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Clifford S. Russell,
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and William J. Vaughan

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ENFORCING POLLUTION CONTROL LAWS

Clifford S. Russell
Winston Harrington
William J. Vaughan

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RESOURCES FOR THE FUTURE

RESOURCES FOR THE FUTURE (RFF) is an independent nonprofit organization that advances research and public education in the development, conservation, and use of natural resources and in the quality of the environment. Established in 1952 with the cooperation of the Ford Foundation, it is supported by an endowment and by grants from foundations, government agencies, and corporations. Grants are accepted on the condition that RFF is solely responsible for the conduct of its research and the dissemination of its work to the public. The organization does not perform proprietary research.

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This book is the product of RFF's Quality of the Environment Division, Paul R. Portney, director. Clifford S. Russell is the director of Vanderbilt University's Institute for Public Policy Studies; at the time this book was written, he was the director of the Quality of the Environment Division at RFF. Winston Harrington is a fellow at RFF. William J. Vaughan, who was a staff member at RFF for fifteen years, is currently an economist with the Inter-American Development Bank. The book was edited by Nancy Lammers and designed by Elsa Williams and Martha Bari. The charts were drawn by Arts and Words. The index was prepared by Lorraine and Mark Anderson.

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Preface

For many years, Resources for the Future has been known as a center for research on alternatives to direct regulation in environmental management. Probably the best-known research coming out of RFF in this field has been the advocacy of effluent or emission charges by Allen Kneese. His early writings on this subject have inspired many other economists to investigate and evaluate the characteristics of such policy instruments when used in various settings.

One of the criteria called on by some researchers in their evaluations is the ease (or difficulty) of monitoring the performance of dischargers under the policy instrument and enforcing the intended behavior of the dischargers, whether it be installation of some technology, maintenance of some discharge level, or honest reporting of actual discharges. Some analysts have asserted, for example, that imposing charges on polluters presents a tougher monitoring and enforcement problem than standard methods of management—often referred to as command-and-control regulation. But others have asserted virtually the opposite: that a charge system would be "self-enforcing." Certainly there is room here for clarification.

Monitoring and enforcing pollution control laws has another and more immediate claim to attention as a policy issue in its own right. This claim arises because evidence is accumulating, principally in surveys undertaken by the U.S. General Accounting Office for the Congress, that inadequate effort and attention are being paid to these aspects of transforming our good pollution control intentions into reality. One way of

stating the problem implied by this evidence is to ask what is now being done and whether it is possible to do better while remaining within the constraints imposed by limited budgets.

Moreover, the problem of monitoring and enforcement, if not quite ignored by environmental economists, has received only a tiny amount of their attention. Indeed, much of the environmental literature implicitly has assumed that dischargers will comply regardless of their self-interest. Thus, clarification of the debate over policy instruments seems to require some effort at strengthening the conceptual base for assessing monitoring programs.

Our recognition of this situation grew out of a research project that set out to study the use of economic incentives as alternatives to direct regulation, funded in 1979 by the Alfred P. Sloan Foundation. The recognition in turn led us to concentrate our attention on monitoring and enforcement. The resulting effort involved the examination of legal, technical, and statistical, as well as economic, issues. Our aims have been, first, to bring these issues together with an account of current practice in such a way as to define "the monitoring and enforcement problem" and, second, to suggest specific directions for further research.

This book has been a long time in the writing. Indeed, at times it must have seemed to supporters and colleagues that the project would never see completion. We offer our deepest gratitude, therefore, to those who stuck with us over the several years it took for the initial idea to be transformed into this book. Most important among these is the Sloan Foundation and, in particular, its vice president, Arthur Singer.

The Sloan Foundation provided RFF with the grant to study alternatives to direct regulation in environmental policy, out of which grew *Enforcing Pollution Control Laws*. Through its matching grant to RFF for environmental quality research, the Andrew W. Mellon Foundation supplied additional critical support.

We have also been encouraged by our many colleagues within RFF. Emery Castle, then RFF's president, was patient with delays and enthusiastic about specific ideas. Early on, Mark Sharefkin and Henry Peskin suggested the relevance of game theory to monitoring and enforcement problems, especially the game-theoretic models from the strategic arms literature. John Mullahy read parts of the book at different stages and offered us his helpful comments, as did Walter O. Spofford, Jr. Our heaviest debt, however, goes to Donald N. Dewees who, as a visiting Gilbert F. White Fellow, read the entire manuscript in its penultimate version and made superb suggestions for restructuring and, we hope, broadening the appeal of an inherently technical book.

Others outside of RFF influenced the shape and direction of the final

manuscript. Parts of chapters 2 and 4 relied heavily upon Winston Harrington's doctoral dissertation and had been reviewed by his committee at the Department of City and Regional Planning at the University of North Carolina. Gorman Gilbert, Milton Heath, Edward Kaiser, and David Moreau, the members of the committee, are due our thanks. Chapter 6 is a shortened version of a paper presented by Vaughan and Russell at the Seventh Symposium on Statistics and the Environment in October 1982, which was published subsequently in *The American Statistician.* Chapter 7 is based on a paper delivered by Russell at the Conference on Energy and Environmental Economics held at Yxtaholm, Sweden, in August 1984. Participants at the conference made useful suggestions that are reflected in this published version.

We would also like to acknowledge the research assistance of Julia Allen, who amassed the information on monitoring technology and ran the survey reported in chapter 2 and its appendix; and Susan Bishop, who did the legal research reflected in chapter 3. This version of the manuscript reflects the helpful comments of three anonymous reviewers and of John Ahearne, vice president of RFF. We are also grateful for the editing of Nancy Lammers, whose many suggestions greatly improved the style and presentation of the manuscript. Finally, we appreciate the enthusiastic help of Betty Cawthorne, who took her usual intensely personal care and interest in the welfare of our manuscript.

February 1986

Clifford S. Russell
Winston Harrington
William J. Vaughan

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1
Introduction to the Problem

Whenever laws and regulations require individuals or corporations to act in ways contrary to their self-interests, it becomes necessary to provide authority and resources to the government for monitoring and enforcement; that is, some effort must be made to observe the actions of those subject to the law. Possibilities for punishing or for at least making credible threats to punish violators of the regulations also must be available. These common-sense observations apply equally to laws intended to discourage the use or abuse of dangerous drugs, to local housing codes, to regulations written under the Occupational Safety and Health Act, and to regulations of state environmental agencies and the U.S. Environmental Protection Agency (EPA).

In any particular setting there will exist particular technical difficulties or opportunities, and even special quirks of the applicable case law, that together will define the specific monitoring and enforcement problem to be solved by the responsible agency. But, even if they are difficult or impossible to answer, the basic questions can be stated simply. How much public money and effort is it optimal to put into looking for violations and carrying through the punishment process? And what punishments fit the crime, in the sense of leading to an optimal rate of compliance now and in the future? Unfortunately, neither of these questions can be answered satisfactorily because it is not known:

- how much damage a violation causes—either directly, or indirectly when an unpunished violator encourages others to defy the law

- how sources will react to the prospect of uncertain punishments that will be determined by a complicated set of probabilities of detection, prosecution, and conviction
- how much detection probabilities are increased by increases in monitoring budgets.

Nonetheless, the conceptual work on crime and punishment of Becker (1968), Stigler (1970), and McKean (1980) can be helpful in keeping straight what ideally should be known and in avoiding extreme solutions, such as assuming that zero violations must be the goal or that only constant surveillance and draconian punishments can produce satisfactory results.

Two other general features of the monitoring and enforcement problem are especially important. One is the legal setting for such activities broadly defined. A second is the often-unrecognized but inevitable problem of uncertainty that is inherent in measurement or observation and the resulting probabilities of missing actual violations and of making false accusations. These errors cannot be entirely avoided, but they can be reduced by expending more effort. Thus, the simple question about monitoring effort really must be a sophisticated one involving probabilities of failure to find violations and of the identification of false violations.

This book is about monitoring and enforcement in the context of pollution control laws, and its specific methods and conclusions reflect that context. But many of its conceptual underpinnings, in particular the normative models of monitoring and enforcement policy ultimately developed, apply to other areas of public policy as well. Thus, the reader with an interest in keeping contaminated food products off supermarket shelves or in encouraging safe and healthy work places will find lessons in what follows, even if the examples used relate to pollution discharges.

Monitoring and Enforcement in the Context of Pollution Control Policy

The point of pollution control is to make the everyday, outdoor environment a more healthful and pleasant one. This ultimate goal has been obscured in the United States, however, where, in reaction to earlier failures, pollution control legislation and regulation have concentrated minds and money on installing technology. The short-term goal has been to reduce pollution by placing upper limits on allowable discharges and forcing the installation of equipment that is capable of attaining those

discharge levels. Neglected in the push for visible achievement have been three especially important long-term issues. The first of these is the net benefit to society—whether the existing set of pollution reduction goals represents an even roughly efficient way to proceed. The second is the future of technology—whether the current approach encourages or discourages decentralized research and development that will lead to a better environment at the same cost tomorrow. And the third is continuing monitoring and enforcement—whether the existing system can provide incentives for continuing compliance by dischargers with whatever set of standards (or pricing schemes) are in force.

The first of these issues has been and continues to be a subject of great interest. Environmental economists especially, but not exclusively, have been drawn to it and have written about alternatives to existing approaches (See, for example, Rose-Ackerman, 1973; Freeman, 1982; and Tietenberg, 1980). Some of this work also relates to the second issue, for it has been shown that different ways of ordering or inducing individual dischargers to do what is required to achieve desired ambient quality goals produce different incentives for efforts to improve pollution control technology (Bohm and Russell, 1985; Magat, 1978; Wenders, 1975). The third issue, in contrast, has been largely, though by no means entirely, ignored by economists and by other policy analysts.

Is Monitoring and Enforcement Really an Issue?

One common thread running through the literatures on efficiency and incentives for technical change is the assumption, implicit or explicit, that polluters, in fact, will comply with the discharge standards they are issued or will pay an accurately drawn bill if charging for emissions is the alternative under discussion. What is almost always missing is examination of this important, one might say vital, assumption. Given the policy fixation outlined above, perhaps this is not very remarkable. But it does seem to fly in the face of another basic assumption of the efficiency literature: that dischargers are motivated by self-interest in responding to whatever orders or charges are in place.

If the world is replete with examples of the pursuit of self-interest leading to the violation of laws, how could so many sound and sober thinkers have ignored this possibility in the pollution control field? A key to the answer lies in another assumption—almost always implicit in the writings in question—that the responsible agency knows just what each individual source is discharging at all times. Thus, the assumption of perfect (and, incidentally, costless) monitoring has supported the assumption of perfect compliance.

A more practical and much smaller body of literature has devoted attention to alternatives to perfect agency monitoring as the motivation for compliance by discharge sources. One theory asserts that sources will try to comply even in the absence of fines for violations. This view, which appears to be common among those actually engaged in enforcement at the state and federal level, essentially rests on the argument that dischargers have many reasons to obey the discharge limits imposed on them or to correct any discovered violations. These reasons include the desire to create a positive public image and not to provoke a broader bureaucratic attack, which might include tax audits or blacklisting on government contractor lists, by being discovered in flagrant violation of one set of regulations. This view is examined more formally in chapter 4.[1]

Another theory is based on an analogy with the U.S. self-reporting system of income taxation. In this view, an acceptably accurate knowledge of actual emissions can be achieved by requiring all sources over some designated threshold to measure their own discharges and report them to the responsible agency. As with the Internal Revenue Service (IRS), the agency need only conduct audits, whether random or directed by the lessons of experience and the characteristics of past violators, to encourage accurate reporting. Violations discovered in the audits would be penalized in administrative, civil, or criminal proceedings depending on severity and evidence of intent.

Two observations can be made immediately about this line of thought. The first is that its major feature, self-monitoring and -reporting, is already a central part of the current system. As will be seen in chapter 2, almost all state environmental agencies rely heavily on self-reporting by polluters for knowledge of what is being discharged. Requirements for such efforts are written into individual water pollution permits under the National Pollution Discharge Elimination System (NPDES) and into the New Source Performance Standards (NSPS) governing new sources of air pollution (See Wasserman, 1984, tables IIIa-1 and IIIa-4).

The second observation, however, is that the IRS has two advantages in administering the U.S. system of self-reporting income taxation that an environmental agency inevitably and unavoidably will lack:

- The IRS has access to an extensive paper record covering most

[1] This approach has been referred to in some places as "voluntary compliance," which implies a situation slightly at variance with the one described; that is, compliance is not entirely voluntary, since there are sanctions held in reserve. Furthermore, "voluntary compliance" will be reserved in this book to refer to a system of enforcement in which sources discovered in violation are not punished immediately but rather are allowed a chance to return to compliance without penalty. This use, too, is slightly misleading, but it does have the advantage of being common.

if not all income for nearly all individuals. Its audits consist largely of checking that record against self-reported income and deductions. Where the IRS's own records (W-2s, 1099s, and so on) are inadequate, it can require proof from the taxpayer that claimed transactions really took place and can check bank account transactions for evidence of unreported income.

- For the largest part of taxable income, it is to the advantage of taxpaying firms or individuals to make sure that the IRS has a complete record for other firms and individuals, because one taxpayer's income is another taxpayer's deduction.

In contrast, for pollution control agencies, there is no complete, independent record of what self-monitoring dischargers are emitting. Once discharges have gone up the stack or out the pipe they have vanished from an enforcement point of view and have left no record in the world. In this sense, they are fugitive events. Even if atmospheric discharge concentrations can be measured by remote monitoring equipment (Williamson, 1981) or source discharges can be inferred from measured ambient quality levels and discharge compositions (see Gordon, 1980; Courtney, Frank, and Powell, 1981), it still is not possible for the agency to monitor on its own schedule. Rather, it must act as discharges occur, or it loses the chance of acting at all. Furthermore, it is generally not in the interest of any particular firm or individual to provide independent evidence of discharges by another source routinely. While someone may be motivated by bounties or simple outrage to report obvious offenses, individuals cannot be counted on to do more than spot the tip of the iceberg. They lack both access to premises for in-stack monitoring and technology that would allow them to measure anything but the very crudest indicators, such as plume opacity for air pollution sources. (As discussed in chapter 8, however, the self-monitoring reports can be used by interested individuals and groups in enforcement actions.)

Some Evidence

The impatient reader may be unimpressed with these arguments and counterarguments. A priori debate about incentives and possibilities is one thing, but where is the evidence that long-term monitoring and compliance *ought* to be an issue? Maybe an ad hoc combination of moral suasion and self-monitoring really is good enough.

This is an understandable, if slightly unfair, position. It is almost impossible to know how common compliance is in the absence of serious monitoring efforts, for the behavior of the polluting companies would change if they knew they were being monitored. Only by contriving

some elaborate and highly artificial independent and confidential measurement could one observe what sources do in the absence of fear of discovery by the responsible environmental protection agency. A priori argument based on the profit-maximizing version of self-interest with limits on the influence of altruism or public relations concerns must therefore remain a major justification for the view that monitoring and enforcement is a problem.

But this is not to say there is *no* evidence on continuing compliance.[2] The studies of both Harrington (1981) and McInnes and Anderson (1981) suggest that a significant fraction of point sources of air pollution are out of compliance for substantial parts of every year. Even more impressively, a 1983 study by the U.S. General Accounting Office (GAO) of wastewater dischargers concludes that failure to comply with permit discharge limits is widespread; the full extent of noncompliance may not be known; and current enforcement practices do not encourage prompt correction of noncompliance after its discovery.

More specifically, the GAO study team reviewed discharge monitoring reports from 531 major wastewater dischargers (roughly half industrial and half municipal) to discover the extent of self-reported violations of permit terms during an eighteen-month period ending 31 March 1982. Furthermore, the team reviewed the completeness of the self-monitoring reporting for each of the sources during the same eighteen-month period. For one subsample of dischargers, GAO explored how long noncompliance continued before enforcement action was taken.[3]

Overall, 31 percent of the dischargers examined were found to have been in significant noncompliance during the period. ("Significant noncompliance" was taken to mean exceeding permitted concentration or quantity limits by 50 percent or more for at least one quality parameter in at least four consecutive months.) The rates were 28 percent for municipal and 21 percent for industrial sources. That these rates might be underestimates of the overall noncompliance is suggested by the fact that 8 percent of the sources failed to submit one or more of the reports required of them during the period, while 37 percent submitted one or

[2] As will be emphasized later in this chapter, "compliance" within the current system can have two meanings. The more common might be restated as having the ability to meet discharge standards as embodied in permits. "Compliance schedules," for example, refer to time tables for installation and approval of equipment that will allow permit terms, written from guideline documents, to be met. This is called "initial" compliance in what follows. The actual meeting of these terms on a day-to-day, week-to-week, or month-to-month basis is the meaning commonly used in this book. This situation will be referred to as "continuing" compliance.

[3] Questions about permit backlogs and expired-but-not-reissued permits were also explored.

more incomplete reports. The GAO report also observes that efforts to check up on self-monitoring are being reduced by the EPA and the states, with data on sampling inspection cut back. Finally, in commenting on the reaction produced by reported significant noncompliance with permit terms, GAO says: "In some cases, formal enforcement action was not taken for years after noncompliance began. In other cases, noncompliance had continued for years even after EPA or the state took enforcement action."

A Source of Confusion: Initial Versus Continuing Compliance

A student of pollution control policy might be tempted to object to the above recitation of evidence and to cite apparently contradictory EPA evidence that shows very high rates of compliance indeed. For example, according to data from EPA's Compliance Data System, more than 90 percent of major stationary sources of air pollution had achieved compliance with state regulatory requirements as early as the middle of 1977.[4]

[4] That left nearly 1,500 sources that had not achieved compliance or were not even on an approved compliance schedule. Moreover, those not yet in compliance tended to be very large sources and were concentrated in the electric power and steel industries (U.S. GAO, 1979). For a number of reasons, these sources presented EPA with a problem. Owners of large facilities often had both the incentives and the means to fight hardest against regulation. They also frequently presented the state agencies with a political problem—especially those sources located in small towns where they provided a large share of local employment. In this context, the 1977 Amendments to the Clean Air Act gave EPA the authority to seek civil penalties (up to $25,000 a day) and administrative noncompliance penalties. Although the courts would remain reluctant to take vigorous enforcement action, the agency at least had a credible threat to make against those choosing not to comply (See Melnick, 1983).

By mid-1981 EPA civil actions had been initiated against 395 facilities, and state civil actions against 78. In addition, about a thousand sources were subject to state or EPA administrative action. Fully half the 1,500 noncomplying sources had achieved initial compliance, while another quarter were on a schedule for achieving compliance within a short while (memo issued May 11, 1981, from Richard Wilson, acting assistant administrator for enforcement, to regional administrators). Most of these cases, therefore, were concluded successfully.

This improvement in compliance during the late seventies was achieved with virtually no actual use of legal penalties, although large penalties were threatened by EPA. Between 1977 and 1981, $27 million in penalties of all types was collected by EPA for violations of the stationary source regulations (Crandall, 1983). State agency collections were even less. These penalties are insignificant, especially when compared with estimated annual investment costs of $3.9 billion for stationary source abatement (U.S. CEQ, 1979).

A critical look at compliance data gathered by EPA is provided by Wasserman (1984). From her data it appears that in 1983, 92.9 percent of existing sources of air pollution with potential emissions of more than 100 tons each year were considered either "in compliance" or "on schedule" toward achieving compliance. The rates for water pollution sources (which must be read from a small, rough graph) were approximately 96 percent for major private industrial sources and 81 percent for major publicly owned sources. ("Major" sources are the largest 15 percent in the national inventory.) As Wasserman explains, however, these data do not reflect compliance with permit terms on a continuing basis.

Thus, there is a problem of definition. Because of its required interest in encouraging the installation of technologies designed to produce desired discharge reductions, EPA historically has defined compliance in those terms; that is, sources are "in compliance" when they have installed and demonstrated (or are installing or have agreed to install) the appropriate equipment. For the purposes of this book—and, it would seem, for clarity in future debate—this type of compliance will be referred to as *initial compliance*. It is simply a successful demonstration that a particular plant or part of a plant is capable of meeting a required limit on discharges. *Continuing compliance*, in contrast, is the ongoing meeting of a discharge limit over days, weeks, and years of routine operation.

The problems an agency has in enforcing initial compliance are considerably different from those for continuous compliance, and a listing of three major differences may illuminate the difficulties of enforcing continuous compliance:

- Achievement of initial compliance usually has no effect in itself on environmental quality. Initial compliance can be satisfied by obtaining and operating correctly in one test the appropriate equipment, but environmental quality will not be affected unless the equipment operates continuously. One exception to this rule occurs when the source complies with the regulation by eliminating the regulated pollutant altogether.
- Achieving initial compliance generally involves assuming a fixed cost, often through the purchase of some major piece of equipment or the modification of a major process. A source that successfully postpones initial compliance postpones this expenditure. Once initial compliance has been achieved, however, avoidance of continuing compliance saves at most a portion of the variable operating cost.
- Once initial compliance has been achieved, that is that; imple-