New institutional economics recognizes positive transaction costs and promises a more realistic analysis environmental problems and policy. Yet it also has a problematic concept of environmental problems. Coase argued that some physical effects between agents are not priced because transaction costs preclude the establishment of markets for them. By transaction costs Coase meant the costs of seeking information, conducting negotiations, making decisions, writing up contracts, and enforcing them.[6] A market can thus fail to emerge for a physical effect when the establishment and enforcement of rights or contracts is costly, when transaction costs outweigh the effect's low value, or when the government has relieved the effect's generator from liability. Government intervention may fail for the same reasons. Thus transaction costs contribute to environmental problems, because they hinder the establishment of markets and government interventions to resolve them.

Coase recognized the reciprocal relationship that underlies the notion of externalities and used the observation in his famous theorem. He harnessed the observation to criticize

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[6] See Coase, "Problem of Social Cost." See also Armen A. Alchian and Harold Demsetz, "Production, Information Costs, and Economic Organization," *American Economic Review* 62 (1972): 777-795; Yoram Barzel, "Transaction Costs: Are They Just Costs?," *Journal of Institutional and Theoretical Economics* 141 (1985): 4-16; Steven Cheung, "The Structure of Contract and the Theory of a Non-Exclusive Resource," *Journal of Law and Economics* 13 (1970): 49-70; Thomas D. Crocker, "Externalities, Property Rights, and Transaction Costs: An Empirical Study," *Journal of Law and Economics* 14 (1971): 451-464; Carl Dahlman, "Problem of Externality" *Journal of Law and Economics* 22 (1979): 141-

the straightforward interventionism of Pigovian welfare economics. He showed that when wealth effects are ignored, the initial assignment of rights does not influence resource allocation under the usual assumptions of the Pigovian approach, which include the omission of transaction costs. In the less often cited part of his work he demonstrated how the initial allocation of rights influences resource allocation when transaction costs are positive. He also argued that government regulation may entail lower transaction costs than markets and be preferable to them in some situations.

However, research in new institutional economics has failed to respect the implications of interdependence. High transaction costs or missing private property rights are often thought to explain the existence of externalities and environmental problems.[7] Yet private property rights are not necessary to avoid or to remedy environmental problems. Collectively exclusive ownership has often secured sustained use of natural resources and environmental regulation has alleviated many environmental problems.[8] Indeed, to associate environmental problems with high transaction costs and missing private property rights is but another way of identifying them with socially non-optimal allocation of resources. If

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162; Gary Libecap, "Property Rights in Economic History: Implications for Research," *Explorations in Economic History* 23 (1986): 227-252.

[7] See Harold Demsetz, "Toward a Theory of Property Rights," *American Economic Review* 57 (1967): 347-73.; Eirik G. Furubotn and Svetozar Pejovich, "Property Rights and Economic Theory: A Survey of Recent Literature," *Journal of Economic Literature* 10 (1972): 1137-62; Garrett Hardin, "The Tragedy of the Commons," *Science* 162 (1968): 1241-1248.

[8] Daniel W. Bromley and Michael M. Cernea, *The Management of Common Property Natural Resources: Some Conceptual and Operational Fallacies* (Washington: World Bank Discussion Papers 57, 1989); S. V. Ciriacy-Wantrup, "The Economics of Environmental Policy," *Land Economics* 47 (1971): 36-45; S. V. Ciriacy-Wantrup and Richard C. Bishop, "Common Property as a Concept in Natural Resources Policy," *Natural Resources*

transaction costs are high and private property rights do not exist to an effect, the market cannot price it and reflect its value in the allocation of resources. If transaction costs are lower and private property rights to the effect exist: the market would price it and allocate resources in the light of its value. The latter allocation is perceived as optimal and more desirable from the welfare standpoint than the former allocation. The prescription for a government intervention may suggest different instruments that the Pigovian approach would recommend, but the omission of interdependence is shared.

Thus both environmental economics and new institutional economics fail to explain why externalities exist, and, for this reason, to fully grasp the nature of environmental problems. As was already indicated above, at the root of the existence of interdependencies is scarcity: when there are multiple claims to environmental resources, it becomes impossible to cater for all of them. Therefore, environmental problems should be understood as conflicts over the use of environmental resources.[9]

The conceptualization of environmental problems as resource use conflicts sheds critical light on the "internalization of externalities" and welfare-maximizing corrections to resource allocation. It suggests that the policy problem is not about attaining socially optimal allocation of resources and maximizing social welfare, but rather about whose welfare counts and whose interests are external. The next section will examine in greater detail problems that underlie normative policy prescriptions in environmental economics.

Journal 15 (1975): 713-727; Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990).

[9] The use of environmental resources is understood broadly in this dissertation, so as to include also their preservation or "non-use."

Both environmental economics and new institutional economics thus identify environmental problems with a deviation of resource allocation from the hypothetical ideal generated by private property rights and markets in the absence of transaction costs.[10] Environmental economics understands environmental policies as instruments with which the allocation of resources can be corrected so as to realize an improvement in social welfare. The identification of environmental problems with socially non-optimal allocation of resources serves a dual role in policy prescriptions. On one hand, it is used as a basis for promoting government intervention when resource allocation and social welfare can arguably be improved. On the other hand, it is also used to reject government intervention when it is not seen to promise improvements in resource allocation and social welfare.

These normative views are problematic, because they assume that there is a unique optimal allocation that would be achieved if only private property rights and markets existed. There is no guarantee of the existence of such an allocation. Different initial assignments of rights would engender different levels and distributions of transaction costs, and also different levels and distributions of costs and benefits of resource use.[11] There-

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[10] See Andrew K. Dragun and Martin P. O'Connor, "Property Rights, Public Choice, and Pigouvianism," *Journal of Post Keynesian Economics* 16 (1993): 127-152.

[11] Institutions influence both transaction and transformation costs: the minimization of transaction costs may not minimize transformation costs or the sum of them. See Oliver Williamson, *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting* (New York: Free Press, 1985). Another view holds that institutions only influence transaction costs. See Kenneth J. Arrow, "The Organization of Economic Activity: Issues Pertinent to the Choice of Market versus Nonmarket Allocation," in *Public Expenditure and Policy Analysis*, 2nd ed., eds. Robert V. Haveman and Julius Margolis (Chicago: Rand McNally College Publishing Company, 1977), 67-81, 77.

fore, any resource allocation could be achieved with several rights configurations. Moreover, when different rights configurations engender different resource allocations, it cannot be said that one configuration results in a more or less optimal allocation than another. All rights configurations result in efficient allocations that have different distributive implications and are not comparable in Pareto-terms.[12] Thus, an allocation of resources engendered by a rights configuration cannot serve as a standard with which to judge allocations based on other rights configurations. *Inter alia*, private property rights cannot form the measurement rod for other ways of establishing resource rights, such as environmental regulation or common property.

Moreover, the notion of optimality does not have an unambiguous relationship to the substantive outcomes of resource allocation. Optimal resource allocations can be considered to be problematic by the affected agents. The optimal allocation of water predominantly for power generation or waste disposal does not console those that would rather use it for recreation or protect the water environment for its own sake. Similarly, the interests of an industry in need of process or cooling water are not served by the optimal allocation of water mainly for recreational uses or for the preservation of water habitat. The dissatisfied can bargain to change the status quo. However, the status quo may not be ideal from their viewpoint even if they do not. The distribution of income, wealth, or

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[12] Daniel W. Bromley, *Economic Interests and Institutions: The Conceptual Foundations of Public Policy* (Oxford: Blackwell, 1989); Calabresi, "Pointlessness of Pareto"; Ciriacy-Wantrup, "Economics of Environmental Policy"; Alan Randall, "Coasian Externality Theory in a Policy Context," *Natural Resources Journal* 14 (1974): 35-54; Warren J. Samuels, "The Coase Theorem and the Study of Law and Economics," *Natural Resources Journal* 14 (1974): 1-33; Arild Vatn and Daniel W. Bromley, "Externalities – A Market Model Failure," *Environmental and Resource Economics* 9 (1997): 135-151.

transaction costs can prevent them from changing the status quo in ways they would desire, or they may find it inequitable to have to protect their interests in the markets.

When the nature of environmental problems as interest conflicts is acknowledged, it becomes clear that to focus on whether some physical effects between agents are priced or not is to miss the point. It is true that an optimal allocation of resources is achieved in theory when private property rights exist and other conditions of perfect competition are met. However, there are numerous such optima. The choice of a particular optimal allocation decides whose interests are realized in it. As the quotes of Sen and Coase argued in the beginning of this chapter,[13] moral judgments must be made to favor a right configuration and its allocative and distributive consequences.

Thus environmental policies should be understood as institutional arrangements that govern the use of environmental resources by resolving conflicts between interdependent agents. They perform this function by protecting certain agents' interests in environmental resources as rights and by creating duties to other agents that are interested in the use of environmental resources. This means that environmental policies establish and assign formal rights to environmental resources. They accomplish this by using different kinds of entitlement rules, which include property rules, liability rules, and inalienable rights.[14] For example, trading systems employ property rules, charges and subsidies are based on liability rules, and "command and control measures" create inalienable rights. For anybody to

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[13] Sen, "Moral Standing of Market," 99; Coase, "Problem of Social Cost," 43.

[14] See Daniel W. Bromley, *Environment and Economy: Property Rights and Public Policy* (Cambridge: Blackwell, 1991); Guido Calabresi and Douglas A. Melamed, "Property Rules, Liability Rules, and Inalienability: One View of the Cathedral," *Harvard Law Review* 85 (1972): 1089-1128.

enjoy protection of her interests, she must also have *de facto* and not only *de jure* rights. Therefore, environmental policies also provide for the implementation and enforcement of formal rights to environmental resources.

The understanding of environmental policies as governance institutions indicates another weakness in environmental economics. It analyzes environmental policies in a framework that ignores transaction costs and reduces them into mere cost or benefit effects, or effects on the supply of opportunities to environmentally harmful activities. This abstracts away all details of the institutional design of environmental policies and is problematic considering the effort the policy makers and regulators make to craft the details of environmental policy. They make the effort because the institutional design of environmental policies establishes formal rights to environmental resources and settles whose interests in them are protected and how. The institutional design of environmental policies also influences their performance in the real world in which transaction costs are positive, because it partly determines what are the *de facto* rights in contrast to the *de jure* rights.

If social welfare arguments cannot provide a neutral basis for policy choices, the traditional economic approaches can only seek to explain policy choices as the result of private welfare maximization. Environmental economics does this implicitly by understanding that policy choices are and should be made so as to maximize social welfare. The government conducts a cost-benefit test as a disinterested broker and enables those having a valuable use for environmental resources to extinguish prior rights to them. New institutional economics explicitly understands the agents to seek protection for their interests in political arenas by promoting the adoption of particular goals and instruments of environmental policy. The size of interest groups, the character of benefits they are seeking, the institu-

tional rules that constitute the policy arenas, and the decision-making rules followed in them all influence how successful the agents will be in their pursuits.[15]

While private welfare seeking may explain some policy choices, it does not explain all of them. Many policy choices in the United States have not improved social welfare, even if they usually have improved environmental quality.[16] Their explanation thus ought to be the benefits they confer upon the environmentalists or the polluters. Changes in the rules regulating participation in collective choices indeed increased the environmentalists' influence in the 1960s and constituted the environmental movement.[17] However, contemporary environmental policies were already under way before the environmental movement became influential. Moreover, it is difficult to convert improvements in environmental quality into environmentalists' improved welfare. On the other hand, while some policies have benefited polluters,[18] it is unlikely that all policy choices have done so. A complementary explanation is that agents may pursue non-welfarist goals in policy choices.

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[15] See Dennis C. Mueller, *Public Choice II* (Cambridge: Cambridge University Press, 1989); Mancur Olson, *The Logic of Collective Action: Public Goods and the Theory of Groups* (Cambridge: Harvard University Press, 1971).

[16] See A. Myrick Freeman III, "Water Pollution Policy," in *Public Policies for Environmental Protection*, ed. Paul R. Portney (Washington: Resources for the Future, 1990), 97-149; Robert W. Hahn, "Economic Prescriptions for Environmental Problems: How the Patient Followed the Doctor's Orders," *Journal of Economic Perspectives* 3(1989): 95-114; Robert W. Hahn and John A. Hird, "The Costs and Benefits of Regulation: Review and Synthesis," *Yale Journal of Regulation* 8 (1991): 233-278.

[17] Karen Orren, "Standing to Sue: Interest Group Conflict in the Federal Courts," *American Political Science Review* 70 (1976): 723-741; E. Donald Elliott, Bruce A. Ackerman, and John C. Millan, "Toward A Theory of Statutory Evolution: The Federalization of Environmental Law," *Journal of Law, Economics, and Organization* 1 (1985): 313-340.

[18] Bruce A. Ackerman and William T. Hassler, *Clean Coal / Dirty Air* (New Haven: Yale University Press, 1982); C. James Koch, and Robert A. Leone, "The Clean Water Act: Unexpected Impacts on Industry," *Harvard Environmental Law Review* 3 (1979): 84-111.

The next section examines more closely how and with what consequences a broader range of motivations could be acknowledged in economic analysis.

Behavioral Motivations and Environmental Policy

Environmental economics assumes that agents revealing preferences for environmental protection expect and obtain welfare gains from the maintenance or improvement of environmental quality. It also assumes that welfare concerns exhaust the agents' motivations for environmental protection. Monetary valuation of the environment is based on this assumption: rational agents are thought to be willing to pay at least an amount that equals the value of changes in environmental quality in order to secure them. The monetary value of the environment or a change in its quality can thus be measured by determining the agents' willingness to pay.[19] As the corollary of these assumptions, environmental economics promotes the choice of welfare-maximizing goals and most cost-effective instruments for environmental policy.[20]

However, these policy prescriptions have not proved very popular. Policy goals and instruments that have been argued not to be welfare-maximizing are often adopted by

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[19] R. Kerry Turner, "The Place of Economic Values in Environmental Valuation," in *Valuing Environmental Preferences: Theory and Practice in the US, EU, and Developing Countries*, eds. I. J. Bateman and K. G. Willis (Oxford: Oxford University Press, 1999), 17-41.

[20] Robert H. Haveman, "Efficiency and Equity in Natural Resource and Environmental Policy," *American Journal of Agricultural Economics* (December 1973): 868-878; Karen Palmer, Wallace E. Oates, and Paul R. Portney, "Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?," *Journal of Economic Perspectives* 9 (1995):119-132; T. H. Tietenberg, "Economic Instruments for Environmental Regulation," in *Economic Policy towards the Environment*, ed. Dieter Helm (Oxford: Blackwell, 1991), 86-110.

policy makers and are not replaced by alternatives that are argued to be superior in welfare terms. For example, risk policies do not equate the marginal costs of saving additional lives, and regulation is still a more common instrument in environmental policy than charges or trading systems. It has also been argued that some environmental policies are outright welfare-reducing.[21] The discrepancy between prescriptions and choices indicates that economics omits factors that influence policy choices in practice.

It is indeed difficult to explain collective choices that do not maximize or that decrease social welfare in the standard economic framework. If agents are self- and welfare-centered, all knowing, and capable of welfare-maximizing choices in an idealized market, they should also reach welfare-maximizing collective choices in an ideal political arena in which transactions are costless and collective choices are voluntarily agreed upon. In this kind of a polity, all collective choices would compensate the adversely affected agents in order to obtain their support. Collective choices would pass an actual compensation test and be true Pareto-improvements. The introduction of a majority rule would allow the majority to benefit at the cost of the minority, even to the detriment of aggregate social welfare.[22] However, this would be likely only in an exploitative polity in which the majority and minority coalitions remain the same or when collective choices are not repeated.

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[21] See Freeman, "Water Pollution Policy"; Hahn, "Economic Prescriptions for Environmental Problems"; Peter Huber, "The Old-New Division in Risk Regulation," *Virginia Law Review* 69 (1983): 1025-1107.

[22] See e.g. James M. Buchanan, "Rent Seeking under External Economies," in *Toward a Theory of the Rent-Seeking Society*, eds. James M. Buchanan, Robert D. Tollison, and Gordon Tullock (College Station: Texas A & M University Press, 1980), 183-194.

Some kind of compensation is usually used to ensure cooperation in polities in which majority and minority coalitions change and when repeated collective choices are made.[23]

Non-maximizing and welfare-reducing collective choices thus seem unlikely under the usual assumptions. It is, of course, possible to argue that they are explained by imperfect information, but it is also an unsatisfactory explanation. Many collective choices over environmental policies are indeed complex and made on the basis of uncertain and imperfect information. However, collective choices are no different in this respect from individual choices, and could be claimed to exhibit less informational problems than choices made in the markets by households and firms. Households have very limited resources to seek information on choice alternatives in choice situations they face infrequently. This is why "lemons" or substandard goods change hands. Firms also make their choices under constraints that pale in comparison to the allocation of time and resources to understand choice situations in collective choices. Think of the effort and cost involved in setting up the Inter-Governmental Panel for Climate Change (IPCC) to support policy choices and responses to mitigate climate change.

The last explanation for policy choices that do not maximize or reduce welfare is that agents may not seek welfare in collective choices, at least exclusively. There are good reasons why this explanation should be taken seriously. First, empirical evidence suggests that agents do not seek to protect the environment only because of expected welfare gains. For example, in Contingent Valuation studies respondents sometimes express strong

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[23] See Robert Axelrod, *The Evolution of Cooperation* (New York: BasicBooks, 1984). Rawls's idea of "the veil of ignorance" can be used to understand situations in which coa-

commitments to environmental protection while refusing to indicate their willingness to pay.[24] Willingness to pay may thus not be a proper measure of their interests in environmental protection. There are also persuasive philosophical and theoretical arguments on why agents may seek non-welfarist goals in collective choices over environmental policy.[25]

Thus it seems warranted to recognize a broader range of behavioral motivations than has been customary in economic analysis. To make space for a broader range of behavioral motivations, including those that are not directly related to the welfare of the choosing agent, the understanding of rationality as a strictly welfare-maximizing behavior must be replaced with a notion of rationality as deliberated and intentional action.[26] This broader notion of rationality can then readily accommodate the pursuit of other goals by agents in addition to their personal welfare.

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litions are uncertain as to their being the minority or the majority. See John Rawls, *A Theory of Justice* (Cambridge: Harvard University Press, 1971).

[24] See Thomas C. Brown and Robin Gregory, "Why the WTA-WTP Disparity Matters," *Ecological Economics* 28 (1999): 323-335; John M. Gowdy, "The Value of Biodiversity: Markets, Society, and Ecosystems," *Land Economics* 73 (1997): 25-41; Bradley S. Jorgensen, Geoffrey J. Syme, Brian J. Bishop, and Blair E. Nancarrow, "Protest Responses in Contingent Valuation," *Environmental and Resource Economics* 14 (1999): 131-150. Clive L. Spash and Nick Hanley, "Preferences, Information, and Biodiversity Preservation," *Ecological Economics* 12 (1995): 191-208.

[25] John Foster, ed., *Valuing Nature? Economics, Ethics, and Environment* (London: Routledge, 1997); Mark Sagoff, *The Economy of the Earth: Philosophy, Law and the Environment* (Cambridge: Cambridge University Press, 1997); Amartya K. Sen, "Environmental Evaluation and Social Choice: Contingent Valuation and the Market Analogy," *Japanese Economic Review* 46 (1995): 23-37; Arild Vatn and Daniel W. Bromley, "Choices without Prices without Apologies," in *The Handbook of Environmental Economics*, ed. Daniel W. Bromley (Oxford: Blackwell, 1995), 3-25.

[26] See e.g. Amartya K Sen, "Maximization and the Act of Choice," *Econometrica* 65 (1997): 745-79; Herbert A. Simon, "Rationality as a Process and Product of Thought," *American Economic Review* 68 (1978): 1-16.

The recognition of a wider range of behavioral motivations means accepting intra-personal and inter-personal value pluralism. Intra-personal value pluralism means that an agent may simultaneously hold different values that could inform her choices in a choice situation.[27] An example is a situation in which one has to choose between going out with friends and visiting one's grandmother: the first alternative may promise greater utility but one may also feel an obligation to do the latter. Agents can be thought to choose between values that are to inform their preferences when their values are in conflict and would call for different choices.[28] Interpersonal value pluralism means that agents may be informed and act upon different set of values in the same choice situation, and arrive at either similar or different choices.

Value pluralism may refer to both substance and form of values. For example, two self-interested and welfare-centered agents may value environmental protection differently: one considering it unimportant and the other important for her welfare. Still, their choices would reveal what they consider as best enhancing their welfare. Under formal value pluralism the agents' preferences can be based on different ethical foundations and their choices do not anymore necessarily reflect what is best for their welfare. For example, if agents hold non-utilitarian consequentialist values, they will not assess choice alternatives they face according to how the alternatives will contribute to their personal welfare, like self-centered welfarists do, but with respect to the other consequences the agents consider

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[27] See Elizabeth Anderson, *Value in Ethics and Economics* (Cambridge: Harvard University Press, 1993). See also Gregory S. Kavka, "Is Individual Choice Less Problematic than Collective Choice," *Economics and Philosophy* 7 (1991): 143-165.

[28] See Anderson, *Value in Ethics and Economics.*

intrinsically valuable.[29] Alternatively, agents need not attach value to the *consequences* of their choices at all: they may attach it to acting in a particular way in the choice situation. An example is a Kantian agent who would rule out certain alternatives because she thinks choosing them would simply be wrong, no matter what the balance of beneficial and adverse consequences would be.

Environmental preferences can thus be based on welfarist, non-utilitarian consequentialist, and deontological foundations. The term "welfarist values" is used here narrowly to refer to egotistic and social utilitarianism. Moreover, utilitarian values are understood to emphasize narrowly understood utility as happiness or usefulness, which has a close connection to an agent's welfare, in contrast to the broader use of the term utility to refer to the degree of the satisfaction of preferences. The narrow conception of utility and utilitarianism is necessary in this dissertation to distinguish between different ethical foundations for preferences. Utility as a preference satisfaction does not enable it.[30]

The preferences of a self-interested welfarist could not induce her to choose in ways that decrease her welfare. An agent whose preferences are shaped by non-welfarist environmental concerns, which cover environmental concerns based on non-utilitarian consequentialism and deontology, in turn could do so. The ethical premises capable of inducing

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[29] See Amartya K. Sen, "Rational Fools: A Critique of the Behavioral Foundations of Economic Theory," *Philosophy and Public Affairs* 6 (1997): 317-344. For examples, see Spash and Hanley, "Preferences, Information, and Biodiversity Preservation."

[30] See John Broome, "Utility," *Economics and Philosophy* 7 (1991): 1-12; Amartya K. Sen, "Utility: Ideas and Terminology," *Economics and Philosophy* 7 (1991): 277-283. See also Jouni Paavola, "Towards Sustainable Consumption: Economics and Ethical Concerns for the Environment in Consumer Choices," *Review of Social Economy* (forthcoming). On utility as preference satisfaction, see John Hicks and R. G. D. Allen, "A Reconsideration of the Theory of Value," *Economica* 1 (1934): 52-76, 196-219.

welfare-reducing behavior do not, by any means, influence the attitude of agents towards the environment only. Quite the contrary: the attitudes expressed, for example, towards the freedom of private enterprise or towards the freedom from government interference often imply that these freedoms are felt by some to be intrinsically rather than instrumentally valuable. They may thus be pursued and defended even to the detriment of these agents' welfare. Additionally, human rights are often defended because they enable broad human agency, which is seen as intrinsically valuable. Their granting may also be considered a duty without reference to its consequences.

The institutional and social context of choice influences but does not determine what values we choose to act upon. Our choices in the market are predominantly informed by self- and welfare-centered values because markets give incentives to act upon them. However, it is still possible to act upon non-welfarist values in the market, when choosing to join a consumer boycott or engaging in green consumerism, for example.[31] Non-market behavior related to family and friends is in turn often (but not always) informed by values other than self-centered welfarism. The same indeterminacy characterizes the institutional settings in which collective choices are made, but they enable agents to pursue non-welfarist goals to a greater extent that the markets.

Value pluralism has some attractive implications for collective choice. Consider, for example, a policy choice over the protection of an endangered species or habitat. It may be that a policy ensuring the preservation of a species or habitat does not improve the

[31] Consumer boycotts or green consumerism are not necessarily chosen because of non-welfarist judgements; they may be chosen to improve welfare. But agents may equally well choose them to pursue some other ends or to behave virtuously.

welfare of any interest group nor the society as a whole. Agents informed exclusively by welfarist values would never choose this policy. Agents informed by non-welfarist values could in turn make the policy choice. The problem with the agents that are exclusively informed by non-utilitarian consequentialist values is that they could seek the protection of the species or habitat in any fashion, and compromise economic, civil, or human rights. The inclusion of agents following deontological values could ensure that the way in which the policy is implemented is attended to. Finally, non-welfarist agents might give inadequate attention to legitimate welfare goals and thus the inclusion of welfarist agents would improve collective choices.

The incorporation of value pluralism into economic analysis is straightforward at the level of analysis pursued here. In the standard formulation, the preferences of an agent are understood as a set of those rankings of choice alternatives that maximize her welfare. The agent is also understood to choose according to her preferences so as to maximize her welfare. The fact that agents are informed by non-welfarist values severs the connection between preferences and choice, or choice and welfare.[32] Preferences can be understood in the usual way as reflecting only the welfare an agent expects to derive from the choice alternatives. In this formulation, values not associated with the agent's welfare are allowed to influence choice directly – the agent sometimes chooses against her preferences. Alternatively, preferences can be understood to include also those rankings of choice alternatives that are not based on welfare comparisons – the agent sometimes prefers and chooses alternatives that do not improve or decrease her welfare. Although the formula-

tion in which preferences do not determine choice is often adopted,[33] the formulation in which choices may not improve welfare of the choosing agent will be followed here.

When agents form judgements about the goals or instruments of environmental policy that are based on formally different ethical foundations, there is no way to commensurate their judgments.[34] The common metric does not exist. Therefore, also value pluralism denies the existence of uniquely optimal policy goals or instruments. Moreover, it also denies the possibility of meaningfully compensating the losers, when they have non-welfarist goals. Still, collective choices must and can be made. Incommensurable values need not be incomparable: choices between them can be worked out in the political arenas. However, there is no universal recipe that would be applicable to every choice situation for ordering values. The characteristics of the choice situation, the constituency participating in the collective choice, and the institutions of collective choice all influence what the ranking of values and goals will be.

The arguments of this section do not mean that environmental economists are redundant and cannot examine how scarce environmental resources are allocated under full value pluralism. The next section outlines in greater detail the implications of interdependencies, positive transaction costs, and non-welfarist motivations.

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[32] See Amartya K. Sen, "Behaviour and the Concept of Preference," *Economica* 40 (1973): 241-59; Sen, "Rational Fools."

[33] See e.g. Amartya K. Sen, "Rights and Agency," *Philosophy and Public Affairs* 11 (1982): 3-39; Bromley, *Economic Interests and Institutions*.

[34] John O'Neill, *Ecology, Policy, and Politics: Human Well-Being and the Natural World* (London: Routledge, 1993).

The Governance Approach: An Outline

The redefinition of externalities as interdependencies, the recognition of positive transaction costs, and the acknowledgement of non-welfarist behavioral motivations broaden the basis of economic analysis of environmental problems and policy. Their implications are outlined below and integrated into a governance approach to environmental problems and policy. The later chapters of this dissertation employ the governance approach to analyze the development of water pollution policy in the United States from early 19th century until the 1970s.

In the governance approach, environmental problems are understood as conflicts over the use of environmental resources. These conflicts emerge because individual agents and groups of them are interdependent with respect to environmental resources: one agent's or group's realization of her / its interests in environmental resources conflicts with the realization of another agent's or group's interests in them, and *vice versa*. Because these relationships of interdependence are reciprocal, resource use conflicts can only be resolved by recognizing some interests in environmental resources at the cost of sacrificing other interests in them. Therefore, the resolution of conflicts over the use of environmental resources by environmental policy or by inaction both requires and implements value judgements on whose interests in environmental resources should be protected and realized.

The interests of agents in environmental resources may or may not be related to their personal welfare, and the governance approach admits this. When values are plural, a common metric is not available for them and optimal solutions to environmental problems cannot exist. Collective choices are arrived at as a result of deliberation that ranks interests in environmental resources. After all, they may be comparable although not commen-

surable. Finally, the governance approach directs our attention to what values inform and why the normative judgements about whose interests in environmental resources should be realized by environmental policy.

Positive transaction costs have two distinct implications for the understanding of environmental problems in the governance approach. First, when the assumption of costless transactions costs goes, the assumptions of perfect knowledge, unlimited cognitive capacity, and timeless economy must go as well. After all, transactions are costly because cognitive capacity is limited, knowledge is imperfect, and real time exists.[35] Agents must allocate time and resources to obtain information and to learn. Learning is based on language and employs and generates knowledge. Language and knowledge are jointly consumed goods: individual agents cannot modify their quantity or quality in perceptible amounts, and can only choose how much of them to use. Thus, agents' perceptions and choices reflect their society's definitions and understandings of choice situations, alternatives, and outcomes. For example, environmental problems may emerge when new uses of resources or interests in them create new antagonistic relationships of interdependence. However, they may also appear when learning or change in values causes a reinterpretation of existing relationships of interdependence as antagonistic.

Transaction costs are important for environmental governance also because resource use conflicts are framed by a particular configuration of transaction costs. Transaction cost configurations – the level and distribution of transaction costs that prevails in a resource use situation – are generated by the resource use situations in question and the ex-

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[35] See especially Dahlman, "Problem of Externality."

isting institutional framework. The resource use situation, which comprises the influence of physical resource attributes and the number and characteristics of resource users and uses, importantly determines the level of transaction costs and also influences their distribution.[36] The institutional framework also influences the level of and distribution of transaction costs. Its importance lies in the fact that it may be changed so as to alter the level and distribution of transaction costs, while physical resource attributes and the characteristics of resource users are more difficult to alter.

The level and distribution of transaction costs in a resource use situation determines the relative difficulty different interest groups experience in forwarding and protecting their interests. Transaction costs are hardly ever distributed equally. The reason can lie either in the resource use situation or in the institutional framework. For example, in the absence of statutory environmental policies, those whose property or person is injured by environmental degradation must seek protection for their interests through markets or courts, and carry the transaction costs of doing so. This distribution of transaction costs protects the interests of those who harm the property or person of others. In this institutional setting agents who cannot show an injury to their person or property (agents who are interested in environmental quality for its own sake) have little chance to forward their interests in environmental resources. However, they can use, albeit at a higher cost, the legislature to forward their interests in environmental resources by inducing it to change the existing institutional framework. For example, the establishment of statutory environmental policies would redistribute transaction costs and alter the relative protection of

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[36] See especially A. Allan Schmid, *Property, Power, and Public Choice: An Inquiry into Law*

different interests in environmental resources. However, statutory environmental policies would not abolish the underlying relationship of interdependence.

In the governance approach, environmental policies are understood as institutions that govern the use of environmental resources and resolve conflicts between agents that have interdependent interests. Environmental policies perform these functions by establishing and providing for the enforcement of rights in environmental resources, which can be done in different ways. Sometimes, as in the case of trading and insurance systems, rights in environmental resources are fully transferable. However, most often rights are established through licensing or permit procedures and entitle only a limited and non-transferable use of environmental resources. The constraints on one interest group's use of environmental resources constitute rights in environmental resources for other interest groups. For example, the public can be free from being exposed to adverse health effects when polluters are bound not to emit toxic substances, and this rule of resource use is enforced.

Environmental policies thus implement value judgements on whose interests in environmental resources should be realized. The configuration of transaction costs influences to what degree any value judgements can be implemented in a particular resource use context. Although the level and distribution of transaction costs is to an important degree determined by the attributes of the resource and its users,[37] they are also influenced by the design of environmental policies as governance institutions. For example, the way environmental regulations formulate rights to environmental resources partly determines the

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and Economics, 2nd ed. (New York: Praeger, 1987).

[37] See Schmid, *Property, Power, and Public Choice*.

difficulty and cost of monitoring the exercise of these rights by different resource users. The formulation of rights also influences the cost of enforcing them. The recognition of positive transaction costs thus demands closer attention to the institutional design of environmental policies and how it influences their performance.

The acknowledgement of broader behavioral motivations in the governance approach changes the understanding of what constitutes the performance of environmental policies and the way judgements can be made about it. Welfare judgements do not enjoy a privileged status when values are plural, and there is no axiomatic way of arriving at social choices when values are incommensurable. Therefore, the performance of governance institutions ought to be characterized with multiple performance criteria that indicate whose resource use goals would be realized under alternative institutional arrangements. This does not deny the use of welfare-criteria, but it calls for the use of other performance criteria as well. These criteria could relate to physical environmental outcomes, such as levels of environmental quality, or to distributive consequences, such as whose interests are realized and how, that would be brought about when choosing a particular institutional arrangement in a resource use situation.

The acceptance of positive transaction costs and broader behavioral motivations makes universal normative judgements on policy goals and instruments impossible. First, resource use goals are likely to vary from resource use situation to another. After all, resources have different uses and the involved interest groups also vary across resource use situations. Moreover, a policy alternative can realize some values better than others. Finally, resource use situations structure resource use conflicts differently and create different transaction cost configurations; policy alternatives will thus engender different out-

comes in different resource use situations. Therefore, judgements concerning policy alternatives must remain contextual and relate to how they would realize different policy goals. This is not a shortcoming., because it encourages careful analysis of resource use situations and improves policy choices, at least so far as the goodness of the policy choices is judged on the basis of how they realize policy goals.

Finally, broadening the basis of economic approach to environmental problems and policy in a way described above allows us to analyze policy choices in more realistic terms and to understand and explain how they come about. In the governance approach it becomes obvious that the institutional framework importantly shapes how different interest groups can participate in collective choices over the use of environmental resources, because it distributes the transaction costs of acting collectively in a particular way and often asymmetrically. For example, the relative ability of interest groups to influence the writing of statutory instructions in the legislature is different from their ability to participate in the promulgation of those rules by administrative agencies. The availability or unavailability of citizen suit provisions to challenge or to enforce the rules of resource use also have different implications for policy outcomes.

Conclusions

This chapter examined the implications of conceptualizing environmental problems as unidirectional externalities, ignoring transaction costs, and acknowledging only welfare motivations for human behavior in the traditional economic approach to environmental problems and policy. The chapter also outlined a governance approach that understands

externalities as instances of interdependencies, recognizes positive transaction costs, and admits non-welfarist behavioral motivations.

The traditional economic analysis is presumptive of welfarist values: it focuses on the welfare implications of goals and instruments of environmental policy and omits their non-welfare implications. This is not a satisfactory way of conducting analysis because many agents are actually concerned about the non-welfare implications of responding to environmental problems in a particular way. This is also one reason why non-economists often criticize the ethical foundations and implications of applying economic analysis to environmental problems.

The chapter indicated a way of accommodating a broader range of behavioral motivations in economic analysis. The notion of rationality as welfare-maximizing behavior can be relaxed so as to include all deliberated, intentional action. Agents can then be understood to seek to realize their values: some of them may be concerned about their personal welfare, others about goals they consider intrinsically valuable, and still others about right or virtuous ways to act. When values are plural and incommensurable, there are no socially optimal choices. The agents are still able to work out their differences and come up with rankings of choice alternatives because values are usually comparable. How ever, the process of working out takes place in a particular institutional framework on the basis of particular decision rules, which structure collective choice and influence whose values are translated into policy by collective choices.

The governance approach opens up interesting lines of inquiry because, in addition to recognizing value pluralism, it admits the reciprocal character of externalities and positive transaction costs. From its viewpoint, environmental problems are conflicts over the use

of environmental resources between interdependent agents that have mutually incompatible interests. Environmental policies resolve these conflicts by implementing social judgements on what interests should be realized with respect to environmental resources. Resource use conflicts emerge and change because of changes in values, knowledge, technology, and resource uses, for example. Changes in these factors may also render existing environmental policies ineffective or/and obsolete.

The recognition of value pluralism and positive transaction costs encourages to examine how resource use situations shape policy problems and how different institutional designs of environmental policies perform in these contexts. However, because the governance approach is not presumptive of values, the judgements about the performance of governance institutions must remain contextual and be based on multiple performance measures that characterize different agents' interests. Thus it does not provide basis for presenting normative prescriptions, but it may facilitate the instrumental search for functional institutional arrangements in the light of agents' goals.

This chapter has aimed at legitimating the governance approach and establishing its conceptual foundation by criticizing, clarifying, and altering the assumptions and concepts that underlie the traditional economic approach to environmental problems and policy. The next chapter substantiates the governance approach in a greater detail to enable its use in empirical research. In the three chapters that follow that one the governance approach will be used to examine the development of water pollution control policy in the United States from the early 19th century until the 1970s.

2. ANALYZING GOVERNANCE INSTITUTIONS: RESOURCE USE, INSTITUTIONAL DESIGN, AND PERFORMANCE

> "institutions may be conceptualized as decision systems on the second level of a three-level hierarchy of decision systems ... [which] on each level can be analyzed with respect to structure, functioning, and performance. Performance need not be measured in pecuniary terms even on the first level, where this yardstick is most frequently employed."[1]

This chapter extends the governance approach to the analysis of environmental problems and policy. The starting point is again the traditional economic approach, which postulates for analysis a world in which competition and knowledge are perfect and transactions are costless to undertake. In this ideal world, welfare-maximizing goals can be identified for environmental policies with certainty, so as to correct the adverse effects of externalities on the allocation of resources. The adopted policies can also be perfectly enforced and the chosen policy goals attained. Put differently, there is little need to understand the rationale for different instruments and institutional designs of environmental policy apart from their welfare implications in the ideal world of perfect competition.

When reciprocal interdependencies and positive transaction costs are acknowledged, it is clear that the institutional design of environmental policies can both cause and resolve

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[1] Decisions are made at 1) operating, 2) institutional, and 3) policy levels. Agents make their recurrent choices at the first level. Constraints for their choices are determined at the second level, and choices between the types of constraints are made at the third level. See S. V. Ciriacy-Wantrup, "The Economics of Environmental Policy," *Land Economics* 47 (1971): 41-42. See also Larry L. Kiser and Elinor Ostrom, "The Three Worlds of Action: a Meta-theoretical Synthesis of Institutional Approaches," in *Strategies of Political Inquiry*, ed. Elinor Ostrom (Beverly Hills: Sage Publications, 1980), 179-222.

governance problems. On one hand, environmental policies establish rights that protect some of the interdependent interests in environmental resources. On the other hand, the design of environmental policies influences the level and distribution of transaction costs and the degree to which any rights can be enforced and implemented. For example, rights nominally or apparently protected by environmental policies can be practically nullified by an institutional design that renders these rights unenforceable.

Finally, the traditional economic approach recognizes only welfare interests in environmental resources. However, agents' interests in environmental resources may also be based on non-welfarist values.[2] When non-welfarist values recognized, the idea of a socially optimal allocation of environmental resources breaks down. Non-welfarist values are simply incommensurable with the welfarist ones and their intensity cannot be measured in monetary terms.[3] When economic analysis acknowledges non-welfarist values, it aims at understanding how policy alternatives realize different interests.

New institutional economics provides a good basis for analyzing the institutional design of environmental policies, because it has paid attention to the design of institutions that govern the use of local[4] and transboundary[5] environmental resources. However, it has

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[2] See William K. Frankena, *Ethics*, 2nd ed. (Englewood Cliffs: Prentice-Hall, 1973); Amartya K. Sen, "Rational Fools: A Critique of the Behavioral Foundations of Economic Theory," *Philosophy and Public Affairs* 6 (1977): 317-344; Amartya K. Sen, "Behavior and the Concept of Preference," *Economica* 40 (1973): 241-259.

[3] See Mark Sagoff, "Should Preferences Count?," *Land Economics* 70 (1994): 127-44; Cass R. Sunstein, "Incommensurability and Valuation in Law," *Michigan Law Review* 92 (1994): 779-861.

[4] Erling Berge and Nils Christian Stenseth, eds., *Law and the Governance of Natural Resources: Studies from Northern Europe and Africa* (San Francisco: ICS Press, 1999) Fikret Berkes, ed., *Common Property Resources, Ecology and Community-Based Sustainable*

mainly examined when voluntary collective action succeeds in establishing governance institutions. The analysis of governance institutions has not progressed beyond classifying and characterizing their features. Moreover, this research has attributed either welfarist or conservationist goals to agents. Little work has been done on the possibilities and implications of accepting value pluralism.[6]

This chapter elaborates the governance approach that pays attention to the design of governance institutions and accepts value pluralism. The governance approach is largely based on research on common property in new institutional economics. However, unlike this line of research, the governance approach treats understands customary institutions, national environmental policies, and international environmental conventions as fundamentally similar both *functionally* and *structurally*. The governance approach also fo-

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Development (London: Belhaven, 1989); Daniel W. Bromley, ed., *Making the Commons Work: Theory, Practice, and Policy* (San Francisco: ICS Press, 1992); Carl J. Dahlman, *The Open Field System and Beyond: A Property Rights Analysis of an Economic Institution* (Cambridge: Cambridge University Press, 1980); Bonnie J. McCay and James M Acheson, eds., *The Question of the Commons: The Culture and Ecology of Communal Resources* (Tucson: University of Arizona Press, 1987); Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990).

[5] See Susan Buck, *The Global Commons: An Introduction* (Washington: Island Press, 1998) Robert O. Keohane and Elinor Ostrom, eds., *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains* (London: Sage, 1995); David G. Victor, Kal Raustiala, and Eugene B. Skolnikoff, eds., *The Implementation and Effectiveness of International Environmental Commitments: Theory and Practice* (Cambridge: MIT Press, 1998) Oran R. Young, ed., *Global Governance: Drawing Insights from the Environmental Experience* (Cambridge: MIT Press, 1997).

[6] See Ostrom, *Governing the Commons*; Edella Schlager and Elinor Ostrom, "Property-Rights Regimes and Natural Resources: A Conceptual Analysis," *Land Economics* 68 (1992): 249-262; and Bonnie J. McCay, "Common and Private Concerns," in *Rights to Nature: Ecological, Economic, Cultural, and Political Principles of Institutions for the*

cuses on the assessment of institutional designs, and not on the conditions of collective action that facilitate the establishment of governance institutions. For this reason, and also because it addresses a wider range of resource use problems than the research in common property does, the governance approach pays more attention to how the attributes of environmental resources and their users constitute policy / governance problems.

In what follows, the first section outlines the implications of value pluralism and positive transaction costs for policy analysis. The second section examines, how physical resource attributes shape policy problems and influence the attainment of policy goals. The third section examines how the attributes of resource users shape policy problems and influence policy outcomes. The fourth section examines the influence of the design of governance institutions on policy outcomes.

From Economics of Efficiency to Economics of Governance

The traditional economic approach proposes social welfare considerations as a guideline for making decisions on environmental policy.[7] That is, the goals and instruments of environmental policy should be chosen so as to allocate environmental resources efficiently and to maximize the net benefits from their use to the society. Too much emphasis on environmental protection when setting policy goals is undesirable, because it would

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Environment, eds. Susan S. Hanna, Carl Folke, and Karl-Göran Mäler (Washington: Island Press, 1996), 111-126.

[7] See e.g. William J. Baumol and Wallace E. Oates, "The Use of Standards and Prices for Protection of the Environment," *Swedish Journal of Economics* 73 (1971): 42-54; Karen Palmer, Wallace E. Oates, and Paul R. Portney, "Tightening Environmental Standards:

reduce human welfare in other fronts more than it directly contributes to it. Similarly, policy instruments that reduce environmental impacts at the lowest cost should be chosen, because doing so would release scarce resources to other socially valuable purposes.

When environmental economics draws our attention to the welfare consequences of environmental goals and policies, it assumes that they are viewed by all agents as an unproblematic basis for making choices on environmental policy. This view is warranted only in a very limited sense. The self- and welfare-centered agents postulated in the basic competitive model of micro-economics could consider welfare consequences a shared basis for making policy choices, because their behavioral motivations are limited by definition to self- and welfare-centered values. However, the behavioral motivations of real agents are not so limited.[8] They may, for example, disregard personal or social welfare, and consider the preservation of environmental resources as an intrinsically valuable end. Also, the agents may not pursue any discernible ends at all, but just seek to act virtuously or to follow behavioral rules they consider inviolable.

The acknowledgment of values that are incommensurable with the welfarist ones is detrimental to economic analysis as it is usually practiced. The acceptance of value pluralism reveals that policy analysis must ultimately remain political and be guided by some

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The Benefit-Cost or the No-Cost Paradigm?," *Journal of Economic Perspectives* 9 (1995): 119-132.

[8] Utilitarianism, non-utilitarian consequentialism, and deontology are formally different foundations for ethical beliefs on substantial issues. For example, a utilitarian would support the preservation of a landscape only if it improved welfare. A non-utilitarian consequentialist could hold the landscape intrinsically valuable and worth preserving for that very reason. Finally, a deontologist could view the act of preservation as virtuous or conforming with a rule of stewardship.

moral values. There is no way to resolve within economic analysis, which of the incommensurable resource use goals should be served by environmental policies. Additional value judgments must be made to decide what counts as a valuable resource use goal. These value judgments could variably emphasize human welfare, environmental protection, or democratic decision-making. The acceptance of value pluralism thus undermines claims for the authority of policy analysis, a healthy and welcome outcome.[9]

The acceptance of value pluralism does not render policy analysis impossible: it just draws attention more broadly to policy outcomes that are relevant in the light of values that inform policy choices. Welfare consequences remain important for agents holding welfarist values. Other agents may consider goals such the preservation of species, habitat, or ecosystems intrinsically valuable. Finally, some agents would consider policy outcomes as acceptable only if proper procedures such as democratic decision-making have been followed. An approach to policy analysis that acknowledges value pluralism would evaluate policy alternatives with respect to all of these goals. From policy practice it could require choices between welfare and other resource use goals, or compromises between them by using Safe Minimum Standards (SFS), for example.[10]

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[9] See Daniel W. Bromley, *Environment and Economy: Property Rights and Public Policy* (Cambridge: Blackwell, 1991); Alan Randall, "Methodology, Ideology, and the Economics of Policy: Why Resource Economists Disagree?," *American Journal of Agricultural Economics* (December 1985): 1022-1029; A. Allan Schmid, *Property, Power, and Public Choice: An Inquiry into Law and Economics*, 2nd ed. (New York: Praeger, 1987); Peter Söderbaum, "Positional Analysis and Public Decision Making," *Journal of Economic Issues* 16 (1982): 391-400.

[10] S. V. Ciriacy-Wantrup, *Resource Conservation: Economics and Policies,* rev. ed. (Berkeley: University of California Press, 1963); Alan Randall and Michael C. Farmer, "Bene-

Economic analysis of environmental problems and policy should admit value pluralism for several reasons. First, agents do have non-welfarist resource use goals, which should not be dismissed in economic analysis.[11] Second, value pluralism is appealing in collective choices in comparison to following one set of values, such as welfarism. For example, welfarists cannot protect an endangered species if human welfare and its preservation are incompatible goals. Non-utilitarian consequentialists could protect it, but they might not consider human welfare adequately. The participation of both welfarists and non-utilitarian consequentialists in policy choice could ensure a more balanced decision. However, the way collective choices are arrived at has intrinsic value neither to welfarists nor to non-utilitarian consequentialists: they could seek their policy goals in a manner that would not be acceptable to those with deontological values.

The policy prescriptions of the traditional economic approach are presumptive of whose values count and in which way: therefore, they are not viewed as legitimate and do not engender desired and legitimate outcomes from the viewpoint of all agents. The incorporation of value pluralism could alleviate the problem.[12] Of course, it is impossible to

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fits, Costs, and the Safe Minimum Standard of Conservation," in *The Handbook of Environmental Economics*, ed. Daniel W. Bromley (Oxford: Blackwell, 1995), 26-44.

[11] See Thomas C. Brown and Robin Gregory, "Why the WTA-WTP Disparity Matters," *Ecological Economics* 28 (1999): 323-335; John M. Gowdy, "The Value of Biodiversity: Markets, Society, and Ecosystems," *Land Economics* 73 (1997): 25-41; Bradley S. Jorgensen, Geoffrey J. Syme, Brian J. Bishop, and Blair E. Nancarrow, "Protest Responses in Contingent Valuation," *Environmental and Resource Economics* 14 (1999): 131-150. Clive L. Spash and Nick Hanley, "Preferences, Information, and Biodiversity Preservation," *Ecological Economics* 12 (1995): 191-208.

[12] I make a value judgement according to which democratic participation in collective choices is good to argue against ignoring non-welfarists in collective choices and their economic analysis. However, I also accept the opposite value judgement that sometimes

offer *ex ante* an exhaustive list of values that do or should inform policy choices, nor is it possible to offer a formula for ranking these values: it needs to be worked out.[13]

Still, it is clear that the policy outcomes should be characterized more broadly and in greater detail than is customary, by using multiple performance measures, for example. This would facilitate learning and the formation of preferences over policy goals and instruments, which are both necessary in the world of limited cognitive capacity, imperfect knowledge, and real time. For example, it matters what are the likely consequences of an environmental policy to the quality of environmental media, the levels of resource uses, and irreversible changes in the environment. The welfare consequences of policy goals and instruments also matter, as do the distribution of their benefits and costs. Finally, it also matters how an environmental policy organizes collective choices over the use of environmental resources – on the basis of deliberated political decision-making or as an aggregate outcome of individual choices at the market or in the courts. [14]

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we should ignore the preferences of agents altogether and do what seems to be best for them. See Olof Johansson Stenman, "Optimal Policy Making when People's Preferences are Inconsistent, Non-welfaristic, or Simply Not Developed," in *Contested Choices: Economics, Ethics, and Environmental Policy*, eds. Daniel W. Bromley and Jouni Paavola (forthcoming); Mark Sagoff, "Should Preferences Count?," *Land Economics* 70 (1994): 127-44. Another reason for ignoring current preferences is that we may want to make choices that form desirable preferences. See Cass R. Sunstein, "Endogeneous Preferences, Environmental Law," *Journal of Legal Studies* 22 (1993): 217-254.

[13] See e.g. Warren J. Samuels, "Diverse Approaches to the Economic Role of Government: An Interpretive Essay," in *Fundamentals of the Economic Role of Government*, ed. Warren J. Samuels (New York: Greenwood Press, 1989), 213-250.

[14] See Ciriacy-Wantrup, "Economics of Environmental Policy," 42. See also Geoffrey M. Hodgson, "Economics, Environmental Policy, and the Transcendence of Utilitarianism," in *Valuing Nature? Economics, Ethics, and Environment*, ed. John Foster (London: Routledge, 1997), 48-63; Arild Vatn and Daniel W. Bromley. "Choices without Prices without

Whatever the policy goals are, several factors influence their attainment. First, the physical attributes of environmental resources – such as their size and the number and type of uses they support – vary and importantly shape both resource use situations and the problems they pose for the resource users and institutions that govern resource use. Second, resource use situations and the challenges they pose for governance institutions are shaped also by the attributes of the resource users, such as their number and the values they hold. Third, the design of governance institutions affects the attainment of any policy goals and partly determines actual policy outcomes, because it establishes and assigns the initial rights to environmental resources and influences their enforceability in practice.[15]

The understanding of policy problems requires a careful analysis of resource and community attributes, because they structure resource use problems in a particular way and thus create particular challenges for governance institutions. Similarly, the design of governance institutions influences what consequences its adoption has in a particular resource use situation. Therefore, judgements about governance institutions must remain contextual, because problems of resource use and resource use goals are context-specific.

The attributes of environmental resources and their users, and the design of governance institutions create impediments for the attainment of policy goals, which can be use-

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Apologies," in *The Handbook of Environmental Economics*, ed. Daniel W. Bromley (Oxford: Blackwell, 1995), 3-25.

[15] See Ronald J. Oakerson, "Analyzing the Commons: A Framework," in *Making the Commons Work: Theory, Practice, and Policy,* ed. Daniel W. Bromley (San Francisco: ICS Press, 1992), 41-59; Elinor Ostrom, "The Rudiments of a Theory of the Origins, Survival, and Performance of Common-Property Institutions," in *Making the Commons Work: Theory, Practice, and Policy*, ed. Daniel W. Bromley (San Francisco: ISC Press, 1992), 293-318; Schmid, *Property, Power, and Public Choice,* 188-195.

fully characterized as *governance costs.*[16] They include the transaction costs of 1) excluding unauthorized users from an environmental resource; 2) regulating authorized resource use; 3) monitoring resource users; 4) enforcing the rules of exclusion and resource use; 5) resolving conflicts over resource use and its rules; and 6) collective choice to establish and modify rules of resource use. *The level of governance costs in these subcategories is jointly determined by physical resource attributes, community attributes, and the design of governance institutions.*

Although governance costs cannot be measured, qualitative judgments can be presented about their level under alternative institutional arrangements and in different resource use situations.[17] For example, the cost of excluding unauthorized users from environmental resources is partly determined by their attributes: compare forests and ocean fisheries in this respect. The number of resource users and their values also affect exclusion costs, because they influence the frequency of attempts at unauthorized resource use. Finally, the design of governance institutions influences exclusion costs, because it partly determines the difficulty of detecting and proving unauthorized resource use. In *toto*, re-

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[16] The breakdown of governance costs is based on Elinor Ostrom's description of functions of successful governance institutions. See Ostrom, *Governing the Commons,* 88-102. For another helpful work, see John Christman, "Distributive Justice and the Complex Structure of Ownership," *Philosophy and Public Affairs* 23 (1994): 225-250.

[17] See David Feeny, "Suboptimality and Transaction Costs in the Commons," in *Designing Institutions for Environmental and Resource Management*, eds. Edna Tusak Loehman and D. Marc Kilgour (Cheltenham: Edward Elgar, 1998), 124-141, 131-133; Oliver E. Williamson, *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting.* (New York: Free Press, 1985). See also Harold Demsetz, "Information and Efficiency: Another Viewpoint," *Journal of Law and Economics* 12 (1969): 1-22.

source and community attributes and the design of institutional arrangements jointly determine the cost of excluding unauthorized users.

As a general rule, the higher the governance costs, the more difficult it will be to control the use of environmental resources. This is one reason why ocean fisheries and global atmospheric resources are being depleted. The distribution of governance costs influences whose interests in environmental resources are realized. However, this does not mean that a low-cost governance structure should be chosen. Resource use goals may well require the establishment of costly governance structures, or certain governance structures may simply be considered as desirable without reference to their outcomes.

Still, governance cost judgements are useful to understand how governance institutions function and what are their likely consequences. Judgements concerning the subcategories of governance costs are often more useful than judgements concerning total governance costs, as will be demonstrated in the empirical chapters. After all, the configuration of governance costs often explains the performance of governance institutions. This does not mean replacing the analysis resource use problems with governance cost considerations. It rather means doing both: to analyze the character of resource use problems and to present governance cost arguments when they add value to the analysis. These arguments are substantiated in the following empirical chapters.

The next section discusses how environmental resources, their users, and institutional design influence governance costs.

Resource Attributes, Policy Problems, and Governance

The physical attributes of environmental resources to an important degree determine the challenges of governing their use. They influence the difficulty of excluding unauthorized users from environmental resources, regulating resource use, monitoring resource users, enforcing the rules of resource use, making collective choices, and resolving resource use conflicts. Some resource attributes such as a large size very obviously and directly complicate governance – the exclusion of unauthorized users from the resource, for example. Resource attributes can also influence governance in less obvious and indirect ways. For example, periodically fluctuating yield of a resource may call for institutional solutions that facilitate storage or curtail resource use when yields are low, and that are difficult to agree upon collectively.

The first task is thus to identify what resource attributes most fundamentally shape the analyzed resource use situation. The resource attributes that warrant attention are 1) the size, boundaries, and divisibility of the resource, 2) the rivalry and non-rivalry (or incompatibility and compatibility) of uses supported by the resource, 3) the number of uses supported by the resource, 4) the mobility of the resource, 5) stability of the yield of the resource over time, 6) the possibility for storage of resource units, and 7) risks, uncertainties, and irreversibility associated with the resource.[18] The rest of the section examines

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[18] See John G. Head, "Public Goods and Public Policy," *Public Finance* (1962): 197-219; John G. Head, "Public Goods: The Polar Case Reconsidered," *Economic Record* 53 (1977): 227-238; Elinor Ostrom, "The Institutional Analysis and Development Approach," in *Designing Institutions for Environmental and Resource Management,* eds. Edna Tusak Loehman and D. Marc Kilgour (Cheltenham: Edward Elgar, 1998), 68-90; Edella Schlager, William Blomquist, and Shui Yan Tang, "Mobile Flows, Storage, and Self-Organized Institutions for Governing Common-Pool Resources," *Land Economics* 70

how these resource attributes structure the resource use problems and influence governance costs. The analysis will assume that the resource use situation remains unchanged and focuses on the independent influence of resource attributes. Obviously, he attributes of a resource use situation interact and the demand for resources and technology change in the real world, continuously altering resource use situations. The implications of a dynamic setting for policy analysis will be discussed briefly in the end of the chapter.

The size of an environmental resource influences the difficulty of excluding unauthorized users, monitoring resource use, and enforcing the rules of resource use. Small environmental resources, such as village ponds, pastures, and forest lots, are at the reach of a small number of users only, and it is relatively easy to monitor and control their behavior. Large environmental resources, such as open range land, watercourses, marine fisheries, and the atmosphere cover extensive geographical areas and have long borderlines, and are costly to control. Clear boundaries and divisibility of some resources, such as agricultural land and forests, facilitates the breaking down of large resources into smaller units to make them easier to govern. In contrast, water resources and air basins are more difficult to divide up than land-based resources. Other things being equal, the larger size and indivisibility of an environmental resource translate into greater difficulty and higher costs of excluding unauthorized users, monitoring resource use, and enforcing its rules.

When resource use is rival – destructive of the units of resource – simultaneous claims to the resource are incompatible. The first rival user in time captures all the benefits the

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(1994): 294-317; Schlager and Ostrom, "Property-Rights Regimes and Natural Resources;" Schmid, *Property, Power, and Public Choice*.

resource unit can offer, and the second user in time goes without benefits. Rivalry may induce competition for the units of resource and lead to the destruction of the resource.[19] Both privately and collectively exclusive governance institutions can prevent competition for resource units: the former excludes all but the individual owner and the latter all but the authorized group of users from the resource.[20] The relative difficulty of exclusion is, however, determined by resource attributes other than rivalry in use, such as the size and divisibility of the resource. Rivalry in use actually facilitates the monitoring of resource use and the enforcement of its rules, because those who suffer from unauthorized rival use will readily discern it. However, although governance institutions do resolve which of the incompatible users has a right to resource use, the economic incentives for competition for the units of resource may increase the cost of enforcement and conflict resolution. Finally, the distributive nature of assigning initial rights to rival resource uses increases the costs of collective action to establish or modify governance institutions.

When resource use is non-rival – that is, not destructive of the resource – it is possible to accommodate simultaneous claims to a resource. There would be no need for the exclusion of a non-rival resource user, if resources were available for non-rival uses at sufficient levels and did not have capacity limitations. This is often not the case. The provi-

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[19] For the original argument, see Garrett Hardin, "The Tragedy of the Commons," *Science* 162 (1968): 1241-1248.

[20] For the original counter-argument to Hardin's, see Ciriacy-Wantrup, "Economics of Environmental Policy," ; S. V. Ciriacy-Wantrup and Richard C. Bishop, "Common Property as a Concept in Natural Resources Policy," *Natural Resources Journal* 15 (1975): 713-727. See also J. H. Dales, "Land, Water, and Ownership," *Canadian Journal of Economics* 1 (1968): 791-804. For a recent analysis of these arguments, see Jean-Marie

sion of a resource and the augmentation of its yield are costly undertakings, which must be financed. Exclusion may thus be necessary to elicit payments from the non-rival resource users. Moreover, a number of non-rival resources do have capacity limitations, beyond which their use ceases to be non-rival. The cost of excluding unauthorized users again depends mainly on resource attributes other than non-rival use, such as the size and divisibility of resource. Non-rivalry increases the cost of monitoring resource use, because unauthorized resource use is not easy to detect. Therefore, it is easy to ride free on the effort and expenditure of others to provide a resource. Non-rivalry has a complex relationship to the cost of making collective choices. It makes it difficult to agree upon the level of resource use to be facilitated and how the costs of provision are to be distributed, because resources vary with respect to their capability of catering for different preferences in them. Some resources are available in the same quantity and quality for all non-rival resource users, who cannot escape from using them at these pre-determined levels. Other resources may make it possible for the individual users to choose their level of resource use according to their preferences, without stating their actual preferences when the costs of provisioning are apportioned among the resource users. Still, their quality may be fixed for all users. Collective choices must address and resolve all these dilemmas.[21]

The possibility for multiple resource uses simultaneously increases the cost of regulating resource use, monitoring resource users, and enforcing the rules of resource use. Because multiple use resources create complex set of interdependencies, the institutions that

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Baland and Jean-Philippe Platteau, *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?* (Oxford: Clarendon Press, 1996).

govern them influence the interests of a number of resource users. Therefore, it increases the cost of making collective choices. Finally, the potential sources of injury multiply and the rules of resource use become more controversial from the viewpoint of all agents. Multiple use thus also increases the need for and the cost of conflict resolution.

The use of mobile or migratory resources, such as many stocks of fish, fowl, and game, is more difficult to govern than that of comparable immobile resources because the former can be accessed by a greater number of users than the latter. Therefore, the cost of excluding unauthorized users is higher for mobile resources than for the immobile ones. It is also more costly to regulate and to monitor the use of a resource in changing locations rather than in a fixed location.[22] Finally, it is costlier to enforce the rules of resource use when the resource is mobile. Namely, although it is possible to discern an unauthorized use of a resource by its adverse effects, it is difficult to make a firm connection between these adverse effects and the agent that caused them.

Fluctuating yield of a resource presents somewhat similar challenges for governance as the mobility of a resource. When the yield of a resource is high, resource users can appropriate the resource at high levels. During the periods of low yield, appropriation must decrease and possibly ceased altogether. Environmental resources such as pastures and stocks of fish and game can have fluctuating yields over time, as do watercourses for many purposes. Coping with fluctuating yield may require different sets of rules of resource use for the periods of high and low yield. As a result, it will be more costly to regulate the use

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[21] See especially Schmid, *Property, Power, and Public Choice*, 78-86.

[22] See Schlager, Blomquist, and Tang, "Mobile Flows."

of a resource with fluctuating yield than a resource with a stable yield. Enforcement of the rules of resource use will also be more costly, and so will be the making of collective choices over the rules of resource use.[23]

A possibility for the storage may relieve the problem of having to adjust to fluctuations in its yield. However, storage presents its own challenges. First, the establishment of storage has to be financed and their costs apportioned among the agents. Second, it has to be decided how much resource units the agents must set aside for storage, keeping in mind that differences in the position of resource users may require the imposition of different storage duties upon them. Thirdly, somebody must be appointed to manage the storage. A principal-agent problem is inevitable: the manager may take advantage of his or her position. Finally, the principles according to which the stored resource units are to be distributed when need arises must be devised. Thus, the possibility for storage transforms the problem of having to adjust the rules of resource use into problems of arranging for the provision of storage, and monitoring the behavior of agents that are responsible for it, which are also costly undertakings.[24]

Risk, uncertainty, and irreversibility associated with the resource have broadly similar implications as the fluctuating yield has. The resource may undergo irreversible changes and be destroyed if the level of resource use is not determined correctly. It is difficult and costly to agree upon the rules of resource use that provide for adequate safety margins. Because it is difficult to verify the state of the resource, resource users may be tempted to

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[23] See Schmid, *Property, Power, and Public Choice,* 136-138; Schlager, Blomquist, and Tang, "Mobile Flows."

violate the rules of resource use. The incentives to cheat may also increase the importance and costs of monitoring and enforcement.

The observations about how the physical attributes of environmental resources influence the governance of their use cannot be ignored in policy analysis, even if policy alternatives would face the same set of physical resource attributes. The performance of governance institutions cannot be predicted without attention to the physical attributes of the resource to be governed, because different governance institutions may resolve the challenges posed by them differently. There are no universally desirable institutional designs, because the fit between governance institutions and the resource use situation matters. Resource attributes that create t challenges for governance may also change when new resource uses and exclusion technologies appear or when the demand for the resource increases. Changes in resource attributes, resource uses, and technology are particularly important in studies like this that examine resource use over long periods of time.

These observations about the implications of physical resource attributes are also useful for designing institutional responses to resource use problems. For example, they underline the importance of and identify obstacles for effective exclusion of unauthorized users from environmental resources. They also indicate how regulation of resource use may have to take into consideration fluctuations in the yield of a scarce resource. Moreover, the observations indicate the difficulty of agreeing upon the level of non-rival resource uses and the way its costs are to be distributed. Careful analysis of physical resource attributes can also explain why governance institutions differ from one resource use situa-

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[24] See Schlager, Blomquist, and Tang, "Mobile Flows."

tion to another and foster critical analysis of alternative governance institutions. The next section examines how the attributes of resource users affect governance.

Community Attributes, Policy Problems, and Governance

The community of resource users includes the agents that are interested in the use of an environmental resource, including those who are interested in its preservation or non-use. The term community of resource users does *not* denote that agents actually are organized as a community, such as a traditional village or a fishermen's association. It rather indicates that agents are interdependent with respect to an environmental resource and have to act collectively to resolve their conflicts.[25] Interdependent resource users thus form a potential community, which may or may not become organized.[26] When an organized community exists, it does not necessarily grant participation in collective choices to all agents. Finally, some organized communities, such as nation-states, may include in collective choice agents that are not interested in the resource in question.

The attributes of the *potential* community of resource users, such as its size and the diversity of the interests and beliefs of its members, affect how the community can act collectively and what is the actual in contrast with the potential community.[27] Also social

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[25] I am following here Schmid, *Property, Power, and Public Choice.*

[26] Interdependent agents can be understood to form what Mancur Olson called a latent group. See Mancur Olson, *The Logic of Collective Action: Public Goods and the Theory of Groups*, 2nd ed. (Cambridge: Harvard University Press, 1971).

[27] Gary D. Libecap, "The Conditions for Successful Collective Action," in *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains*, eds. Robert O. Keohane and Elinor Ostrom (London: Sage, 1995), 161-190; Edella Schlager and William Blomquist, "Heterogeneity and Common Pool Resource Manage-

capital or their former experience from collective action and formal and informal institutional arrangements influence their ability to act collectively.[28] Furthermore, community attributes influence what kind of governance institutions can be established and how burdensome it is to enforce and maintain them.

The community attributes that warrant attention in policy analysis include 1) the size of the potential community, that is, the number of interdependent agents; 2) the number, size, and interests of coalitions of resource users within the potential community; 3) the values that motivate resource users in the community and in the coalitions, and the differences between them; 4) the knowledge available for agents in the community and in the coalitions, and the differences between them, and 5) trust, former successful experiences from collective action, and the informal and formal institutions that facilitate or hinder collective action among agents.

The size of a community of resource users has similar effects on governance as the size of the resource has, although the two factors are independent. The size of the community increases the difficulty and transaction costs of establishing governance institutions and the cost of governance thereafter. The greater the community, the higher are the costs of obtaining information about others. Therefore, the costs of exclusion, regulation of resource use, monitoring, and enforcement are higher in large communities than in the small ones.

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ment," in *Designing Institutions for Environmental and Resource Management*, eds. Edna Tusak Loehman and D. Marc Kilgour (Cheltenham: Edward Elgar, 1998), 101-112.

[28] See Michael Woolcock, "Social Capital and Economic Development: Toward a Theoretical Synthesis and Policy Framework," *Theory and Society* 27 (1998): 151-208; Stephen Knack and Philip Keefer, "Does Social Capital Have an Economic Payoff? A Cross-Country Investigation," *Quarterly Journal of Economics* 112 (1997): 1251-88.

It also more costly to make collective choices and to resolve conflicts in large communities than in the small ones.

The number of coalitions and the degree to which their interests are adversarial affect the costs of acting collectively: the more numerous and adversarial the coalitions, the higher the transaction costs and the more difficult to resolve resource use problems cooperatively. The size of coalitions affects transaction costs in their internal dealings and determines their chances for successful collective action. Policy analysis should thus identify coalitions, their principal interests, and other sources of heterogeneity to understand the ability of agents to resolve the resource use problems they face.[29]

The values held by resource users form their actual (in contrast to the attributed) behavioral motivations and influence what resource use goals they seek. More formally, values constitute the agents' preferences by providing the basis for ranking the choice alternatives they face. Values are not as uniform or as immutable as is presumed in traditional economic analysis. Rather, an agent may hold and act upon a variety of values and different groups may espouse different values. Values also do evolve and the dominant values change in the community of resource users.[30]

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[29] Robert O. Keohane and Elinor Ostrom, "Introduction," in *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains*, eds. Robert O. Keohane and Elinor Ostrom (London: Sage, 1995), 1-26; Libecap, "Successful Collective Action;" Schlager and Blomquist, "Heterogeneity and Common Pool Resource Management."

[30] On motivations in governance, see David Feeny, Susan Hanna, and Arthur McEvoy, "Questioning the Assumptions of the 'Tragedy of the Commons' Model of Fisheries," *Land Economics* 72 (1996): 187-205, 189-191. On value pluralism, see Elizabeth Anderson, *Value in Ethics and Economics* (Cambridge: Harvard University Press, 1993); John

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Social norms and institutions partly determine what values are operative in particular behavioral contexts. For example, markets reward and give incentives for self-interested and welfare-centered behavior, while other social arenas, such as polities or families, make space for different behavioral motivations. However, institutions do not and cannot determine human behavior. For example, although markets reward self-interested and welfare-centered behavior, they do not and cannot exclude behavior based on other motivations from the market any more that the polities or families can exclude the *homo economicus* from within their ambit.

The injunction to pay more attention to values and to understand them more broadly does not mean that "the mechanics of utility" should or even could be replaced by "the mechanics of plural values." Plural values are not automatically translated into policies that realize them and it may in fact be altogether impossible to identify choice alternatives that are agreeable to all agents when they hold incommensurable values.[31] Still, collective choices must, can, and will be made. The question is, whose values are translated into policies, to what degree, and why.

Values influence collective action in different ways. The greater the homogeneity of values, the lower the cost of collective action. The predominance of welfarist values may lower the costs of negotiation, making decisions, and conflict resolution, because welfarist agents can be persuaded to an agreement by compensating them. This may not work with

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O'Neill, *Ecology, Policy, and Politics: Human Well-Being and the Natural World* (London: Routledge, 1993).

agents informed by non-welfarist values. On the other hand, self- and welfare-centered behavior increases the costs of monitoring and enforcement and rule following may correspondingly lower these costs. Rule following may also entail low costs of making collective choices and resolving conflicts. Differences in values may explain behavior specific to particular coalitions and the resource use goals they seek. However, social norms and institutional structures also influence what values can be voiced where, and what values are transformed by collective choices into policies.

Knowledge influences the agents' preferences and the way policy problems are constituted within their community. More formally, knowledge constitutes the agents' preferences by informing the ranking of alternatives about how the alternatives contribute to her goals. Knowledge thus fundamentally constitutes what choice is about. Therefore, institutional change may not be so marginal as is sometimes argued. Abrupt shifts in choices may happen, because knowledge is socially constructed, imperfect, and asymmetrically distributed.[32] Shared understandings, such as our beliefs about the impacts of first- and second-hand smoking, are not easily changed by an individual agent, but when they do change for a reason or another, individuals are hard-pressed to revise their beliefs and behavior. Because knowledge is costly to obtain, it is likely to remain imperfect: new infor-

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[31] See e.g. Kenneth J. Arrow, *Individual Values and Social Choice* (New York: Wiley, 1951); Amartya K. Sen, "The Impossibility of a Paretian Liberal," *Journal of Political Economy* 78 (1970): 152-157.

[32] The question about the smoothness of institutional change is a matter of "resolution." At a general level, the overall institutional framework changes only gradually. However, change may be much more abrupt at the level of particular institutional arrangements. Witness, for example, the change of both informal and formal institutions governing

mation may become available at any time and result in a partial or complete re-ranking of choice alternatives. Agents may also have unequal access to information and incentives to withhold it from others, while they have incentives to find out about these asymmetries. Shifts in them may again result in the re-ranking of choice alternatives. On the other hand, continuity is maintained by agents' clinging to old beliefs, sometimes even at the face of evidence that has rendered them obsolete.

It is therefore necessary to examine what knowledge is available for agents, because it determines the understandings and definitions of policy problems and what alternatives are seen to be available. Knowledge also influences how agents assess alternative courses of action and choose between them. Policy analysis should also examine the differences that may exist in the knowledge available for different coalitions of agents, and how institutions determine whose knowledge will be acted upon.

The fifth community attribute that influences governance is social capital. Sometimes the term "social capital" is used to refer to all factors that explain the ability of a community to act collectively, but here it is used for several reasons more narrowly. First, the number of resource users and the heterogeneity of their interests, values, and knowledge are better kept apart from what is understood with social capital, because they do not exhaust all factors that influence the ability of a community ability to act collectively. For example, one must be able to explain why some homogeneous communities have failed to act collectively and why some heterogeneous communities have successfully cooperated.

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smoking in public places. My argument is that the idea of smooth, gradual change may be misleading when analyzing particular institutional arrangements.

Social capital is formed by former successful collective action, shared experiences, trust, and informal and formal institutions, which facilitate further collective action. The "amount" of social capital, which maybe cannot be measured but may, nevertheless, be judged qualitatively, influences the cost of acting collectively: the more there is social capital in the community, the lower the cost of acting collectively. A greater amount of social capital may also reduce other categories of governance costs.[33]

Next section discusses how the design of environmental policies as governance institutions affects the realization of policy goals.

Policy Response, Institutional Design, and Governance

The design of governance institutions influences, to which degree any objectives of resource management can be realized, taking the pertinent resource and community attributes as given. The design of governance institutions includes 1) the way the governance institutions establish and organize ownership and management functions, and 2) the way the rules of governance institutions are formulated. These two aspects of the design of governance institutions are discussed in greater detail shortly. The argument is again that the design of governance institutions creates impediments for resource management that can be understood as governance costs.

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[33] On institutions, incentives and governance, see Feeny, Hanna, and McEvoy, "Questioning the Tragedy of the Commons,"192-195; Paul Seabright, "Managing Local Commons: Theoretical Issues in Incentive Design," *Journal of Economic Perspectives* 7 (1993): 113-134. See also Knack and Keefer, "A Cross-Country Investigation;" Lindon Robison and Marcelo Siles, *Social Capital and Household Income Distribution in the United States: 1980-1990* (Michigan State University, Department of Agricultural Economics, Report No. 545, 1997). Woolcock, "Social Capital and Economic Development."

The conventional understanding is that governance institutions determine the level of resource use benefits, typically meaning that private property maximizes them.[34] However, a reverse relationship between governance institutions and benefits of resource use is more likely: the value of resource use influences how costly governance institutions can be adopted: valuable resource uses make it possible to establish expensive governance institutions such as private property.[35] Conversely, common ownership and environmental regulation are more likely to govern resources that offer only thin streams of benefits or when private property is too costly to establish and maintain.[36]

Private property is a costly solution to govern the use of environmental resources. The parceling out of environmental resources for individual owners lengthens the borderlines to be policed from what is necessary under collective ownership.[37] Private property thus entails higher cost of excluding unauthorized users, monitoring resource use, and enforcing the rules of resource use than common ownership, other things being equal. Private property also rests the regulation of resource use on contracting and litigation and

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[34] See e.g. Armen A. Alchian, "Some Economics of Property Rights," *Il Politico* 30 (1965): 816-829; Armen A. Alchian and Harold Demsetz, "The Property Right Paradigm," *Journal of Economic History* 33 (1973): 16-27; Harold Demsetz, "Toward a Theory of Property Rights," *American Economic Review* 57 (1967): 347-73.

[35] Daniel W. Bromley, *Economic Interests and Institutions: The Conceptual Foundations of Public Policy* (Oxford: Blackwell, 1989); Thrainn Eggertsson, "The Economics of Control and the Costs of Property Rights," in *Rights to Nature: Ecological, Economic, Cultural, and Political Principles of Institutions for the Environment*, eds. Susan S. Hanna, Carl Folke, and Karl Göran Mäler (Washington: Island Press, 1996), 157-175; Barry C. Field, "The Evolution of Property Rights," *Kyklos* 42 (1989): 319-345.

[36] See Dahlman, *The Open Field System*; Field, "Evolution of Property Rights;" Donald N. McCloskey "English Open Fields as a Behavior toward Risk," *Research in Economic History* 1 (1976): 124-176.

[37] Eggertsson, "Economics of Control;" Field, "Evolution of Property Rights".

collective choices over the rules of resource use emerge under private property as aggregate results of the contracts made in the market and the resolution of resource use conflicts in the courts. The use of markets and courts for these purposes is costly. Indeed, if private property was a low cost governance structure, we would observe it to govern the use of many environmental resources, such as the environmental media, that provide only thin streams of conventional resource use benefits.

The view of private property as a low cost governance institution rests on an understanding according to which non-transferable use rights entail infinite transaction costs. Thus governance institutions that incorporate inalienable rights (rights which cannot be traded away by their holders) are always more costly than private property that enables the alienation of rights. However, this reasoning ignores that the "infinite" transaction costs are not realized at all when exchange is ruled out. That is, non-transferability of rights can be understood as a measure economizing on transaction costs. More often, however, the rationale of not allowing exchange is elsewhere. It may relate to the predictable undesirable outcomes of exchange, the felt unacceptability of exchange in some areas of life without regard to its consequences, or the simple fact that no need is felt for it.

Arguments on the universal desirability of private property thus have a misplaced emphasis. The exchange of resource rights is not of fundamental importance for resource management: their establishment, assignment, and enforcement is. Market exchange is just one way to allocate resource rights after their initial assignment. It has some attractive features, such as the incentives it creates for the management and allocation of resources. However, it has also weaknesses, such as an inability to protect the interests of third parties. Other ways to allocate rights, such as rotation or political allocation based

on merit, need, or equal access can be devised. They may not allow the movement of resources to their most valuable use, but the need for it is not universal: it is of value when resource users have welfarist values and goals and resource uses change rapidly. Conversely, governance institutions that do not allow exchange of resource rights may be feasible when resource use is customary and does not change or when interest in indivisible environmental resources are widely shared. Inalienable resource rights can also be chosen to realize non-welfarist resource use goals.

Governance costs are relevant also when resource users pursue non-welfarist goals. These goals may not be exclusively or even primarily "environmental." For example, resource users may be concerned for the continuity of a customary resource use. The resource use goals held by agents influence what kind of governance institutions they will prefer and what kind of resource allocation will be realized. The level of resource use benefits influences how complex and costly governance structures are likely to be adopted. This is true also when non-welfarist values inform policy choices, because they do not render welfare considerations unimportant. More importantly, the level of governance costs influences to what degree any resource use goals can be realized.[38] Therefore, governance costs would be considered also by those who hold non-welfarist goals.

Although the level of governance costs is to an important degree shaped by resource and community attributes, the design of governance institutions also influences and may

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[38] Obviously, it is possible to adopt dysfunctional institutions that entail high governance costs to realize one coalition's resource use goals. This is possible when the maintenance of open access serves the interest of the coalition. The fourth chapter examines how this took place in the early 20th century United States.

redistribute them. The impacts of resource and community attributes and institutional design may be either dependent or independent. For example, the governance cost implications of adopting private property may be different for resources from which it is easy / difficult to exclude unauthorized users, implying dependency between the institutional design and resource attributes. On the other hand, governance costs are likely to be higher in a community of highly welfare-centered and self-interested agents than in a community of rule-followers, no matter what the resource attributes are. It is also conceivable that the influence of community attributes on governance costs may depend on the institutional design, because the latter may influence the incentives of resource users.

It is now possible to examine how the design of governance institutions influences governance costs. It was already argued above that the design of governance institutions relates to how the ownership and management functions of governance are organized and how institutional rules are formulated. Ownership functions[39] – who has what rights and decision-making authority over an environmental resource – have mixed effects on governance costs. To vest all ownership rights in a single owner may decrease the costs of regulating resource use and making decisions on resource use. On the other hand, it may increase the costs of exclusion, monitoring, enforcement, and conflict resolution. Collective ownership may have the opposite effect and increase the costs of regulating resource use and making collective choices, while decreasing the costs of exclusion, monitoring, enforcement, and conflict resolution.

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[39] See McCay, "Common and Private Concerns;" Ostrom, *Governing the Commons*; Schlager and Ostrom, "Property-Rights Regimes and Natural Resources."

Although ownership functions do influence governance costs, management functions have a more significant effect on them. Management functions include 1) exclusion of unauthorized users from the resource; 2) regulation of authorized resource use; 3) monitoring of resource use and compliance with its rules; 4) enforcement of the rules of resource use; 5) making of collective choices over the rules of resource use; and 6) conflict resolution.[40] The rest of the section examines in greater detail the different ways of implementing these functions and their implications for governance.

The exclusion, regulation, monitoring and enforcement functions can be left to individual resource users, or new agents can be constituted to undertake them. These new agents can be authorized individuals, groups of individuals, organizations, or administrative agencies, for example. Judgements about the level of governance costs generated by the organization of management functions must remain contextual. For example, decentralized monitoring and enforcement by resource users can be low-cost solutions for small resources, such as pastures and forest lots. However, specialized and centralized administrative agencies can be low-cost solutions for managing large environmental resources, such as watercourses or air basins. In both cases, the resources the agents command, the legal powers they hold, and the way they can make decisions influence governance costs and outcomes of governance.

Collective choices can be made and conflicts resolved in a number of social arenas, such as the markets, courts, legislatures, and administrative agencies. These social arenas set different rules for participation in collective choices and conflict resolution and influ-

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[40] See the references in the previous footnote.

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ence the relative power of agents. For example, markets and courts weigh the interests of individuals according to their ability and willingness to pay, while political participation in the legislature is today based on citizenship or residence and the rule of one vote for one person.[41] Markets and legislatures also distribute the costs of collective choice and conflict resolution differently between the agents.

The level of governance costs generated by using a social arena to make collective choices or to resolve conflicts are again contextually determined and must be contextually assessed. For example, in an institutional arrangement governing the use of a communal forest or pasture, conflicts may be resolved at lowest cost in a political arena, such as the village meeting. However, it would be extremely costly to use the legislature to resolve recurrent conflicts over the management of a national air basin. Indeed, most formal contemporary governance institutions, such as environmental policies, include a graduated system for making collective choices and resolving conflicts. Frequent minor issues are decided and resolved in the administrative agencies and less frequent and more important issues in the courts and in the legislatures.

The last dimension of institutional design is the formulation of institutional rules. The formulation of exclusion rules and the rules of resource use may importantly influence the costs of excluding unauthorized users, regulating resource use by authorized users, monitoring resource use and compliance with its rules, and enforcing the rules of exclusion and resource use. The formulation of these rules influences the level of governance costs in a

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[41] Political participation was still conditioned by personal wealth in the 19th century United States. Only those were franchised who either fulfilled minimum wealth requirements or who paid a required minimum amount of taxes.

few key ways. First, rule formulations make it variably costly to obtain information on the behavior of resource users and to measure their use of the resource. An example is the formulation of exclusion rules in water pollution control programs. A prohibition of such discharges into watercourses that constitute a nuisance is an ambiguous rule that increases exclusion costs,[42] because it leaves it to the courts to determine what constitutes a nuisance in any particular case. A general prohibition by statute of all discharges without a permit entails lower exclusion costs, because it is less costly to identify an unauthorized user under this rule than under the rule that prohibits the creation of a nuisance. In addition to the rules of exclusion and resource use, important are also the decision and other rules that condition the making of collective choices and conflict resolution.

Particular institutional features do not entail universally low or high governance costs. The burden of conducting a comparative institutional analysis is to find alternative institutional solutions and to assess their relative governance costs implications *in the context of given resource and community attributes*. The resource and community attributes importantly influence what the governance cost implications of an institutional design are, and there is no escape from the necessity of contextual judgements. On the other hand, this somewhat more burdensome methodological approach to policy analysis has the merit of being potentially able to provide more relevant and poignant observations and conclusions about specific policy problems and alternatives in the light of adopted policy goals.

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[42] Many early water pollution control statutes prohibited the creation of a nuisance and were difficult to enforce. See Edwin B. Goodell, *A Review of Laws Forbidding Pollution of Inland Waters in the United States*, 2nd ed. (Washington: U.S. Geological Survey; Water-Supply and Irrigation Paper No. 152, 1905).

Conclusions

This chapter extended the governance approach to the analysis of policy problems and assessment of governance institutions. Instead of attributing resource use goals to agents, the approach seeks to identify and clarify them: it acknowledges that agents are motivated by different values, some of which may emphasize non-welfarist resource use goals. Value pluralism denies the possibility to conventional welfare-centered, aggregative policy analysis[43] and emphasizes the need to provide information about the realization of different values and interests under different policy alternatives to facilitate learning and the formation of preferences over them.

The chapter argued that environmental problems are more heterogeneous than the notion of unidirectional externalities implies. Therefore, a careful analysis is needed to understand what challenges particular resource use situations present for the realization of resource use goals. The chapter suggested that policy problems can be understood as being constituted by the physical attributes of environmental resources and the attributes of their uses and users. The chapter also argued that the concept of governance costs helps to understand how the attributes of the resource and its users and the institutional design of policy responses influence the attainment of policy goals. Governance costs include the transaction costs of governing resource use: the attributes of environmental resources and their users and the design of governance institutions jointly determine them.

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[43] Aggregative policy analysis such as cost-benefit analysis assesses policies with a single performance measure. Environmental impact assessment is an example of an approach that employs multiple measures. See Bromley, *Environment and Economy*; Jouni Paavola, "Review of Valuing Nature? Economics, Ethics, and Environment," *Review of Social Economy* 56 (1998): 389-393; Söderbaum, "Positional Analysis."

The governance approach does not promote the use of any particular institutional arrangements, nor mask choices between different interests in environmental resources. Moreover, it does not impose motivations on agents and therefore cannot generate normative prescriptions: it seeks to conduct the assessment of alternative governance institutions in the light of their actual motivations. However, the governance approach does facilitate learning, preference formation, and democratic debate in policy choices, and the crafting of institutional solutions to resource use problems when the resource use goals have been worked out. It may also yield a better understanding of policy problems and choices of responses to them than the traditional approaches.

The governance approach can also be used to analyze past policy problems and responses to them to learn both theoretical and empirical lessons. This is the use to which it will be put in the following three chapters, which examine the governance of water quality in the United States from the early 19th century until the 1970s. While this chapter focused on essentially static resource use situations, in the dynamic setting of a historical research resource use situations do change. Changes in population, technology, knowledge, and values can alter resource use situations and thus reconstitute policy problems, because they may create new relationships of interdependence or alter the understanding of existing relationships of interdependence. Changes in population, technology, knowledge, and values may also render prior institutional solutions ineffective or obsolete. Finally, the distribution of wealth and the institutional framework that structures collective choices may also change, changing the relative power of different groups to translate their interest into policy.

3. INDUSTRIAL WATER POLLUTION AND 19TH CENTURY COMMON LAW: BARGAINING ON ENVIRONMENTAL QUALITY

> "In a world in which there are costs of rearranging the rights established by the legal system, the courts, in cases relating to nuisance, are, in effect, making decisions on the economic problem and determining how resources are to be employed."[1]

Industrialization created the first more notable water pollution problem in the early 19th century United States. True, human wastes had polluted water already earlier in large cities, such as New York, but this did not cause more than sporadic public responses.[2] Water pollution caused by industrial discharges resulted in a wave of litigation that intensified from the early 19th century until about the First World War.[3] Less intense litigation thereafter does not mean that industrial water pollution ceased to be a problem: it rather means that the locus of water pollution policy moved away from the courts to the legislatures and newly created state agencies. On the other hand, sewage discharges replaced industrial discharges as the foremost water pollutant in the end of the 19th century, a phenomenon that will be examined in the next chapter.

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[1] Ronald Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (1960): 1-44, 27.

[2] John T. Cumbler, "Whatever Happened to Industrial Waste: Reform, Compromise, and Science in Nineteenth Century Southern New England," *Journal of Social History* (Fall 1995): 149-171; John Duffy, *The Sanitarians: A History of American Public Health* (Urbana: University of Illinois Press, 1990); Charles E. Rosenberg, *The Cholera Years: The United States in 1832, 1849, and 1866* (Chicago: University of Chicago Press, 1960).

[3] See cases cited in Peter N. Davis, "Theories of Water Pollution Litigation," *Wisconsin Law Review* (1971): 738-816.

This chapter aims at understanding how and with what consequences the courts governed the use of water on the basis of the 19th and early 20th common law. The chapter analyzes water pollution litigation without limitation particular jurisdictions,[4] because it aims to outline the contours of institutions that governed the use of water in the 19th century United States. The use of material from several jurisdictions is also necessary to identify institutional innovations and changes that took place in particular jurisdictions and were not adopted in all of them. Finally, studies of the 19th century common law in one or a few jurisdictions have provided conflicting interpretations of how common law evolved,[5] so a study that covers several jurisdictions may provide new insights.

Industrial water pollution followed the advancement of the frontier and industrialization and became a problem first in the North-East and then in the Mid-West, the West, and the South. Water-powered mills and tanneries were the earliest industrial polluters. Ore and coal mines became significant water polluters in the mid-19th century, and pulp and

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[4] About two hundred fifty case reports were collected for this research. A quarter of the cases was litigated on the basis of riparian law against industrial polluters. This chapter analyzes the most important of them. Over a third of cases were litigated on the basis of the law of private nuisances against municipal polluters. The rest are court proceedings related to local ordinances or water pollution control statutes.

[5] Many scholars have argued that law changed to the benefit of the rising industry. See Morton J. Horwitz, *The Transformation of American Law, 1780-1860* (Cambridge: Harvard University Press, 1977); James Willard Hurst, *Law and Economic Growth: The Legal History of the Lumber Industry in Wisconsin, 1836-1915* (Cambridge: Belknap Press, 1964); Harry N. Scheiber, "Property Law, Expropriation, and Resource Allocation by Government: the United States, 1789-1910," *Journal of Economic History* 33 (1973): 232-251; Theodore Steinberg, *Nature Incorporated: Industrialization and the Waters of New England* (Amherst: University of Massachusetts Press,1991). Others have argued that law maximized wealth or improved efficiency. See Richard A. Posner, *Economic Analysis of Law*, 4th ed. (Boston: Little and Brown, 1992); Gary D. Libecap, "Economic Variables and the Development of the Law: The Case of Western Mineral Rights," *Journal of Economic History* 38 (1978): 399-458.

paper mills and packaging houses followed the suit in the end of the 19th century. Early industrial discharges contained solids that settled on the riverbeds, obstructed navigation, contributed to flooding, destroyed fisheries, and interfered with the use of water for power generation and other industrial purposes. Industrial discharges also contained organic matter, which decomposed in water, depleted oxygen and decimated aquatic life, spoiled water supplies, and created stench that interfered with the use of riparian properties. Finally, acidic and toxic discharges spoiled water supplies, corroded equipment and machinery, and destroyed fisheries.[6]

Industrial discharges thus created resource use conflicts between the industrial polluters and the downstream industrial water users, other riparians such as farmers, and fishermen. The conflicts between the industrial polluters and the downstream industrial and other riparians were resolved in the courts on the basis of common law in a manner to be examined shortly. The fishermen were often left without any remedy against industrial polluters. The states did not usually seek to protect the fisheries in the courts or on the basis of statutory law, because they considered industrial development more important than the fisheries. Although the question why the fisheries were not protected is interesting, it will not be examined in this chapter.[7]

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[6] Davis, "Water Pollution Litigation." See also Terence Kehoe, *Cleaning Up the Great Lakes: From Cooperation to Confrontation* (DeKalb: Northern Illinois University Press, 1997); Steinberg, *Nature Incorporated*; Joel A. Tarr, *The Search for the Ultimate Sink: Urban Pollution in Historical Perspective* (Akron: University of Akron Press, 1996).

[7] Fish protection statutes existed in states in which fishing was important. See Edwin B. Goodell, *A Review of Laws Forbidding Pollution of Inland Waters in the United States,* 2nd ed. (Washington: U.S. Geological Survey; Water-Supply and Irrigation Paper No. 152, 1905). They were enforced e.g. in State v. American Forcite Powder Manufacturing Co, 50 N.J. L. 75, 11 A. 127 (1887); State v. Kroenert, 13 Wash. 644, 43 P. 876 (1896);

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In what follows, the first section examines how early water law treated water uses as exclusive private property and how the doctrine of reasonable use transformed water rights in the first third of 19th century. The second section examines how the balancing test altered the rules of water use in the mid-19th century. The third section examines the counter-reaction to balancing in the end of the 19th century. The fourth section analyzes riparian law as a governance institution, indicating its consequences for water users and water quality. The conclusions elaborate empirical observations and connect them to the theoretical arguments of the previous chapters.

From Early Riparian Law to the Doctrine of Reasonable Use

The evolution of common law in the 19th century has been subject to a continuing academic debate. Some scholars have argued that the change of common law in the 19th century provided "a capital subsidy" for the nascent industry in the form of reduced liability for both accidental and intentional injuries.[8] Others have denied that such a change

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and Commonwealth v. Sisson, 189 Mass. 247, 75 N.E. 619 (1905). One reason why fisheries were not protected was the enthusiasm with artificial fish propagation. See Donald J. Pisani, "Fish Culture and the Dawn of Concern over Water Pollution in the United States," *Environmental Review* 8 (1984): 117-131; John F. Reiger, *American Sportsmen an the Origins of Conservation*, rev. ed. (Norman: University of Oklahoma Press, 1986); Philip V. Scarpino, *Great River: An Environmental History of the Upper Mississippi, 1890-1950* (Columbia: University of Missouri Press, 1985).

[8] See e.g. Horwitz, *Transformation of American Law*; Hurst, *Law and Economic Growth*; Scheiber, "Resource Allocation by Government"; Steinberg, *Nature Incorporated.* See also E. P. Krauss, "The Legal From of Liberalism: A Study of Riparian and Nuisance Law in the Nineteenth Century Ohio," *Akron Law Review* 18 (1984): 223-253; John s. Martin, "Water Law and Economic Power: A Reinterpretation of Morton Horwitz's Subsidy Thesis," *Virginia Law Review* 77 (1991): 397-426.

took place.[9] Still others have argued that common law changed in the 19th century so as to maximize wealth or to improve economic efficiency.[10] This chapter argues that the evolution of the 19th century riparian law was more complex than these (not necessarily incompatible) arguments suggest.

The most important areas of common law that governed the use of water in the 19th century were riparian law and the law of private and public nuisances. Riparian law established rights to the use of water and provided remedies for their protection.[11] The doctrine of private nuisance provided remedies against the injuries that the use of water visited upon the use and enjoyment of private property other than water rights, such as riparian land. Finally, the doctrine of public nuisances provided remedies for the protection of public health and navigation, for example.[12] This chapter focuses on riparian law because industrial polluters were usually sued on the basis of it.[13]

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[9] See Gary T. Schwartz, "Tort Law and the Economy in Nineteenth Century America: A Reinterpretation," *Yale Law Journal* 90 (1981): 1717-75; Alan Watson, "The Transformation of American Property Law: A Comparative Approach," *Georgia Law Review* 24 (1990): 163-221.

[10] See Posner, *Economic Analysis of Law*; Rubin, "Common Law and Statute Law."

[11] See T. E. Lauer, "Reflections on Riparianism," *Missouri Law Review* 35 (1970): 1-25; Scott and Coustalin, "Evolution of Water Rights."

[12] See American Law Institute, *Restatement (First) of the Law of Torts* (1939); Henry P. Farnham, *The Law of Waters and Water Rights*, vols. 1-3 (Rochester: Lawyers' Cooperative Publishing Company, 1904).

[13] Cases involving industrial polluters were usually litigated under riparian law, because industrial discharges mainly injured water use. Cases involving municipal polluters were in turn litigated under the law of private nuisances, because sewage discharges most often injured the use of riparian land and especially residences because of the stench it created. See e.g. Davis, "Water Pollution Litigation."

The United States inherited its water law from the United Kingdom during the colonial era. The early English water law protected existing uses of water strictly against interference by novel or extraordinary uses of water.[14] The seniority of water use and the ripari-ans' right to a natural flow of water similarly protected expectations that customary uses of water can continue without interference. Customary water uses included the use of water for domestic and agricultural purposes, and for the generation of power in small and traditional mills. An interference with a senior water use or the natural flow of water entitled the injured agent to compensation. A typical injury was the flooding of upstream riparian land by water backed up by a milldam. In effect, early English water law treated water uses as private property. Absolute rights like these could be maintained before the use of water intensified and made conflicts a commonplace.

The early 19th century witnessed a departure from the early English water law in both the United Kingdom and in the United States. The use of water for power generation intensified and the number and scale of mills, milldams, and millponds increased. As a re-

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[14] The usual view is that early English law strictly protected rights to water use and other property. See Robert G. Bone, "Normative Theory and Legal Doctrine in American Nuisance Law: 1850-1920," *Southern California Law Review* 59 (1986): 1101-1226; Joel Franklin Brenner, "Nuisance Law and the Industrial Revolution," *Journal of Legal Studies* 3 (1973): 403-433; Daniel R. Coquillette, "Mosses from an Old Manse: Another Look at Some Historic Property Cases about the Environment," *Cornell Law Review* 64 (1979): 761-821; Carol M. Rose, "Property Rights, Regulatory Regimes and the New Takings Jurisprudence – An Evolutionary Approach," *Tennessee Law Review* 57 (1990): 577-596. Others have argued that early English law was more complex. See Anthony Scott and Georgina Coustalin, "The Evolution of Water Rights," *Natural Resources Journal* 35 (1995): 821-979; Paul M. Kurtz, "Nineteenth Century Anti-Entrepreneurial Nuisance Injunctions – Avoiding the Chancellor," *William and Mary Law Review* 17 (1976): 621-671. On English law during the industrial revolution, see Brenner, "Nuisance Law and Industrial Revolution"; John P. S. McLaren, "Nuisance Law and the Industrial Revolution – Some Lessons from Social History," *Oxford Journal of Legal Studies* 3 (1983): 155-221.

sult, conflicts over the flooding of the upper mill's wheel by the lower mill's dam, and over the diversion of water by the upper mill to the detriment of the lower one, became common. Large mills also exposed a great number of downstream riparians to their water use. Industrial water pollution enters the picture here. Water-powered mills had thrown their wastes into water from very early on, as this was the easiest way to get rid of them. The practice became problematic when mills became larger and more numerous.[15]

The new conflicts over the injuries the upper riparians visited upon the lower ones changed riparian law in the early 19th century. The old conflicts over the flooding of upstream riparian land by milldams had involved only a few agents. The courts could resolve these conflicts by assigning exclusive private property rights to either the upstream riparian or the downstream mill owner and letting them bargain after that. Of course, the upper riparian, if given the right by the court, could refuse to sell it to the mill owner. This could happen when the upper riparian attached intrinsic value to his or her property or considered certain ways of behavior as right or virtuous. Moreover, exchanges between two uniquely situated agents cannot constitute a proper market. As John R. Commons noted, a bargained transaction requires five parties: a seller, an alternative seller, a buyer, an alternative buyer, and the judge. This indicates one possible rationale behind the 19th

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[15] Millponds changed from traditional seasonal ponds created by dams a few feet high to large, permanent ponds with dams over 10 feet high. See Rose, "Property Rights and Regulatory Regimes"; Steinberg, *Nature Incorporated.* On 19th century water law, see Glen J. MacGrady, "The Navigability Concept in the Civil and Common Law: Historical Development, Current Importance, and Some Doctrines that Don't Hold Water," *Florida State University Law Review* 3 (1975): 511-615; A. Allan Schmid, *Evolution of Michigan Water Laws: Response to Economic Development* (East Lansing: Michigan State University, Agricultural Experiment Station, Circular Bulletin No. 227, 1960); Scott and Coustalin, "Evolution of Water Rights."

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century mill acts, which either relieved the mills from liability to the injuries they visited upon the upper riparians by flooding their land or allowed the mills to flood upstream riparian land by compensating the owners.[16]

However, injuries do travel further downstream than upstream: the new conflicts over the upper riparians' water use involved a large number of agents. Private property rights worked less satisfactorily in the new situation. If the right was given to the polluter, the downstream riparians faced incentives to ride free on any attempt at buying the polluter's right. If the right was given to downstream riparians, the polluter faced high transaction costs in negotiating an exchange and possibly a hold-out situation. The change in water law was brought about in the United States in the beginning of the 19th century.[17]

The institutional innovation made an early appearance in the New York case of *Palmer v. Mulligan* (1805). In this case, the owner of a saw mill, situated in the upper Hudson river, complained that the upstream sawmill's dam had made it more difficult to float logs to his mill, increased the number of logs lost to the current, and that the rubbish from the upper mill frequently choked his water sluice. The court agreed on the principles that governed the case, namely, what is the acceptable level of interference with the rights of another riparian, but divided on its facts. For Justice Livingston,

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[16] On mill acts, see Horwitz, *Transformation of American Law*; Schmid, *Evolution of Michigan Water Laws*. On bargained transactions, see John R. Commons, *Institutional Economics: its Place in Political Economy* (New Brunswick: Transaction Publishers, 1990). On the 19th century beliefs concerning property, see Carol M. Rose, *Property and Persuasion: Essays on the History, Theory, and Rhetoric of Ownership* (Westview Press, 1994); Gregory S. Alexander, "Time and Property in the American Republican Legal Culture," *New York University Law Review* 66 (1991): 273-352.

[17] See Rose, "Property Rights and Regulatory Regimes; Scott and Coustalin, "Evolution of Water Rights."

> "its [the *sic utere tuo* maxim] operation must be restrained within reasonable bounds, so as not to deprive a man of the enjoyment of his property merely because some trifling inconvenience or damage to others"[18]

Palmer v. Mulligan incorporated a rudimentary conception of reasonable use as a reduced liability. A more influential and elaborate definition of reasonable use was formulated in *Tyler v. Wilkinson* (1827), a federal case involving several textile mills situated at both sides of the state border between Massachusetts and Rhode Island at the falls of the river Pawtucket. Downstream mill owners complained of the diversion of water by upstream mills, arguing that the upstream mills only had a right to residual water not needed by the downstream mills. The case exemplifies Carol Rose's argument according to which the injuries visited by upstream riparians upon the downstream riparians pushed riparian law to change.[19] The court rejected the downstream riparians' claim, defined the rights of the involved parties on the basis of their customary use, and assigned to all a duty relative to their rights to adjust their water use during general dearth of water. In the highly influential opinion of the court, Justice Story declared:

> "I do not mean to be understood, as holding the doctrine, that there can be no diminution whatsoever ... by a riparian proprietor ... for that would be to deny any valuable use of it. There ... must be allowed of that, which is common to all, a reasonable use. The true test of the principle of and extent of the use is, whether it is to the injury of the other proprietors ... The diminution, retardation, or acceleration, not positively and sensibly injurious by diminishing the value of the common right, is an implied element in the right of using the stream at all. ... The maxim is applied, 'sic utere tuo, ut non alienum laedas'."[20]

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[18] Justice Livingston, concurring in Palmer v. Mulligan, 3 Caines 307 (N.Y.), 2 Am. Dec. 270 (1805, 274).

[19] See Rose, "Property Rights and Regulatory Regimes."

[20] Tyler v. Wilkinson, 24 F. Cas. 472, (No. 14,312 (C.C.D.R.I. 1827, 474).

It is worth quoting *Tyler v. Wilkinson* at some length. First, Justice Story's language emphasizes the riparians' common ownership of water. This is a departure from the earlier doctrine that had treated the riparians' existing water uses as their private property. If the first user in time had enjoyed exclusive rights to water, others would have faced high asking prices and transaction costs in securing their water use. Yet in the East water flow could be and was used for power generation in successive mills unlike in the arid West, where water rights based on prior appropriation governed water uses that diminished the amount of water available for the downstream users. Common ownership facilitated new uses of water and weakened the protection of existing water uses. However, Justice Story qualified his relaxation of liability for injuries by referring to the *sic utere tuo* – maxim.

The doctrine of reasonable use developed in the cases in which the lower riparians complained of the water use by the upper riparians was soon applied to formally similar cases, including those over the pollution of water. For example, *Wheatley v. Chrisman* (1855), a case from Pennsylvania, involved a riparian who complained of the diversion and pollution of water by an upstream lead mine. The plaintiff sought damages by alleging that the mine had rendered water unfit for his cattle. The defendant argued that he had a right to use a reasonable amount of water for his business. Justice Black argued in the upper court's opinion that affirmed the lower court's award of damages:

> "The necessities of one man's business cannot be the standard of another's rights in a thing which belongs to both. ... The defendant had a right to such use as he could make of the water without materially diminishing it in quantity, or corrupting it in quality. If he needed more, he was bound to buy it."[21]

Justice Black emphasized common ownership of water just like Justice Story did in *Tyler v. Wilkinson*. This opinion also clarifies reasonable use of water: it was not determined by what is convenient for one's business but depended on the use of water by others. The opinion indicates that water rights remained transferable. What had changed was the initial assignment of rights to water. During the early water law, private rights existed to status quo water use and they had to be bought out or compensated for if somebody wanted to make a new use of water that affected others. Under the new doctrine of reasonable use, all riparians had in principle equal rights to the use of water, provided that their use did not significantly interfere with that of others. Obviously, this doctrine left it to the courts to judge what constituted a "significant" interference with another riparian's water use. Yet this new formulation could in principle facilitate new developmental uses of water while still protecting existing water uses from major interference.[22]

However, changes soon took place in the doctrine of reasonable use that altered its implications. These changes are examined in the next section.

The Balancing Test and Reasonableness as a More Valuable Use

The doctrine of reasonable use formulated by Justice Story in *Tyler v. Wilkinson* in 1827 was transformed into a balancing test in two mid-19th century cases: *Snow v. Parsons* (1956) from Vermont and *Hayes v. Waldron* (1863) from New Hampshire. Both

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[21] Wheatley v. Chrisman, 24 Pa. St. 298, 64 Am. Dec. 657 (1855, 658).

[22] Riparian law protected only the value of riparian rights. The award of damages restored the diminution in the value of rights caused by the defendant. While damages were determined by the court, an injunction allowed the plaintiff to price her right herself. It was then in the defendant to decide whether to stop the interference or to buy the right.

cases addressed a conflict between an upstream industrial polluter and a downstream riparian plaintiff. Another commonality was that the industrial defendants had large-scale operations and had invested more to their water use than the plaintiffs. Finally, these cases and others that later endorsed them expressed an explicit concern for the economic progress of the state and the defendant's contribution to it.[23]

In *Snow v. Parsons* (1856), a downstream mill owner complained about an upstream tannery, alleging that its spent bark obstructed the operation of his water wheel. The trial court awarded the sought-after damages for the plaintiff. The defendant appealed and the higher court reversed the trial court's judgment and remanded the case. The opinion of the higher court, written by Chief Justice Redfield, indicates how routinely the doctrine of reasonable use was by this time applied in the courts to cases involving industrial pollution. In the very beginning of the opinion, Chief Justice Redfield states that

> "The important, and as I think the only, question in this case is, whether it is proper for extensive tanneries upon moderate-size streams to expend their refuse, or spent bark, into the stream ... The reasonableness of such use must determine the right, and this must depend upon the extent of detriment to the riparian proprietors below. If it essentially impairs the use below, then it is unreasonable and unlawful. ... Within reasonable limits, those who have a common interest in the use of air and running water must submit to small inconveniences to afford a disproportionate advantage to others."[24]

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[23] See Snow v. Parsons, 28 Vt. 459, 67 Am. Dec. 723 (1856) and Hayes v. Waldron, 44 N.H. 580, 84 Am. Dec. 105 (1863). These cases were endorsed later in Jacobs v. Allard, 42 Vt. 303, 1 Am. Rep. 331 (1869); Hazeltine v. Case, 46 Wis. 391, 1 N.W. 66 (1879); Canfield v. Andrews, 54 Vt. 1, 41 Am. Rep. 828 (1882); Red River Roller Mills v. Wright, 30 Minn. 249, 44 Am. Rep. 194 (1883); Lockwood Co. v. Lawrence, 77 Me. 297, 52 Am. Rep. 763 (1885); Barnard v. Sherley, 135 Ind. 547, 34 N.E. 600 (1893), 47 N.E. 671 (1897).

[24] Snow v. Parsons, 28 Vt. 459, 67 Am. Dec. 723 (1856, 724-725).

After reciting the established definition of reasonable use, Chief Justice Redfield goes forward and gives an altogether new twist to it:

> "And the reasonableness of plaintiff submitting to this inconvenience must depend upon its extent, and the comparative benefit to the defendants, to be judged by the triers of the facts."[25]

For Chief Justice Redfield, the more valuable of the incompatible uses of water was reasonable and merited affirmation by the court as a right. The spirit of his definition of reasonable use of water is very different from Justice Story's definition. For Justice Story, all riparians had in principle equal rights to the use of water, and he explicitly ruled out superior rights to water on the ground of, for example, the priority of appropriation or occupancy.[26] Chief Justice Redfield now reformulated reasonable use to allow a riparian who had identified a more valuable water use to extinguish other riparians' rights to the use of water without even compensating them.

Chief Justice Redfield's formulation of reasonable use soon obtained following in cases decided in other jurisdictions, such as New Hampshire, Maine, Wisconsin, Minnesota, and Indiana. The New Hampshire case of *Hayes v. Waldron* (1863) is the most widely and frequently cited of them. In this case, a riparian landowner sued an upstream saw mill for damages, complaining that the shavings and sawdust discharged from the mill were deposited on his land. The trial court found for the defendant. The plaintiff appealed and

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[25] Snow v. Parsons, 28 Vt. 459, 67 Am. Dec. 723 (1856, 725).

[26] Priority by a long enough period of time may give rise to a prescriptive right and Story did not deny that. Prescriptive rights are exclusive private property rights and superior to common riparian rights. What Justice Story had in mind was to deny that priority of use or occupancy could rank ordinary claims to the use of water among the equally situated riparians. See Tyler v. Wilkinson, 24 F. Cas. 472, (No. 14,312 (C.C.D.R.I. 1827, 474).

complained of the instructions to the jury to take into account the universal practice in the industry when deciding whether the discharges from the saw mill were reasonable or not. The higher court sided with the plaintiff and did not accept the instructions. The court granted a new trial and argued that reasonability must depend on the facts of the case and the specific circumstances of the challenged water use, and that allowing proof on the universal practice in industry would open up a door for unproductive and endless inquiries. However, most of the opinion of the higher court, written by Justice Bellows, reviews the legal principles applicable to the case. Justice Bellows, just like Chief Justice Redfield did in *Snow v. Parsons*, first endorses the established definition of reasonable use:

> "The general principles that govern the use of running streams, in respect to the abstraction, detention, or diversion of the water, must also govern in respect to the deposit in the stream of waste matter and foreign substances and resulting from the process of manufacture; namely, that a reasonable use may be made, and nothing more."[27]

Later Justice Bellows emphasizes that the reasonableness of water use depends on the circumstances of the case, and that whether a use is reasonable must be determined by the triers of facts. These are the most often cited arguments presented in *Hayes v. Waldron.* Justice Bellows then moves on to endorse the use of the balancing test, formulated less than a decade earlier by Chief Justice Redfield in *Snow V. Parsons,* in cases over the pollution of watercourses:

> "Whether...it may be rightfully done must depend upon the question whether...it is or is not a reasonable use of the stream; and in determining that question, the extent of the benefit to the mill-owner, and of inconvenience or injury to others, may...very properly be considered."[28]

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[27] Hayes v. Waldron, 44 N.H. 580, 84 Am. Dec. 105 (1863, 106-107).

[28] Hayes v. Waldron, 44 N.H. 580, 84 Am. Dec. 105 (1863, 108).

In *Snow v. Parsons*, balancing favored the industrial defendant. In *Hays v. Waldron*, the outcome would have been similar had it been at stake, but the question posed for the higher court was different. However, balancing did not always work out an advantage to an industrial defendant. For example, in the Minnesota case of *Red River Roller Mills v. Wright* (1883), the owner of the downstream flouring mill at Red River complained of the discharge of shavings and sawdust from an upstream saw mill, alleging that the discharges clogged up his flume and wheel to his injury. The trial court found for the defendant and refused the injunction sought by the plaintiff. The plaintiff appealed successfully: the higher court reversed the trial court's judgement and ordered a new trial. In the opinion of the higher court, Justice Mitchell just added the burden of proof to the definition of reasonableness as the more valuable water use:

> "Whenever ... use of a stream by one riparian owner interferes with the reasonable use of the stream by a lower riparian ... by the interruption, diversion, abstraction, or pollution of the water, the burden of proof is upon the former to show that his use is reasonable; and the greater the injury is to the lower owner, the greater necessity for such use must the upper owner show in order to establish its reasonableness. The reasonableness of such use must determine the right, and this must depend in a great degree upon the extent of the detriment to the riparian proprietors below."[29]

All the cases analyzed so far, with the exception of *Tyler v. Wilkinson*, emerged from the prototypical early conflicts over industrial discharges, in which the upper riparian polluted water to the injury of the lower riparian and which involved only one plaintiff and defendant. However, there is no reason why conflicts over water pollution should involve only two agents. Conflicts between several agents became increasingly common in the

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[29] Red River Roller Mills v. Wright, 30 Minn. 249, 44 Am. Rep. 194 (1883, 197).

late 19th century, together with the increasing size and number of the mills and more intensive use of water. These developments threatened to make conflict resolution costly.

A solution was to allow several plaintiffs to join or defendants to be joined in one suit. An early use of the solution was made in the federal case of *Woodruff v. North Bloomfield Gravel Mining Co.* (1883). In this "debris case" a land owner complained of hydraulic mining companies upstream on the Yuba river in California, alleging that their solid discharges were deposited on his land to his injury. The case was of great importance: the activities complained of had covered prime agricultural land far away downstream in the Sacramento Valley with two to fifteen feet thick gravel deposits. The defendants demurred to their joining in a single suit. The federal district court overruled the demurrer and allowed the suit to proceed. In the court's opinion, Justice Sawyer argued:

> "No inconvenience or additional costs can result to the several defendants...joined with others, who also contribute to the same nuisance by originally independent action – action in its inception and first stages several, but ultimately, co-operating to produce the nuisance. On the contrary, it is convenient to dispose of it in one case, and the costs are diminished to each individual rather than increased by a single suit."[30]

This innovation was soon applied together with the balancing test in *Lockwood Co. v. Lawrence* (1885). In this Maine case, the downstream textile mill complained of the discharge of shavings and sawdust from the sawmills upstream on the Kennebec river. Both the plaintiff and the defendants had made extensive investments in the use of waterpower and contributed to the economic progress of the state. The plaintiff sought to enjoin the

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[30] Woodruff v. North Bloomfield Gravel Mining Co., 16 F. 25 (1883, 30). On mining controversies in the 19th century California, see Robert L. Kelley, *Gold vs. Grain: The Hy-*

discharge of refuse from the upper mills in a suit in which the defendants were joined. The trial court granted the injunction with respect to most of the discharges and dischargers. In anticipation that the defendants – who according to the facts of the case made a less valuable use of water than the plaintiffs – cannot buy their way of continuing their depositing of wastes into the stream in the customary way, Justice Foster declared that

> "Neither should this injunction issue immediately. The respondents must have a reasonable time in which to prepare for the disposal of such waste as is inhibited from going into the river."[31]

Yet another version of the doctrine of reasonable use was adopted in a few jurisdictions in the late 19th century. This version categorically favored a water use wherein the public interest was seen to lie. Although this rule never obtained much following, it is worth discussing as the culmination point of developments that weakened the legal protection of customary water uses in the 19th century. The categorical balancing rule was formulated in the Pennsylvania case of *Pennsylvania Coal Co. v. Sanderson* (1886). In this complex case, a riparian complained of a coal mining company, alleging that its mine drainage had made a brook's water unsuitable for domestic use, killed all the fish from it, and corroded and rendered worthless water distribution system at the farm. The court of common pleas entered a non-suit in the hearing of the plaintiff's case. The plaintiff appealed and the higher court remanded the case for trial. The lower court rendered a verdict for the plaintiff. The defendant appealed, but the ruling of the lower court was af-

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draulic Mining Controversy in California's Sacramento Valley - A Chapter in the Decline of the Concept of Laissez Faire (Glendale: Arthur H. Clark Co., 1959).

[31] Lockwood Co. v. Lawrence, 77 Me. 297, 52 Am. Rep. 763 (1885, 778).

firmed. The plaintiffs then disputed the amount of damages, and on appeal the determination of damages was remanded to the lower court. The lower court altered the damages, after which the defendants appealed. In the final hearing eight years after the filing of the suit, and after the plaintiff had died and his wife resumed charging the case, the Supreme Court of Pennsylvania reversed its position, aligned with the defendant, and denied compensation from the plaintiff:

> "The plaintiff's grievance is for a mere personal inconvenience; and ... mere private personal inconveniences, arising in this way and under such circumstances, must yield to the necessities of a great public industry, which, although in the hands of a private corporation, subserves a great public interest. To encourage the development of the great natural resources of a country trifling inconveniences to particular persons must sometimes give way to the necessities of a great community."[32]

In theory, this decision rendered riparians injured by the discharge of mine drainage remediless in Pennsylvania and licensed the mine operators to take their property without compensation. Courts in a number of jurisdictions considered the Sanderson ruling problematic and refused to endorse it despite frequent pleas by the industrial polluters. The decision was also soon afterwards repealed in Pennsylvania in *Robb v. Carnegie Bros. & Co.* (1891), so it did not have much influence in practice.[33] Very few states ever adopted categorical balancing rules of the Sanderson type. However, in Indiana and Massachusetts municipal polluters were sometimes awarded immunity against private damage claims, with an explicit reference to public interest that were argued to lie on their side.[34]

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[32] Pennsylvania Coal Co. v. Sanderson and Wife, 113 Pa. 126, 6 A. 453 (1886, 459).

[33] Robb v. Carnegie Bros. & Co. Limited, 145 Pa. St. 338, 22 A. 649 (1891).

[34] See Barnard v. Sherley, 135 Ind. 547, 34 N.E. 600 (1893), 47 N.E. 671 (1897).

To conclude, the balancing test allowed an agent making in the court's opinion a more valuable water use to extinguish what in the court's opinion was the less valuable water use without compensation. This meant that the traditional uses of water by riparian farmers and owners of small traditional mills had to yield to the interests of new, large-scale industrial establishments. Not surprisingly, the balancing test was not accepted everywhere: for example, New York rejected it until the decision of *Boomer v. Atlantic Cement Co.* in 1970.[35] There was also a more general reversal towards a stricter protection of riparian rights in the Progressive Era, which will be will be discussed in the next section.

The Return towards Reasonableness as Non-Injurious Use

The balancing test was not adopted in all jurisdictions in the United States. For example, the courts in New York and in New Jersey repeatedly rejected balancing because of its problematic distributive implications. The categorical balancing test formulated in the *Sanderson* case met even stronger resistance, despite the equally intense attempts of industrial defendants to have it endorsed by the courts. A common theme in the decisions that rejected balancing was the rising power of corporations.

A firm rejection of the Sanderson doctrine was made in *Columbus Coal & Iron Co. v. Tucker* (1891) from Ohio. In this case, a riparian complained of an upstream coal mine, alleging that the coal slack, dirt, and refuse from its dumps were washed into the adjacent creek, killing the fish, making water unfit for cattle, filling the bed of the creek and causing the flooding of his land, destroying a spring on his land, and covering his land with coal

[35] See Boomer v. Atlantic Cement Co., 26 N.Y.2d 29, 25 N.E.2d 870, 309 N.Y.S.2d 312

debris. The trial court awarded damages to the plaintiff. On the defendant's appeal, the circuit court affirmed the verdict. The defendant then appealed to the Supreme Court of Ohio, which also affirmed the verdict. On its final appeal, the defendant sought the endorsement of the Sanderson rule and argued that public interest is on its side. Justice Spear responded in the opinion of the court:

> "Nor is it of consequence that the operation of the company's mines tends to the development of the country's natural resources. But few enterprises ... fail to advance the general good. Along with many evils ... valuable services have been rendered to the public by them, and many comforts and necessaries are afforded the people by them which the capital of single individuals would be inadequate to produce. At the same time they are not ... public enterprises, but, on the contrary, are organized and maintained wholly and entirely for private gain; and as soon as gain ceases to follow their operation, just so soon do the operations themselves cease."[36]

The Sanderson doctrine was rejected even more forcefully in *Beach v. Sterling Iron & Zinc Co.* (1895) from New Jersey. In this case, the owner of a paper mill sought an injunction and complained of an upstream mine, alleging that its discharges discolored water and made it unfit for the manufacture of white tissue paper. The defendant's mine shaft penetrated through a groundwater-bearing layer of rock, which had caused a rapid flow of a suspension of water and colorful clay into the shaft. The pumping of this suspension into the adjacent stream has discolored it. The discoloration disappeared when the defendant drained the shaft and built settling ponds, except after larger gushes of colorful water into the shaft or operational failures. The defendant resisted the granting of an injunction by an appeal to the Sanderson doctrine and to the fact that he had eliminated the reason for the

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(1970).

[36] Columbus & H. Coal & Iron Co. Tucker, 48 Ohio St. 41, 26 N.E. 630 (1891, 632).

complaint. The Chancery Court still granted the injunction, arguing that it established the plaintiff's right without burdening the defendant. In the opinion of the court, Vice Chancellor Pitney responded to the defendant's appeal to the Sanderson doctrine:

> "Whether you flood the farmer's fields, so that they cannot be cultivated, or pollute the bleacher's stream, so that his fabrics are stained, or fill one's dwelling with smells and noise, so that it cannot be occupied in comfort, you equally take away the owner's property. ... in each case the utility of his property has been impaired by a direct invasion ... This is the taking of his property in a constitutional sense."[37]

The strict attitude of Vice Chancellor Pitney is, perhaps, partly explained by the relative novelty of draining mines as a use made of watercourses in New Jersey. According to his own words, "No case of a stream fouled by mining operations has ... so far as I know, been presented to our courts."[38] Moreover, the economy of New Jersey was more diverse than that of other states, with the exception of New York, and thus there was no need to bow to mining industry. The rejection of the Sanderson doctrine by the Supreme Court of Ohio in *Columbus Coal & Iron Co. v. Tucker* was therefore all the more significant, because Ohio's economy rested much more centrally on steel industry and on the mining of coal and ores than New Jersey's. The attempts of industrial defendants to have the Sanderson doctrine endorsed also failed elsewhere. Even states that initially adopted the Sanderson rule ultimately ceased to follow it.[39]

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[37] See Beach v. Sterling Iron & Zinc Co., 54 N.J. Eq. 65, 33 A. 286 (1895,).

[38] Beach v. Sterling Iron & Zinc Co., 54 N.J. Eq. 65, 33 A. 286 (1895, 289).

[39] See Beach v. Sterling Iron & Zinc Co., 54 N.J. Eq. 65, 33 A. 286 (1895, 288-290). See also the opinion of the Supreme Court of Indiana in Barnard v. Sherley (1897). Barnard v. Sherley, 135 Ind. 547, 34 N.E. 600 (1893), 47 N.E. 671 (1897).

The ordinary balancing version of reasonable use has fared much better than the Sanderson doctrine: it was incorporated into the first *Restatement of the Law of Torts* and is followed in many jurisdictions today. However, it was also rejected in many jurisdictions when industrial defendants sought its endorsement for their benefit. This was no wonder: balancing had disturbing distributive implications before effective statutory programs to protect interests in water quality. When the disposal of wastes was the most valuable use of water, as it frequently was in industrial rivers, the polluters could take the other riparians' water rights without compensation.

One case in which balancing was rejected is *Strobel v. Kerr Salt Co.* (1900) from New York. In this case, downstream mill owners complained of an upstream salt factory, alleging that it had unreasonably diverted and polluted water so that they had lost water power and been injured by the corrosion of machinery and equipment. The plaintiffs sought an injunction, but both the Supreme Court (the trial court in New York) and its Appellate Division denied it. The trial judge had cited the *Sanderson* opinion and the opinion of a similar Indiana case *Barnard v. Shirley* (1893) to support his decision. In the opinion of the Court of Appeals of New York, which reversed the lower courts' verdicts, Justice Vann first criticized the trial judge's finding:

> "trial judge was of the opinion that the plaintiffs ... could not prevent the defendant ... from devoting the stream to a new and unusual use, diverting the water, and turning 'a fresh-water stream into a salt-water stream.' This would amount to a virtual confiscation of the property of small owners in the interest of a strong combination of capital."[40]

Justice Vann then continued:

> "While the courts will not overlook the needs of important manufacturing interests ... they will not permit substantial injury to neighboring property ... They will not change the law relating to the ownership and use of property in order to accommodate a great business enterprise. ...the fact that he has invested much money and employs many men ... does not ... permit him to ... so pollute the rest of the stream as to render it unfit for ordinary use."[41]

In effect, Justice Vann endorses Justice Story's definition of reasonable use as one that does not substantially injure other riparians' use of water. In his recital of the principles of riparian law, Justice Vann only adds a layer of new elements that had been incorporated into riparian law during the three quarters of the century that had passed since Justice Story had formulated the doctrine of reasonable use. Justice Vann's opinion appealed to other courts in New England: they cited *Strobel v. Kerr Salt Co.* approvingly when deciding against big industrial polluters. The stricter attitude also reflected the fact that the courts were at the turn of the century already aware that industrial discharges could often be abated at a relatively low cost.[42]

The new attitude towards industrial polluters left a durable mark on common law in *Whalen v. Union Bag & Paper Co.* (1913). In this New York case, a riparian complained of an upstream pulp mill, alleging that the mill's effluents made water unfit for domestic

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[40] Strobel et. al. v. Kerr Salt Co., 164 N.Y. 303, 58 N.E. 142 (1900, 145).

[41] Strobel et. al. v. Kerr Salt Co., 164 N.Y. 303, 58 N.E. 142 (1900, 147-148).

[42] See Worthen & Aldrich v. White Spring Paper Co., 74 N.J. Eq. 647, 70 A. 468 (1908). Massachusetts courts were also strict toward industrial polluters but they did not follow the New York tradition. See Parker v. American Woolen Co., 195 Mass. 591, 81 N.E. 468 (1907); MacNamara v. Taft, 196 Mass. 597, 83 N.E. 310 (1908). Abatement methods are discussed in e.g. Strobel et. al. v. Kerr Salt Co., 164 N.Y. 303, 58 N.E. 142 (1900); Parker v. American Woolen Co., 195 Mass. 591, 81 N.E. 468 (1907); MacNamara v. Taft, 196 Mass. 597, 83 N.E. 310 (1908).

use and cattle. The plaintiff sought an injunction to prevent future injury and damages for past injuries. The trial court awarded both. On appeal, the Appellate Division partly reversed and partly modified the judgement so as to reduce the damages and to eliminate the injunction. The plaintiff accepted the reduced damages but appealed on that part of the judgement that had eliminated the injunction. The Court of Appeals of New York then reversed the Appellate Division's judgment and granted the injunction. *Whalen* is significant because its decision was followed in New York for over a half of a century until overruled in *Boomer v. Atlantic Cement* Co. in 1970. The injunction put out of business a pulp mill that had employed 500 people when the annual damages for the past injuries it had created were $ 100 per year. In the opinion of the court, Justice Werner declared that

> "The setting aside of the injunction was apparently induced by a consideration of the great loss likely to be inflicted on the defendant by the granting of the injunction as compared with the small injury do to the plaintiff's land by that portion of the pollution which was regarded as attributable to the defendant. Such balancing of injuries cannot be justified by the circumstances of this case."[43]

Continued Justice Werner:

> "Although the damage to the plaintiff may be slight as compared with the defendant's expense of abating the condition, that is not a good reason for refusing an injunction. Neither courts of equity nor law can be guided by such a rule, for if followed to its logical conclusion it would deprive the poor little litigant of his little property by giving it to those already rich."[44]

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[43] Whalen v. Union Bag & Paper Co., 208 N.Y. 1, 101 N.E. 805 (1913). The case is discussed in Driscoll v. American Hide & Leather Co., 170 N.Y. Supp. 121 (1918). The decision in *Whalen* was overruled in the controversial Boomer v. Atlantic Cement Co., 26 N.Y.2d 29, 25 N.E.2d 870, 309 N.Y.S.2d 312 (1970).

[44] Whalen v. Union Bag & Paper Co., 208 N.Y. 1, 101 N.E. 805 (1913).

Several explanations exist for why the courts portrayed a stricter attitude towards industrial polluters at the turn of the century. A number of the cases were litigated in states such as New York and New Jersey that had been strict about industrial pollution throughout the 19th century. They had more diverse economies than other states and did not have to bow to the interests of any particular industry. That is, the more dependent a state from a particular industry, the more likely is the law to change to support it. This would explain why balancing was accepted in the late 19th century in the Midwest, where economies were less developed and complex than in the East. Moreover, the enactment of water pollution control statutes in many states at the turn of the century legitimated and demanded stricter attitude towards polluters in the courts. Furthermore, it became evident that industrial water pollution could be abated, sometimes even at a relatively low cost. This observation made it easier for the judges to award both damages and an injunction: they knew they could protect the plaintiffs' interests without putting the defendants out of business. This could have been the outcome in cases where the victorious plaintiffs had non-welfarist values and were unwilling to bargain with the defendants. The courts of New Jersey seemed to be particularly well aware of opportunities to abate industrial discharges, although references to abatement technologies appear also in other contemporary cases.[45] Finally, resistance to the power of the big business formed part of the values and beliefs at the turn of the 20th century and informed the court decisions as well.

[45] See especially Parker v. American Woolen Co., 195 Mass. 591, 81 N.E. 468 (1907); MacNamara v. Taft, 196 Mass. 597, 83 N.E. 310 (1908).

Riparian Law as a Governance Institution

Riparian law constitutes an institutional arrangement for governing the use of water and it can be analyzed and assessed by using the governance approach to environmental problems and policy that was proposed in the two earlier chapters. This section examines what kind of an institutional arrangement riparian law constituted and what were the implications of its institutional design. The section concludes by attempting explain why common law changed as it did during the 19th century.

As noted in the beginning of this chapter, early English water law treated the riparians' uses of water as private property. The increasing scarcity of water later forced the courts to abandon the idea of the prior water users' absolute property rights to their customary water uses. This was accomplished by the formulation of the doctrine of reasonable use in the early 19th century. As water rights remained tradable and were allocated by markets, changes in riparian law did not alter the decision-making and authority structures significantly. The most significant changes in the governance of water use took place in the rules of water use.[46]

Before moving on to these changes, it is necessary to examine how common law excluded unauthorized users from water. After all, exclusion is the precondition of governing the use of environmental resources such as water. Riparian law identified an exclusive group – the riparians whose land abutted to the stream – authorized to make use of its

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[46] See Bone, "American Nuisance Law." See also John R. Commons, *Legal Foundations of Capitalism* (Madison: University of Wisconsin Press, 1959).

water.[47] The rights of riparians were formally equal: they all had a right to make a beneficial use of water and the non-riparians were excluded from doing so. As riparians, the early industrial polluters thus had a right to use water for power generation and other purposes, including the disposal of wastes. Non-riparians' unauthorized waste disposal was seldom if ever an issue in litigation, because the use of water for waste disposal was easy to control: it required access to a watercourse. Non-riparians were not as easy to exclude from other uses of water, because jurisdictions took different positions to the right of the riparians to convey water to non-riparians. For example, the rights of new water users such as private and public water companies were first unclear and often clarified by statutory declarations.[48] Still, exclusion did not present major problems for governance.

Common law also established rules for the riparians' use of water. Early English water law required compliance with the *sic utere tuo ut non alienum laedas* – maxim. The cases that expounded the doctrine of natural flow just gave a different name for the same rule of non-interference: the *sic utere tuo* – maxim employed the language of use-based water rights, while the concept of natural flow belonged to the language of land-based water rights. The rule of non-interference prohibited uses of water that would injure the other

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[47] See Joseph Angell, *A Treatise on the Law of Watercourses*. Fifth Edition (Boston: Little and Brown, 1854); John M. Gould, *A Treatise on the Law of Waters, Including Riparian Rights, and Public and Private Rights in Waters Tidal and Inland* (Chicago: Callaghan, 1883); Henry P. Farnham, *The Law of Waters and Water Rights*, vols. 1-3 (Rochester: The Lawyers' Cooperative Publishing Company, 1904).

[48] For example, the ownership of riparian land was not always seen to authorize a municipality or a water company to deliver water to non-riparians and to limit the water use of other riparians to ensure the quality of water. See People v. Hulbert, 131 Mich. 156, 91 N.W. 211 (1902). See also Angell, *Law of Watercourses*; Gould, *Law of Waters* (1883); Goodell, *Laws Forbidding Pollution.*

riparians. The rule worked when water was abundant in all uses made of it, but became problematic when incompatible water uses became commonplace.[49]

The rule of reasonableness replaced the earlier rules of water use during the first third of the 19th century. It relaxed liability for injuries and created an expectation that one could initiate a developmental water use without a fear that other riparians would sue for a minor interference with their rights. The courts obviously determined what constituted a minor interference with a water use. The rule of reasonableness, as it was formulated by Justice Story, could have governed the use of waters in a way that at the same time facilitated developmental uses of water and protected existing rights to water use. The developmental users of water could have proceeded by compensating for the injuries they visited upon existing water rights or by buying off their holders.

The balancing test expanded opportunities for new water uses without legal liability for the injuries they visited upon others. It was a "rule of capture" among the riparians that rendered water almost an open-access resource: any riparian who identified a more valuable water use than the existing ones could have his or her new water use endorsed as a right, and extinguish other riparians' incompatible rights without compensation. Similarly, the Sanderson doctrine allowed the taking of private property for an alleged public use by a private actor without compensation. While, perhaps, reducing the transaction costs of allocating water to its most valued uses, these rules weakened the security of all water rights and mainly served to redistribute wealth. These rules of water use also had

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[49] This is not to say that no interference was allowed with water rights early on. The courts had to recognize a cause of action before the plaintiff could proceed. The determi-

adverse consequences for water quality, because the less valuable traditional water uses depended on a certain level of water quality, but the new valuable use of watercourses as waste sinks directly degraded it.

The rules of water use do not count for much if they are not complied with. Rules can be effective only when water use is monitored and the rules themselves are enforced. Common law delegated monitoring in a decentralized fashion to the riparians themselves: to protect their interests in water quality, riparians had to monitor the water use of other riparians. This institutional solution worked during most of the 19th century. Riparians could usually easily detect when their use of water was injured by the solid, organic, acidic, or toxic discharges of industrial polluters.[50] Centralized monitoring would have been costlier under these circumstances.

Common law also delegated the enforcement of the rules of water use to the riparians themselves: it was up them to seek the affirmation and restoration of their rights in the courts. A case at law for damages could be used to restore the pecuniary value of injured riparian rights, while a case in equity for an injunction allowed, in principle, the riparian to put an end to the injurious water use. However, an injunction also allowed the riparian to trade away his or her affirmed right to water quality to the polluter. According to Louise

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nation of the cause of action required an assessment of whether the injury complained of was significant enough to warrant the court's attention.

[50] In most cases the plaintiffs easily identified the source of injurious water pollution. Sometimes it was the next mill a few hundred yards upstream. See e.g. Palmer v. Mulligan, 3 Caines 307 (N.Y.), 2 Am. Dec. 270 (1805); Snow v. Parsons, 28 Vt. 459, 67 Am. Dec. 723 (1856); Hayes v. Waldron, 44 N.H. 580, 84 Am. Dec. 105 (1863). At other times the source was further away, but usually not more than half a dozen miles upstream. See Lockwood Co. v. Lawrence, 77 Me. 297, 52 Am. Rep. 763 (1885).

Halper, this was a common outcome of early nuisance litigation in New York.[51] It is relatively easy to explain why trading took place after litigation in most cases.

Most plaintiffs initiated an action in the court against a polluter to obtain compensation or to be able to sell a right endorsed by an injunction: they were willing to bargain to begin with and hoped to be the sellers. This is how economic theory envisions agents would always behave. If the plaintiff won his or her case, the defendant usually was a willing buyer. When the plaintiff had entered the court with a financial restitution in mind and won the case, the two could bargain and agree on the sale of the right. After obtaining legal assistance for litigation, the additional costs exchanging the right were negligible for the two parties. Transaction costs were higher in cases involving a group of plaintiffs and/or defendants and could in principle prevent transactions. However, several plaintiffs and/or defendants appear only in a small fraction of all cases in water pollution litigation. Sometimes, as in the *Whalen* case, the industrial defendant could not strike a deal with the plaintiff and had to close down. Two reasons could lead to this outcome. First, a plaintiff willing to bargain could ask so high a price that it could not be afforded by the defendant. Second, a plaintiff could act on non-welfarist values and refuse to bargain at all: this could happen with aggrieved plaintiffs.

It is important to acknowledge that although riparian law in principle protected the value of water rights, the actual level of this protection depended on the adopted rules of

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[51] See, for example, Louise A. Halper, "Nuisance, Courts, and Markets in the New York Court of Appeals, 1850-1915," *Albany Law Review* 54 (1990): 301-357; Christine Rosen, "Differing Perceptions of the Value of Pollution Abatement across Time and Place: Balancing Doctrine in Pollution Nuisance Law, 1840-1906," *Law and History Review* 11 (1993): 303-381.

water use. For example, a strict adherence to a rule that allowed only a minor physical interference with a water use gave much stronger protection of the value of that water use than a rule that allowed greater physical interference. Balancing rules that only compared the pecuniary values of incompatible water uses obviously gave even weaker protection for existing water rights. Finally, riparian law protected water quality only indirectly, by making it more costly for the industrial polluters to deposit their wastes into water.

While decentralization could entail low monitoring costs in most streams, the decentralized enforcement of riparian rights was a costly institutional solution. It also distributed enforcement costs between the polluters and other riparians so as to discourage enforcement. Namely, the injured riparians had to initiate the suits at their own cost and often also ended up paying them, although the courts could redistribute the costs. Transaction costs of litigating could easily exhaust the benefits a traditional riparian water user could expect from the restoration or affirmation of her water rights: traditional water uses were not particularly valuable in pecuniary terms and an ordinary riparian could not expect large damages. Furthermore, court proceedings were seldom initiated jointly by several plaintiffs, which is indicative of high transaction costs of acting collectively and incentives to ride free. Finally, where the balancing test was applied, a traditional riparian could hardly expect to prevail in her suit at all.

A disincentive for the private enforcement of water rights was that its benefits were non-rival and available for all downstream riparians when made available for a particular plaintiff. Thus, there was an incentive among the potential plaintiffs to ride free. However, different industrial wastes structured the situation differently. The abatement of solid discharges, such as sawdust, wood residues, and mining debris provided exclusive benefits

for the plaintiff, because the solids visited injury mainly upon the immediately adjacent downstream riparian. Organic and chemical discharges visited similar injuries upon many downstream riparians. A self-interested, welfare-centered agent would not contribute to enforcement when he or she could not be excluded from any of its benefits. The incentives of industrial defendants were different with respect to litigation in general and the enforcement of water rights in particular. The injurious water uses of industrial polluters were valuable and the defendant captured all the benefits defensive litigation could yield. Typical industrial defendants thus had the resources and incentives to litigate as long as possible to obtain a favorable decision.

The cases do support the line of reasoning suggested above. Sometimes, like in the *Sanderson* case, the defendant obtained a favorable decision after a long litigation in the courts. Moreover, the plaintiffs, at least in the *Sanderson* and *Whalen* cases, appear to have been driven by motives other than their personal welfare: they endured the costs of long litigation knowing that the monetary rewards from successful enforcement of their rights would not make them even. Welfare-centered plaintiffs would have ceased and in most cases probably did cease unfavorable litigation much earlier. The industrial water users had greater incentives than ordinary riparians to enforce their water rights against industrial polluters. Indeed, a large proportion of early riparian rights cases was litigated between two or more industrial water users.

The enforcement outcomes under riparian law illustrate well Mancur Olson's arguments on the prospects of collective action. First, a group of homogeneous agents such as traditional riparians who are injured by industrial water pollution may fail to organize themselves as a group and to forward their interests when they face incentives to ride free

and the benefit of collective action for each of them is relatively small. On the other hand, in a group of heterogeneous agents those with a lot at stake, such as the industrial polluters, may afford to provide a high-exclusion cost good for themselves and for the other free-riding riparians as well.[52]

Under riparian law the rules of water use emerged as the result of private litigation. The riparian plaintiffs set the agenda for collective choice by initiating a stream of cases according to the injuries visited upon them and their ability and willingness to pay for litigation. The judges affirmed the existing rules of water use or formulated new ones when resolving conflicts in the courts. The resources the plaintiffs and defendants commanded determined the degree to which they could participate in collective choice. The probability and prospective gains of winning litigation determined their willingness to litigate and thus to participate in collective choice. Both the resources and prospects of winning litigation favored industrial polluters: they had the incentives and resources to continue litigating as long as it was possible to obtain a favorable decision. This was not the case with typical plaintiffs. The way riparian law organized conflict resolution and collective choice weighed the interests in water by their value. In fact, riparian law served as a governance institution mainly for those who used water for industrial purposes, and facilitated the allocation of water for use as a waste sink by the growing industry.

The way riparian law structured participation in collective choices partly explains why riparian law changed as it did during the 19th century. The usual explanations would be that all 19th century institutional changes 1) improved social welfare by providing net

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[52] See Mancur Olson, *The Logic of Collective Action: Public Goods and the Theory of*

benefits or 2) benefited a powerful interest group. The first explanation, the so-called "naïve theory of institutional change," simply argues that institutions promising net benefits for the agents are chosen. This explanation does not pay attention to the process of institutional change (how individual incentives to change institutions are translated into institutional changes that provide net benefits for the society) nor to who benefits from institutional change: net benefits are simply assumed. The second theory explains institutional change as a result of rent seeking by interest groups, which may either contribute to overall economic welfare or reduce it.[53]

The movement from the notion of water uses as private property to the original doctrine of reasonable benefited agents that put water into valuable industrial uses without making traditional riparians much worse off, depending, of course, how the courts understood the limits of acceptable interference with their rights. The second movement from the doctrine of reasonable use toward balancing test again benefited industrial users of water. However, at this time those suffering from pollution were made significantly worse off. The balancing test amounted to a potential Pareto-improvement test conducted by the court, which allowed the riparian making in the court's opinion a more valuable water use

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Groups, 2nd ed. (Cambridge: Harvard University Press, 1971).

[53] On theories of institutional change, see Thrainn Eggertsson, *Economic Behavior and Institutions* (Cambridge: Cambridge University Press, 1990), 247-280. On naïve theory, see Harold Demsetz, "Toward a Theory of Property Rights," *American Economic Review* 57 (1967): 347-73. On rent seeking theory, see James M. Buchanan, "Rent Seeking under External Economies," in *Toward a Theory of the Rent-Seeking Society*, eds. James M. Buchanan, Robert D. Tollison, and Gordon Tullock (College Station: Texas A & M University Press, 1980), 183-194; Anne O. Krueger, "The Political Economy of the Rent-Seeking Society," *American Economic Review* 64 (1974): 291-303; Robert D. Tollison, "Rent Seeking: A Survey," *Kyklos* 35 (1982): 575-602.

to take the water rights of the other riparians without compensation. Strict liability would have performed an equal test but entailed a different distributive outcome. Thus the main consequence of this institutional change was to redistribute wealth. Finally, the courts' stricter posture in the end of the 19th century benefited most riparians except the industrial polluters, who were adversely affected by the institutional change. Nevertheless, their losses were mitigated by the existence of relatively low-cost abatement methods. Therefore, *from the viewpoint of the traditional theories of institutional change*, the first and third institutional changes could have been welfare improving and the second one primarily redistributive and possibly welfare-reducing.

However, there are a number of problems this explanation. First, it does not explain why the industry benefited from the rules of water use in the early 19th century when it was weak in comparison to other water users, and why it could not have its way at the turn of the century when it was very powerful indeed. It is, of course, possible to view the common law judges as the colleagues of the Walrasian auctioneer, that is, as brokers that unerringly choose welfare maximizing rules when presented with a choice. This is, in fact, what Richard Posner argued explicitly and Douglass North implicitly in his early work.[54] On this account, the judges modified common law on every occasion so as to maximize social welfare. The stricter attitude towards industrial polluters at the turn of the century would, in this light, be a welfarist response to losses from water pollution. Welfare improvement was promised because more numerous and intensive uses of water were made

[54] Douglass C. North and Robert Thomas, *The Rise of the Western World: A New Economic History* (Cambridge: Cambridge University Press, 1973); Douglass C. North, *Struc-*

than earlier and the costs of abating pollution were lower. A similar argument would explain why reasonable use was originally adopted to the injury of traditional riparians.

However, this reasoning fails to explain the adoption of the balancing test in the mid-19th century. Balancing did not promise welfare improvements over what alternative rules could yield and it benefited only the industry.[55] Indeed, a double standard must be adopted to explain the 19th century changes in common law as a string of welfare improvements. The common law judges were most of the time all-knowing and benevolent maximizers of social welfare, but somehow lost their grip in the middle of the 19th century, with a result that the industry was successful in its rent seeking. However, this stretches the cost-benefit explanation of institutional change too far.

Additional insights into why riparian law changed during the 19th century can be obtained by analyzing how values changed during the period. Little or no interference with existing property rights was allowed by the courts in the early 19th century. This kind of strict protection of property rights was compatible with the early republican thought, which saw property primarily as the political foundation of society and the source of the

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ture and Change in Economic History (New York: Norton, 1981); Posner, *Economic Analysis of Law.*

[55] See e.g. Gregory M. Travalio, "Pay Up or Shut Down: Some Cautionary Remarks on the Use of Conditional Entitlements in Private Nuisance Cases," *University of Florida Law Review* 38 (1986): 209-251. See also A. Mitchell Polinsky, "Resolving Nuisance Disputes: The Simple Economics of Injunctive and Damage Remedies," *Stanford Law Review* 32 (1980): 1075-1112; A. Mitchell Polinsky, "Controlling Externalities and Protecting Entitlements: Property Right, Liability Rule, and Tax-Subsidy Approaches," *Journal of Legal Studies* 8 (1979): 1-48.

citizen's independence, rather than as an instrument of generating wealth.[56] That is, republican thought attributed intrinsic value to private property.

Predominant values changed towards a utilitarian direction throughout the course of the 19th century. The utilitarian values culminated in the Progressive Era at the turn of the 20th century, when the resource use guideline of people like Gifford Pinchot was "the greatest happiness for the greatest numbers." Values like these called for and legitimated the alteration of rules of water use without regard to the implications of doing so for the protection of existing water uses. It can be inferred from the case reports of the latter half of the 19th century that the judges believed the industry to be the vanguard of economic development and improved social welfare.

Public opinion turned against the corporations and big business in general in the end of the 19th century, when their misuse of power had been amply demonstrated. The dominant values were still welfare-centered, but it was now considered that social welfare and the interests of large corporations were not in harmony. The judges were not insulated from the social developments that surrounded them, and thus their decisions reflected these changes in values, beliefs, and attitudes.

Conclusions

Riparian law changed as a governance institution on several occasions in the 19th century. The early water law strictly protected existing water uses and did not allow an interference with them by novel or extraordinary water uses. The first change in water law

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[56] See Rose, *Property and Persuasion*; Gregory S. Alexander, "Time and Property."

took place when the doctrine of reasonable use weakened the protection of existing water rights in the first third of the 19th century to the benefit of novel water uses, by allowing what the courts considered a minor interference. The mid-19th century witnessed a second change in riparian law, the establishment of balancing as a test of reasonable use. It further weakened the protection of existing water uses and allowed the taking of prior water rights without compensation by private agents who had found what the court deemed a more valuable water use. Finally, the third change in water law took place in the end of the 19th century when the courts strengthened the protection of existing water uses by not allowing a major interference with them.

The first and second changes in riparian law mainly benefited the growing industry which used the watercourses for power generation and waste disposal. The main loser in these institutional changes was the traditional riparian, who used water for domestic and agricultural purposes and for livestock husbandry. The third institutional change benefited the traditional water users, water companies, and industrial water users. The direct loser in this third institutional change was the industrial polluter.

The changes in the governance institutions are explained by a number of factors. First, the use of water changed during the 19th century and engendered a more complex set of interdependencies. Industrial use of water for production processes became all the time more important and public water supply emerged as a new use of water. The discharges of the earliest mills (except the tanneries) would not have interfered with these new water uses significantly: after all, solids settle shortly after they are discharged. However, industrial effluents changed in the course of time, solids becoming less significant and organic and chemical compounds becoming more important. Therefore, industrial polluters

were interdependent with water companies and industrial water users in addition to the traditional riparians in the end of the 19th century.

The institutional framework in which the collective choices over the rules of water use were made partly explains the outcome. Litigation weighed the condensed interests of industrial polluters more heavily than the diffuse interests of traditional riparians in the early part of the 19th century: rules favorable to industrial polluters emerged because the industrial polluters had incentives and resources to continue litigating until they achieved their goals. The traditional riparians in turn had disincentives to enforce their rights in the courts. The situation changed towards the end of the 19th century. Industrial water users had more concentrated interests in water quality than the traditional riparians and stronger incentives to protect them in the courts.

The change in values and beliefs provides additional explanations for the institutional changes that took place in the 19th century. The gradual weakening of the protection of existing water uses took place at the same time when republican values attributing intrinsic value to private property were replaced by utilitarian values that viewed private property as an instrument to attain wealth. The mid-19th century beliefs also associated industrialization with affluence and development. Finally, the dark side of industrialization and the growth of corporate power was acutely felt at the turn of the 20th century, which may partly explain the stricter protection of existing water uses. Another factor that explains it was the spread of knowledge on the abatement of industrial discharges.

This analysis of the governance of water quality by riparian law exemplifies, illuminates, and clarifies a number of arguments made in the theoretical chapters. The analysis shows how the institutional framework gives incentives to act upon particular values. Ri-

parian law regulated the participation in collective choices by the ability and willingness to pay and thus gave effect to welfarist values. The analysis also shows how important the transaction costs of acting collectively and incentives to ride free are for the analysis of environmental problems and policy. The evidence suggests that the industrial polluters often bought out traditional riparian plaintiffs that had won a case for an injunction. However, there is no evidence of traditional riparians buying out polluters. This also underlines the consequences of adopting the balancing rule in the mid-19th century. Water companies, whose activities are examined in greater detail in the next chapter, sometimes bought out polluters. Yet the state legislators usually found it necessary to grant eminent domain power to water companies to enable them to take land and water rights to protect their water supplies. This suggests that transaction costs hindered bargaining or that other factors, such as the capability to hold out, hindered bargained transactions.

This chapter examined the governance of water quality by riparian law in the 19th century. Industrial pollution was the main threat to water quality that was addressed by the riparian law. However, industrial discharges started to lose their role as the leading pollutants of water towards the end of the century, when municipal sewage discharges took their place. The next chapter examines how this altered water pollution problems and responses to them.

4. THE PURSUIT OF SAFE WATER: INSTITUTIONS, TECHNOLOGY, AND PUBLIC HEALTH, 1830-1920

> "Instead of instituting a legal system of rights which can be modified by transactions on the market, the government may impose regulations which state what people must or must not do and which have to be obeyed. ...
>
> there is no reason why, on occasion, such governmental administrative regulation should not lead to an improvement in economic efficiency."[1]

This chapter examines how institutions, technology, knowledge, and values are intertwined. Economic historians usually consider that new institutions and technologies promising net benefits for agents automatically replace existing inferior institutions and technologies.[2] This view is based on the assumptions according to which agents are motivated exclusively by self- and welfare-centered values and have perfect knowledge. In short, it takes human motivations and knowledge as givens and not subject to change. This chapter accepts that knowledge and values are socially constructed and change. It also acknowledges that knowledge is imperfect and that agents may have non-welfarist

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[1] See Ronald H. Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (1960): 1-44; 17-18.

[2] See e.g. Lance E. Davis and Douglass C. North, *Institutional Change and American Economic Growth* (Cambridge: Cambridge University Press, 1971); Douglass C. North and Robert Paul Thomas, *The Rise of the Western World: A New Economic History* (Cambridge: Cambridge University Press, 1973); Douglass C. North, *Structure and Change in Economic History* (New York: Norton, 1981); *Empirical Studies in Institutional Change*, eds. Lee J. Alston, Thrainn Eggertsson and Douglass C. North (Cambridge: Cambridge University Press, 1996).

goals. Knowledge and values may thus influence both technological and institutional change and be influenced by them.

This chapter examines technological and institutional changes related to the protection of public health from polluted water from the early 19th century until about 1920. A number of changes took place in institutions, technology, knowledge, and values during the period, which make it a fruitful object of analysis. Rapid urban growth in the 19th century worsened living conditions in terms of noise, polluted air and water, inadequate disposal of solid wastes, and frequent epidemics of diseases. As a consequence, life expectancy decreased and mortality and morbidity increased from what they had been earlier.[3] Cities responded to the health crisis by constructing water supply and sewer systems after the mid-19th century.[4] However, these new urban technologies first reproduced the

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[3] Robert W. Fogel, "Nutrition and the Decline in Mortality since 1700: Some Preliminary Findings," in *Long-Term Factors in American Economic Growth*, eds. Stanley L. Engerman and Robert E. Gallman (Chicago: University of Chicago Press, 1986). The decline of life expectancy and increased mortality in the 19th century are new observations. Several factors explain them. Urban living conditions played a role. So did the immigration of people with low nutritional status and high susceptibility for diseases, who also transmitted their susceptibility to their children via meager fetal and infant welfare. The more frequent epidemics as a result of greater mobility of people also played a role. Fogel argues that better health and nutrition have significantly contributed to long-term economic growth. See Robert W. Fogel, "Economic Growth, Population Theory, and Physiology: The Bearing of Long-Term Processes on the Making of Economic Policy," *American Economic Review* 84 (1994): 369-395.

[4] See Stuart Galishoff, "Triumph and Failure: The American Response to the Urban Water Supply Problem, 1860-1923," in *Pollution and Reform in American Cities, 1870-1930*, ed. Martin V. Melosi (Austin: University of Texas Press, 1980), 35-57; Joel A. Tarr, James McCurley, III, Francis C. McMichael, and Terry F. Yosie, "Water and Wastes: A Retrospective Assessment of Wastewater Technology in the U.S., 1800-1932," *Technology and Culture* 25 (1984): 226-263; Joel A. Tarr, James McCurley, and Terry F. Yosie, "The Development and Impact of Urban Wastewater Technology: Changing Concepts of Water Quality Control, 1850-1930," in *Pollution and Reform in American Cities,*

problems they were expected to resolve at even a grander scale, but subsequent developments in water filtration and treatment ultimately made water safe for public health.

The traditional legal foundation for the protection of public health, the common law of public nuisances, was first supplemented with local boards of public health and local ordinances and later with state boards of health and water pollution control statutes.[5] Medical and lay knowledge on the etiology of diseases also changed. While sickness was still considered God's punishment for one's sins in the early 19th century, the mid-19th century beliefs associated disease with environmental quality and provided a strong agenda for reform.[6] The environmental theory of disease was in turn replaced by the bacteriological theory at the end of 19th century.

Knowledge and values interacted with and influenced the institutions and technologies of the protection of public health in a complex way. The cholera epidemics in 1832, 1849, and 1866 shattered the religious beliefs according to which it was everybody's personal responsibility to strengthen his or her moral stamina to withstand the attack of an epidemic

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1870-1930, ed. Martin V. Melosi (Austin: University of Texas Press, 1980), 59-82. Infrastructure investments were also influenced by the ways of financing them and the rules of collective choice in the local governments. For example, cities that assessed and charged the cost of sewers from property owners progressed slower than cities that used municipal bonds or that established special sewer districts with taxing power.

[5] See John Duffy, *A History of Public Health in New York City, 1866-1966* (New York: Russell Sage Foundation, 1974); Edwin B. Goodell, *A Review of Laws Forbidding Pollution of Inland Waters in the United States*, 2nd ed. (Washington: U.S. Geological Survey, Water and Irrigation Paper 152, 1905); William J. Novak, *The People's Welfare: Law and Regulation in Nineteenth-Century America* (Chapel Hill: University of North Carolina Press, 1996); Barbara Gutmann Rosenkrantz, *Public Health And The State: Changing Views in Massachusetts, 1842-1936* (Cambridge: Harvard University Press, 1972).

disease. The epidemics and sanitary surveys forged a new understanding according to which something could be done to prevent disease and transformed the protection of health from a private matter into a public one. Population was also born as a concept and a set of parameters that could be subjected to optimization. The Progressive public health professionals optimized by choosing water filtration and treatment to reduce morbidity and mortality and eased on the enforcement of water pollution control policies that required costly sewage treatment.

In what follows, the first section examines traditional sanitary technology and legal institutions for the protection of public health, demonstrating how they were rendered obsolete by changes in medical knowledge and urban technology after the Civil War. The second section examines how and with what consequences the courts were used by water companies, their customers, and riparians to protect their interests in water quality against municipal polluter. The third section examines state boards of public health and water pollution control statutes, which were established in the end of the 19th century and how they influenced technological change. The fourth section assesses the consequences of these new institutional solutions and the technologies they helped to bring out.

Traditional Sanitary Technology and Legal Institutions

In the early 19th century, water works and sewers existed only in a few larger cities, such as New York and Philadelphia. Most cities still relied on the traditional technological

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[6] See e.g. Charles Rosen, *A History of Public Health*, exp. ed. (Baltimore: Johns Hopkins University Press, 1993); Charles E. Rosenberg, *The Cholera Years: The United States in 1832, 1849, and 1866* (Chicago: University of Chicago Press, 1962).

solutions for their water supply and disposal of human wastes. This meant that private and public wells, springs, and natural watercourses ordinarily supplied water. Cesspools and privy vaults were used to dispose of human wastes. When a need arose, they were emptied and the human wastes used as a fertilizer on agricultural land or tipped on the nearest vacant lot or into a watercourse.[7]

When cities were small and population densities low, traditional water supply and sanitation technologies did not endanger public health. However, the situation changed when cities grew rapidly in the 19th century. The disposal of increasing amounts of human wastes on the ground or into watercourses polluted the principal supplies of drinking water in many communities and resulted in frequent epidemics of water-borne diseases, such as cholera, typhoid, typhus, and diarrhea.

Medical and lay knowledge did not yet make a connection between disease and polluted water in the early 19th century. Religious beliefs still associated disease with God's punishment for one's sins. Sometimes disease was understood to have climatic and topographical causes, which indeed broadly matched with the etiology of some diseases, such as yellow fever and malaria. Finally, diseases were also considered to originate from an exposure to filth and bad odors or miasmas emanating from putrefying organic matter. These theories combined in an understanding according to which wanting moral behavior was the primary reason for and could predispose to disease, while odors, filth, and certain

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[7] See Ellis L. Armstrong, Michael C. Robinson, and Suellen M. Hoy, eds., *History of Public Works in the United States, 1776-1976* (Chicago: American Public Works Association, 1976) Nelson Blake, *Water for the Cities: A History of Urban Water Supply Problem in the United States* (Syracuse: University of Syracuse Press, 1956); Galishoff, "Triumph and Failure"; Tarr et al., "Water and Wastes."

climatic and topographical characteristics were secondary reasons for disease that signified the presence of an immediate threat to health. That is, health and its protection were utterly matters of private morality.[8]

The greatest perceived threats to public health in the Antebellum Era were slaughterhouses, rendering establishments, rotting carcasses, and stinking mill ponds.[9] The common law of public nuisances provided for the protection of public health against these threats. A public nuisance was anything that injured the private property of a large number of people; interfered with public rights, such as the right to navigation; or that endangered the health, safety, or morals of the public.[10] A public plaintiff, such as the state, its attorney general, or an authorized organ of the local government, was usually expected to initiate a suit to abate a public nuisance. A private plaintiff could also obtain a right of ac-

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[8] John Duffy, *The Sanitarians: A History of American Public Health* (Urbana: University of Illinois Press, 1990); Gerald N. Grob, "Disease and Environment in American History," in *Handbook of Health, Health Care, and the Health Personnel*, ed. David Mechanic (New York: Free Press, 1983); Charles Rosen, *History of Public Health*; Rosenberg, *Cholera Years*.

[9] Many 19th century court cases addressed these threats for public health. On a slaughterhouse, see Metropolitan Board of Health v. Heister, 37 N.Y. 661 (1868). On a rendering establishment, see Fertilizing Co. v. Hyde Park, 97 U.S. 659 (1878). Cases involving mill ponds will be discussed below. See also Alan I. Marcus, "The Strange Career of Municipal Health Initiatives: Cincinnati and City Government in the Early Nineteenth Century," *Journal of Urban History* 7 (1980): 3-29. On the meaning of pollution, see Adam W. Rome, "Coming to Terms with Pollution: The Language of Environmental Reform, 1865-1915," *Environmental History* 1 (1996): 6-28.

[10] See Henry P. Farnham, *The Law of Waters and Water Rights, Vols. I-III* (Rochester, The Lawyers' Cooperative Publishing Co., 1904). See also Louise A. Halper, "Nuisance, Courts, and Markets in the New York Court of Appeals, 1850-1915," *Albany Law Review* 54 (1990): 301-357; Michael S. McBride, "Critical Legal History and Private Actions Against Public Nuisances, 1800-1865," *Columbia Journal of Law and Social Problems* 22 (1989): 307-322.

tion if he or she had suffered a special injury, different in kind and not only in degree from that suffered by the public at large.

Early public nuisance actions, such as the New York case of *Mills v. Hall* (1832),were often initiated by private plaintiffs.[11] The plaintiffs were successful in their complaints at least when there was a threat of a cholera epidemic in the air. In *Mills v. Hall*, the plaintiff complained that a mill dam corrupted the atmosphere of its neighborhood and impaired his family's health. The defendant argued that the plaintiff could not sue because the nuisance was a public one and that he had a prescriptive right to maintain it. The trial court awarded damages to the plaintiff and the defendant moved for a new trial. Justice Sutherland rejected the motion by declaring:

> "If the defendants have for twenty years been permitted to over-flow the plaintiff's land with their mill pond, so far as the injury to the land is concerned, they have by that length of possession acquired a right to use it in that manner, and are not responsible in damages to the plaintiff. ... but if such overflow spread disease and death through the neighborhood, it may be abated, and he must respond in damages for the special injury which any individual may have sustained from it"[12]

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[11] All solids that flowed down the stream were deposited in the mill ponds, because the flow of water was more or less halted in them. As mill ponds were relatively shallow, they warmed up rapidly during the summer months, providing ideal conditions for the growth of algae and microbes in nutrient-rich water.

[12] Mills v. Hall, 9 Wendell 315 (N.Y.), 24 Am. Dec. 160 (1832, 162). See also Story v. Hammond, 4 Ohio Rep. 833 (1831); State v. Buckman, 8 N.H. 203 (1836). Public nuisance defense was common in private and public nuisance suits, because the courts scrutinized the right of action carefully in actions on public nuisance and were often reluctant to grant it. See Paul M. Kurtz "Nineteenth Century Anti-Entrepreneurial Nuisance Injunctions – Avoiding the Chancellor," *William and Mary Law Review* 17 (1976): 621-671. For another viewpoint, see McBride, "Private Actions against Public Nuisances."

States and local governments were reluctant to use public nuisance suits to protect public health before the Civil War. Still, when they did so they shared the same concerns as private plaintiffs: filth and odor that were seen to spread death and disease in their vicinity. For example, in *Commonwealth v. Webb* (1828), the Attorney General of the Commonwealth of Virginia initiated an action against a mill owner arguing that his dam was a public nuisance that rendered water stagnant and air impure. On trial the jury twice disagreed and failed to make a verdict. The defendant demurred to the renewed bill presented to the court the next year. In a response to the demurrer, Justice Daniel instructed judgment to the defendant. In an opinion that deviated from the position of other courts – by not endorsing the protection of public health as a legitimate public interest and cause of action for a public plaintiff – he argued:

> "to support the prosecution ... it ought to be alleged and proved, that the obstructions placed in Little creek ... produced a stagnation of the waters thereof, in or near a *public highway*, or some other *place, in which the public have such special interest.*"[13]

A public nuisance suit had weaknesses as a measure for the protection of public health. First, public nuisance suits, like all court proceedings, required a lot of time. This made them less than ideal when there was a need to act promptly to protect public health from an imminent danger.[14] Second, it was difficult to prevent the creation of threats to public

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[13] Commonwealth v. Webb, 6 Rand. (Va.), 726 (1828, 819), emphasis in original.

[14] The doctrine of public nuisance allowed abatement without a court's prior approval under certain circumstances. Therefore, there was a legal basis for a speedy action to abolish threats to public health. However, whoever abated a nuisance on his own initiative remained liable for damages. See People ex rel. Copcutt v. Board of Health of City of Yonkers, 140 N.Y. 1, 35 N.E. 320 (1893). A city that prayed for an injunction to protect

health by public nuisance suits: the courts were at their best in delivering remedies for the injuries already incurred and sometimes belittled prospective injuries.[15] Third, both public and private plaintiffs had disincentives to initiate public nuisance suits, because they were costly and plaintiffs had to carry the costs of litigation initially and to face the odds of not winning the case. There was thus demand for an institutional solution that would facilitate speedy action to protect public health at a low cost for the acting party.

Frequent epidemics and rising policy consciousness resulted in the 19th century to a gradual adoption of an institutional solution – the local board of public health – in all urban and rural communities. Both its diffusion and later undermining hinged on the same developments in medical knowledge. Edwin Chadwick in 1842 and John Snow in 1855 demonstrated the connection between the incidence of disease and environmental quality in England. The observation was verified in the United States in the sanitary surveys of John Griscom in New York in 1848, Lemuel Shattuck in Massachusetts in 1850, and the Citizen's Association of New York in New York City in 1865.[16] These mid-19th century sanitary surveys indicated that public interventions could reduce mortality and morbidity and they also provided legitimation and a strong agenda for a public health reform.

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its water supply could also be denied relief if its own record was not clean. See Topeka Water Supply Co. v. City of Potwin Place, 43 Kan. 404, 23 P. 578 (1889).

[15] Many courts belittled complaints that sought to prevent prospective injuries. See e.g. Morgan v. City of Binghamton, 102 N.Y. 500, 7 N.E. 424 (1886); Newark Aqueduct Board v. City of Passaic, 45 N.J. Eq. 393, 18 A. 106 (1889).

[16] See Charles Rosen, *History of Public Health,* 187-191, 213-221, and 261-265. On the values of the proponents of public health reform, see Charles E. Rosenberg and Carroll Smith-Rosenberg, "Pietism and the Origins of the American Public Health Movement: A Note on John H. Criscom and Robert M. Hartley," *Journal of the History of Medicine and Allied Sciences*, 23 (1968): 16-35.

The first local boards of public health were temporary divisions of local government or ad-hoc civic associations established to fight an approaching epidemic. The establishment of local boards of public health, the enactment of local public health ordinances, and their enforcement were usually authorized either in the charter of the local government or by general authorization statutes. For example, the legislature of New York granted to the local governments a power to enact local health laws in 1798 in the advent of a yellow fever epidemic. Permanent local boards of public health became common by the Civil War, when cholera approached the United States the third time and when the connection between environmental quality and diseases had already been clearly established.[17]

The courts endorsed the power of local boards of public health to enact and enforce ordinances until the last quarter of 19th century, at least when there was a threat of an epidemic. *Metropolitan Board of Health v. Heister* (1868)[18] from New York is a good example. The metropolitan board was somewhat extraordinary, because it was established by the state legislature in anticipation of the cholera epidemic of 1866, and because its jurisdiction covered four urban counties in the metropolitan area of New York City. The board determined that Heister's slaughterhouse – which was in a densely populated area of the central city – was a public nuisance and ordered him to discontinue his operations. The board also prohibited the driving and slaughtering of cattle in the city center and

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[17] See Duffy, *Public Health in New York City*; Duffy, *The Sanitarians*; Novak, *People's Welfare*; Rosen, *History of Public Health*; Rosenberg, *Cholera Years*.

[18] Metropolitan Board of Health v. Heister, 37 N.Y. 661 (1868). On its history, see Duffy, *Public Health in New York City*; Rosenberg, *Cholera Years*. Even a more prominent case endorsing the police power of a local government is Fertilizing Co. v. Hyde Park, 97 U.S. 659 (1878). This case dealth with a rendering establishment.

Heister violated the prohibitions. Heister sued to enjoin the board from stopping him driving cattle to his slaughterhouse and slaughtering the cattle in it, challenging the constitutionality of ordinances and the board's use of summary powers. The trial court found for Heister, but on the board's appeal the judgment was reversed. In the opinion of the Court of Appeals of New York, Chief Justice Hunt responded to the alleged unconstitutionality of the public health ordinances:

> "the health regulations of the district operate upon his cattle and his slaughter-house, in the same manner that they do upon live property owned by all others, and the use of the streets for dangerous purposes or the prosecution of a business dangerous to the public health is regulated by the ordinances in question. This practice is not forbidden by the constitution, and has been recognized from the organization of the state government, and is to be found in nearly every city or village charter which has been granted by the legislature "[19]

When moving on to the questioned authority of the Board to act summarily, as it had done when stopping the slaughterhouse's operation, Chief Justice Hunt said:

> "from the earliest organization of the government, the absolute control over persons and property, so far as the public health was concerned, was vested in boards or officers, who exercised a summary jurisdiction over the subject, and who were not bound to wait the slow course of the law"[20]

Chief Justice Hunt concluded the opinion of the court by reflecting upon Heister's choice of challenging the constitutionality of the powers of the Metropolitan Board of Health instead of pursuing his interest in the ways made possible by the board:

> "He refuses to litigate before the board, the question whether his pursuit is dangerous to the public health, but places himself upon their want of power

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[19] Metropolitan Board of Health v. Heister, 37 N.Y. 661 (1868, 667).

[20] Metropolitan Board of Health v. Heister, 37 N.Y. 661 (1868, 669).

over the subject. He cannot complain now, that their judgment upon the facts is to be held conclusive upon him."[21]

Local boards of public health were also treated favorably elsewhere during the third cholera pandemic. For example, the court of the Massachusetts case of *City of Salem v. Eastern Railroad Company* (1868) upheld the orders of a local board of public health to a railroad company. The board determined that the building of a railroad across a mill pond had rendered its water impure and created a public nuisance, and ordered the railroad company to remove it. When the company did not act promptly, the board used its summary powers and had the nuisance abated. The City of Salem later sued the railroad company to recover its costs. The defendant argued that the board had neglected to give it a notice when determining that a public nuisance existed. The trial judge requested a clarification of legal principles that should govern the case from a full court before putting the case before a jury. The court reviewed the case and ordered the trial to proceed according to its instructions. In the opinion of the court, Justice Wells declared:

> "The authority of the board of health ... stands upon similar ground. Their action is intended to be prompt and summary. They are clothed with extraordinary powers for the protection of the community from noxious influences affecting life and health, and it is important that their proceedings should be embarrassed and delayed as little as possible by the necessary observance of formalities."[22]

The court cases litigated during the great epidemics helped to consolidate the authority of local boards of public health. However, the courts scrutinized their activities more strictly in the last quarter of the 19th century, when time had passed since the cholera epi-

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[21] Metropolitan Board of Health v. Heister, 37 N.Y. 661 (1868, 671).

demics and there was a general movement toward scrutinizing public interventions into private matters more closely.[18] However, by this time, the same changes in medical knowledge that had pointed toward the adoption of local boards of public health for the protection of public health had already indirectly undermined them. Namely, the findings associating disease and environmental quality corroborated proposals for projects to deliver clean water to the urbanites with networked systems of water supply, and to dispose of their wastes in the similar fashion. The construction of water supply systems started in large cities, such as Boston, New York, and Philadelphia, in the end of 18th century. However, it really took off in urban communities after the Civil War, when the promise of improved public health through the provision of clean water was substantiated. The construction of sewer networks followed with a lag of a few decades, booming in the last two decades of the 19th century.[23]

The adoption of networked urban systems exposed a city's water supply to sewage contamination originating far away upstream and exposed water users far away downstream to its sewage discharges. In other words, a local board could not anymore protect public health in a community, because important threats to public health resided outside its jurisdiction. The establishment of state authorities and rules for water use was to be the

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[22] City of Salem v. Eastern RR. Co., 98 Mass. 431 (1868, 443).

[23] See e.g. Armstrong, Robinson, and Hoy, eds., *Public Works in the United States*; Blake, *Water for the Cities*; Letty Anderson, "Fire and Disease: The Development of Water Supply Systems in New England, 1870-1900," in *Technology and the Rise of the Networked City in Europe and America*, eds. Joel A. Tarr and Gabriel Dupuy (Philadelphia: Temple University Press, 1988); Joel A. Tarr, "Sewerage and the Development of the Networked City in the United States, 1850-1930," in *Technology and the Rise of the Networked City*

solution to the problem. However, before the new institutional solutions were adopted, the parties interested in and affected by the quality of water had to rely on common law and the courts to resolve their conflicts. The next section will discuss this interlude with its consequences in greater detail.

The Retreat to Common Law

Conflicts over municipal sewage discharges became very frequent in the late 19th century and were more complex than the conflicts over industrial discharges had been.[24] Because most early industries discharged solids, they did not inflict injuries over long distances. Therefore, the early conflicts over industrial discharges usually involved only a few agents. The conflicts became more complex in the end of the 19th century, because industrial discharges interfered with the use of water for public water supply. Still, the conflicts over municipal sewage discharges were usually even more complex, because sewage discharges spoiled the water supply of a number of downstream communities and interfered with the use of water and the enjoyment of private property by a large number of downstream riparians.

The local boards of public health failed to resolve the conflicts over sewage discharges, because their powers did not reach outside their jurisdiction. Moreover, local communities had no incentives to control sewage discharges within their own jurisdiction:

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in Europe and America, eds. Joel A. Tarr and Gabriel Dupuy (Philadelphia, Temple University Press, 1988).

the costly undertaking would have primarily benefited the downstream communities. Therefore, common law was temporarily the only legal foundation for resolving inter-locality conflicts over sewage discharges. The rest of the section examines court cases initiated by water companies, their customers, and riparians.

Protection for the Quality of Water Supplies

Water companies and local communities sometimes initiated court proceedings against municipal and other polluters to protect their interests in water quality. Their success was modest at best, except under the threat of an epidemic. An example is *McCallum v. Germantown Water Co.* (1867) from Pennsylvania. In this case a water company sued an upstream woolen and carpet mill, arguing that its discharges of dyes, hair, and organic residues made water unfit for human consumption and requesting an injunction. The trial court granted it. The defendant appealed, but the Supreme Court of Pennsylvania affirmed the lower court's judgment. On appeal the question was whether the defendant had, as it alleged, a prescriptive right to pollute the stream. The water company had acquired rights to the water of the stream as it was authorized to do by its charter, and it was also empowered to protect its water supply from pollution and other interference. The Supreme Court rejected the defendant's claim by referring to the evidence that the water of the stream had been suitable for human consumption a few years earlier and that its quality had improved during the preliminary injunction. Still, it was the approaching chol-

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[24] Conflicts over sewage pollution obviously occurred also before the end of the 19th century, albeit less frequently. See Peter N. Davis 'Theories of Water Pollution Litigation,' *Wisconsin Law Review* 1971: 738-816.

era and the connection between it and polluted water that most concerned the court. In its opinion, Justice Read declared

> "no right [was] gained by user to pollute the water, so as to unfit it for drinking, before that period; the actual pollution afterwards is unprotected by prescription, and was simply both a public and a private nuisance ... there is an interference with a flow of water affecting vitally a whole community, and particularly in the advent of cholera, which may be caused, and will be certainly aggravated, by the use of foul or impure water."[25]

This early case is an extraordinary one because the challenged pollution of water was of industrial origin and because the case was litigated in the advent of a cholera epidemic. The late 19th century courts did not usually side with the water companies seeking to protect the quality of their water supplies,[26] especially if the water companies supplied large cities from large navigable streams. These water companies did not usually have an alternative water supply, but it was even more difficult to grant superior rights for any community to large, navigable streams: every city had an interest not only to take water from the stream, but to discharge its wastes into it as well. The courts refused to interfere with discharging sewage into watercourses, because they did not see an alternative to it: in the light of the prevailing beliefs human wastes were more dangerous in the city than in the watercourses. Moreover, sewage treatment methods did not yet exist.

Newark Aqueduct Board v. City of Passaic (1889) from New Jersey is a case in point. Newark outgrew its earlier water supplies after the mid-19th century. The city took over

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[25] McCallum v. Germantown Water Co., 54 Pa. 40, 93 Am. Dec. 656 (1867, 664-65).

[26] An exemption from the usual treatment of water companies can be found from an Indiana case of Indianapolis Water Co. v. American Strawboard Co., 53 F. 970, 57 F.

the private water company that had supplied its water, decided to take its water from the Passaic river, and built new facilities for the purpose. Shortly after, the City of Passaic was chartered four miles upstream from Newark's water intake and made plans to build sewers discharging into the Passaic river. The Passaic was a public river by the old English definition: tide ebbed and flowed beyond the City of Passaic. The aqueduct board brought an action to enjoin the City of Passaic from completing the sewers and discharging sewage into the river, alleging that doing so would endanger public health in Newark. The water company based its case on a bacteriological explanation how the injury to public health would be worked out in Newark if the City of Passaic was allowed to discharge its sewage into the river. It backed up its case with statistics on the incidence of typhoid, cholera, and dysentery in the upper city. The case is worth citing at greater length, because it illustrates the treatment of water companies in other cases as well. In the opinion of the court, Chancellor McGill first noted on the aqueduct board's right of action:

> "As the Passaic river at Newark's water intake is a tidal stream, that city has no special right in the water of the river in virtue of its riparian ownership, nor can I see how it can claim such right under the legislation to which I have referred."[27]

1007 (C.C.D. Ind. 1893). In this case the court awarded an injunction to a water company. However, the defendant was a pulp mill, not a municipality.

[27] Newark Aqueduct Board v. City of Passaic, 45 N.J. Eq. 393, 18 A. 106 (1889, 108). See also New Boston Coal and Mining Co. v. Pottsville Water Co., 54 Penn. 164 (1867); Topeka Water Supply Co. v. City of Potwin Place, 43 Kan. 404, 23 P. 578 (1889); Helfrich v. Catonsville Water Co., 74 Md. 269, 22 A. 72 (1891). Navigability is discussed in Glenn J. MacGrady, "The Navigability Concept in the Civil and Common Law: Historical Development, Current Importance, and Some Doctrines that Don't Hold Water," *Florida State University Law Review* 3 (1975): 511-615.

The legislation, which Chancellor McGill referred to, was the charter of the company. It empowered the company to construct facilities and to obtain water rights to supply water to the inhabitants of the city. It had a right to confiscate private water rights but it only applied to ordinary watercourses, where the riparians held rights to the use of water. Chancellor McGill also ruled out a right of action in a public nuisance suit. The injury was in his opinion not different in kind from that suffered by every other citizen of the state, and the company had not been authorized to bring a suit to protect the public interest. Finally, Chancellor McGill downplayed the evidence on the prospective injury to public health. The defendant had procured chemical analyses of water quality – of the type that was developed during the earlier theories of disease – measuring the amount of organic solids in water. Their presence indicated the susceptibility of water for putrefaction and generation of odors that were deemed dangerous to public health. These traditional tests showed that the sewage discharges from the City of Passaic would disappear before reaching Newark's water intake as the result of "the river's natural tendency to purify itself." Chancellor McGill discredited the bacteriological theory of disease, which had gained foothold in the 1880s in the medical and public health circles, by arguing:

> "why, if imperceptible germs of disease, fraught with danger to health and life, continue in water after all traces of the sewage from which they come, so far as they can be detected by the chemist, are lost, have not their dangerous qualities become manifested in Newark long before this? This experience seems to be a complete negation of the danger theory advanced in support of this application, or is sufficient, at least, to render it doubtful whether the danger apprehended is more than chimerical. I deem it of sufficient weight to justify me in withholding a preliminary injunction."[28]

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[28] Newark Aqueduct Board v. City of Passaic, 45 N.J. Eq. 393, 18 A. 106 (1889, 112).

The context of the case sets Chancellor McGill's opinion into stark light. Newark had the highest mortality figures among the large cities and was pronounced the nation's unhealthiest city in the end of the century.[29] The reserved attitude of the court towards the new theory of disease was not unique, nor was this the last time when a court discredited bacteriological evidence. The Supreme Court of the United States did not fully credit bacteriological evidence presented in *Missouri v. Illinois* (1901, 1906) on the threat the sewage discharges of Chicago presented to the inhabitants of St. Louis in Missouri.[30]

The treatment of water companies in the courts directed them to rely on market transactions and the eminent domain powers granted to them for acquiring riparian land and water rights to protect the quality of their water supplies. Indeed, watershed management became and still today is an important tool for water companies and local governments to protect their water supplies. For example, the City of New York has aggressively protected its water supply in the Catskills watershed and a number of municipalities jointly established the New Jersey Water District for watershed protection. Watershed management included the control of watersheds by voluntary purchases and the taking of land and water rights, regulation of activities in it, frequent inspections of the watershed, reforestation, the building of sewage treatment plants to upstream watershed communities, and the

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[29] See Stuart Galishoff, *Safeguarding the Public Health: Newark, 1895-1918* (Westport: Greenwood Press, 1975): Stuart Galishoff, *Newark: The Nation's Unhealthiest City, 1832-1895* (New Brunswick: Rutgers University Press, 1988).

[30] Missouri v. Illinois, 180 U.S. 208 (1901), 200 U.S. 496 (1906).

control of small point-sources of pollution, such as individual farms.[31] This demonstrates how polluters have enjoyed a de facto right to use the watercourses as waste sinks.

The water companies also faced other pressures as the result of their litigation with their customers who were injured by the polluted water delivered to them. In what follows, this area of litigation will be discussed in greater detail.

Protection from and Compensation for Sickness and Death

The incidents in which water companies distributed contaminated water to their customers were extremely serious in the 19th and early 20th century, often resulting in sickness and death of a large number of people. Typhoid was the most common disease caused by the distribution of polluted water. The scale of typhoid epidemics in the late 19th century and early 20th century perhaps best illustrates how serious the problem was. Typhoid epidemics that rendered sick at least 1000 people and that killed 50 persons or more as the result of the distribution of polluted water occurred in Plymouth, Pennsylvania in 1885, in Lowell and Lawrence in Massachusetts in 1890-91, in Chicago in 1890-92, in

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[31] See e.g. Kelley v. City of New York, 27 N.Y.S. 164 (1894); Merritt v. City of New York, 21 N.Y. App. Div. 165, 47 N.Y.S. 506 (1897); In re Gilroy, 52 N.Y.S. 990 (1898); Board of Health of the State of New Jersey v. Ihnken, 72 N.J. Eq. 865, 67 A. 28 (1907). See also Jacob L. Crane, "Reforestation Progress in Pennsylvania," *The American City* 23 (1920): 403-406; Thaddeus Merriman, "Sanitation in the Catskill Watersheds," *Journal of the American Water Works Association* 13 (1925): 11-14; "Progress Report of Committee on Watershed Protection," *Journal of the American Water Works Association* 10 (1923): 453-461; Sherman E. Chase, "The Sanitation of Watersheds," *The American City* 40 (January 1929): 103-105.

Ithaca, New York in 1903, in Pittsburgh in 1902-04, in Cleveland in 1903, and in Scranton, Pennsylvania in 1906, for example.[32]

These typhoid epidemics occurred when the bacteriological theory of disease was already part of the established medical and lay knowledge.[33] The theory connected the occurrence of water-borne diseases to polluted drinking water and indicated that public health could be protected by making the water safe. Like the cholera epidemics had done earlier in the 19th century, the typhoid epidemics directly and indirectly engendered changes in common law, statutory law, and public health regulations. They also induced technological changes. Again the process of institutional change was complex: although the identification of the connection between polluted water and disease was a necessary condition for institutional change, workable technological alternatives to protect public health were also needed before institutions changed.

The courts held water companies only to a very lax standard of care before measures were available to make water supplies safe for the consumers. An example is provided by the Pennsylvania case of *Buckingham v. Plymouth Water Co.* (1891), which arose from the typhoid epidemics in Plymouth, Pennsylvania in 1885. This epidemic was the first one for which an origin could be established by the medical profession. A member of a riparian household contracted typhoid fever in winter and his excretions were thrown outside the house. The spring thaw flushed them into the river from which the water company

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[32] George C. Whipple, *Typhoid Fever: Its Causation, Transmission and Prevention* (New York: John Wiley & Sons, 1908); George A. Johnson, "The Typhoid Toll," *Journal of the American Water Works Association* 3 (1916): 249-313.

took its water, causing the epidemic. William Buckingham, the plaintiff, lost two children in the epidemic and also other members of his household became sick. He sought compensation and alleged that the water company had acted negligently when delivering polluted water. The court of common pleas granted the defendant's motion for a non-suit on the ground that the plaintiff could not show negligence. The court supported its judgment by referring to the evidence that the company did not know of the existence of typhoid fever in the house adjoining its water supply, that it had no control over the property on which the typhoid case occurred, and that nothing alerting had been observed in the inspections of the watershed by the superintendent of the company. The plaintiff had offered evidence on the existence of typhoid fever at the banks of the stream supplying water to the company and on the contamination of the water, which the company in his opinion should have known, but was denied an opportunity to present the evidence in the trial. On appeal, the Supreme Court of Pennsylvania noted in a *per curiam* opinion:

> "We need not discuss the rulings of the court below upon the plaintiff's offer of evidence, for the reason that their rejection did him no harm. The plaintiff's case disclosed no cause of action; and if the evidence rejected had been admitted, he would not have been entitled to recover."[34]

The *Buckingham* court's does not differ from those expressed in other similar contemporary cases. For example, the court of the Wisconsin case of *Green v. Ashland Water Co.* (1898) opined that the plaintiff could not recover because of the deceased Green's

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[33] On bacteriological beliefs, see Nancy Tomes, *The Gospel of Germs: Men, Women, and the Microbe in American Life* (Cambridge: Harvard University Press, 1998).

[34] Buckingham v. Plymouth Water Co., 142 Pa. 221, 21 A. 824 (1891, 824). For the origin of the Plymouth epidemic, see Whipple, *Typhoid Fever.*

contributory negligence: he should have known that typhoid fever existed in the area and was likely to be contracted by drinking from public water supply.[35] These decisions were based on an understanding that the water companies did not have the means to improve the quality of water they supplied. Although water filtration was studied in the 1880s in the Lawrence Experimentation Station in Massachusetts, its effectiveness was not universally known before the turn of the century, nor was it applicable in all circumstances. Thus verdicts against water companies would potentially have left the urbanites altogether without water supply. A bad water supply was deemed better than no supply at all, and those who had lost their health or life had to absorb their losses.

The courts required better standard of care in the beginning of the 20th century. In the Connecticut case of *Hayes v. Torrington Water Co.* (1914), the plaintiff, who had suffered typhoid fever as the result of drinking polluted water, sought damages on the basis of the water company's negligence. The trial court entered a non-suit in the customary fashion because the plaintiff had not in its opinion shown the defendant's negligence. However, the Supreme Court of Errors of Connecticut reversed the lower court's judgment on the plaintiff's appeal, and ordered a new trial. In the opinion of the court, which is representative of the similar cases litigated elsewhere at the same time, Justice Beach declared:

> "The duty which a water company owes to the public and to its customers is that of reasonable care and diligence in providing an adequate supply of wholesome water ... if the exercise of such care would have disclosed a reasonable probability of such infection, then it becomes the duty of the water company to adopt whatever approved precautionary measures are,

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[35] Green v. Ashland Water Co., 101 Wis. 258, 77 N.W. 722 (1898).

under the circumstances of the case, reasonably proper and necessary to protect the community which it serves from the risk of infection."[36]

Justice Beach also pondered whether the company should have modified its reservoirs to improve sedimentation and purification of water or have filtered water. The standard of care required from the water companies tightened when the water filtration and treatment technologies became available. The law changed because the judges knew they could require more without putting the water companies out of business and leaving the urbanites without water supply. Vice versa, water filtration and treatment became more widely adopted partly because of the pressure the court decisions and the regulations and orders of the state boards of public health put on the water companies.[37]

The next section examines the relationship between institutions and technology in private nuisance litigation between the municipal polluters and downstream riparians.

Protection against and Compensation for the Injury to Private Property

Unlike industrial polluters, municipal polluters were usually sued under the common law doctrine of private nuisance. The reason was simple. Sewage discharges created

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[36] Hayes v. Torrington Water Co., 88 Conn. 609, 92 A. 406 (1914, 407). See also Jones v. Mt. Holly Water Co., 87 N.J. Law 106, 93 A. 860 (1915); Stubbs v. City of Rochester, 226 N.Y. 516, 124 N.E. 137 (1919).

[37] In most states public health authorities imposed technological requirements on water companies when they reviewed their plans for supplying water. These statutory or common law based requirements for water companies were discussed in e.g. City of Burlington v. Burlington Water Co., 53 N.W. 246 (1892); Attorney General v. City of Grand Rapids, 175 Mich. 503,141 N.W. 890 (1913); Hayes v. Torrington Water Co., 88 Conn. 609, 92 A. 406 (1914, 407); Purnell v. Maysville Water Co., 193 Ky. 85, 234 S.W. 967 (1921); New York v. New Jersey, 256 U.S. 296 (1921).

strong stench that interfered with the use and enjoyment of riparian properties. They couls also injure the riparians' use of water, but an injury to the use and enjoyment of a residence or riparian land was typically the plaintiffs' primary complaint.[38]

At first many courts were reluctant to restrict the cities' disposal of human wastes into water. This was consistent with the medical beliefs, which considered the human wastes more dangerous within the city than in the adjacent watercourses. For example, Massachusetts courts ruled in two early cases, *Child v. City of Boston* (1862) and *Merrifield v. City of Rochester* (1872), that cities are not to be held liable for the damages occasioned by sewers if they do not act negligently. The principle was expressed clearly in *Merrifield v. City of Rochester*. In this case, a mill owner complained that the sewage and solids discharged by a city sewer damaged his boiler and interfered with his use of steam power in his mill. Thus the case was about an injury to the use of water. The trial judge sent the case to the full court to obtain instructions as to how to proceed in it. In the full court's opinion, Justice Wells declared:

> "For the incidental disadvantage, loss or inconvenience necessarily resulting to individuals ... from such action; or from the execution of the work, in a proper and skillful manner ... or from the maintenance and use of the drains ... without negligence in their care and management, no action of tort can be maintained against the city. This exemption of municipal bodies ... from liability, and corresponding subordination of individual rights and interests to the safety, health, and welfare of the general public, is a principle of frequent application."[39]

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[38] On common law actions, see Farnham, *Law of Waters*; American Law Institute, *Restatement of the Law of Torts* (St. Paul: American Law Institute, 1934-39). On private nuisance cases against municipal polluters, see Davis, "Water Pollution Litigation."

[39] Merrifield v. City of Worcester, 110 Mass. 216, 14 Am. Rep. 592 (1872, 597). See also Child v. City of Boston, 4 Allen 41, 81 Am. Dec. 680 (1862). Traditionally, local governments were not liable in their governmental role. However, they adopted in the

Justice Wells instructed the assessors to find out whether the city had acted negligently, to verify if the plaintiff had a right of action. By applying the doctrine of negligence – which was developed to resolve conflicts over accidental injuries – to intentional injuries, the courts effectively relieved the municipalities from liability for the injuries they created. The sewerage systems were designed, constructed, and operated for the very purpose that injured downstream riparians. Thus the municipalities could not often be shown to have acted negligently. Behind the ruling may have been a view that a greater evil, a threat to public health, was avoided by letting a smaller evil, an interference with riparian rights, to take place. The courts were less tolerant to physical interference with the use of residences and riparian land by strong stench, flooding, or depositing of solids: cities were not seen to have a right to create either a private or public nuisance.[40]

The Massachusetts rulings were modified in Indiana to restrict the liability of municipalities even further. The Supreme Court of Indiana adopted a categorical balancing rule in favor of municipal polluters which was much like the Sanderson rule applied in Pennsylvania in riparian rights litigation over mine drainage in favor of the mining companies.

19th century "non-governmental" activities, such as investments in and maintenance of physical urban infrastructure. After a period of search of applicable legal principles, local governments were held subject to the same rules of liability as private persons when undertaking these activities. Therefore, these decisions may portray a confusion over the legal principles applicable to local governments.

[40] That cities do not have a right to create a nuisance was expressed in Brayton v. City of Fall River, 113 Mass. 218, 18 Am. Rep. 470 (1873, 473). The *Merrifield* opinion went further by allowing uncompensated injuries to private property. The doctrine of negligence was appropriate when sewers caused accidental injuries by flooding a property or a

The Supreme Court of Indiana expressed its dilemma clearly in *City of Valparaiso v. Hagen* (1899). In this case, nineteen downstream riparians sought an injunction to prevent the City of Valparaiso from constructing sewers and discharging sewage into the Salt Creek. The circuit court granted injunction to the plaintiffs, and the defendant appealed. In the opinion of the Supreme Court of Indiana, which reversed the lower court's judgment, Justice Hadley argued:

> "to forbid a discharge of sewage into Salt creek is to deny to the city the right to discharge it anywhere, and thus to leave it without ordinary means of sanitation. ... sewage must be dispatched or the city abandoned. ... the principle of the greatest good to the greatest number must be permitted to operate, and private interest yield to the public good"[41]

Not all courts were as generous toward the municipal polluters as those of Indiana. Even the courts of Massachusetts tightened up their line, which is already visible in *Middlesex Co. v. City of Lowell* (1889). In this case, a manufacturing establishment sought to restrain the City of Lowell from discharging sewage into its mill pond, where it settled on the bottom of the pond and produced bad-smelling gases. In his opinion, Justice Oliver Wendell Holmes preceded his granting of injunction to the plaintiff by a blunt statement on the legal principles that governed the case:

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cellar with sewage, for example. See Rowe v. Portsmouth, 56 N.H. 291, 22 Am. Rep. 464 (1876); Krantz v. Baltimore City, 64 Md. 491, 2 A. 908 (1886).

[41] City of Valparaiso v. Hagen, 153 Ind. 337, 74 Am. St. Rep. 305, 54 N.E. 1062 (1899, 1064). See also City of Richmond v. Test, 18 Ind. App. 482, 48 N.E. 610 (1897). On the Sanderson rule, see Pennsylvania Coal Co. v. Sanderson and Wife, 113 Pa. 126, 6 A. 453 (1886). These late 19th century cases have a "all or nothing" conception of the use of watercourses for disposing of wastes. Sewage treatment methods already existed, but they were not widely used and became more common later in the early 20th century.

> "plaintiff is entitled to an injunction, unless the defendant has acquired a prescriptive right to discharge through its sewers upon the plaintiff's land, substantially, the amount which it now discharges"[42]

Rulings against municipal polluters were also routinely delivered elsewhere. The Supreme Court of Illinois affirmed injunctions enjoining municipalities from discharging sewage in *City of Jacksonville v. Doan* (1893) and *Village of Dwight v. Hayes* (1894). The former case was brought by a riparian, whose residence was plagued by odors so strong in the summertime that "the occupants could not sleep unless the doors and windows were closed; that the members of his family were rendered sick and vomited from the effects of stench; and that his place was rendered unhealthy; and, indeed unfit to occupy as a residence."[43] In the latter case, a downstream riparian successfully sought to enjoin the construction of a sewer system by an upstream village. Similar judgments were made in California, Connecticut, New York, New Jersey, North Carolina, and Pennsylvania.[44]

The courts delivered strict judgements mainly in those states that also had strong departments of public health and new water pollution control statutes: the courts in these states were well informed about the consequences of their choices and the technological alternatives that were available for the defendants. It is also likely that the legislative in-

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[42] Middlesex Co. v. City of Lowell, 149 Mass. 509, 21 N.E. 872 (1889, 873).

[43] City of Jacksonville v. Doan, 145 Ill. 23, 33 N.E. 878 (1893, 880). For the other Illinois case, see Village of Dwight v. Hayes, 150 Ill. 273 37 N.E. 218 (1894).

[44] See, for example, Peterson v. City of Santa Rosa, 119 Cal. 387, 51 P. 557 (1897); Morgan v. City of Danbury, 67 Conn. 484, 35 A. 499 (1896); Nolan v. City of New Britain, 69 Conn. 668, 38 A. 703 (1897); Chapman v. City of Rochester, 110 N.Y. 273, 18 N.E. 88 (1888). Attorney General v. City of Paterson, 58 N.J. Eq. 1, 42 A. 749 (1899); Rhodes v. City of Durham, 81 S.E. 938 (1914); Good v. City of Altoona, 162 Pa. 493, 29

terventions to public health and water pollution that had created the health departments and water pollution control statutes also called for and legitimated judicial interventions to them. Anyway, the strict judgements delivered by the courts induced technological change by forwarding the development and adoption of sewage treatment methods. For example, the adoption of a sewage treatment method is already discussed as a routine matter the defendant had left without due attention in the Michigan case of *Attorney General v. City of Grand Rapids* (1913).[45]

This analysis demonstrates that institutions and technology were intertwined in all areas of water pollution litigation. The law was influenced by what technological alternatives were seen to be available and it influenced what technologies were available and used. The legislatures still remained under pressure to improve the protection of new interests in water quality, because the remedies delivered by the courts were not satisfactory to the water companies nor for their customers. This pressure resulted in the establishment of new institutional solutions at the end of the 19th century. They are discussed in greater detail in the next section.

Water Pollution Control Statutes and State Boards of Health

Early water pollution control statutes often reiterated the common law of public nuisances by prohibiting the intentional spoiling or poisoning of water supplies and the throwing of carcasses into them. Most of them were enforceable only by the state or its

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A 741 (1894); Blizzard v. Borough of Danville, 175 Pa. 479, 34 A. 846 (1896); Owens v. City of Lancaster, 182 Pa. 257, 37 A. 858 (1897).

Attorney General, because a right of action was not granted to the injured parties nor to the local boards of public health. The early water pollution control statutes were occasionally enforced. An example is *State v. Wheeler* (1882) from New Jersey. However, cases of enforcement are rare considering how common the statutes were.[46] This reflects the unwillingness of public plaintiffs to initiate enforcement actions.

Other early statutes prohibited the pollution of watercourses used as a public water supply and granted to a water company a power to protect its water quality against upstream polluters. An example is offered by *Lewis v. Stein* (1849) from Alabama, which was litigated after the second cholera epidemic. The Act of 1820 incorporating the water company of Mobile made it an offense to obstruct the Three Mile creek or to place logs, bushes, earth, or other material into it. The proprietor who operated Mobile's water works sued an upstream mill owner who had discharged sawdust into the creek. The circuit court made a verdict to the plaintiff. On appeal, the higher court affirmed the judgment. In the words of Justice Dargan,

> " the legislature of the state passed the act under which this suit is brought, imposing a penalty on any one who should obstruct or injure the waters of the creek... This act is still in force, and has been by several subsequent acts recognized as an existing law. We then have the clear and unequivocal evidence of the legislative will that no one should injure the waters of this

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[45] Attorney General v. City of Grand Rapids, 175 Mich. 503,141 N.W. 890 (1913).

[46] *State v. Wheeler* (44 N.J.L. 88, 1882) was about the enforcement of a statute that reiterated the common law of public nuisances. See also State v. Buckman, 8 N.H. 203 (1836). A water company did not have a right of action under a similar statute in Topeka Water Supply Co. v. City of Potwin Place, 43 Kan. 404, 23 P. 578 (1889). Arkansas, Delaware, Florida, and Georgia had only rudimentary statutes at the turn of the 20th century. See Goodell, *Laws Forbidding Pollution,* 34-35.

particular stream. In opposition to this act prohibiting an injury to the water, we can not infer a grant or authority to do so in violation of the act."[47]

However, in many states early water pollution control statutes did not delegate a clear right of action to the local governments or water companies.[48] There were also other reasons why a local government or a water company could not have a right of action to protect its interests successfully in the courts, such as its taking of water from a navigable river in which tide ebbed and flowed.[49] Furthermore, the courts were often simply reluctant to constrain the use of water or land by others and expected the local governments and water companies to utilize their statutory authority to purchase or to take land and water rights to protect their water supplies.[50] Both became common practices in watershed management, as they are still today.

Water pollution control statutes became more comprehensive after the establishment of state boards of health. The first state board of public health was established in Massachusetts in 1869 by a statute that also required it to investigate the causes of sickness and death and the effects of localities, employment, and circumstances on public health, and to present initiatives for legislation.[61] The board consisted of seven members, nominated by the governor, and a secretary chosen by the board. None of the positions, except that of

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[47] Lewis v. Stein, 16 Ala, 214, 50 Am. Rep. 177 (1849, 180). Statutes that applied to individual watercourses were common in the 19th century. They established and vested in the water companies or local governments the authority to protect their water supply.

[48] Topeka Water Supply Co. v. City of Potwin Place, 43 Kan. 404, 23 P. 578 (1889).

[49] See Newark Aqueduct Board v. City of Passaic, 45 N.J. Eq. 393, 18 A. 106 (1889).

[50] See People v. Hulbert, 131 Mich. 156, 91 N.W. 211 (1902); City of Battle Creek v. Goguac Resort Association, 181 Mich. 241, 148 N.W. 441 (1914).

the secretary, were paid. The board was authorized to investigate the pollution of waters in the state in 1875 and three years later it was delegated "the general supervision of all rivers, streams, and ponds ... which are or shall be used by any city or town as a source of water supply." The statute of 1878 also prohibited the discharging of human excrement, sewage, drainage, refuse, and polluting material into the watercourses from which water was taken for public use within twenty miles upstream from the water intake. However, it exempted the badly polluted industrial rivers of Merrimac, Connecticut, and sections of Concord, and all acquired rights to pollute any watercourses. Finally, in 1886 the state legislature established the Lawrence Experimentation Station and empowered the state board of health to experiment with water and wastewater treatment methods. The water companies and polluters were also required to report to the state board of health.[51]

The 1869 example of Massachusetts in establishing a state board of health was followed in California 1870, Washington DC 1871, Minnesota 1872, Virginia 1872, Michigan 1873, Maryland 1874, Alabama 1875, Wisconsin 1876, and Illinois 1877. All states established departments of public health by the First World War. At first the state boards were authorized to investigate water pollution, its consequences, and ways to abate it.

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[51] The board was established by "*An Act to Establish a State Board of Health,*" Massachusetts Acts and Resolves 1869, Chapter 420, Section 2 (June 21, 1869), pp. 738-739, 738. The granting of only investigative powers was common in the late 19th century. See Leroy Parker and Robert H. Worthington, *The Law of Public Health and Safety, and the Powers and Duties of Boards of Health* (Albany: Mathew Bender, 1892), p. 85. On authorization to investigate the pollution of watercourses, see Massachusetts Acts and Resolves 1875, Chapter 192 (May 8, 1875). The discharge prohibitions were established by Massachusetts Acts and Resolves 1878, Chapter 183, Section 4 (April 26, 1878). Experimentation with water and sewage treatment and reporting requirements were based on Massachusetts Acts and Resolves 1886, Chapter 274 (April June 9, 1886). See Rosenkrantz, *Public Health And The State.*

Their findings on water pollution problems, their effects, and the ways to mitigate them strengthened the position of local boards of public health and water companies in the courts. State boards also successfully promoted new water pollution control legislation on the basis of their investigations.

Some states authorized their state boards of health to administer and enforce statutory water pollution control programs already in the late 19th century, and others followed after the turn of the century.[52] In his review of the state departments of public health in 1916, Charles Chapin assessed those of Massachusetts, New York, Pennsylvania, New Jersey, and Maryland to be the best in the country in overall terms. With the exception of New York, these states also fared best in Chapin's assessment of their ability to control water and sewage. These states were also the first ones to enact comprehensive water pollution control statutes.[53]

A typical comprehensive water pollution control statute prohibited the discharging of sewage and possibly other wastes to those watercourses from which water was taken for public use. They still often exempted certain discharges, industries, or watercourses from their provisions. The statutes also often authorized the state boards of health to promulgate regulations and established reporting requirements for the local boards of public

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[52] On state boards of public health, see Goodell, *Laws Forbidding Pollution*; Parker and Worthington, *Law of Public Health and Safety*; Stanley D. Montgomery and Earle B. Phelps, *Stream Pollution: A Digest of Judicial Decisions and A Compilation of Legislation Relating to the Subject* (Washington; US Public Health Service, Public Health Bulletin 87, 1918); George C. Whipple, *State Sanitation: A Review of the Work of the Massachusetts State Board of Health* (Cambridge, 1917).

health, water companies, and municipal polluters. Sometimes the statutes granted the power to enforce statutory provisions and regulations only to the state boards of health or to the state courts, while at other times the local boards of public health were authorized to enforce the statutes.[54]

The courts endorsed the states' use of police power to protect public health at the turn of the 20th century, when typhoid epidemics ravaged many large cities. The bacteriological theory of disease was already an accepted part of the medical and lay knowledge in the early 20th century. It provided a firm basis for identifying threats to public health and their creation by, for example, polluting water supplies was not considered a part of private property rights. Therefore, the regulation of polluters' activities was deemed as legitimate exercise of police power. The typhoid epidemics added weigh, urgency, and legitimacy to the public interventions.

City of Durham v. Eno Cotton Mills (1906) from North Carolina provides an example. The City of Durham complained that sewage discharged from a mill into the Eno river 18 miles upstream from its water intake polluted its water supply. The city requested an injunction on the basis of a statute that prohibited sewage discharges into the watercourses that supplied the public. The trial court granted the requested injunction, and the defen-

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[53] On the establishment of state boards, see Charles Rosen, *History of Public Health*, 224. See also Charles V. Chapin, *A Report on State Public Health Work* (Chicago, 1916), pp. 61 and 195-196. On statutes, see Goodell, *Laws Forbidding Pollution.*

[54] See Goodell, *Laws Forbidding Pollution*; Montgomery and Phelps, *Stream Pollution*; Special Advisory Committee on Water Pollution, *Report (First) on Water Pollution* (Washington, 1935); Special Advisory Committee on Water Pollution, *Water Pollution in the United States: Third Report* (Washington, 1939).

dant appealed. In the opinion of the Supreme Court of North Carolina, Justice Walker affirmed the lower court's granting of injunction:

> "We must assume that the defilement of the water is an injury which is forbidden by the Legislature for perfectly good and sufficient reasons. It is not for us to question the policy or expediency of such an enactment. In this respect the Legislature has a large discretion ... Such legislation is not intended merely to abate an existing nuisance, but to prevent that being done which is a menace to the public health, and which it is supposed may become a deadly peril and a public nuisance because fatal in its consequences. It is not, therefore, a void law because it is founded upon mere apprehension of evil, but is a precautionary measure which is clearly within the police power of the state"[55]

Similar cases were litigated in other states, such as Massachusetts, New Jersey, and Pennsylvania, that had progressive water pollution control policies.[56] However, a number of them were litigated against industrial polluters that discharged sewage or other wastes from their mills into watercourses, or against unimportant violators of the regulations protecting watersheds. State health departments occasionally litigated cases against municipal polluters, but they are very uncommon considering that every municipality that had sewers discharged sewage into the nearest watercourse, and that municipalities frequented the courts as defendants in private nuisance litigation.

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[55] City of Durham v. Eno Cotton Mills, 141 N.C. 615, 54 S.E. 453 (1906, 461).

[56] See Stone v. Heath, 179 Mass. 385, 60 N.E. 975 (1901); Sprague v. Dorr, 69 N.E. 344 (1904); State Board of Health v. Jersey City, 55 N.J. Eq. 116, 35 A. 835 (1896); State v. Diamond Mills Paper Co., 63 N.J. 111, 51 A. 1019 (1902); State Board of Health v. Borough of Vineland, 72 N.J. Eq. 862, 68 A. 110 (1907); Board of Health of the State of New Jersey v. Ihnken, 72 N.J. Eq. 865, 67 A. 28 (1907); Commonwealth v. Emmers, 70 A. 762 (Pa., 1908); Commonwealth v. Kennedy, 87 A. 605 (Pa., 1913). See also Miles City v. Montana State Board of Health, 39 Mont. 405, 102 P. 696 (1909); State v. Morse, 84 Vt. 387, 80 A. 194 (1911).

Indeed, state health departments had another front to protect public health in addition to the legal one: technology. The establishment of the Lawrence Experimentation Station by the legislature in Massachusetts in 1886 is the most obvious example of promotion of technological development under the auspices of state health departments. However, research and technological development had a much broader base in state health departments and it resulted in many innovations related to water supply and sanitation that are in everyday use still today.[57] These innovations include slow filtering of raw water, the treatment of drinking water with chlorine, ozone, and ultraviolet light, and the active sludge method of sewage treatment.

The new technological solutions were spread out with the support of new water pollution control statutes, which required the submission of plans and designs for new water works and sewage treatment plants for review by the state board of health. The sanitary engineers who reviewed the plans were eager to promote the use of water filtration and treatment instead of universal waste water treatment. In their opinion, the former alternative was less costly and allowed the streams to be used more fully for inexpensive waste disposal. As George C. Whipple said,

> "the greater the natural purity of the water the less work is demanded of a purification plant... It is possible, however, to overemphasize the relative results that can be accomplished by prevention of pollution... It is of course desirable that our streams and lakes be kept pure, and this is especially true when such waters are to be afterwards used as sources of water supply. Nevertheless a small amount of pollution can be more readily and

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[57] See, for example, Rudolf Hering, "Sewage and Solid Refuse Removal" in *A Half Century of Public Health*, ed. Mazyck Ravenel (New York: Arno Press, 1921); George C. Whipple, "Fifty Years of Water Purification," in *A Half Century of Public Health*, ed. Mazyck Ravenel (New York: Arno Press, 1921).

> efficiently removed by modern devices for purifying water, and at much less cost, than by the methods of purifying sewage. That it is cheaper to purify water than it is to purify sewage should be apparent to anyone who thoughtfully considers the nature of these two liquids."[58]

Pronouncements like this were part of the Progressive mindset in the early 20th century. For the Progressives, social reform should forward social welfare. Like the better-known strand of the Progressive thought that focused on the conservation of natural resources such as forests, soil, and water resources,[59] the public health professionals of the Progressive Era sought to conserve the "vital" or human resources of the nation. Although welfare-seeking, the sanitary engineers and public health professionals were not self-centered as the naïve theory of institutional change would assume. They engaged in this early "technology forcing" on the basis of their new bacteriological understanding and welfare-centered values so as to maximize social welfare, not their own. The legislatures and administrative agencies were more amenable to the Progressive beliefs than the courts, which are usually more insulated against changes in social values.

The next section examines how effective the new institutional and technological measures were in the protection of public health.

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[58] See George C. Whipple, "Clean Water as a Municipal Asset," *The American City* 4 (1911): 161-165. See also George W. Fuller, "Is it Practicable to Discontinue the Emptying of Sewage into Streams?" *The American City* 7 (1912): 43-45; George G. Whipple, "Standards of Purity for Rivers and Waterways," *The American City* 7 (1912): 559-561; H. Burdett Cleveland, "The Economics of Sewage Disposal," *The American City* 23 (1923): 235-236.

Chlorine Treatment for Water and Legal Institutions

The effectiveness of early institutions that governed water quality to protect public health naturally varied from state to state. It depended on many factors, such as on the strain put on the watercourses by waste disposal; the behavior of polluters, public health authorities, and those suffering from water pollution; and the design of legal institutions within which water pollution control activities took place. Understanding water pollution control statutes as institutions governing water quality helps to assess how their ability to protect public health improved during the 19th and early 20th century, and what problems still imbued them after the First World War.

The governance approach emphasizes that management of environmental resources toward any goal requires effective exclusion of unauthorized users, regulation of authorized users, monitoring of resource use and compliance with its rules, enforcement of the rules of resource use, inexpensive conflict resolution, and collective choices over the rules of resource use that are open for the resource users to participate in.[60] Resource and community attributes and the design of governance institutions influence how effectively these functions of governance can be carried out.

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[59] On the Progressive conservation movement, see Samuel P. Hays, *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890-1920* (Cambridge: Harvard University Press, 1959).

[60] See Bonnie McCay, 'Common and Private Concerns,' in *Rights to Nature: Ecological, Economic, Cultural, and Political Principles of Institutions for the Environment*, eds. Susan S. Hanna, Carl Folke, and Karl-Göran Mäler (Washington: Island Press, 1996); Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990); Edella Schlager and Elinor Ostrom, "Property-Rights Regimes and Natural Resources: A Conceptual Analysis," *Land Economics* 68 (1992): 249-262.

The early governance institutions – the common law of public nuisances and the early statutes that reiterated common law – hardly accounted for anything. The way they excluded unauthorized resource users was problematic. They prohibited only specific water uses that were deemed harmful to public health and retained otherwise open access to watercourses. Both the common law of public nuisances and early water pollution control statutes made it necessary to determine in each case whether the pollution of a watercourse was prohibited or not. This definition of exclusion also complicated the regulation and monitoring of water use and the enforcement of the rules of water use. For these and other reasons, the common law of public nuisances and early water pollution control statutes were enforced only sporadically: when there was an epidemic or another imminent threat to public health, for example.

While water pollution control statutes contained in the early 20th century a more general exclusion of polluters and were easier to enforce, they weren't without problems. In some states, such as Massachusetts, the statutes exempted already acquired rights to pollute. Other states exempted all existing industrial discharges or discharges of specific industries, usually of those which were the most important for the state's economy. Moreover, sometimes the statutes only applied to watercourses from which water was taken for public use. Even more commonly, they excluded the most intensively polluted rivers of the state. Thus only a fraction of polluters and waters were actually subject to the new rules of water use. Even more importantly, early administrative agencies enjoyed wide discretion consistently with the Progressive Era's belief in the expert's ability to solve problems. Wide discretion enabled the public health professionals to seek public health

and welfare goals by influencing the technological choices of water companies rather than by enforcing the legal institutions that were in the statute books.[61]

Still, the governance institutions improved during the period so as to better protect the public health. The appearance of local boards of public health and state boards of health improved the regulation of resource use, monitoring of water use, and the enforcement of rules of water use in comparison to the earlier situation in which private plaintiffs protected their interests in a healthy environment in the courts with public nuisance suits. The movement from local to state-wide governance took place because the use of water resources intensified and the scale of its harmful consequences increased. The summary powers of local boards of health and their hearings lowered the costs of conflict resolution, as now only a fraction of conflicts resulted in costly court proceedings. These changes in governance made it less costly to intervene into a resource use that was deemed to impair public health. Whether this was enough to improve public health depended on the change in the scale and nature of activities that threatened it, but even allowing for that, the answer must be affirmative.

Decrease in typhoid mortality is a measure of the performance of new institutional solutions. In Massachusetts typhoid mortality decreased from 91 per one hundred thousand population in 1870 to about one third or 37 by 1890. This decrease was achieved when

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[61] For an example of the exclusion of particular watercourses, see Massachusetts Acts and Resolves 1878, Chapter 183, Section 3 (April 26, 1878). This exemption is discussed in Brookline v. Mackintosh, 133 Mass. 215 (1882). Industrial discharges were exempted in Connecticut and New York, while Nevada, South Dakota, and Virginia exempted discharges from mines and New Hampshire discharges of the forest industry. For other examples, see Goodell, *Laws Forbidding Pollution*; Special Advisory Committee on Water Pollution, *Water Pollution in the United States.*

the control of discharges and the protection of watersheds were the only means to reduce typhoid mortality, as water filtration had not yet become widely adopted. In the following twenty years typhoid mortality again dropped to about one third, reaching 13 in 1910. This drop was based on the control of discharges, protection of watersheds, and filtration of supplied water. Chlorine treatment was used only after 1910 and it caused a further drop in typhoid mortality from 13 to 2 in just a decade by 1920. The total reduction in typhoid mortality between 1870 and 1920 was impressive 98 percent.[62] The figures for Massachusetts are representative of other Eastern and Midwestern states, which were vanguards of public health. According to Whipple, the combined typhoid mortality for all New England states and the states of New York, New Jersey, Maryland, California, Minnesota, and Michigan dropped from 55 in 1880 to 21 in 1905 per 100.000 population. This decrease is very similar to that experienced in Massachusetts.

The control and abatement of sewage discharges, other measures for watershed protection, water filtration, and water treatment were obviously not the only factors that brought about the decrease typhoid mortality. A number of other factors were involved. The general improvement in personal and food hygiene, improved nutritional status, better medical care, and health education all contributed to it. Still, it is fair to say that improved

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[62] For the figures, see Rosenkranz, *Public Health And The State,* p. 223; Whipple, *Typhoid Fever*. See also Gretchen A. Condran, Henry Williams, and Rose A. Cheney. "The Decline of Mortality in Philadelphia from 1870 to 1930: The Role of Municipal Services," *Pennsylvania Magazine of History and Biography* 108 (1984): 153-177.

water supply and sanitary practices and the control of water pollution were responsible for a significant proportion of this decrease in mortality.[63]

Although technological developments in at the turn of the 20th century were largely responsible for safeguarding public health from water-borne diseases, they rendered the legal institutions of water pollution control redundant. The filtration and chlorine treatment of water before its distribution to consumers made it possible to use watercourses for disposing of sewage without endangering public health: there was no longer an urgent need to control and to abate sewage discharges, and the legal rules that required it could be ignored. The decrease of cases initiated by public plaintiffs under the water pollution control statutes from the previous higher level after the First World War speaks of this attitude toward water pollution control.[64]

Water pollution control statutes ceased to be enforced partly because of the Progressive Era's beliefs and the way they informed the organization of public administration. The Progressives held in high esteem the ability of experts to solve problems and sought to free them from the political restraints that had impaired the effectiveness of local public administration in the era of political machines. The new breed of public health and sanita-

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[63] See Whipple, *Typhoid Fever,* 108. See also Fogel, "Nutrition and the Decline in Mortality; Thomas McKeown, *The Modern Rise of Population* (London: Edward Arnold, 1976); Edward Meeker, "The Improving Health of the United States, 1850-1915," *Explorations in Economic History* 9 (1972): 353-373; Edward Meeker, "The Social Rate of Return on Investment in Public Health, 1880-1910" *Journal of Economic History* 34 (1974): 392-419; Simon Szreter, "Economic Growth, Disruption, Deprivation, and Death: On the Importance of the Politics of Public Health for Development," *Population and Development Review* 23 (1997): 693-728.

[64] See Davis, "Water Pollution Litigation" and *American Digest: Century Edition* (St. Paul: West Publishing Co., 1897-1904) and the following decennial editions.

tion experts thus had a wide discretion and could choose not to pursue the enforcement of water pollution control statutes that were seen as redundant. Instead, their utilitarian mindset demanded full use of watercourses for disposing of wastes as this, in their opinion, promised greater net benefits for society than better in-stream water quality. Social movements, such as the Audubon Society and the Izaak Walton League, which demanded stricter water pollution control since the early 20th century, needed a long time before they could have their interests count in the public health administration that was fortified against outside interference.

Conclusions

Legal institutions for the protection of public health underwent several changes in the 19th and early 20th century. The common law of public nuisances was the traditional legal foundation for the protection of public health by both public and private plaintiffs. During the 19th century, local boards of public health and local ordinances were established in a growing number of communities to complement the common law of public nuisances. State boards of health were then established in the last quarter of the 19th century. Statutory water pollution control programs were developed along with other public health legislation after the establishment of state boards of health and existed in a number of states in the beginning of the 20th century.

The establishment of local boards of public health and public health ordinances benefited most residents of local communities and was against the interests of operators of water-powered mills and "nuisance industries," such as slaughtering or rendering establishments. Lower class residents could also be injured, as they were considered harboring

vice and disease and thus a prime target for middle-class interventions. The establishment of state boards of health and water pollution control statutes created diffuse health and amenity benefits to the residents of the local communities and the state. They limited decision-making authority and increased tax burden in local communities and increased the costs of water companies and industry as well. Injured were also the property owners and small enterprises whose waste disposal became an object of state intervention.

The changes in institutions that protected public health were related to changes in the use of water. An interdependence was first perceived to prevail between the producers of filth and odors and the public's health. The local boards of public health and health ordinances were an institutional response to this interdependency. Another response to the intra-locality interdependence was the construction of networked water supply and sewer systems. They soon made whole communities interdependent: an upstream community's disposal of human wastes spoiled the downstream community's water supply and endangered its health. State boards of health and water pollution control statutes were an institutional response to this interdependency. Another response was the development of methods for sewage treatment and water filtration and treatment, of which the latter ones became dominant.

Values and beliefs were centrally involved in the foregoing institutional changes. The religious beliefs of the early 19th century considered health a private matter which could be protected with an action in the court, if necessary. Secularization and the new findings on the connection between the occurrence of disease and environmental quality provided an agenda for reform and legitimated it; this partly explains the establishment of both local and state boards of health. The new public bodies such as the state boards of health also

cultivated professionalism and created a breed of public-spirited authorities. This culminated in the Progressive Era, when the public health authorities and sanitary engineers made institutional and technological choices so as to generate "the greatest good for the greatest numbers."

Also other factors were involved in the institutional changes that occurred in the 19th and early 20th century in the protection of public health. The cities changed from the turn of the 19th century homogeneous middle-class "Arcadia" into large industrial centers with diverse populations and deep social stratification. At the same time, the participation of lower social classes in collective choices gradually expanded. The direct political decision-making authority thus gradually moved away from the wealthiest social classes to the poorer ones. This possibly decreased hesitation to regulate the use of private property. On the other hand, populist political leaders were not particularly keen on public health reform, which was perceived as a middle-class concern.

This chapter has also brought up issues that illuminate arguments made in the theoretical section of this dissertation. The development of institutions for the protection of public health demonstrates how importantly knowledge and beliefs frame choices and how a change in them may rapidly result in institutional change. Witness, for example, the rapid adoption of local and state boards of public health after the connection between public health and environmental quality was made. Another issue the analysis illustrates well is the influence of a change in resource use and technology on governance. Changes in water use and sanitation because of the establishment of the networked urban systems first rendered the local institutional solutions for the protection of public health obsolete. Later, changes in water supply technology enabled the state authorities to cease enforcing

the water pollution control statutes. This brings up the third important point: the influence of the institutional framework and institutional decision rules on choices. The new administrative agencies enjoyed wide discretion and could make important political choices.

Water pollution became a complex problem in the early 20th century. Municipal sewage discharges from an increasing number of growing cities rendered many watercourses practically open sewers. At the same time, industrial discharges grew and their nature changed. Moreover, watercourses were put in a greater number of uses than earlier. Common law formed the core of institutions that governed water quality at the turn of the 20th century. Statutory water pollution control programs complemented it in a number of states. Yet both of them were unable to resolve interstate conflicts over water pollution, which became common at the turn of the 20th century. The next chapter examines institutional responses to them in greater detail.

5. INTEREST CONFLICTS, CHANGING POLICY ARENAS, AND THE 20TH CENTURY FEDERAL WATER POLLUTION CONTROL POLICY

> "But in choosing between social arrangements ... we have to take into account the costs involved in operating the various social arrangements (whether it be the working of a market or of a government department) as well as the costs involved in moving to a new system."[1]

This chapter examines how the institutional framework structures collective choices and how the institutional framework and the design of governance institutions influence whose resource use goals are realized. The chapter's empirical focus is on the development of federal water pollution policy in the 20th century.

The federal government became involved in water pollution control when the Congress enacted the Rivers and Harbors Act of 1899, which prohibited the throwing of refuse and wastes into navigable waters.[2] Next the Congress enacted The Oil Pollution Act of 1924, which prohibited the discharge of oil from vessels into coastal waters.[3] However, these statutes only protected navigation and did not address the water pollution problems that most concerned the public: local and interstate pollution of water by sewage and in-

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[1] See Ronald H. Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (1960): 1-44; 44.

[2] See Rivers and Harbors Act, § 13, 30 Stat. 1152 (1899). See also Albert E. Cowdrey, "Pioneering Environmental Law: The Army Corps of Engineers and the Refuse Act," *Pacific Historical Review* 44 (1975): 331-349; N. William Hines, "Nor Any Drop to Drink: Public Regulation of Water Quality, Part III: The Federal Effort," *Iowa Law Review* 52 (1967): 799-861.

[3] Oil Pollution Act, 43 Stat. 604 (1924). See also Hines, "Nor Any Drop to Drink III."

dustrial discharges which endangered public health and injured private and public interests. Chemical and toxic pollution also became common at the turn of the 20th century.[4]

Despite the conservation movement's promotion, the federal government avoided further direct involvement in water pollution control until the enactment of the Water Pollution Act of 1948.[5] However, the federal government was drawn into water pollution control indirectly. The states used the Supreme Court of the United States to resolve their conflicts in a string of cases that started with *Missouri v. Illinois* in 1901.[6] The federal government also promoted interstate compacts to resolve these conflicts cooperatively.[7] Third, the federal government established the US Public Health Service in 1912 with

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[4] See H. M. Beardsley, "Interstate Pollution of Streams," *Journal of the American Water Works Association* 15 (1926): 335-340; John Emerson Monger, "Administrative Phases of Stream Pollution Control," *American Journal of Public Health* 16 (1926): 789-794. See also Joel A. Tarr, "Searching for a Sink for an Industrial Waste: Iron-Making Fuels and the Environment," *Environmental History Review* 18 (1994): 9-34; Andrew Hurley, "Creating Ecological Wastelands: Oil Pollution in New York City, 1870-1900," *Journal of Urban History* 20 (1994): 340-364.

[5] Water Pollution Control Act, 62 Stat. 1155 (1948). See also Hines, "Nor Any Drop to Drink III." Federal government's involvement hinged on its jurisdiction over the matter, which was long seen to be based on interstate commerce clause. See Sidney Edelman, "Federal Air and Water Control: The Application of the Commerce Power to Abate Interstate and Intrastate Pollution," *George Washington Law Review* 33 (1965): 1067-1087.

[6] See Missouri v. Illinois (Demurrer) 180 U.S. 208 (1901); Missouri v. Illinois 200 U.S. 208 (1906). See also New York v. New Jersey, 256 U.S. 296 (1921), Sanitary District of Chicago v. United States, 266 U.S. 405 (1925), Wisconsin v. Illinois, 278 U.S. 367 (1927), Wisconsin v. Illinois, 281 U.S. 179 (1929), New Jersey v. City of New York, 283 U.S. 473 (1931), New Jersey v. City of New York, 289 U.S. 712 (1932), New Jersey v. City of New York, 290 U.S. 237 (1933), and Wisconsin v. Illinois, 289 U.S. 395 (1933).

[7] See Edward J. Cleary, *The ORSANCO Story: Water Quality Management in the Ohio Valley under an Interstate Compact* (Baltimore: Johns Hopkins University Press for the Resources for the Future, 1967); N. William Hines, "Nor Any Drop to Drink: Public Regulation of Water Quality, Part II: Interstate Arrangements for Pollution Control," *Iowa Law Review* 52 (1966): 432-457. See also Seth G. Hess, "Interstate Action to Control Pollution," *State Government* 23 (1950): 204-207.

authority to investigate water pollution and its effects on public health.[8] Fourth, the Joint International Commission, based on the Boundary Waters Treaty between the United States and the United Kingdom, was involved in the water pollution problems in the Great Lakes area since the early 20th century.[9]

The federal government became directly involved in water pollution control after the Second World War and its role grew steadily thereafter. The Water Pollution Control Act of 1948 limited the federal government's role to interstate water pollution problems and only gave a temporary existence to the federal program. It took a quarter of a century and several amendments to transfer the principal responsibility for water pollution control from the states to the federal government and to erase those institutional design principles from the federal water pollution control program that made it ineffective.[10] Even after the reform of 1972 the federal program did not control all sources of water pollution and remained far from effective.

In what follows, the first section examines water pollution problems and the federal government's role before the Second World War. The second section discusses the state and interstate institutions that governed water quality before the federal program's consolidation. The third section examines federal water pollution control legislation between 1948-61. The fourth section analyzes the federal program's development during the

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[8] Public Health Service Act, 37 Stat. 309 (1912).

[9] See Terence Kehoe. *Cleaning Up the Great Lakes: From Cooperation to Confrontation* (DeKalb: Northern Illinois University Press, 1997); Tarr, "Searching for a Sink." See also Hurley, "Creating Ecological Wastelands."

[10] See James Joseph Flannery, *Water Pollution Control: Development of State and National Policy* (Ph.D. Dissertation: University of Wisconsin, 1956).

1960s. The fifth section examines the reform of the federal programs in the early 1970s. The conclusions summarize and elaborate upon the chapter's observations and indicate connections to the theoretical arguments.

Water Pollution and the Federal Government in the Early 20th Century

Urbanization generated water pollution problems in the early 20th century as it had done in the late 19th century as well. Cities constructed sewerage systems and extended their existing ones to serve a greater number of people.[11] Their sewage discharges injured the use streams for public water supply, livestock production, and recreation, and also interfered with the use of water for industrial processes, power generation, and navigation. The scale of sewage pollution problems grew steadily and caused conflicts between the states early in the 20th century.[12]

Industrial pollution increased at the same time and also threatened public health and injured private and public interests. The average size of industrial establishments at least

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[11] See e.g. Ellis L. Armstrong, Michael C. Robinson, and Suellen M. Hoy, eds., *History of Public Works in the United States, 1776-1976* (Chicago: American Water Works Association, 1976); Nelson Blake, *Water for the Cities: A History of Urban Water Supply Problem in the United States* (Syracuse: Syracuse University Press, 1956); Joel A. Tarr, "Sewerage and the Development of the Networked City in the United States, 1850-1930," in *Technology and the Rise of the Networked City in Europe and America*, eds. Joel A. Tarr and Gabriel Dupuy (Philadelphia: Temple University Press, 1988), 159-185.

[12] See Missouri v. Illinois (Demurrer) 180 U.S. 208 (1901); Missouri v. Illinois 200 U.S. 208 (1906); New York v. New Jersey, 256 U.S. 296 (1921); Sanitary District of Chicago v. United States, 266 U.S. 405 (1925); Wisconsin v. Illinois, 278 U.S. 367 (1927); Wisconsin v. Illinois, 281 U.S. 179 (1929); New Jersey v. City of New York, 283 U.S. 473 (1931); New Jersey v. City of New York, 289 U.S. 712 (1932); New Jersey v. City of New York, 290 U.S. 237 (1933); Wisconsin v. Illinois, 289 U.S. 395 (1933); George C.

tripled between the Civil War and the First World War, when measured by the number of employees. The output and environmental impacts of average industrial establishments grew by at least a factor of ten and sometimes by a factor of forty during the same period because of economies of scale and speed.[13] The manufacturing of new products and technological change resulted in the use of new production processes and raw materials and the pollution of water by new chemicals, some of which were toxins. For example, the internal combustion engine increased the demand for steel, rubber, and petroleum. Smelters in turn adopted a new coking method in the early 20th century to reduce air pollution, with a result of polluting water with phenols.[14] Finally, industrial production clustered in specialized industrial centers: the steel industry in the Chicago-Gary area and in Pittsburgh, the textile industry in New England, the forest industry in Wisconsin, and the oil and chemical industry in New York and New Jersey.[15] Filtration and chlorine treatment of drinking water did not protect public health from the new industrial pollutants.

Many states established statutory water pollution control programs at the turn of the 20th century to protect public health. These programs usually attempted to reduce or to

Lay, "Suits by States to Abate Nuisances," *United States Law Review* 65 (1931): 73-85; Beardsley, "Interstate Pollution of Streams;" Monger, "Stream Pollution Control."

[13] See Jeremy Atack and Peter Passell, *A New Economic View of American History: From Colonial Times to 1940* (New York: Norton, 1994), 474-480; Alfred D. Chandler, Jr, *The Visible Hand: The Managerial Revolution in American Business* (Cambridge: Belknap Press, 1977), 240-286.

[14] See Martin Melosi, "Hazardous Waste and Environmental Liability: An Historical Perspective," *Houston Law Review* 25 (1988): 741-779; Tarr, "Searching for a Sink."

[15] Atack and Passell, *Economic View of American History*; Hurley, "Creating Ecological Wastelands;" Michael Storper and Richard Walker, *The Capitalist Imperative: Territory, Technology, and Industrial Growth* (Oxford: Blackwell, 1989).

mitigate the effects of sewage discharges and seldom had provisions concerning industrial discharges.[16] In most states the attention shifted from the prevention of pollution to the treatment of public water supplies and other measures to protect public health rather than to improve in-stream water quality. Local governments did not benefit from their own investments in waste water treatment, so it was in their interest to discharge their wastes untreated and to treat the water they supplied to their inhabitants instead.[17] Local governments made these choices with the endorsement of the state authorities, because other than public health interests were not heard in collective choices. This does not mean that water pollution control ceased in the early 20th century. Many states enforced their water pollution control programs, at least on occasion. Moreover, riparians protected their interests in water quality in the courts. They could either exact compensation for the injuries pollution had visited upon them from municipal and industrial polluters, or obtain an injunction enjoining these polluters from discharging their wastes into watercourses.

The federal government had an interest in water quality as the protector of interstate commerce and navigation. Dumping became an impediment for navigation in the late 19th century: contractors collecting urban wastes cut their costs by tipping their loads to near-

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[16] See e.g. John T. Cumbler, "Whatever Happened to Industrial Waste: Reform, Compromise, and Science in Nineteenth Century Southern New England," *Journal of Social History* (Fall 1995): 149-171; Flannery, "Water Pollution Control;" Glenn Harris and Seth Wilson, "Water Pollution in the Adirondack Mountains: Scientific Research and Governmental Response, 1890-1930," *Environmental History Review* 17 (1993): 47-71; N. William Hines, "Nor Any Drop to Drink: Public Regulation of Water Quality, Part I: State Pollution Control Programs," *Iowa Law Review* 52 (1966): 186-235; Earl Finbar Murphy, *Water Purity: A Study in Legal Control of Natural Resources* (Madison: University of Wisconsin Press, 1961).

est watercourses, coating them with floating rubbish and filling up the channels. In 1886 the Congress passed an act prohibiting dumping into New York Harbor. The prohibition was extended by the Rivers and Harbors Act of 1899 to the throwing of refuse and wastes into all navigable waters without a permit from the Army Corps of Engineers. The Oil Pollution Act of 1924 then prohibited the discharge of oil from vessels to coastal waters. These two statutes only sought to protect navigation and the federal government's direct role in water pollution control did not have any broader basis in the early 20th century.[18]

However, the federal government was drawn into water pollution control indirectly because water pollution had interstate effects. The states tried to and sometimes could resolve their conflicts over water pollution by informal cooperation. For example, Minnesota and Wisconsin coordinated their financial support to the twin cities of Minneapolis and St. Paul to enable them to build facilities for sewage treatment and to reduce the pollution of the upper Mississippi River. The states of the Ohio River Valley successfully cooperated to eliminate phenol pollution in the 1920s. However, sometimes the states were unable to solve their conflicts over water pollution cooperatively and litigated them.

The first suit between the states over water pollution was initiated as a result of the conflict of Illinois and Missouri over Chicago's sewage discharges. Chicago had built in the mid-19th century a system that supplied water from Lake Michigan, to which the city0 also discharged its wastes. As a result, Chicago's typhoid mortality and morbidity figures

[17] See Louis P. Cain, "An Economic History of Urban Location and Sanitation," *Research in Economic History* 2 (1977): 337-289.

were among the highest ones in the country in the end of 19th century.[19] Chicago made an ambitious plan to remedy the situation. It proposed to reverse the flow of the Chicago River, the primary carrier of its wastes, and to reroute it via a 30-mile ship canal to the Illinois River instead of Lake Michigan. The city implemented the plan and started to divert water from Lake Michigan to augment the flow of the Chicago River and the ship canal, to flush what has been called the greatest toilet in the world to the Illinois River.

Sewage flowed from Chicago first to the Illinois River and then to the Mississippi River some distance upstream from St Louis, Missouri. The health authorities of the city and the state of Missouri were not pleased to receive the untreated sewage from an upstream city of over a million inhabitants. Missouri brought a complaint in 1901 against the city of Chicago and the state of Illinois in the Supreme Court of the United States, seeking to enjoin them from continuing to discharge sewage to the Mississippi River. The Supreme Court issued in 1906 an opinion according to which Missouri had not shown that Chicago's sewage discharges endangered public health in St Louis so gravely as to give it a cause of action in the Supreme Court.[20] Later Illinois was sued by other Great Lakes states because of Chicago's diversion of water to flush its "toilet." The litigation, which lasted until the 1930s, ended to a judgement that required Chicago to limit its diversion and to build the world's largest sewage treatment plant. New York and New Jersey had a

[18] See Cowdrey, "Pioneering Environmental Law;" Diana D. Eames, "The Refuse Act of 1899: Its Scope and Role in Control of Water Pollution," *California Law Review* 58 (1970): 1444-1473; Hines, "Nor Any Drop to Drink III."

[19] See, for example, George C. Whipple, *Typhoid Fever: Its Causation, Transmission and Prevention* (New York: John Wiley & Sons, 1908).

[20] See Missouri v. Illinois, 180 U.S. 208 (1901), 200 U.S. 496 (1906).

conflict over New Jersey's plans to construct a trunk sewer and to discharge sewage to the sea off the coast of New York. Later they litigated over New York's dumping of wastes to the sea from which they were washed to the shores of New Jersey.[21]

The federal government also established the US Public Health Service in 1912 and authorized it to investigate water pollution and its effects on public health. The research conducted under the auspices of the US Public Health Service established the present understanding of many water pollution problems. Although the US Public Health Service did not have any power to abate water pollution, it had an indirect influence on water quality through the support it gave to the state departments of public health that administered water pollution control programs in most states.

The federal government was also a party to the Boundary Waters Treaty made in 1909 with Great Britain. The treaty established the Joint International Commission to govern the waters of the Great Lakes. Although the Joint International Commission never became a central player in water pollution control, it completed around the First World War an extensive and innovative investigation of water quality and pollution in the Great Lakes.[22] The treaty also legitimated the federal government's involvement in water pollution control in the Great Lakes and other boundary waters.

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[21] See Missouri v. Illinois (Demurrer) 180 U.S. 208 (1901); Missouri v. Illinois 200 U.S. 208 (1906). See also New York v. New Jersey, 256 U.S. 296 (1921), Sanitary District of Chicago v. United States, 266 U.S. 405 (1925), Wisconsin v. Illinois, 278 U.S. 367 (1927), Wisconsin v. Illinois, 281 U.S. 179 (1929), New Jersey v. City of New York, 283 U.S. 473 (1931), New Jersey v. City of New York, 289 U.S. 712 (1932), New Jersey v. City of New York, 290 U.S. 237 (1933), and Wisconsin v. Illinois, 289 U.S. 395 (1933).

[22] See Kehoe, *Cleaning Up the Great Lakes.*

The federal government with its interest in protecting navigation was thus not directly involved in the central water pollution problems of the day: the states and the courts dealt with them. However, riparian and nuisance law administered by the courts and state water pollution control programs administered by the departments of public health only catered to the interests in public health and private property. That is to say, as governance institutions, the common law, statutory state water pollution control programs, and what federal law existed ignored the fact that watercourses could support fisheries and recreation, if adequate water quality was maintained. This does not mean that nobody was interested in the fisheries or recreational water uses in the early 20th century. It rather means that the overall institutional framework did not grant effective participation to the groups having these interests in collective choices over the governance institutions.[23]

Anglers lamented already in the 19th century the effects of water pollution in publications such as *Field and Stream*. In the early 20th century, organizations close to the conservation movement started to campaign for water pollution control. Audubon Society's interests were in the protection of water fowl from pollution, especially from oil. Izaak Walton League's platform was somewhat broader. Its members were mostly recreational hunters and fishersmen, but it also expressed concerns for the effects of water pollution on economy, public health, landscape, and heritage.[24] The Interstate Committee on Preven-

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[23] On pollution and shellfish in Mississippi, see Philip V Scarpino, *Great River: An Environmental History of the Upper Mississippi, 1890-1950* (Columbia: University of Missouri Press, 1985). On Northwestern salmon fisheries and pollution, see Columbia River Fishermen's Protective Union v. City of St. Helens, 87 P.2d 195 (1939).

[24] John F. Reiger, *American Sportsmen an the Origins of Conservation* (Norman: University of Oklahoma Press, 1986); Stephen Fox, *John Muir and His Legacy: The American*

tion of Pollution of Coastal Waters and Beaches, The Waterways League of America, the National Coastal Anti-Pollution League, and the Oyster Growers' and Dealers' Association of North America also campaigned for water quality in the early 20th century.[25]

The growth of conservation movements is explained by several factors. The affluence of middle classes in the early 20th century translated to increased appreciation of and demand for recreation. The middle-class members of conservation movements had skills and resources to organize themselves and being organized for a common cause enabled them to socialize, network, and gain status in non-profit activities which were in high social esteem. All these benefits facilitated continued collective action among the conservationists. Finally, the movements commanded economic support from outside: their publications formed an important advertising channel and the enterprises of recreational industry, such as manufacturers of hunting rifles and other weapons, directly supported them.[26]

Conservation organizations promoted federal leadership in their "crusade against water pollution." The Audubon Society lobbied for the Oil Pollution Control Act of 1924 together with interest groups representing the states of Atlantic seaboard and coastal resort cities, such as the National Coastal Anti-Pollution League.[27] Izaak Walton League

Conservation Movement (Boston: Little and Brown, 1981); Robert Gottlieb, *Forcing the Spring: The Transformation of the American Environmental Movement* (Washington: Island Press, 1993); Scarpino, *Great River*; Flannery, "Water Pollution Control."

[25] See Flannery, "Water Pollution Control," 203-210.

[26] On the membership of conservation movements, see e.g. Gottlieb, *Forcing the Spring*; Fox, *John Muir and His Legacy*. For an example of their publications as important advertising outlets, see issues of *Outdoor America* from the late 1920s.

[27] See e.g. "The New Anti-Oil Pollution Law," *Bird-Lore* 26: 304 (1924). See also Flannery, "Water Pollution Control," 203-210.

grew rapidly in the mid-1920s, boasting 200,000 members in 1927, and started campaigning for clean water. The League prepared a nation-wide survey of water quality in 1927, lobbied for water pollution control policies, and promoted projects for the protection of fisheries and wildlife in both the state and federal arenas.[28] The League was successful in establishing the Upper Mississippi Fish and Wildlife Refuge in 1924 and in pushing through other fish and wildlife protection measures.[29]

The Izaak Walton League almost achieved its goals in the 1930s. A conference organized in December 1934 by Senator Augustin Lonergan of Connecticut and sponsored by the Izaak Walton League raised water pollution to the national political agenda.[30] The conference's majority report proposed interstate compacts to resolve interstate water pollution problems and that the National Resources Committee, an inter-departmental New Deal committee, should investigate water pollution and coordinate activities related to it.[31] The Izaak Walton League prepared a minority report proposing a federal agency with powers to investigate water pollution and to coordinate abatement activities.[32]

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[28] See Charles W. Folds, "National Pollution War Opens," *Outdoor America* 5/4 (1926): 5-6; Charles W. Folds, "Pollution Bureau Opens," *Outdoor America* 5/6 (1927): 26-27; Charles W. Folds, "Pollution Campaign Progresses," *Outdoor America* 5/7 (1927): 5; William D. Hatfield, "Sewage Pollution in the United States is Appalling," *Outdoor America* 5/10 (1927): 15-17; William D. Hatfield, "Sewage Pollution in the United States," *Outdoor America* 5/12 (1927): 12-13.

[29] On Izaak Walton League's achievements, see "League's Conservation Platform," *Outdoor America* 10/6 (1932): 4. On the role of the Izaak Walton League in the establishment of the Upper Mississippi Wildlife Refuge, see Scarpino, *Great River.*

[30] See "A National Plan for Water Purification," *New Waltonian* 2/7 (1935): 8-10. See also Flannery, "Water Pollution Control," 203-210.

[31] Harold L. Ickes, Secretary of the Interior, was the chairman of the National Resources Committee. Other full members included Harry H. Woodring, Secretary of War; H. A. Wallace, Secretary of Agriculture; Harry L. Hopkins, Secretary of Commerce; Frances S.

Several water pollution control bills were presented in the Congress after the conference. The Barkley bill (S-4627) passed the Senate in the 74th Congress but it was drawn back as a result of Senator Lonergan's move to reconsider the bill. He considered the Barkley bill weak and in all likelihood wanted his own water pollution control bill to pass before those of others. Another water pollution control bill, the Vinson bill, passed in the House of Representatives a few weeks later. Had it not been for Senator Lonergan's motion to reconsider, the United States would have had a federal water pollution control program in the mid-1930s. In the 75th Congress water pollution control bills passed both the Senate and the House. However, President Roosevelt vetoed the bill because it contained a federal loan program, arguing it could not be afforded.[33] The Second World War then directed the attention elsewhere.

However, the Izaak Walton League did not come out with empty hands from its crusade for clean water. The National Resources Committee conducted three surveys on water pollution in the late 1930s. Water pollution control activities were also included in the New Deal efforts under the Emergency Relief and Construction Act to mitigate the effects of the Great Depression. These activities included the sealing of old coal mines and the construction of intercepting sewers and municipal waste water treatment plants. Finally, the federal funding of infrastructure investments such as waste water treatment

Perkins, Secretary of Labor; and F. C. Harrington, Works Progress Administrator. Advisory committee members were Frederic A. Delano, Charles E. Merriam, Henry S. Dennison, and Beardsley Ruml. See National Resources Committee, *Water Pollution in the United States: Third Report of the Special Advisory Committee on Water Pollution* (Washington: Government Printing Service, 1939), ii.

[32] See "A National Plan for Water Purification," *New Waltonian* 2/7 (1935): 9-10.

plants during the New Deal set a precedent and was to find its way into the federal water pollution control legislation a few decades later.

Next section examines state legislation and interstate compacts, which remained the principal institutional arrangements for governing water quality.

Governance by State Legislation and Interstate Compacts

The lack of federal legislation did not mean that interests in better water quality were not served at all. State water pollution control programs gradually protected new interests in water quality after the 1920s. The institutional design of state programs also improved and facilitated their enforcement. Third, interstate compacts were established to govern water quality in interstate waters and filled what had been an institutional vacuum. This section examines first the development of state water pollution control policies from the 1920s until the 1960s and concludes by discussing interstate compacts.

In the early 20th century state departments of public health viewed the prevention of pollution as a luxury that could not be afforded. They saw that water filtration and treatment could protect public health at a low cost and make the enforcement of existing water pollution control policies unnecessary. However, industrial pollution created problems that were difficult to resolve with the solutions that had worked with sewage pollution.[34] Moreover, conservation movements such as the Izaak Walton League lobbied for better

[33] See Flannery, "Water Pollution Control," 203-210.

[34] Joel A. Tarr, "Industrial Wastes and Public Health: Some Historical Notes, Part I, 1876-1932," *American Journal of Public Health* 75 (1985): 1059-1067; Joel A. Tarr, Terry

in-stream water quality and water pollution control policies in the state legislatures.[35] These pressures resulted in gradual reform of water pollution control programs.

State water pollution control programs were assessed in the three broad surveys conducted by the National Resources Committee's Special Advisory Committee on Water Pollution. The members of the Advisory Committee were specialists in areas centrally related to water pollution and its control.[36] The Advisory Committee heard and obtained contributions from federal and state authorities, representatives of industrial organizations and trade associations, and members of a number of organizations belonging to the conservation movement, including the Izaak Walton League and the Audubon Society.

The Advisory Committee assessed that only eight states had "maximum" control over water pollution in 1935. For the committee, the "maximum" control meant that the responsibility and authority for controlling water pollution was delegated to one state agency that was empowered to determine what constituted prohibited pollution of water and to compel its abatement. The maximum control also required that state legislation

Yosie, and James McCurley, "Disputes over Water Quality Policy: Professional Cultures in Conflict, 1900-1917," *American Journal of Public Health* 70 (1980): 427-435.

[35] On Izaak Walton League's activism in Wisconsin, see Flannery, "Water Pollution Control," 51-72; On activism in Maine, see Richard W. Judd, "The Coming of the Clean Water Acts in Maine," *Environmental History Review* 14 (1990): 51-73

[36] The Advisory Committee on Water Pollution was chaired by Abel Wolman, Chief Engineer of the Maryland State Department of Health. Other members in 1939 included W. B. Bell, Chief of the Division of Wildlife Research in the US Biological Survey; Thorndike Saville, Dean of the College of Engineering at New York University; William A. Snow, Chief of the Technological Branch of the Bureau of Mines; Elmer Higgins, Chief of the Division of Scientific Inquiry of the Bureau of Fisheries; and R. E. Tabbett, Senior Sanitary Engineer of the US Public Health Service. See the Natural Resources Committee, *Water Pollution in the United States*, xi-xii.

should not limit municipal bonding or borrowing to enable the authorities to compel the construction of municipal sewage treatment plants.[37]

The Committee also identified a number of general weaknesses in state water pollution control programs. The first weakness was that state water pollution control programs contained numerous exemptions. Sometimes exempted from the provisions of water pollution control statutes were certain watercourses, usually those industrial streams that were among the most polluted waters in the state. With some irony the Committee noted that when all exempted watercourses were accounted for, one state's water pollution control provisions only applied to its coastal waters. Other water pollution control programs exempted certain industries, usually those that were most important for the state's economy. Finally, sometimes certain cities or municipalities were exempted from the provisions of water pollution control statutes. Understandably, the Committee recommended the elimination of these exemptions.[38]

The Committee also noted that water pollution control statutes contained indefinite and ambiguous wording, such as prohibition of pollution "in quantities injurious to public health." This made it difficult for the state departments of health or other agencies administering water pollution control programs to establish that a violation of the provisions had taken place. This was an obvious drawback in any potential litigation. It also indirectly weakened the incentives for state agencies to issue administrative orders, as their

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[37] National Resources Committee, *Report on Water Pollution by the Special Advisory Committee on Water Pollution* (Washington: Government Printing Office, 1935), 12-20.

position would not have been strong if a polluter challenged the order in a court. The Committee recommended the removal of indefinite language and the establishment of a clear basis for enforcing the provisions.[39]

The third major weakness was the lack of provisions to relax limitations on the bonding and taxing powers of the local governments. These limitations had been established to prevent local governments from becoming indebted and to protect the local tax payers. However, the limitations also served as a pretext not to comply with the abatement orders of the state agencies administering water pollution control programs and sometimes simply made compliance impossible. Therefore, the Committee recommended the removal of bonding and taxing limitations to improve the enforceability of water pollution control programs against municipalities.[40]

The fourth and fifth weaknesses of state water pollution control programs were not unconnected to their enforceability. According to the Committee, too many state programs lacked explicit delegation of mandatory powers to state agencies. As a result, the agencies could not issue binding and enforceable orders to the polluters to ensure their compliance with statutory requirements. The state agencies also lacked authority to establish what constituted a prohibited pollution of water under the statute. The Committee

[38] National Resources Committee, *Report on Water Pollution*, 15-16; Edwin B. Goodell, *A Review of Laws Forbidding Pollution of Inland Waters in the United States,* 2nd ed. (Washington: US Geological Survey, Water-Supply and Irrigation Paper 152, 1905).

[39] See *Report on Water Pollution*, 16.

[40] See *Report on Water Pollution*, 16-17. Municipal polluters are still the most blatant violators of the Clean Water Act, alleging they cannot afford to treat their sewage better. See Susan Hunter and Richard W. Waterman, *Enforcing the Law: The Case of the Clean Water Acts* (Armonk: M.E. Sharpe, 1996), 60-61.

saw that the absence of a clear standard of acceptable and unacceptable pollution hindered the enforcement of water pollution control programs and unnecessarily weakened the position of state agencies in the courts. Naturally, it recommended the explicit delegation of both powers to state agencies.[41]

The other weaknesses the Committee identified included the multiplicity of acts pertaining to water pollution control in many states. The Committee recommended the repealing of all of them and the writing of new comprehensive water pollution control statutes. The responsibility over water pollution control was also scattered to several state agencies according to the interest in water quality to be protected: public health authorities administered issues that were pertinent to public health, the departments of agriculture administered those pertinent to agriculture, and so on. Finally, in some states there was no administrative oversight whatsoever over water pollution control. That is, fourteen states still had only penal and nuisance statutes and common law to govern water quality.[42]

The next survey of state water pollution control programs was conducted by the staff of the U.S. Senate's Committee on Public Works in 1963, and it provides a good opportunity to contrast the situation in the early 1960s with that in the late 1930s. According to the Staff Report, in thirty-five out of fifty states the primary responsibility for water pollution control rested in one agency representing all interests in water quality. These agencies were generally authorized to determine the permitted discharges into the waters of the state and to issue permits to the polluters. In the majority of the states, the department of

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[41] See *Report on Water Pollution*, 16-17.

[42] See *Report on Water Pollution*, 18-19.

public health administered the water pollution control program. However, independent water pollution control agencies had become almost as common. Over a half of the states had issued an administrative order and initiated an action in a court to enforce their water pollution control programs.[43]

The Staff Report also identified problems in state water pollution control programs. First, while a number of states had some experience in enforcing their water pollution control programs, only a few of them had enforced their programs actively. Although the success of these states in securing compliance with administrative orders and court actions had been very good, other states had not taken similar steps. The cooperative spirit of state water pollution control boards and commissions and the representation of industrial and municipal interests in them partly explain the wide-spread unwillingness to enforce water pollution control statutes and regulations, especially when they related to industrial pollution.[44] The Staff Report also indicated that appropriations for water pollution control were very small, ranging from about a cent to about 25 cents per capita a year from state to state. This reflected only a weak commitment to water pollution control when the legal institutions were already capable of being adequately implemented and enforced.[45]

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[43] See *A Study of Pollution – Water: A Staff Report to the Committee on Public Works* (Washington: Committee on Public Works, United States Senate, 1963), 74-77.

[44] On cooperative spirit, see Flannery, "Water Pollution Control," 111-112; Judd, "Coming of the Clean Water Acts in Maine; Kehoe, *Cleaning Up the Great Lakes.* On inattention to industrial pollution, see Tarr, "Industrial Wastes and Public Health." The EPA's personnel still today emphasizes cooperative spirit and eschews from strict enforcement of the Clean Water Act. See Hunter and Waterman, *Enforcing the Law*, 59-62.

[45] See *A Study of Pollution – Water*, 74-76. For comparison, the expenditure for all areas of environmental quality rose to about 15 cents per capita in states spending the least by the year 1970, and to over a dollar per capita in those states which spent the most on envi-

The movement toward more comprehensive water pollution control programs from the 1920s until the 1960s is, perhaps, best illustrated by the adoption of water quality standards. In its report in 1935, the National Resources Committee expressed a view according to which water quality standards would be a necessary foundation for comprehensive water quality management. Only the drinking water quality standards issued by the Department of Commerce existed before the Second World War. By 1963, the majority of states had legislation directing or allowing the establishment of stream classification or water quality standards, and about half of the states had already established them. However, many states, such as California and Michigan, felt that they did not provide an adequate basis for enforcement. Later, water quality standards were pushed to the background also in the federal program.[46]

State programs were unable to resolve interstate water pollution problems, because state authorities had no control over the sources of water pollution that resided outside their jurisdiction. Neither did they have incentives to abate interstate pollution that originated from their own jurisdiction, because it would have mainly benefited the downstream states. Quite the contrary, states had incentives to do nothing to abate the pollution of interstate waters. For example, in Ohio the Bense Act of 1908 "exempted every village

ronmental quality. For the year 1980 the expenditure for environmental quality was below 5 dollars per capita in the less eager states and over 30 dollars per capita in the most ambitious states. All the figures are presented in current prices. For the 1970 and 1980 figures, see James P. Lester, ed., *Environmental Politics and Policy: Theories and Evidence* (Durham: Duke University Press, 1989), 332-333.

[46] Natural Resources Committee, *Report on Water Pollution*, 49-56; *A Study of Pollution – Water*, 79-82; A. Myrick Freeman III, "Water Pollution Policy," in *Public Policies for*

and municipality along the Ohio River from installing sewage-treatment works until similar facilities were provided by all municipalities upstream of it."[47] The act was in force until 1948, when it was repealed to facilitate the establishment of the Ohio River Sanitary Commission. There was also a disincentive to abate the pollution of intra-state waters, because a state that adopted a strict policy made itself unattractive as a location for industries that deteriorated water quality.

The states used both informal and formal cooperation to resolve water pollution problems. The Council of State Governments coordinated actions related to water pollution and published a model water pollution control statute in 1951, for example. There were also other organizations, such as the Water Pollution Control Federation and the Association of State and Interstate Water Pollution Control Administrators, which facilitated informal cooperation among the states. Finally, departments of public health cooperated informally and succeeded in eliminating phenol pollution from the Ohio River in the 1920s, for example. Phenol pollution had been a thorny problem to public health authorities. Phenols reacted with the chlorine added to drinking water to sterilize it and formed compounds that spoiled the taste of water. When the consumers turned to water supplies that had not been treated with chlorine, they exposed themselves to water-borne diseases.[48]

Environmental Protection, ed. Paul R. Portney (Washington: Resources for the Future, 1990), 97-149.

[47] See Cleary, *The ORSANCO Story*, 21.

[48] See Special Advisory Committee on Water Pollution of the National Resources Committee, *Water Pollution in the United States: Third Report* (Washington: Government Printing Office, 1939). See also Hines, "Nor Any Drop to Drink II."

Formal compacts to resolve interstate water pollution problems appeared in the 1930s. The first interstate agency to control water pollution was the Interstate Sanitary Commission. It was established by a compact between New York, New Jersey, and Connecticut in 1935 to control the pollution of their coastal, estuarial, and tidal waters. The Interstate Commission for the Delaware River Basin (INCODEL) was established in the 1930s by reciprocal legislation in New York, New Jersey, Pennsylvania, and Delaware. INCODEL was transformed in the 1960s into a formal interstate compact. The Tri-State Compact was formed between Minnesota, North Dakota, and South Dakota in 1938 to govern water quality in the Red River. Finally, the Interstate Commission on the Potomac River Basin saw daylight a few years later in 1940, and the New England Interstate Water Pollution Control Compact was established immediately after the war in 1947.[49]

The Ohio River Sanitary Commission (ORSANCO) provides a window for understanding how interstate compacts governed water quality. It was formed by a compact between New York, Pennsylvania, West Virginia, Virginia, Ohio, Indiana, Illinois, and Kentucky, but there was also federal representation in it. The negotiations for the establishment of ORSANCO were conducted in the 1930s. The Congress approved the compact in 1940 but, because of the war efforts, the compact became operational only in 1948. As New York and Virginia had only small stakes in Ohio River's water quality, and because West Virginia remained passive, Pennsylvania, Ohio, Kentucky, Indiana, and Illinois were the active parties in the compact.[50]

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[49] Hines, "Nor Any Drop to Drink II;" *Water Pollution in the United States,* 72-78.

[50] See Cleary, *The ORSANCO Story.*

ORSANCO relied extensively on the mobilization of the public and on the voluntary cooperation of the polluters. It provided support for campaigns for the municipal sewage treatment plants and influenced public opinion before the ballots over issuing municipal bonds to finance the project were organized. It also organized industry-wide committees to establish guidelines for good industrial practices and to find technological solutions to industrial water pollution. Guidelines were established for the handling of oil in terminals, for example. Industry committees fostered the cooperation between the interstate commission, state authorities, and industrial polluters. For example, an informal system was instituted for notifying of accidental spills that could injure water works or industrial water users downstream. Later, ORSANCO established a network of fully automated water quality monitoring stations that provided continuous water quality information.[51]

Interstate compacts shared no common template and had different functions and scopes of authority. INCODEL and the Potomac Commission were research and advisory bodies that did not have rule making or enforcement authority. The New England Interstate Compact had only a little broader mandate. The Tri-State Compact and ORSANCO had some enforcement power that rested on unanimous decisions among the parties to the compact. The interstate compacts did not have a significant effect on water quality. Half of them did not grant rule making or enforcement powers, and thus governed water quality in the interstate waterways exclusively on the basis of reciprocal state action. While they fostered cooperation and induced the states to take joint responsibility of shared watercourses, they could not move state organizations or actors against their will. The com-

[51] See Cleary, *The ORSANCO Story*.

pacts that were vested with broader powers in turn avoided testing the limits of cooperation among the states or between the interstate agency, state agencies, and the polluters. [52]

Thus the states found themselves in a situation that resembled a Prisoner's Dilemma: no state had an interest to be a vanguard in water pollution control and to repel industry to more lenient states. Yet they would have benefited from better water quality. Interstate compacts provided only very limited scope for cooperation and left out the governance of intrastate waters. The federal government's involvement was another alternative: it is examined in greater detail in the next section.

The Birth of the Federal Water Pollution Control Program

When states were still making interstate compacts, the conservationists were successful in their promotion of a national water pollution control policy. However, the victory was at best only partial, because the act that in the end passed the Congress was stripped of most of the features that the conservation movement had promoted. These features included the establishment of a federal agency with rule-making and enforcement powers to oversee the control of water pollution. As a result, the new federal water pollution control program was not as effective as was hoped for by the conservation movement. Adding insult to the injury, it was only a temporary one.

The Water Pollution Control Act of 1948 governed water quality only in interstate waters when pollution originating from one state endangered public health or welfare in another state. The Act declared such pollution of interstate waters a public nuisance. It

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[52] See Hines, "Nor Any Drop to Drink II."

authorized the Surgeon General to notify the polluter responsible for the nuisance and to inform state and interstate water pollution control agencies about the notification. The notification to the polluter could contain recommended remedial measures. The Surgeon General was required to give a second notification if remedial action did not commence in a timely fashion, possibly with instructions to state and interstate agencies to consider the initiation of court proceedings. If the two notifications did not secure the abatement of the nuisance, a hearing could be organized in front of a board authorized to make recommendations on the abatement of water pollution. Finally, the US Attorney General could be asked to file a suit against the polluter after obtaining consent of the state from which pollution originated, or if the state suffering from pollution requested it.[53]

The Water Pollution Control Act of 1948 also provided for inexpensive federal loans for the planning and construction of municipal sewage treatment plants. However, no funds were appropriated for the loan program and loans were never disbursed on the basis of this Act. The Water Pollution Control Act of 1948 also authorized the Surgeon General to conduct surveys on water pollution and its abatement in collaboration with state and interstate authorities and to publish the results of such studies. Finally, the Surgeon General was to promote cooperation among the states.[54]

The Water Pollution Control Act of 1948 was extended by three years in 1953 before it was replaced by the Federal Water Pollution Control Act in 1956. The provisions on the abatement of interstate pollution were modified so as to eliminate any reference to a

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[53] See Water Pollution Control Act, 62 Stat. 1155, Sec. 1 (d) 1-8 (1948).

[54] See Water Pollution Control Act, 62 Stat. 1155, Sec. 5-8 (1948).

public nuisance. The Surgeon General lost the authority to notify the polluters and was directed instead to notify the state or interstate authorities when discharges to interstate waters or their tributaries endangered public health or welfare in another state. The Surgeon General was authorized to call a conference of the involved parties and could make recommendations on the basis of its findings to the state and interstate authorities. If remedial action was not taken within six months, the Surgeon General could call a public hearing. The hearing board could make suggestions and recommendations for the abatement of water pollution on the basis of its findings. The Secretary of Health, Education, and Welfare was authorized to initiate a suit after obtaining the consent of the state from which the interstate pollution originated or a request from the state suffering from it.[55]

The Federal Water Pollution Control Act of 1956 transformed the loan scheme of the 1948 Act into a grant program for the construction of municipal sewage treatment plants and appropriated $ 50 million per year for it. The maximum of 30 percent or $ 250.000 of federal funding was made available for construction projects. The Act also made federal grants available for the development and administration of state water pollution control programs.[56] Otherwise, the Act of 1956 systematized, expanded, and reordered the provisions of the Act of 1948. The provisions on the federal authority to resolve interstate water pollution problems were moved towards the end of the statute and that a subsection was added to them emphasizing the primary responsibility of state and interstate agencies for remedial action. These changes were concessions to states' rights coalition.

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[55] Federal Water Pollution Control Act Amendments, 70 Stat. 498, Sec. 8 (1956).

[56] Federal Water Pollution Control Act Amendments, 70 Stat. 498, Sec. 5-6 (1956).

The Federal Water Pollution Control Act Amendments of 1961 conserved the basic institutional design of the federal water pollution control program and introduced only a few changes into it. The amendments transferred the administration of the federal program from the Surgeon General to the Secretary of Health, Education, and Welfare. Federal institutions were also extended to govern water quality in all interstate and navigable waters. Upon a request from the state, the Secretary could all a conference when interstate or navigable waters were polluted by intra-state sources. The Secretary was also allowed without a state's consent to request the Attorney General to bring a suit after the hearing in case of interstate pollution. In a case of intra-state pollution the Secretary still needed the consent of the state's Governor.[57]

The Federal Water Pollution Control Amendments of 1961 increased appropriations for the grant program from the earlier $ 50 million gradually to $ 100 million per annum. The amendments also increased the maximum grant from $ 250.000 to $ 600.000 for a single project, while retaining the maximum of 30 percent grant funding for a project. Projects serving several municipalities were allowed larger grants of up to $ 2.400.000. This meant a shift from funding treatment plants of small communities to funding them in large urban centers. The amendments of 1961 also allocated more grant funds to the administration of state water pollution control programs.[58]

By 1961 the conference-hearing-suit procedure and the grant program for the construction of municipal sewage treatment plants had become the cornerstones of the federal

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[57] Federal Water Pollution Control Act Amendments, 75 Stat. 204, Sec. 7 (1961)

[58] Federal Water Pollution Control Act Amendments, 75 Stat. 204, Sec. 4-5 (1961)

water pollution control program. Both legs of the federal program were contested by the interest groups. The conservation movement sought greater federal authority to control water pollution, but the states and industry were reluctant to agree to it. The cumbersome conference-hearing-suit procedure reflected the balance of power among them. The conservation movement had reservations about the grant program because they considered it to reward polluters, while the states and local governments supported it. Republican President Eisenhower also opposed the grant program. He vetoed a water pollution control bill that passed the Congress in 1961 because it contained increased appropriations for the construction grants. Yet he had supported the construction of interstate highways with federal funding. The Amendments of 1961 were in the end passed with their higher appropriations after Democratic President Kennedy had taken office.[59]

The federal water pollution control program could not boast impressive results in its first fifteen years. Twenty enforcement conferences were called by the year 1963. Two of them addressed intra-state pollution at the requests of the Governors of Michigan and Washington. Four conferences proceeded to the hearing stage. One suit was initiated when the federal government sought to compel the City of St. Joseph, Missouri to install sewage treatment facilities, but the case was settled in the end out of court.[60] The federal government awarded grants of $ 370 million for a total of 4250 projects by 1963 and funded on average 20 percent of their costs. Together the projects that had received federal funding served about 40 million people. Although investments in municipal sewage

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[59] J. Clarence Davies III, *The Politics of Pollution* (New York: Pegasus, 1970), 42-43.

[60] *A Study of Pollution – Water*, 55-56; Hines, "Nor Any Drop to Drink III," 855.

treatment works increased by about a third after the establishment of the federal grant program, they could have increased also without it. The local governments might have made the larger investments voluntarily: they became more affluent over time and concern for the effects of water pollution became more wide-spread among the public.

In the early 1960s the federal program existed formally but was largely ineffective in practice. However, the new decade had more in store for the federal program. The next section examines the changes in the federal program during the 1960s.

Pressures Mount on the Federal Water Pollution Control Program

While the federal water pollution control program became established by 1961, its institutional design was dictated by interest groups that did not wish to see extended federal authority over the control of water pollution.[61] The states and the industry had been the major opponents of the federal authority in water pollution control. While the states and the industry continued to oppose federal authority, the proponents of federal policy gained strength. The old conservation movements and the new environmental movements became more radical and the courts gave them an opportunity to voice their grievances. In what follows, the section first briefly discusses how water pollution problems changed in the 1960s and then examines how the federal legislation responded to them.

Water pollution changed as a policy problem in the 1960s and was widely publicized by Rachel Carson's *Silent Spring*, Frank Graham's *Disaster by Default*, and David

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[61] See e.g. Harvey Lieber, *Federalism and Clean Waters: The 1972 Water Pollution Control Act* (Lexington: Lexington Books, 1975).

Zwick's and Marcy Benstock's *Water Wasteland.* Large fish kills became a commonplace because new synthetic pesticides, such as DDT and its derivatives, killed in even small quantities a vast number of fish and fowl far downstream from the point of their discharge. New synthetic detergents coated watercourses with blankets of foam that could be several meters thick. Finally, the Torrey Canyon accident in 1967, the Santa Barbara oil spill in 1969, and the mercury scare after the Minamata incident in Japan demonstrated the havoc large-scale chemical pollution of water created.[62]

The development of the federal water pollution control legislation in the 1960s reflected these changes in the public's exposure to water pollution. The Water Quality Act of 1965 created the Federal Water Pollution Control Administration in the Department of Health, Education, and Welfare, realizing the conservation movement's long-standing goal of a federal water pollution control agency. The act also required the states to establish water quality standards for the interstate waters within their bounds and plans for implementing them. Discharges leading to the violation of these water quality criteria were declared to be subject to abatement according to the provisions of the act. The Secretary could, on his or her own initiative, tackle pollution that threatened the marketing of shellfish in interstate commerce.[63]

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[62] See Rachel Carson, *Silent Spring* (Boston: Houghton & Mifflin, 1962); Frank Graham, Jr, Disaster by Default: Politics and Water Pollution (New York: M. Evans and Co., 1966); David Zwick and Marcy Benstock, Water Wasteland (New York: Grossman, 1971). See also Samuel P. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955-1985* (Cambridge: Cambridge University Press, 1987); Kehoe, *Cleaning Up the Great Lakes*; Michael R. Reich, *Toxic Politics: Responding to Chemical Disasters* (Ithaca: Cornell University Press, 1991).

[63] Water Quality Act of 1965, 79 Stat. 903, Sec. 2, 5, and 6 (1965).

The Water Quality Act of 1965 increased the maximum grants for the construction of municipal sewage treatment works from the previous $ 600.000 to $ 1.200.000 for a project, and from $ 2.400.000 to $ 4.800.000 for projects that served several municipalities. The ceiling of federal funding was raised to fifty percent in ordinary projects and to sixty percent in projects that were accepted parts of a metropolitan or regional plan. The Act expanded the grant program to demonstration projects on controlling pollution from the overflow of combined sewers.[64] These changes refocused the grant program to funding treatment plants in large urban centers.

A mere year later the Clean Water Restoration Act of 1966 declared the Secretary's authority to abate water pollution that had international impacts. The Act also formalized the procedures for conducting conferences and hearings, which had not been proscribed in earlier federal legislation. The Act of 1966 established the right of interested parties to voice their concerns in the conference and authorized the Secretary to request, under the threat of forfeiture, reports from polluters concerning their discharges and their abatement. These institutional changes indicate that abatement of water pollution was now taken seriously as an important part of the federal water pollution control program. The Clean Water Restoration Act of 1966 also extended the prohibition of discharge of oil from vessels to apply to all navigable waters.[65]

The Clean Water Restoration Act of 1966 also modified the federal program's grant provisions. The Act now promised fifty percent federal funding for river basin manage-

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[64] Water Quality Act of 1965, 79 Stat. 903, Sec. 4 (1965).

[65] Clean Water Restoration Act, 80 Stat. 1246, Sec. 206-211 (1966).

ment by state or interstate agencies. The Act also transformed the grant program for demonstration projects into a grant program for research and development on abatement of pollution from the overflow of combined sewers, advanced sewage treatment methods, methods for treating industrial wastes, and on estuarine pollution. The caps on construction grants were abolished and the maximum federal funding share increased to sixty percent under certain conditions. The federal funding share was increased retroactively for already completed projects by providing for refunding of the already incurred construction costs. Finally, the Act of 1966 increased appropriations for the construction grant program from $ 150 million per annum gradually to $ 1250 million per annum.[66]

The Water Quality Improvement Act of 1970 repealed the old Oil Pollution Act of 1924, because the revisions made four years earlier in 1966 had rendered it practically unenforceable. The Act included altogether new provisions for oil pollution control. It prohibited the discharge of oil from vessels and from on- and off-shore facilities into navigable waters and adjoining shorelines in quantities that were determined harmful by regulations to be issued by the President. The Act required the operators of all vessels and facilities to inform federal authorities immediately about a violation of the regulations – when an oil spill occurred, for example. The Act established a revolving fund for the speedy clean-up of discharges and authorized the President to undertake such clean-up and to recover its costs from the culpable operator, if the operator did not commence timely remedial action. Finally, the Act extended many provisions concerning oil pollution to toxic pollutants, in-

[66] Clean Water Restoration Act, 80 Stat. 1246, Sections 201-205 (1966).

structed the President to prepare regulations for their identification and removal, and required the preparation of a national contingency plan to deal with oil and toxic pollution.[67]

The other provisions of Water Quality Improvement Act of 1970 required the establishment of standards of performance for marine sanitary devices to prevent the discharge of untreated sewage from vessels and the certification of these devices. The Act also made the compliance with applicable water quality standards a precondition to obtaining federal permits or licenses. This provision was aimed at providing a way to control thermal discharges from power plants, which were licensed by federal authorities.[68] Moreover, the Act required all federal facilities to comply with the applicable water quality standards. Finally, the Act provided grants for demonstration projects on the control of pollution from acid and other mine drainage, new methods of pollution control in the Great Lakes area, and water treatment and water pollution control in the native villages of Alaska. The Act also provided funds for the training of personnel for the municipal sewage treatment plants, as it was now increasingly noticed that treatment plants were not functioning in an intended way because of the lack of trained personnel.

The changes in the federal legislation during the 1960s meant that the federal government was more involved in the governance of water quality than it had been a decade ago. The federal legislation authorized the administrator of the federal program to abate pollution on his own initiative when pollution from one state endangered public health or welfare in another state or in another country, or when it interfered with the interstate

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[67] Clean Water Restoration Act, 80 Stat. 1246, Section 102 (1970).

commerce on shellfish. At the request and consent of a state, the administrator could also abate pollution in intra-state waters. The federal program had also special provisions concerning oil and toxic pollution, and it provided a significant amount of grant funds for research and development and the construction of municipal sewage treatment plants.

However, federal legislation did not yet incorporate authority to compel the compliance of states and polluters. The need for that authority increased significantly during the 1960s. The public was now concerned about water pollution and did not view with satisfaction federal conferences and hearings that seemed to go on for ages without producing visible results.[69] Water pollution also had effects that sometimes required timely reaction. There was a need for federal action because, although some states were capable of acting to abate water pollution, others were not. The whole setting where the states felt that their activism in water pollution control would only injure them economically was not conducive to improved water quality management.

The next section examines the developments that led to a greater federal authority in water pollution control in the beginning of the 1970s.

Federal Water Pollution Control Policy after 1970

While the federal water pollution control legislation developed toward greater comprehensiveness and federal authority during the 1960s, social change outpaced legal change. First, new, more radical environmental movements emerged and the older con-

[68] See Clean Water Restoration Act, 80 Stat. 1246, Section 103 (1970); Davies, *Politics of Pollution*, 46-49.

servation organizations adopted a more radical rhetoric that lamented environmental degradation and demanded public response. Several popular books also critically examined the pollution of water and its ineffective control by federal and state authorities. Finally, the first Earth Day in 1970 mobilized the masses behind the environmental agenda and the opinion polls verified that they were all the more concerned about environmental quality.[70]

Secondly, the courts issued decisions, such as *Scenic Hudson Preservation Conference v. Federal Power Commission* (1966), *Sierra Club v. Morton* (1972), and *U.S. v. SCRAP* (1973) that expanded the standing to sue and enabled citizen groups to litigate both against the administration and the polluters. The Administrative Procedures Act, which was enacted in the 1940s to provide a check against the reforms initiated by the administration, was now interpreted anew with the result of opening up administrative decision-making to interest groups that demanded reforms faster than the administration was willing or capable of supplying them. Finally, statutory provisions for citizen suits, promoted by Joseph Sax and pioneered in Michigan, were incorporated into federal legislation for the first time in the Clean Air Act of 1970, and became common thereafter. These le-

[69] For references to evidence, see the footnote in the beginning of the next section.

[70] On environmental movement see Robert Cameron Mitchell, "From Conservation to Environmental Movement: The Development of the Modern Environmental Lobbies," in Michel J. Lacey (ed.), *Government and Environmental Politics: Essays on Historical Developments since World War Two* (Washington: Woodrow Wilson Center Press, 1989). For rhetoric, see "The Rape of San Francisco Bay: Praise the Buck and Pass the Dirt," *Audubon Magazine* (March-April, 1968), 45-65; "Great Lakes – Great Mess," *Audubon Magazine* (May-June 1968), 30-45. For "muckraking", see Graham, *Disaster by Default*; Zwick and Benstock, *Water Wasteland*. On Earth Day, see Gottlieb, *Forcing the Spring*, 105-114; On public opinion, see Davies, *Politics of Pollution*, 77-82; Riley E. Dunlap, "Trends in Public Opinion toward Environmental Issues, 1965-1990," in *American Environmen-*

gal changes meant that citizens could compel administrators of federal environmental laws to fulfill their statutory obligations and directly enforce the legal provisions of federal environmental statutes in the courts.[71]

Environmental activism and the courts' approving attitude towards environmental issues came together in the Refuse Act episode in the beginning of 1970s. Section 13 of the Rivers and Harbors Act of 1899, known as the Refuse Act, prohibited the throwing of refuse and wastes into navigable waters without a permit from the Army Corps of Engineers. The Act's original aim was to protect navigation from dumping, but a series of court decisions reinterpreted the Act's discharge prohibition increasingly broadly. In *United States v. Republic Steel Co.* (1960) the Supreme Court of the United States declared that the discharge of suspended solids that settled on the bottom of a watercourse constituted a violation of the Act. The Supreme Court argued later in *United States v. Standard Oil* (1966) that the Act's prohibition also applied to the accidental discharge of oil.[72]

talism: The U.S. Environmental Movement, 1970-1990, eds. Riley E. Dunlap and Angela G. Mertig (Philadelphia: Taylor and Francis, 1992), 89-117.

[71] See Scenic Hudson Preservation Conference v. FPC, 354 F.2d 608 (2d Cir. 1965), Sierra Club v. Morton, 405 US 727 (1972), United States v. SCRAP, 412 U.S. 689 (1973). On APA, see Richard B. Stewart, "The Reformation of American Administrative Law," *Harvard Law Review* 88 (1975): 1667-1813. On standing and citizen suits, see Adeeb Fadil, "Citizen Suits against Polluters: Picking up the Pace," *Harvard Environmental Law Review* 9 (1985): 23-82; Robert R. Lohrmann, "The Environmental Lawsuit: Traditional Doctrines and Evolving Theories to Control Pollution," *Wayne Law Review* 16 (1970): 1085-1135; Karen Orren, "Standing to Sue: Interest Group Conflict in the Federal Courts," *American Political Science Review* 70 (1976): 723-741.

[72] See United States v. Republic Steel Co., 362 U.S. 482 (1960); 362 United States v. Standard Oil Co., 384 U.S. 224 (1966). See also Cowdrey, "Pioneering Environmental Law;" Eames, "Refuse Act of 1899," 1448-54; William H. Rodgers, Jr., "Industrial Water Pollution and the Refuse Act: A Second Chance for Water Quality," *University of Pennsylvania Law Review* 119 (1971): 761-822, 769-776.

The Refuse Act was attractive, because it contained an absolute discharge prohibition: it was easy to prove its violation in the court and it provided for criminal sanctions to enforce the discharge prohibition. The act also provided for a *qui tam* action that enabled private parties to request the Attorney General to enforce the Act in the court and to collect the reward prescribed by the statute. The first suits to enforce the statute against industrial polluters were brought in 1969, and many more of them were initiated in the next two years. However, it was at the discretion of the Attorney General whether to bring a suit after receiving a request from the private informer to initiate an action. Before private enforcement under the Refuse Act became wide-spread, the Justice Department issued guidelines concerning the use of discretion in prosecuting cases under the Refuse Act, recommending the Attorneys not to prosecute its violators in most cases.[73]

It also emerged that the Army Corps of Engineers had issued only a handful of discharge permits and yet thousands of industrial polluters discharged their wastes into the watercourses. In 1970 the Nixon Administration declared that it would require discharge permits from all industrial polluters on the basis of the Refuse Act. The Army Corps of Engineers was to administer the program together with EPA. Thousands of permit applications were filed. However, the permit program backfired almost immediately after its establishment. First, the court of *Kalur v. Resor* (1971), a case initiated by Kalur on behalf of the recreational users of the Grand River in Ohio, declared that the Army Corps of Engineers could not issue permits to industrial polluters without preparing an Environ-

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[73] Kehoe, *Cleaning Up the Great Lakes*; Cowdrey, "Pioneering Environmental Law;" Eames, "Refuse Act of 1899;" Rodgers, "Industrial Water Pollution and the Refuse Act."

mental Impact Assessment as required by the NEPA of 1970. It was obviously impossible to do so for every permit, so the issuance of permits froze until the Congress exempted it from the EIA requirement in the Clean Water Act of 1972. In *United States v. Pennsylvania Industrial Chemical Co.* (1972) the court decided that a polluter could not be convicted of the violation of the statute before a permit had been issued to it. These court decisions left the Nixon administration's unlucky permit program in a limbo.[74]

The Federal Water Pollution Control Act Amendments of 1972 significantly revised the federal water pollution control program. The drafters of the Act of 1972 transferred the attractive elements of the Refuse Act and the lessons learned during the short-lived permit program based on this act to the new federal water pollution control program. The Federal Water Pollution Control Act Amendments of 1972 made it unlawful to discharge any pollutant except in compliance with the statute's provisions. Pollutants could only be discharged legally by obtaining a NPDES (National Pollutants Discharge Elimination System) permit, which specified the discharge limitations of the permitted facility for specific pollutants, established its compliance schedules, and presented monitoring and reporting requirements for the facility. The permits were valid for five years at a time. Refuse Act permit applications were deemed to be applications for the NPDES permit.[75]

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[74] Kalur v. Resor, 335 F. Supp. 1 (D.D.C. 1971); United States v. Pennsylvania Industrial Chemical Co., 461 F.2d. 468 (3d Cir. 1972). See also Cowdrey, "Pioneering Environmental Law;" Eames, "Refuse Act of 1899;" Lettie McSpadden Wenner, "Federal Water Pollution Control Statutes in Theory and Practice," *Environmental Law* 4 (1974): 252-61; Rodgers, "Industrial Water Pollution and the Refuse Act."

[75] Federal Water Pollution Control Act Amendments of 1972, 86 Stat. 816, Sec. 301-309 and 402 (1972); Wenner, "Federal Water Pollution Control Statutes," 252-61.

The conditions of a NPDES permit were to be based on different requirements for the period between 1977 and 1983 and for the period after 1983. The permit conditions were also to be determined differently for different classes of polluters. For the period between 1977 and 1983, effluent limitations for publicly owned treatment plants were to be based on the performance achievable by secondary treatment. For the later period, the best practicable waste treatment method decided their effluent limitations. The effluent limitations for other (industrial) existing sources that discharged directly into watercourses were to be based in the first period on the performance of best practicable control technology currently available, and for the period after 1983 on the best available technology economically achievable. Effluent limitations for the existing polluters discharging into the publicly owned treatment works were to be based on pre-treatment standards to be promulgated by the EPA. Finally, effluent limitations for new sources were to be based on the National Standards of Performance for New Sources, to be promulgated by EPA for the categories of sources of pollution on the basis of performance achievable by the application of the best available demonstrated control technology, processes, and operating methods.[76] The purpose of these performance-based limitations was technology-forcing.

The Federal Water Pollution Control Act Amendments of 1972 identified water quality as an alternative basis for the conditions of NPDES permits, if limitations based on technological performance did not realize water quality standards. The Act of 1972 required

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[76] See Federal Water Pollution Control Act Amendments of 1972, 86 Stat. 816, Sec. 201, 301, 306, and 402 (1972); Hunter and Waterman, *Enforcing the Law*, 32-39; Wesley Magat, Alan J. Krupnick, and Winston Harrington, *Rules in the Making: A Statistical Analysis of Regulatory Agency Behavior* (Washington: Resources for the Future, 1986); Wenner, "Federal Water Pollution Control Statutes," 252-61.

the establishment of water quality standards for all watercourses and their review and acceptance by the Administrator of the EPA. If a state failed to promulgate acceptable standards, the EPA could promulgate them for the state in question. However, water quality considerations never became central in administration of the federal water pollution control program, because technology-based regulation was administratively more feasible and got over time even more central role.[77] A state could also prepare a state implementation plan and apply for authority to implement the federal water pollution control program within its jurisdiction. Again, the state implementation plan was to be subjected to review and approval by the Administrator of the EPA. Federal grants were made available for the states only if they prepared the prescribed plans in an accepted manner.[78]

The federal water pollution control program's grant provisions did not undergo as radical changes as the provisions concerning the abatement of water pollution. The administration of state and interstate water pollution control programs, research and demonstration projects, and the training of personnel for sewage treatment plants continued to be eligible for federal grant funding. The construction grants now funded seventy-five percent of the total costs of sewage treatment plants and augmented reimbursement of already incurred construction costs was provided for certain projects. The annual appropriations for construction grants increased from $ 1250 million per year gradually to $

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[77] See Federal Water Pollution Control Act Amendments of 1972, 86 Stat. 816, Sections 302-303 (1972). See also Thomas O. McGarity, "Media Quality, Technology, and Cost-Benefit Balancing Strategies for Health and Environmental Regulation," *Law and Contemporary Problems* 46 (1983): 159-233.

[78] See Federal Water Pollution Control Act Amendments of 1972, 86 Stat. 816, Sec. 302-303 (1972).

7000 million per year. All federal grants were qualified so as to require the full cooperation of the recipient state with the federal water pollution control authorities.[79]

The progress in water pollution control remained slow after the Amendments of 1972 in the face of the daunting task imposed upon the Administrator by the legislators. The rules governing water quality as outlined in the FWPCA Amendments of 1972 proved burdensome to establish. While all significant dischargers of conventional pollutants were licensed during the 1970s, the last performance criteria for toxic pollutants were promulgated as late as in the end of the 1980s. Moreover, the Amendments of 1972 did not regulate non-point sources of pollution, although they accounted for over a half of conventional pollution when the Amendments of 1972 were passed and contributed to toxic pollution.[80] The control of non-point sources was against the interests of local governments and owners of farmland, and it would also have entailed high transaction costs.

The federal program's enforcement improved less than its enforceability. The amendments of 1972 mandated a response to non-compliance and availed administrative, civil and criminal sanctions for the purpose. In practice, sanctions were applied in a graduated manner. Those polluters whose permits were pending or were based on temporary performance criteria were not subject to standard enforcement. Informal contacts, letters of notification, and compliance orders were used in ordinary cases and self-reporting re-

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[79] See Federal Water Pollution Control Act Amendments of 1972, 86 Stat. 816, Sec. 101-212 (1972).

[80] See e.g. Robert W. Adler, Jessica C. Landman, and Diane M. Cameron, *The Clean Water Act 20 Years Later* (1993); Peter Cleary Yeager, *The Limits of Law: The Public Regulation of Private Pollution* (Cambridge: Cambridge University Press, 1990); Freeman, "Water Pollution Policy."

quirements and compliance schedules were enforced more strictly than effluent limitations. Civil and criminal sanctions were used only against repeat offenders and grossly negligent or willful violators. The administrator retained enforcement power where state authorities implemented the program. The act also availed citizen suits to enforce the rules of water use or to compel the administrator to act. However, while they provided a check on the administrator's discretion, citizen suits never became central enforcement tools.[81]

The federal water pollution control program's influence on water quality has been modest. The limited nationwide and time series data does not exhibit clear trends in water quality since the late 1970s. It is obviously somewhat difficult to know what water quality would have been in the absence of the current program, a situation that is the correct standard for judging its performance. Water quality would probably have deteriorated, but not significantly as the earlier federal program and state programs would have functioned in the absence of the reforms of 1972. That said, the federal water pollution control program has been argued to have improved water quality in locations where it used to be low, and its effects on toxic pollution of water have been positive.[82]

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[81] See Hunter and Waterman, *Enforcing the Law*; Lettie M. Wenner, *The Environmental Decade in Court* (Bloomington, Indiana University Press, 1982); Yeager, *The Limits of Law*; Paul B. Downing and James N. Kimball, "Enforcing Pollution Control Laws in the US," *Policy Studies Journal* 11:55-65 (1982). On citizen suits, see Fadil, "Citizen Suits against Polluters."

[82] See Adler, Landman, and Cameron, *Clean Water Act 20 Years Later*; 13-86; Freeman, "Water Pollution Policy."

Conclusions

The governance of water quality changed several times in the 20th century. At the turn of the 20th century, the governance of water quality was based on common law, state legislation, and federal legislation protecting navigation. The states first used the Supreme Court of the United States to resolve their conflicts over the pollution of interstate waters. The states then engaged in informal and formal cooperation to resolve these conflicts. Finally, federal water pollution control legislation was enacted to govern interstate pollution. After that, the federal water pollution legislation changed so as to address the pollution of intrastate waters, which also made states interdependent.

The Supreme Court of the United States took up interstate conflicts on a case by case basis and did not create universal rules to resolve them. It also indicated that another basis for resolving them must be sought. State cooperation had a limited ability to do so: it only engendered resolutions that benefited the polluters and improved water quality or were based on a voluntary assumption of duties. The early federal legislation's functioning part was the grant program that financed the construction of municipal sewage treatment plants. It benefited local tax payers by lowering their tax burden and local industries could often discharge to municipal sewage treatment plants for free and shield themselves from private litigation and public enforcement. Downstream water users enjoyed improved water quality. Those paying federal taxes lost. When the reform of the federal legislation made the abatement provisions effective in 1972, it limited state authority, imposed more stringent requirements on industrial polluters, and benefited downstream water users.

The differential treatment of municipal and industrial polluters is a noteworthy aspect of the federal program. Grants for the construction of municipal sewage treatment plants

modified the incidence of benefits and costs closer to what it was in the abatement of industrial pollution. Namely, the abatement of industrial and municipal discharges mainly benefits downstream water users. Industrial polluters can pass on abatement costs in prices to their customers, who in turn capture benefits of abatement. Municipal polluters cannot do so. Industrial polluters can also influence their abatement costs more than the municipal polluters or even benefit from abatement: industrial effluents form only a fraction of the throughput of an industrial facility, while municipal sewage treatment plants only process waste. The grant program also provided a leverage to prop the states into action and to ensure their cooperation.

Water use and technology have not engendered new interdependencies in the 20th century, so the reason for the change of governance institutions lies elsewhere. Changes in the relative importance of different arenas of collective choice and changes in the rules for making rules are good candidates. The states needed to resolve their conflicts but did not want to relinquish their authority to control water pollution to the federal government. Therefore, they first resorted to the Supreme Court of the United States, which, however, was reluctant to assume the role. Voluntary cooperation also excluded direct federal authority. However, it was an inadequate basis for conflict resolution because it did not enable coercing the parties to comply. Federal intervention was the remaining alternative.

The federal legislature was long the primary political arena in which collective choices over the governance of water quality were made. The states and the industry were well positioned to protect their interests in the federal legislature until the 1960s. They could ensure that the federal water pollution control legislation in its inception only addressed conflicts over the pollution of interstate waters in addition to providing federal grants.

Moreover, the states had an effective power to block federal intervention into interstate pollution if they wanted to. However, the situation changed in the 1960s. The emergence of new environmental concerns in the 1960s changed the balance of power in the federal legislature. At the same time, the courts assumed for over a decade a more central role in collective choices over environmental governance. The courts also modified rules that regulated participation in conflict resolution and collective choices in the courts to the benefit of those forwarding environmental protection.

The most important theoretical argument substantiated by empirical analysis is indeed the significance of institutions that structure collective choices. The analysis also demonstrated the influence of the institutional design of governance institutions on their performance and the influence of resource attributes on governance. The institutional design of the federal program was practically unenforceable before the reform of 1972, because its rules of exclusion and use were ambiguous and compliance with them could not be effectively monitored or enforced. Resource attributes influenced the institutional design adopted in the reform of 1972. Technology-based rules of water use were adopted because they entailed lower transaction costs than rules based on water quality considerations. Yet they were often unable to achieve adopted water quality goals and were more expensive to the polluters than the water quality based rules would have been. Finally, discharges from non-point sources were ignored although they made up a half of the load of many conventional pollutants, because institutional solutions to govern them entailed very high governance costs. These governance costs thus shielded one group of polluters and influenced policy performance.

6. CONCLUSIONS

The governance approach developed in this dissertation research provides a good understanding of the development of water pollution policy in the United States from the early 19th century through the 1970s. The dissertation's theoretical goal was to develop a more realistic and nuanced approach to environmental problems and policy than the traditional economic approach is, while still retaining a firm basis in contemporary economic theory. The primary role of empirical research in the dissertation was to support theoretical work by providing a test-bench for theoretical ideas. Yet the empirical analysis of the long-term development of water pollution problems and policy demonstrates the long history of environmental governance that is often forgotten in contemporary environmental debates. We can also learn from the past failures in environmental governance that could help us avoid similar experiences in the future.

The first and second chapters of the dissertation develop the governance approach as a critical response to the dominant Pigovian tradition in Environmental Economics. The dissertation outlined the governance approach by combining elements from New Institutional Economics, Social Choice Theory, and Original Institutional Economics. The main characteristics that distinguish the governance approach from the traditional approach are 1) its understanding of environmental problems as resource use conflicts that emerge because of human interdependence, 2) the recognition of positive transaction costs, and 3) the acknowledgement of a broad set of behavioral motivations, some of which may not emphasize the improvement of individual or social welfare in the usual narrow sense.

In essence, the governance approach understands environmental problems as resource use conflicts that originate from the interdependence of agents. Their interdependence arises from the scarcity of resources and the physical attributes of environmental resources: agents simply cannot always have their ways simultaneously. The interdependence of agents forces a choice over whose interests in the use of environmental resources are to be protected upon those who make collective choices. For the governance approach, environmental policies are institutional arrangements that resolve resource use conflicts by implementing social judgements on what interests in environmental resources should be realized. Environmental policies accomplish this by establishing rights and duties with respect to environmental resources and by providing for their enforcement. The social judgements that underlie the choice and assignment of rights and duties with respect to environmental resources are often based on concerns for narrowly understood economic welfare, but also other values may inform them. The values that give direction to collective choices and the knowledge that informs them are socially constructed and frame choices in particular ways. Thus a change in values and knowledge may also change choice problems and choices. This is the essence of environmental governance.

The governance approach provides tools for analyzing environmental policies as governance institutions. It offers concepts with which to examine how the attributes of environmental resources and their users structure policy problems and pose challenges for governance institutions. The governance approach also offers concepts with which to analyze the design of governance institutions and to assess their likely consequences in different resource use situations. It assesses the performance of policy alternatives by multiple measures that reflect different interests in the environmental resource in question

and provides a realistic account of how policy alternatives would perform in the real world. Because the governance approach does not presume values, it does not generate normative judgements about the choice of policy goals or instruments. It rather encourages the identification and clarification of values that are to inform choices. The governance approach also helps to develop institutional responses to the identified policy problems in the light of adopted policy goals.

The governance approach has also other attractive features. Although it is informed by economics, the governance approach facilitates interdisciplinary research on environmental problems and policy. It also enables the use of diverse materials and analysis by both quantitative and qualitative methods. The governance approach is particularly useful for those that do qualitative fieldwork or archival work. The ability of the governance approach to support theoretical, methodological, and methodical pluralism expands the sphere of scholars that can participate in the debate on environmental problems and policy. The governance approach is also equally applicable to local customary resource management, national environmental policies, and international environmental conventions and enables to draw lessons in a one area or level of environmental governance and apply them in other areas or levels. Finally, the governance approach fosters careful analysis and the making of well-grounded observations and conclusions. This may improve policy choices and the design of policy responses in the future. It also enables us to critically evaluate proposals for universal or superior solutions to environmental problems.

The governance approach can also be used to examine past policy problems and responses, as was demonstrated in the empirical part of this dissertation. The dissertation sought to explain the change and performance of institutions that have governed water

quality as the result of the interaction of agents motivated by particular values and informed by particular knowledge within the institutional framework that structured their interaction and influenced their power in particular ways.

Several reasons informed the choice of the development of water pollution and its control over a long period of time as the subject for empirical research in this dissertation. A historical perspective enabled comparative institutional analysis and offered both theoretical and empirical lessons. Water pollution and its control were in turn good choices for the subject of empirical research, because water pollution problems have changed over time and a number of different institutions have been adopted to govern water quality. Also the policy goals have changed; they first emphasized the protection of property, then the protection of public health, and finally the protection of the environment because of instrumental or non-instrumental reasons. A historical perspective also demonstrated the continuity of human behavior with respect to environmental resources and provided a standpoint from which to analyze more critically recent policy problems and responses.

Water pollution problems have changed in the past century and a half, creating new interdependencies and conflicts over water pollution and pressures for the adoption of new governance institutions or the alteration of the existing ones. In the 19th century, discharges from early industrial establishments injured the downstream riparians' traditional and industrial water uses. Conflicts over industrial discharges usually involved relatively few agents, as the solids contained in industrial discharges worked their adverse consequences near the point of discharge. The construction of water supply and sewer systems in the latter half of the 19th century engendered new uses of water for public water supply and the disposal of human wastes. Entire communities became interdependent when one

community's disposal of human wastes endangered public health in another. In the 20th century, industrial and municipal discharges have increased and made the states interdependent. At the same time, recreation has become established as a new use of water that is incompatible with the use of water for disposing of wastes and sometimes also with the use of water for public water supply.

Riparian law governed the use of water for disposing of industrial wastes in the 19th and early 20th century. Early riparian law did not allow interference with the existing water uses by novel or extraordinary water uses, such as the disposal of industrial wastes. However, riparian law changed in the 19th century so as to facilitate an increasing use of watercourses for disposing of industrial wastes, even without compensating for the injuries doing so visited upon others. The losers in this institutional change were the riparians that used water for traditional household and agricultural purposes or for operating small, traditional water-powered mills. The courts improved the protection of existing water uses towards the end of the 19th century against the interests of industrial polluters.

The character of industrial pollution as a policy problem, the character of riparian law as a governance institution, and changing values explain the changes in the 19th century riparian law. Collective choices over the rules of water use emerged under riparian law as a result of private litigation in the courts. The riparians who were injured by industrial discharges did not usually have particularly valuable water uses and they had incentives to ride free on the efforts of others to enforce rights to water quality. The polluters in turn had both the resources and incentives to advance their water use in the courts. Collective choices made on the basis of ability and willingness to pay for one's water use and litigation engendered rules that favored valuable water uses, such as the disposal of industrial

wastes. The concerns for economic development and beliefs according to which the industry was the vanguard of economic development facilitated the change of governance institutions to the benefit of polluters by the courts. The late 19th century tightening up resulted from changes in technology and values. The rising power of corporations caused wide concern at the turn of the 20th century, and the courts shared it. It was also easier for the courts to require more from the industrial polluters when the courts knew the polluters could often abate their discharges at a relatively low cost.

Several institutions protected public health from polluted water in the 19th and early 20th century. Traditionally, the law of public nuisances had provided the legal basis for protecting health for both public and private plaintiffs. When the protection of health became a public matter around the mid-19th century, the local boards of public health and local ordinances were the new institutional responses. Local institutional solutions conferred health and amenity benefits especially to the middle-class residents of local communities, while they usually worked against the interests of the operators of nuisance industries and lower-class residents. State boards of public health and state water pollution control legislation were adopted to complement the local institutional responses in the late 19th century, when local communities had become independent as a result of changes in urban infrastructure. The institutional responses made at the state level had adverse consequences to the water companies and benefited their customers in the first place. They could also confer benefits to other water uses and burden the local taxpayers.

These institutional changes reflect above all changes in values and beliefs. The establishment of local institutional solutions in the mid-19th century was driven by values that considered the protection of human health a moral duty and by the new findings that asso-

ciated disease and environmental quality. The same values and beliefs also informed the establishment of state boards of health. However, the secularization of the American society transformed the concerns for the protection of public health towards the end of the 19th century, basing them increasingly on a utilitarian foundation. The establishment of institutions for the protection of public health at the state level was also informed by the bacteriological theory of disease. Indeed, the water pollution control statutes that were established in many states at the turn of the 20th century were a part of a larger effort at conserving the nation's vital or human resources. The utilitarian basis of public health policies at the turn of the 20th century also explains why sewage treatment dropped from the policy agenda when other measures could protect public health at a lower cost.

Several institutional solutions were tried and set aside to govern water quality in the 20th century, before federal legislation assumed its current dominant role. At the turn of the century, the governance of water quality was based on common law, state legislation, and federal legislation protecting navigation. None of these institutions could address the interdependence of states, yet it increasingly caused conflicts after the beginning of the 20th century. The states first tried to resolve their conflicts in the Supreme Court of the United States. However, the Supreme Court was unwilling and unable to provide a permanent solution to the interdependence of states. Informal and formal cooperation between the states was the second institutional alternative that was tried. However, it did not provide a good basis for resolving conflicts, because it was based on voluntary participation and thus eliminated the possibility of coercion. Then federal legislation was enacted in the mid-20th century to resolve the conflicts over interstate pollution and to fund the construction of municipal sewage treatment plants. This mainly benefited local tax-

payers, industry, and downstream water users at the cost of federal taxpayers. Later, the federal legislation was reformed to harmonize state water pollution control legislation and to provide augmented financial support for the construction of municipal sewage treatment plants. These changes conferred benefits to the local taxpayers and downstream water uses. They were against the interests of the states and industrial polluters.

The 20th century changes in the governance institutions reflect changes in the institutional framework within which collective choices are made, changes in the relative power of different interest groups, and changes in the values that have informed institutional choices. Litigation in the Supreme Court of the United States and informal and formal state cooperation were abortive attempts at resolving interstate conflicts without the involvement of the federal government. The federal legislation enacted in 1948 was mostly a symbolic nod to the conservation organizations, because the states and industry could influence collective choices in the federal legislature and prevent the federal program from becoming effective until the 1960s. The courts then opened up participation in conflict resolution and collective choices in the courts to environmental movements, which were growing at the same time because of increasing environmental concerns and general social activism. As a result, the environmental movement and environmental concerns in general commanded greater influence also in the legislatures and elsewhere.

The legal institutions that have been adopted to govern water quality form an onion-like or nested institutional structure. The inner core of the governance institutions is formed by riparian law and the law of private and public nuisances, which have been used since the early 19th century to protect private property and water use from water pollution. Common law is still used for the purpose. Today it is only enveloped by federal and

state legislation that set limits to its applicability. For example, statutory law creates inalienable entitlements to water quality, which cannot be taken nor traded away on the basis of private contracting or common law. Local ordinances and state water pollution control legislation form the second layer of governance institutions and were used to protect public health from polluted water in the 19th and early 20th century. Today's state legislation still forms a layer of its own although it has been harmonized by federal legislation. Finally, the third layer is formed by the federal and other institutions that were adopted to resolve interstate water pollution problems and to harmonize state water pollution control programs in the 20th century. This complex institutional structure reflects the complex set of interdependencies that characterize the use of water resources today.

The governance approach also enables us to form judgements about the effectiveness of particular governance institutions in practice. Even when and where riparian law formally protected the existing uses of water from the injuries created by novel and extraordinary water uses, the cost of protecting one's water rights were high and the similarly situated injure riparians had incentives to ride free. Therefore, riparian law did not protect existing water uses against the injuries created by the disposal of wastes as effectively in practice as it did in theory. Similar discrepancies between the formal and actual consequences characterize also other governance institutions. Local boards of public health often became activated and enforced local ordinances only when there was an imminent threat of an epidemic. The non-paid ex-officio posts did not give incentives to perform and there were no effective ways to compel performance. The birth of state agencies was accompanied with the professionalization of their personnel, which gave better incentives to perform in the public office. After all, it influenced one's career opportunities. On the

other hand, administrative decision-making was neither accountable nor transparent, which enabled the agency staff to implement their own goals as public policy. This rendered the state water pollution control programs that existed in the statute books ineffective in practice. The reformed federal program illustrates another reason why policies may not deliver. Although the Federal Water Pollution Control Act Amendments of 1972 expressed ambitious water quality goals, the choice of technology-based rules and the omission of non-point sources of pollution explain why the federal program did not have a greater influence on water quality. Of course, also other factors, such as the sheer burden of promulgating the rules of water use and monitoring and enforcing them contributed to the federal program's meager performance in terms of its effect on water quality.

The empirical research on the governance of water quality in the United States in the past century and a half also underlined and clarified several arguments made in the theoretical part of this dissertation research. First, the empirical research demonstrated that distinguishing between different kinds of values helps to understand both institutional change and performance. Both welfarist and non-welfarist values have influenced the choice and change of governance institutions, and what should be understood to constitute their performance. The empirical research also highlighted how changes in knowledge, such as the changes in the theories of diseases, can rapidly result in institutional change. Changes in technology were in turn demonstrated to render institutions obsolete or dysfunctional equally rapidly. Finally, the institutional framework and the rules for making rules were demonstrated to importantly influence the relative power of interest groups and the collective choices they make.

A number of questions remain to be answered after the completion of this dissertation research. They provide a fertile possibility for future research. First, the governance approach would benefit from the refinement of the theory of collective choice under value pluralism. The seminal works in social choice theory provide important building blocks for making progress in this area, but weaving their contributions into the conceptual fabric of the governance approach still requires a significant effort. The general applicability of the governance approach would in turn benefit from a research that examines governance at the local, national, and international levels and addresses the theoretical, methodological, and empirical problems of doing so. The empirical area of this dissertation research also provides a number of exciting possibilities for research. First is the relationship between the organizational form of collective actors, such as state water pollution control authorities and conservation organizations, and their ability to forward their goals. The second area is the relationships between the widening participation in political decision-making in the local and state levels, the making of infrastructure investments, and reform policies in the late 19th century and early 20th century. The third area is how the availability and change of institutional solutions to finance infrastructure investments, such as special assessments, municipal bonding, and special districts, have influenced the capability of local governments to make investments in urban infrastructure. Fourth, research on the progressive movement's role in the protection of public health would improve our understanding of both the reform of public health policies and the Progressives. Fifth, the research suggests that environmental concerns were more influential at the turn of the century than is usually believed. Research on conservation organizations and why they lost their influence around the 1930s would also be needed.

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