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DANGEROUS PREMISES

**AN INSIDER'S VIEW
OF OSHA ENFORCEMENT**

DON J. LOFGREN

**ILR Press
SCHOOL OF INDUSTRIAL AND LABOR RELATIONS
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PREFACE

Many books stress the need for the Occupational Safety and Health Administration (OSHA). Some criticize OSHA for being too weak. Others decry overregulation of the workplace. And still others use statistical methods to analyze OSHA's effectiveness. But this is the first book that describes firsthand an inspector's view of OSHA enforcement.

Statistics do not begin to describe the thousands of people each year who, as a result of OSHA enforcement, will not suffer hearing loss from working in a noisy factory, a disease from exposure to a harmful chemical, or disabling workplace-related injuries. Nor do statistics begin to describe the plight of the thousands of workers who, in spite of OSHA's goals, continue to work in dangerous premises in which management takes no responsibility for safety and health.

What are the legal responsibilities, political pressures, and personal limitations an inspector faces in trying to do his or her job? What can an inspector accomplish? And how could OSHA be improved, given the problems it has in reaching its goal of assuring every working man and woman a safe and healthful workplace? These are some of the questions *Dangerous Premises* addresses.

Dangerous Premises is based on my experiences as an OSHA health inspector for the state of California. Of the 162 workplace inspections I conducted during three years ending in 1985, about 40 resulted in citations for one or more serious violations. Ten of the narratives included here concern these employers. I have chosen these narratives because they illustrate the problems of enforcement and the challenges OSHA faces in meeting its goals.

After reading this book, one might well conclude that OSHA has failed in changing the attitudes of the thousands of employers across

America for whom workplace safety is clearly a low priority. But although many companies do not comply with OSHA's requirements, many do. In many of these companies, the requirements for safety and health surpass those of the government. I have conducted inspections that resulted in no citations or in citations for only minor infractions. I have inspected many companies—large and small—that maintain a high level of compliance and commitment to their employees' well-being. Many of these companies have comprehensive safety and health programs and correct problems as they arise. One of the narratives in this book is about such a company. To run a business, particularly a small business, with the aim of maintaining the well-being of one's employees takes courage, good sense, and hard work. Such employers deserve everyone's respect and the rewards they earn for their financial risk.

Dangerous Premises was written with the hope that, by revealing what happens during and as a result of an inspection, readers will be able to make informed judgments about the need for OSHA and how OSHA could better realize its goals.

The identities of the companies and individuals in the narratives have been changed to maintain their privacy. Any similarity to real people, living or dead, is coincidental.

I. INTRODUCTION

The Occupational Safety and Health Act (OSH Act) was enacted into federal law in 1970 "to assure safe and healthful working conditions for working men and women."¹ The act provides for the Occupational Safety and Health Administration (OSHA) to set and enforce regulations for workplace safety and health through a graduated system of civil penalties; for a separate agency, the Occupational Safety and Health Review Commission, to hear appeals concerning citations, including those resulting from errors made by inspectors, and to check the power of the enforcement branch; and for the National Institute of Occupational Safety and Health to conduct research and promote safety and health through education and information dissemination.

In addition to the right to a place of employment "free from recognized hazards," the OSH Act grants employees the right to be notified by their employer if they are being overexposed to toxic materials or harmful physical agents; the right to file a confidential complaint with OSHA regarding unsafe conditions; and the right not to be discriminated against by the employer for exercising any rights granted by the act. Employees also have the right to have representatives participate in an OSHA inspection.

Employer rights include the following: the right to an opening conference and to accompany an inspector on an inspection; the right to seek a variance from a standard if another equal or better protective method of control is found; and the right to appeal any citations and fines that may be issued as a result of an inspection.²

One of the aims in formulating the OSH Act was to assign responsibility for occupational safety and health to the one entity that has the power to effect physical or personnel changes in the workplace—the

employer. Congress's hope was that most employers would comply voluntarily by referring to pertinent standards and texts and by seeking public or private help when necessary. The law was structured, however, so that compliance could be enforced through the use of penalties.

The 1970 OSH Act allows states to establish their own OSHA programs, modeled on the original act. Federal OSHA has the power to approve and if necessary repeal state programs and is required to monitor the activities of state plans on a continuing basis. Differences exist among individual programs, but states that have their own agencies are required to set up compliance programs and to enforce standards that are "at least as effective" as or identical to the federal program. Federal and state enforcement procedures are basically the same.

Within certain limits, enforcement policies for federal and state programs may differ. For the most part, however, the differences between federal and state programs are no greater than those that may occur within federal OSHA under different presidential administrations or among regional offices of federal OSHA.

How an OSHA Inspection Is Conducted

OSHA inspections are initiated in response to an employee complaint about unsafe working conditions or an accident or as a follow-up of an earlier inspection. An employer may also be selected for an inspection from an OSHA list of companies in high-hazard industries. Except under limited circumstances, employers are not given advance notice of inspections.

Upon arrival at a work site for an inspection, the inspector will contact an appropriate employer representative, most often a plant manager, site superintendent, or owner. After explaining the purpose of the visit and showing identification, the inspector will generally describe the three phases of the inspection: the opening conference, the walkaround, and the closing conference. Employer and employee representatives have the right to be included in all three phases.

The opening conference is held with management and the employee representative, if one is available. The inspector discusses the OSHA program, employer and employee rights and responsibilities under the OSH Act, and the procedures for conducting the inspection. The inspector will examine pertinent records, including those for illnesses and injuries, and obtain an overview of the business. He

or she will also review components of the company's safety and health program, if there is one.

The next phase of the inspection is the walkaround of the plant or job site. Both the employer and employee representatives have the right to accompany the inspector on this "tour." The walkaround is intended to enable the inspector to observe firsthand the hazards employees face and to determine whether the business is complying with required safety and health regulations. Evaluations are expected to be objective and professional, and throughout the walkaround, the inspector points out unhealthful and unsafe conditions to the employer.

The inspector notes whether machines are properly guarded, personal protective equipment is being used, ventilation appears adequate, and any other necessary items for controlling hazards are present or absent. The inspector usually conducts employee interviews, in private, to learn more about potential hazards and the company's safety and health program. Should noise or airborne contaminants need to be measured, arrangements for testing are made, often for a few days later.

Once the walkaround and necessary tests have been conducted, the inspector holds a closing conference with the employer representative and employee representative, if available. Depending on the complexity of the inspection, the closing conference may be held on the same day as the opening conference or several weeks later.

During the closing conference, the inspector formally reports his or her findings concerning the company's safety and health program. If there are no violations, the inspection usually ends with an encouraging remark from the inspector. If a citation is issued, the employer is given a description of those items in violation of OSHA standards and is informed whether any of the violations are of a serious or otherwise penalizable nature. Alternatively, citations may be mailed to the employer soon after the inspection.

When penalties are imposed, they are determined based on the gravity of the hazard and on the employer's history and safety awareness. Maximum amounts for each first-instance serious violation range from \$1,000 to \$5,000 depending on the OSHA program. Higher penalties may be assessed for repeated violations, willful conduct, or failure to abate a previously identified hazard.

The inspector also establishes dates by which the violations must be corrected, in consultation with the employer, and suggests ways to eliminate the hazard or sources of assistance. Procedures for receiving extensions of abatement dates and the rights of appeal are also explained. The employer is required to post a copy of a citation at or near where the violation occurred for three days or until the violation is abated, whichever is longer.

Cited employers may appeal a citation, the penalty, and/or the abatement date. The employer has fifteen working days from the time the citation is received to file the appeal. Most OSHA programs have a method for reviewing a citation with an employer before the formal appeal is filed. Adjustments in the penalty and a settlement are often the outcome of these conferences.

In the absence of a settlement, a formal appeal is held before an administrative law judge. The burden of proof is on OSHA. Either party may contest the decision of the administrative law judge, first to the managing appeals commission or board and then through the judicial system, up through to the Supreme Court.

Employees may not appeal a violation, but they may appeal a decision by OSHA *not* to issue a violation. They may also contest the time an employer is allowed to abate a hazard or request an informal conference with OSHA to discuss any aspect of a citation. They are also allowed to participate in appeal hearings.

Industrial Hygiene

The hazards discussed in this book primarily affect workers' health rather than their safety. Health hazards in an occupational setting include those that may cause harm through exposure to chemicals, noise, or microwave radiation. Examples include hearing loss as a result of noise, a fatal respiratory disease caused by inhaling minerals such as asbestos or silica, or a debilitating injury to the nervous system as a result of contact with a chemical that can penetrate the skin. In contrast, safety hazards include those that can cause death or injury by burial or fall or as a result of physical contact with machinery or electricity.

Health hazards generally are investigated by compliance health officers, called industrial hygienists, who are trained to recognize, evaluate, and help control health hazards in an industrial setting. Because of the complexities of evaluating and documenting hazards,

the administrators of the OSH Act and equivalent state acts have separated matters of safety and health so that there are two categories of inspectors: safety inspectors and industrial hygiene inspectors. Small companies in the private sector may have one person who oversees both safety and health, whereas many large companies have specialists, as in OSHA.

One of the primary concerns of the industrial hygienist is evaluating the amount of contaminant or physical agent to which a person has been exposed and which can enter or otherwise affect his or her body. Equally important is whether the amount of exposure is sufficient to cause physical harm. Much of his or her time an industrial hygienist is concerned with airborne contaminants, which have to be sampled with special instruments and equipment to determine the exposure level. The sampled level is then compared with legal and recommended limits.

The exposure levels of a contaminant in the air are usually expressed in parts of X contaminant per million parts of air or in milligrams of X contaminant per cubic meter of air. For example, visualize for a moment 999,999 white marbles in a given space and one red marble buried among the white marbles. It can be said that there is one part red marble per 1 million parts "contaminated" white marbles, abbreviated 1 ppm. Similarly, 1,000 parts hydrogen cyanide gas to 1 million parts of contaminated air (1,000 ppm) can be generated in a plating shop as a result of a salt solution of copper cyanide being accidentally mixed with an acid solution. At levels above 300 ppm, equivalent to 0.03 percent, hydrogen cyanide is immediately lethal, although it is only a small fraction of the air.

As another example, one milligram of titanium dioxide dust per cubic meter of air (1 mg/m^3) is thrown up during light sanding of a metal part for a jet airplane. This level is equivalent to a speck of metal being dispersed throughout small particles of dust, smaller than the human eye can discern, and distributed evenly in about a three-foot-by-three-foot cube. This concentration of titanium dioxide is one-tenth the exposure limit and poses no risk for most people who inhale it every day. Exposure limits for airborne contaminants are provided with a time factor for exposure. This follows from a principle of toxicology that, besides the concentration level, the amount of toxicant that can safely be taken into the body depends on the length of time of the exposure. Most limits are for an eight-hour workday, calculated as an eight-hour time-weighted average (8

hr TWA). What this means is that excessive levels may be experienced during the workday but the average exposure must be equal to or less than the established limit. For most of the working population *but not all*, day-in and day-out exposure at or below a limit during a forty-hour week is believed not to cause ill health even over a working lifetime.³

Not all chemical exposure limits are based on eight-hour exposure. Some chemicals can cause harm in a shorter time if the level is high enough. For instance, spraying an enamel paint containing toluene in a room with minimal ventilation could cause the painters to experience serious symptoms, even if they were painting for only an hour. To prevent the fast-acting effects of toluene, OSHA adopted a short-term exposure limit of 150 ppm, averaged over any fifteen-minute period.

Scope of the Book

The inspections described in this book are typical of OSHA health inspections in which there is serious noncompliance. The hazards represented—absestos, solvents, lead, noise, carbon monoxide, and formaldehyde—are some of the most prevalent occupational health risks in the nation. Over time, tens of thousands of workers throughout the work force, a few here and a dozen there, in hundreds of thousands of workplaces across America, are affected. Some are at immediate risk; others will suffer at some time in the future.

The inspection narratives are grouped by hazard. Each chapter begins with a discussion of the health effects of the hazard to help the reader understand the reason for regulation and the risk workers face. Several of the discussions also include background on how the chemical benefits society. Chronicled throughout are the hard-won battles OSHA and other groups have waged to pass today's regulations.

2. ASBESTOS

Asbestos is a fibrous mineral with unique physical properties. It does not conduct electricity, is resistant to fire, and is an outstanding insulation against heat and cold. It is nearly indestructible and can be powderized and mixed with cement, spun and woven into textiles, or pressed to form a paper.

As a result of these and other unique properties, asbestos has found its way into thousands of products since it was produced commercially around the turn of the century. For many years, it was used to make a sprayed-on insulation for acoustical ceilings and steel girders. Much of this insulation is still in place, "decorating" ceilings or protecting steel girders from buckling in the event of a fire. Asbestos was also used as an insulation for electrical wires, steam pipes, and boilers until substitutes were found. Thousands of tons of asbestos fibers strengthen products such as cement pipe, outdoor siding, and shingles, while thousands of tons of products made from asbestos cement enclose buildings or transport storm water and sewage. Asbestos has also been widely used as an insulating and reinforcing agent in the manufacture of roofing tar paper and vinyl floor tiles and in certain fire-resistant paper products and textiles. The mineral was even used at one time in welding blankets and in fire fighters' and foundry workers' fire- and heat-resistant protective clothing. Its outstanding insulating properties still favor its use in brake shoes and clutch discs. These and other asbestos-containing products sold well, and asbestos is now all around us—in the cars we drive, the machines we work with, and the buildings we work in.¹

But, despite its usefulness, asbestos has caused some serious health effects. Tens of thousands of once-unsuspecting workers and consumers have already been affected, and many more will be in the

future. What has been learned, tragically, is that the penalty for unsafe use of the mineral and its products can be death. Chronic exposure beginning at the age of eighteen can result in death by the age of forty and in some cases sooner.

Death from asbestos exposure can take several forms, including asbestosis, lung cancer, mesothelioma, and other cancers. Asbestosis is a lung disease caused by exposure to high levels of asbestos dust. A noncancerous yet disabling and deadly disease, asbestosis occurs as a result of indestructible microscopic asbestos fibers lodging deep in the lungs and, in time, causing a buildup of scar tissue. The fibers both scar and stiffen the lungs, inhibiting their ability to expand and reducing the volume of air that can be inspired, progressing to partial or full manifestation of the disease.

The first symptom, usually shortness of breath with exercise, is often not noticed until nearly a decade after the victim's first exposure to asbestos. Symptoms may then progress to shortness of breath even while at rest, coughing, noises from the lungs called "rales," a bluish or purplish color to the mucous membranes and skin, loss of weight, for some a feeling of pain and tightness in the chest, and eventually, in the most severe cases, death. The victim slowly, incrementally, suffocates. Some victims in the latter stages of the disease must carry a bottle of oxygen with them just to stay alive. Death can occur from pulmonary hypertension or attendant lung infections or from cardiac failure because of the destruction of the lungs.

Exposure to asbestos can also cause cancer. Some heavily exposed groups have suffered an incidence rate of more than 50 percent. Cancer of the lung poses the greatest threat and is often fatal. Lung cancer from asbestos exposure usually has a long latency period, some twenty or more years after exposure has begun. Smoking increases the risk of the disease, so that smokers who are chronically exposed to asbestos have a ninety-two times greater chance of getting lung cancer than the general population of nonsmokers.

Another disease caused by asbestos exposure, called mesothelioma, is a cancer of the tissue membranes that surround the lung cavity and abdominal organs. It has a latency period of thirty to forty years, spreads rapidly from its place of origin to other areas, and is usually fatal. It is extremely rare among people who have not been exposed to asbestos but accounts for 10 to 18 percent of asbestos-induced cancer. Other forms of cancer have also been observed at higher

rates among asbestos workers than among the general population, though with less frequency than lung cancer or mesothelioma.

The adverse effects of asbestos exposure were known as far back as two thousand years ago in ancient Rome, where slaves were required to work with the mineral. And it is now known that between the 1930s and 1960s—the “boom” years for asbestos—much of the asbestos industry in the United States was aware of its adverse effects but hid and then denied the hazards.² In the meantime, hundreds of thousands of workers making or using asbestos products were exposed, and many died as a result.

The regulatory history of asbestos in the workplace (i.e., enforceable national standards) starts with the 1970 OSH Act, some forty years after American workers first began seeking compensation for diseases resulting from exposure. Earlier enforceable regulations were weak and limited in scope and, for most workers, nonexistent before 1970. The OSH Act promised mandatory risk reduction for workers across the nation, with the opportunity for further risk reduction as the need could be proven or political opposition overcome.

The earliest voluntary standard for asbestos in the United States, set in 1938, recommended a limit equivalent to thirty fibers per cubic centimeter of air (30 f/cc).³ By contrast, the first OSHA-determined asbestos exposure level, adopted in May 1971, was 12 f/cc as an eight-hour time-weighted average. This level was presumed to be one workers could be exposed to for a lifetime “without undue risk”—a chilling thought by current standards.

At the time OSHA adopted the mandatory 12 f/cc standard in 1971, many health scientists thought this level was too high. The Industrial Union Department of the AFL-CIO acted on this concern and that same year petitioned federal OSHA to adopt a lower standard. As a result of this effort, an emergency standard of 5 f/cc was adopted in December 1971 and affirmed six months later. Included in the standard was a statement that the level would be dropped to 2 f/cc in 1976. In setting the new standard, OSHA indicated that the risk of cancer from asbestos exposure had not been fully considered and that both the 5 and 2 f/cc limits had been set to prevent asbestosis.

In October 1975, at the insistence of the AFL-CIO, OSHA proposed that the level be lowered to 0.5 f/cc.⁴ It was OSHA's stated attempt to regulate asbestos as a human carcinogen at what was

thought at the time to be the lowest level that could be achieved by industry and be measurable. The proposal was put on hold and its supporting documentation was later shot down by the courts in a decision over the standard for the carcinogen benzene, during which OSHA's method of risk assessment was rebuked. This loss was mildly atoned for in July 1976, however, when the enforceable standard was automatically lowered to 2 f/cc.

The issue did not die, though. The National Institute of Occupational Safety and Health (NIOSH), the research branch of OSHA, in December 1976 recommended that the standard be lowered to 0.1 f/cc. At the time, thousands of workers were breathing in asbestos at levels far above this limit. Surveys of some plants revealed exposures in the range of 0.3 to 22 f/cc, requiring the use of respirators in many operations.⁵ One study in 1975 showed surprisingly high exposures (9.9 to 26.2 f/cc) among workers who wore asbestos fire- and heat-proof protective clothing.

In November 1983, OSHA again attempted to lower the limit to 0.5 f/cc through the issuance of an emergency temporary standard. The asbestos industry immediately challenged the lower standard through a group unabashedly called the Asbestos Industry Association. The association won, and the emergency standard was stayed by the courts and thrown out in March 1984 as invalid.

OSHA countered a month later with another proposal in which it recommended a new exposure limit and a comprehensive set of rules for asbestos control. This proposal also applied to the construction industry, which previous proposals, directed instead at fixed industries, had ignored. The proposal, however, was stalled.

Finally, two years later, in July 1986, a comprehensive standard was passed that included an exposure limit of 0.2 f/cc. This standard sets forth rules on how the limit and other protective measures are to be met and applies to all industries, including construction. A court challenge by a business group called the Asbestos Information Association, made up of fifty or so companies involved in the mining of asbestos or the manufacture of asbestos-containing products, failed to alter the standard significantly.

OSHA maintained that the 0.2 f/cc limit was necessary to reduce the risk of cancer and asbestosis to a minimal yet feasible level. Feasible was defined as capable of being measured in the air and complied with by the affected industries without prohibiting use. (Banning of substances is in the purview of other agencies, such as

the Environmental Protection Agency.) Over a fifteen-year period, the mandatory exposure limit for asbestos had been reduced from 12 f/cc to 0.2 f/cc—a *sixtyfold drop*.

Years of unregulated use of asbestos have left much human data regarding the potency of asbestos exposure. Much of this information was included in the documentation OSHA used to support the 1986 standard. Consider the following risk assessments, for example:

- For every thousand workers exposed to asbestos time-weighted averages of 0.2 f/cc for forty hours a week for a working lifetime (forty-five years), seven will die from an asbestos-induced cancer and five will suffer from asbestosis. (Note that the standard does not prevent all cancer; it only reduces the risk.)
- At the previous exposure limit of 2.0 f/cc, the risk was such that sixty-four people would die from asbestos cancer and fifty would contract the disabling asbestosis for every thousand exposed workers.
- Occupational exposure for one year to 0.1 f/cc, a value that can currently be exceeded at many workplaces using or manufacturing asbestos or at construction sites involved in demolition, results in about 15 deaths out of 100,000 so exposed, and one year of work exposure to 10 f/cc, which is near and above the level to which thousands of temporary employees have undoubtedly been exposed and just a shade under OSHA's first-ever exposure limit of 12 f/cc, results in about 1,271 cancer deaths per 100,000 workers.⁶

The risk is greater, of course, at higher levels of exposure and for longer periods of time, which is why epidemiological studies have found that groups of workers who were highly exposed to asbestos often suffered death rates of more than 50 percent. OSHA admits that a significant risk still exists at the 0.2 f/cc level but that the current exposure limit is based "on a determination that this level is the lowest level that can feasibly be attained in operations in workplaces in both general industry and construction."⁷

There is currently a background level of asbestos to which we are all exposed, estimated to be 0.003 to 0.0000003 f/cc in outdoor air, depending on whether we live in an urban or rural area. One risk assessment by the National Research Council estimated that the can-

cer risk for the urban public exposed to ambient levels of asbestos for twenty-four hours a day for a lifetime is 1 to 7 out of 100,000 exposed.⁸ (The current lifetime risk of death from cancer from all causes, including smoking, is about 25 percent or 25,000 out of 100,000.)

Many products are still made from asbestos, including certain papers, textiles, cement pipes and sheets, tiles, felts, and friction products such as brake shoes. Other products and uses have been banned over the years. In the 1970s, for example, the Environmental Protection Agency (EPA) banned the application of sprayed-on asbestos in buildings and of asbestos-containing pipe lagging, and the Consumer Products Safety Commission banned the use of asbestos in consumer patching compounds and artificial fire logs. In 1986, the EPA proposed a ban on the manufacture, importation, and processing of asbestos cement pipe and fittings, roofing felts, flooring felts, vinyl asbestos floor tile, and asbestos clothing. Included in the proposal was a plan to phase out other products containing asbestos, such as brake shoes and clutch discs, as substitutes become available.⁹

Regardless of future action by the EPA on the manufacture and importation of asbestos-containing products, asbestos will be with us in products and structures for many years, along with the opportunity for significant exposure and risk from its unsafe use, particularly during the demolition of asbestos-containing materials (asbestos in a contained form and without physical action to release fibers poses no risk). The 1986 comprehensive OSHA standard for control of exposure to asbestos, if enforced and complied with, will help considerably in preventing deaths from occupational exposure to the still widely used materials containing asbestos.

The Asbestos Wonderland

I had made inspections of asbestos rip-outs before, but the demolition of a former Johns-Manville plant was of a different magnitude.

"How soon can you get out there?" Dave, my boss and district manager, asked as he gave me the assignment. A subcontractor had filed a complaint, alleging that the main demolition contractor was being too carefree with asbestos.

From the tone in his voice, I sensed it was going to be a difficult inspection. "In about an hour," I replied.

I went to our file cabinets and looked at the Johns-Manville file. There had been several inspections at the plant over the years. Results from air monitoring, both the company's and ours, had indicated that the levels for the manufacturing operations were below the two-fiber limit then enforced. But there had been no recent inspections. No one had mentioned to me that a Johns-Manville plant even existed in the state, presumably because the plant had been closed down for some time. The file also showed that the company had received a "serious/repeat" citation almost seven years before for an asbestos "spill" when dust containing asbestos had been spilled and not cleaned up. Johns-Manville had appealed the citation, which carried a fine of \$260, lost the appeal in a decision a year later, and appealed again to the next level. The company had lost that appeal too, but, more interesting, the decision had inexplicably come seven years after the citation was originally issued and while the plant was in the midst of being demolished. The file had confirmed the obvious: the plant had definitely made asbestos-containing products.

Later that day, a safety inspector and I were heading out for the plant. Approaching our turnoff, we looked for the plant but could not find it among the refinery towers and other buildings in the rundown industrial area. About halfway along the road, three buildings with gray corrugated walls and roofs, rising thirty to forty feet, loomed ahead. Nearing the end of the road, we passed by the plant's empty parking lot: weeds grew tall through the cracks in the asphalt. As we turned to park, the six-foot-high block letters on a side of one

of the buildings stood out as if they were written in bright red rather than the now-fading black: JOHNS-MANVILLE.

We got out of the car and walked toward the former administrative building, where we were met by Jim Levy, the site superintendent for the demolition contractor, Malbuc.

After the formalities of the opening conference, Levy briefly explained that his dad, who owned part of Malbuc Construction as well as his own construction company, had given Levy the demolition project to run. His dad and his partners had bought the remaining equipment and structures from Johns-Manville through a bid and planned to resell all salable equipment and scrap any remaining metal for money. Johns-Manville still owned the land, he explained, and was trying to sell it.

Levy further explained that the job had been started about three months earlier and that he was using a fourteen-man crew to salvage the steel and other parts that could be scrapped. Subcontractors had bid and paid cash for the right to scrap certain parts, such as the electrical wire, motors, cranes, lights, and even some of the buildings that could be dismantled, moved, and rebuilt.

We told Levy that we needed to tour the site, interview workers, and possibly take some samples. Levy offered no resistance and led us out of the office.

We headed toward the east end of the building where asbestos cement pipe had been manufactured. The pipe was made of Portland cement, sand, and asbestos and was used extensively for water mains, sewer pipes, storm drains, and utility ducts. About 200,000 miles of the pipe had been used in the United States alone. Some of the pipes were large enough for an adult to stand in or for thousands of gallons of water to flow through each minute.

Inside the building, the roof and walls were mostly intact. There were man-sized holes at various spots in the roof where someone had apparently knocked out portions to retrieve something salvageable. The holes seemed to be where the ceiling lights had been. Most of the inside of the building had already been gutted, and the contractor had set up a cleared area for forklifts and heavy tractors.

A little farther west, the process equipment was still bolted into the cement floor, but in other places, all that was left was duct work hanging from the ceiling. Off to the side, two cutters worked their acetylene and oxygen torches over a doomed piece of equipment,

showering orange sparks onto the cement floor. The floor was marred and pocked and littered with dirt, oil, plastic remnants of wire, nuts, bolts, and other miscellaneous rejections of a salvage crew that had time only for what it could sell.

In the center of the building stood rows of long giant autoclaves that I later learned had been used to cure the newly formed pipes. Toward the front of one of the autoclaves, the encasing wire and black covering had been removed, along with white insulation, which formed a sizable pile on the floor. A large bare spot of steel showed through. Someone had stripped the insulation to check the autoclaves for their worth in steel.

"Did any of your crew strip the insulation?" I asked Levy.

"No, I don't think so."

I stepped into the area and picked up a small piece of the insulation so that I could have it analyzed for asbestos, placed it in a plastic bag, and marked where it had come from. I snapped several photographs. We continued with the tour of the building.

Over in the far west corner was another large pile of insulation on the floor. Directly above was a steam pipe with insulation missing. I took a sample and pictures.

In this portion of the building, large production equipment remained that had not yet been sold or salvaged. Climbing onto a platform, I could see where the asbestos cement slurry once flowed on its way to being formed into the shape of a cylinder. I chipped off a piece of the dried cement from the process bed for analysis.

We next stepped outside. The baghouses used for air pollution control were still connected by several large metal ducts to the pipe-manufacturing building. The baghouses had been installed to recover the dust generated from the mixing and machining operations and to filter out the dust so that mostly clean air was returned to the environment. The steel, boxlike baghouses were on stilts, so that their tops rose at least twenty-five feet. I climbed to the first level and found a small hatch. A yellow plate near the hatch warned of an asbestos hazard:

Caution
Asbestos
Avoid Creating Dust
Breathing Dust May Cause Serious Body Harm

I cracked the door and took a sample of a gray flufflike mineral substance.

Back on the ground, I called over two workers and spoke with them privately. Both of them appeared to be in their early twenties. I explained that I was an OSHA inspector, checking out whether the workers handling asbestos at the site were being protected.

"Did you guys get any training or information on an asbestos hazard here?"

"No."

"Did either of you have to go inside the baghouse?"

"Yeah, I did," one of the workers replied.

"What did you do in there?"

"I was told to go in and check out how it might be demolished, how much metal might be inside."

"Did you know that there might be asbestos in there?"

"I thought there might be. Shouldn't we be wearing masks or something?"

"If there is asbestos in there, yes; you should have been protected." The poor guy had probably gotten a lifetime of asbestos exposure working in the baghouse, I thought. "There are probably other areas around here where you might be exposed."

"I knew this job was full of shit. The stuff we have to do. I knew that things weren't right. I don't need to get cancer. These guys here are full of shit."

He went on for a few more minutes about the place and concluded by saying, "I'm not going to work here anymore." I told him I would issue citations to the contractor if safety violations were being committed, but that did not seem to convince him to continue working for Levy. I thanked them and let them go back to work, or home.

From the baghouse, we cut across the center yard toward another manufacturing building. On the way, we came upon a pile of steam pipes that had been stripped of their insulation. Patches of white, caulky, fibrous material were scattered over a fifteen-by-thirty-foot area.

"Who worked on these pipes?" I asked Levy.

"Oh, I guess some of our cutters. I'm not sure. It could have been left by Johns-Manville people." His credibility was slowly sinking.

I took pictures and some samples of the insulation. It would have to be cleaned up promptly if it contained asbestos.

We continued over to the other manufacturing building, where most of the demolition was going on. Outside, on the far western end of the building, a large barren concrete pad showed evidence of having been the site of processing equipment. Off to the side of the pad sat several pieces of six-foot-high semicircles of steel plate. Two cutters slowly burned through the inch-thick steel, breaking what probably was a process tower into smaller sections that could be more easily loaded and stored on a truck bed for transportation to the harbor.

"Hey, can I talk with you?" I yelled to one of the cutters, staying out of reach of the sparks. The cutter shut off his torch and lifted up his goggles.

I walked over to him and introduced myself. I learned that he had been at the site since the job started and was aware that there was asbestos around.

"What areas have you been working in?" I asked.

"Oh, the yard, and both these buildings."

"Do you know who stripped the insulation off the autoclaves or the steam pipes?"

"Yeah, I did. We had to get a look at the metal."

"Did you remove it dry?"

"No, we wetted it down with a hose first."

"Did you wear any respirators or clothing or take any other precautions?"

"No. It doesn't matter. I'm too old to get cancer from this stuff."

"How old are you?"

"Sixty-one."

"Yeah, you probably won't get cancer from this job, but I'm worried about the younger guys who have more years ahead of them."

The cutter nodded. I thanked him for his time.

Levy and I walked into the west end of the building and found six cutters working over a steel frame that must have held additional processing equipment and now supported only a second level, which would itself be scrapped for iron. Levy explained that they were just about done with this building. The processing equipment in the center, as well as the building itself, might be sold, he said.

I talked with several of the cutters and learned that they had just recently been hired and that they had not stripped any asbestos. I found no problems in this section, so we continued our walkaround of the building.

We soon met up with another one of Levy's partners and, to my surprise, the former Johns-Manville plant manager. I held a quick opening conference with both of them. Levy then excused himself and left his partner to complete the inspection.

Levy's partner appeared nice enough on the surface, but I could sense through our initial small talk that he was concerned with the problems I might pose for him.

I asked the plant manager several questions about the site and its former production activities.

He explained that the building we were in was where asbestos brick insulation, called Thermo-12, was made, but that the company had switched about five years earlier to a nonasbestos product made from lime and silica. He pointed to some asbestoslike material on the ground and some bricks of white friable insulation in a drying box off to the side. He said that the material was the nonasbestos product they made before the plant was closed. (Later that day I took a sample of the material to be analyzed; by this time I did not trust anyone.)

We talked about the other areas at the site where there might have been asbestos. In response to a question about whether Johns-Manville might have left any asbestos debris on the floors or strewn about outside, the plant manager replied that the company had cleaned the manufacturing areas during the closing, leaving the floors and outside yards clean. "We cleaned the building—washed the equipment, even the walls."

"Oh, yeah," added Levy's partner, "the floors were so clean, you could eat off them." I wrote that comment down verbatim.

We continued with the walkaround, leaving the brick-insulation manufacturing building and passing by some now-dry waste ponds on the far north end of the site.

"There shouldn't be much asbestos in those ponds," the plant manager replied to a question about contamination.

Farther along, we passed a small storage shed. Inside were some curious-looking barrels against a wall. A closer look revealed that the labels on the fifty-five-gallon barrels read "ASBESTOS."

"What's the percentage?" I asked.

"One hundred percent."

It was pretty late in the afternoon, so we made the boiler room our last stop. It was located in the building where the pipes had been lined with vinyl chloride polymer and was full of insulated pipe.

"Asbestos?" I asked, pointing to the insulated pipe.

"Yes," the plant manager said.

On the half-mile walk back to the office, the plant manager and I fell back so we could talk privately. In a confidential tone, he said that the contractor had been "messing up" by exposing his employees to asbestos and not following the regulations and that the contractor, not Johns-Manville, was responsible for all the asbestos debris. He added that he was glad to see OSHA inspecting. He explained that Johns-Manville had sold the demolition job to the "lowest bidder," but he had soon found out that the company doing the job knew nothing about asbestos. He said he had tried to change their ways but had been unable to.

I asked him if the contract called for complying with California OSHA regulations.

"Yes, it did," he replied.

"Why didn't you shut the job down, or give us a call? Johns-Manville even has its own industrial hygienists. Why didn't they come out here and help?" I asked somewhat accusingly. With that, the conversation ended.

Arriving at the row of administrative buildings, we stepped into the contractor's makeshift office, which appeared to be the remains of an executive's office. It had been redecorated with the plant's future in mind: nothing on the walls, a desk littered with empty beer cans, and a floor that was used as a wastebasket. I held a conference here with Levy, his partner, their foreman, the Johns-Manville plant manager, and the OSHA safety engineer.

I first reviewed what I had observed and explained that I would be submitting all the samples I had taken to the laboratory for asbestos analysis. I warned them that there was undoubtedly plenty of asbestos at the site and that I thought their handling procedures were not up to OSHA standards. I asked them not to do any more work with suspected asbestos-containing materials until I got back to them the next day. They agreed but acknowledged that they would have to work with it in the future and took issue with my saying they had not been handling the asbestos correctly.

"Couldn't we clean it off our clothes with an air hose?" Levy asked. The OSHA safety engineer looked at me and rolled his eyes.

"No, that's one of the worst things you could do. It would just put it into the air for you to breathe," I explained.

Levy asked for a copy of the asbestos regulation. Their foreman followed up by asking whether asbestos was known to cause cancer.

"I would like to take you to a hospital with some shipyard workers, who could best answer that question," I replied. "Many people have already died from asbestos-induced cancer."

Their ignorance and irresponsibility made me sad. The contractor may have been naive as far as bidding on the demolition job and not considering what was involved, but that did not absolve him of the need to comply with safety and health laws. I could not figure out whether the contractor had simply made a bad business decision or, rather, whether Malbuc had consciously decided to take on the job and work around any problems a regulatory agency might pose. Someone at Johns-Manville should have known better.

At the close of the meeting, I told the contractors that we would be back the next day with the laboratory results.

Before I could enforce any corrective steps on what appeared to be a bona fide asbestos disaster, we first had to get the samples analyzed. Legally, OSHA could not take steps or issue a violation without documentation that asbestos was present.

We left the site with six samples. I had used all the sample bags I had brought and could have filled a dozen more.

I returned to the site the next afternoon and spent a couple of hours exploring other areas of the operation that I had missed the first day. The day two tour was presented by the Johns-Manville plant manager and Levy's partner. The additional walkaround proved fruitful. I found a well-dusted ball mill, some other baghouses, and another set of insulated autoclaves away from the manufacturing building. I took additional samples to identify contaminated areas that needed cleaning up and possible asbestos in structures that were still intact.

The main discovery on day two was two waste ponds on the south end of the site. The drains and waste from the pipe-manufacturing building had been poured into these ponds over the years. It was an ugly site, more so since I knew the ponds were full of asbestos. One pond was dry; the other still had water in it. The dry pond was the larger of the two, measuring about three hundred feet long and one hundred feet wide. The surface was cracked and crumbly, like a miniature Death Valley. The smaller pond was partly filled with water and about half the size of its neighbor. The ponds had once been a necessary part of the manufacturing process, but now they were all liability.

Later that afternoon, I asked the demolition partner about his crew's asbestos-handling practices. He finally admitted that his employees had been stripping off asbestos insulation and crawling around much of the contaminated equipment. He contradicted what had been said the day before, that the crew consistently used wet methods to contain the dust, had respirators, and even used disposable protective suits. When I asked him to show me the protective equipment, he replied, after a cursory look, that "they must have been stolen." It was time to give the office a call for the lab results.

I called the office and talked with my supervisor, who had the results. Five out of the six samples had contained asbestos, he said, up to 70 percent by weight. The contractor's work was now linked to samples positive for asbestos, in hazardous concentrations. Employees had been exposed without any warning on the hazards of asbestos and without training in safe handling practices. Additionally, large areas of the site had been contaminated.

"Well, Dave, I think I'm going to have to shut them down," I told my supervisor over the phone.¹⁰

"Do what you have to. Let them know about their right to hold an informal conference. I'll set aside Monday morning."

An informal conference is a right provided to employers issued a shutdown order so they can discuss or challenge the order with OSHA officials.

I hung up the phone and looked around the room. There was silence for about a minute. The faces of the demolition partners and the foreman turned from disbelief into anger. I was surprised to see the Johns-Manville manager so surprised, even hurt. He spoke first.

"Isn't that a little drastic?"

"No. There is no compliance out here. Too much asbestos debris is scattered about, and the workers haven't been trained for the hazards. There's just too much asbestos and uncontrolled demolition. We have to have an abatement plan before work can continue," I replied.

"You can't shut us down," Levy jumped in. "We have crews working; we'll lose money. It's just not that bad. The guys aren't getting into asbestos now. You can't shut us down when we're only cutting steel."

"They have to be kept out of the asbestos areas until they know where they are and the mess has been cleaned up by a protected crew," I countered.

"There's no asbestos in the brick-insulation building where we're cutting now. Let us work in there until this thing gets straightened out, and then we won't have to lay off any of the crew. They don't have that easy a time finding work. We may have about three to four more days to do in there with the entire crew cutting."

Levy had a point. Although there was overwhelming evidence of disregard for the asbestos regulations, I was hard pressed to come up with a legal rationalization for keeping them from cutting steel in an area where there was no hazard.

"Okay. I'll tag-out all areas other than the west end of the brick-insulation building, where you can cut steel. I want it explained to your crew about the tag-out and the asbestos hazard at the site."

The OSHA safety engineer and I went out and hung tags on stands and equipment in the restricted area, which encompassed more than two-thirds of the sixty-acre site. When we had finished hanging the tags, I asked the demolition foreman to get his workers together so I could talk with them.

"I'm an industrial hygiene inspector with OSHA, and I have been conducting an inspection about the possible asbestos hazard at this site. There is a lot of asbestos here, and you guys will need to get training in how to protect yourselves, and the company will have to put together a control program. Asbestos is a known carcinogen and can cause lung disease. I have shut down most of the site except the west end of the brick-insulation building. You won't get into asbestos if you stay in that area and cut. We'll lift the shutdown after the mess is cleaned up and the company is complying with the state's OSHA standard. Any questions?"

"Yeah. Will we get showers and suits to wear?" one cutter asked.

"Maybe. It will depend on what you'll be doing. The guys actually working with asbestos will need to be protected. The rest of you will just need to know where it is and stay away from it. Any more questions? If anyone works in the restricted area, the company could get fined \$1,000 and someone could be charged with a misdemeanor."

As the crew broke to go home, some workers grumbled. The older cutters gave me cold stares. They knew they would be cutting for only a few more days and then would be laid off.

Before leaving the site, I talked to the contractors about the need for compliance with the asbestos standard and the requirement for an abatement plan to clean up the existing mess and deal with the

rest of the demolition properly. I urged them to hire an outside consultant, since handling asbestos was more than they should have had to deal with themselves. My suggestion for professional help got no response, though if ever professional help was needed on a demolition job, it was at a plant that had manufactured and used asbestos-containing materials on as grand a scale as this one did.

I asked the Johns-Manville manager to get some support from his office by getting a corporate industrial hygienist involved. Johns-Manville should have done this from day one, and especially once they had selected a contractor with no experience with asbestos demolition. The plant manager remained silent.

Levy promised he would work on a written abatement plan over the upcoming weekend and bring it to the informal conference planned for the following Monday.

I was grateful to get out of the place. It was my first shutdown, and it had taken some gritting of my teeth to tell Levy and his partners that they were temporarily out of business. I looked over my shoulder more than once while walking back to my car.

As the safety engineer and I drove out, I stopped by the guard shack and asked the teenage guard whether he had done any asbestos removal at the site.

"No. My dad won't let me work in there with all that asbestos. I'm just to watch the gate."

"Good for your dad."

When I asked him who his dad was, it turned out to be one of Levy's partners. The partner had enough doubts about the job to prevent his son from working there.

The Monday after the shutdown, Levy came into the OSHA office and sat down to discuss his abatement plan. He presented his plan, stiffly joking that he had not done so much writing since high school. It did not take us long to review the two pages he handed us. The plan looked as though it had been developed by someone who knew very little about asbestos control.

The OSHA regional supervisor, who also attended the conference, rejected the plan and allowed the shutdown to continue. After tactfully explaining the inadequacies of the plan, we gave Levy a copy of an asbestos abatement program another contractor had developed. We told Levy that the plan would help him rewrite his own. We also gave him a publication from the National Institute of Occu-

pational Safety and Health that contained background material for setting up an asbestos control program and training for his crew. We tried to impress upon him the magnitude and difficulty of the project he had taken on and urged him to seek the advice of a consultant.

Levy took the material but refused our suggestion to seek outside help, saying he could do it himself. There was no law forbidding this. The California OSHA regulation at the time allowed anybody to do asbestos work, as long as they followed the standards requiring that asbestos be cleaned up promptly, dust suppression methods used, and the workers protected. The burden was on OSHA to prove wrongdoing. Unfortunately, given the delay in deciding appeals and the amount of proof necessary to obtain a temporary restraining order from the superior court, "bad actors" could contaminate an area and be long gone, escaping justice.

The abatement plan Levy was asked to prepare would at least force him to think about the asbestos hazard and what constituted proper work practices, although it was not required by any standard. Given the magnitude of the hazard at the site, we felt comfortable in asserting our authority beyond its usual bounds.

We were on firmer ground for the shutdown, however, and flatly told Levy that his crew could not do asbestos work until the workers were trained and an asbestos control program was in place. We further informed him that someone from our office would attend his worker training. We concluded the conference by saying that citations for the earlier violations would be issued at a later date. Levy argued over the demands but lost. Though his eyes were shaded by dark glasses, it was easy to sense his rage. He left quietly, promising to drop off the revised plan as soon as he could.

Several days later, Levy submitted a revised plan. It was nearly identical to the sample we had given him. He also told us the date he planned to train his crew in asbestos handling.

The required training session was given to about twelve crew members and three OSHA officials, including myself, my boss, and his boss, the regional supervisor. Surprisingly, the training, which was given by Levy's foreman, was well done. I later learned that the foreman had read the entire NIOSH document we had given to Levy and had taken everything to heart.

Besides classroom training, members of the crew were taken on a tour to help them identify asbestos-containing materials. The fore-

man pointed at different areas of asbestos contamination and explained that a separate cleanup crew would be designated and that those workers selected would be required to wear respirators and disposable suits, to use wet removal procedures, and to bag the asbestos material as they went.

At the conclusion of the employee-training program, the cleanup crews were permitted to go to work, and the tagged-out areas were progressively lifted as the asbestos was cleaned up. We started to have hope for the project.

I monitored the cleanup crew on its first assignment by placing samplers on workers who were assigned to bag asbestos insulation waste from the pipe-manufacturing building. The crews wore approved paper respirators and disposable protective clothing. I also took several area samples in the building and outdoors, particularly by the waste ponds. The latter samples were taken in an effort to see whether the location was contaminated enough to produce high background levels of asbestos even outside.

The laboratory reported the results of my sampling within a week. A high value of 0.02 f/cc was reported for the breathing-zone samples of the workers and values of less than 0.01 f/cc for the areas outdoors, including those downwind of the dry asbestos pond. All values were strikingly below the action level of 0.10 f/cc and the ceiling level of 10 f/cc, at which protective clothing would have been required according to the standard then in effect. It was ironic, and demonstrated a weakness in the standard, that members of the cleanup crew were wallowing in asbestos up to their ankles, yet protective clothing technically was not required because the levels in the air were low. What might happen if the workers took their clothes home with them and the asbestos dried out in the meantime? The standard then in effect did not deal with this question as well as it could have. The inspector could call the clothes contaminated waste and require the worker to dispose of them at the end of the shift only if it could be documented that the worker would otherwise be exposed above the action level of 0.10 f/cc over an eight-hour period.

The low levels of asbestos in the air were surprising, but less so given that most of the work was completed in wide-open areas. Also, the members of the cleanup crew used their hands and a shovel to pick up the asbestos, which barely disturbed the material. And they used water—lots of it.

Now that the contractor was complying with the law, surpassing it in some instances, I met with Levy to close out the report.

Although the contractor was now in compliance, there were still about five pages of citations with fines. My explanation that the citations were all for "past sins" did not mollify the obviously upset Levy. The citations and fines may even have been on the light side, since the contract with Johns-Manville had called for compliance with California OSHA standards and there was a basis for citing Levy for willful neglect.

I went over each violation. The company received a serious citation for having uncontrolled asbestos spills in four locations, a serious citation for failure to inform and train the crew regarding the asbestos hazard, and an automatic \$500 fine and citation for failure to notify our office before beginning the demolition job.

This latter requirement and its mandatory not-to-be-reduced fine were unique to California at the time. The state legislature had developed this useful requirement in an attempt to initiate greater motivation for compliance from day one of an asbestos job. The reasoning was that those who reported would in most cases comply better with the standards if they knew that they could be subject to an inspection. Those who did not wish to comply faced a nonnegotiable \$500 penalty if caught. My experience had been that the result was greater compliance and fewer disasters. But there were exceptions.

Levy took the citations, complaining about unnecessary regulations and unjust fines. The fine totaled \$1,775. I warned Levy that further fines could be imposed if there were more violations.

Levy called me back as I was leaving and demonstrated a coin-operated video game he had installed for his workers. I watched as he shot down invading spaceships on the screen, scoring several thousand points in less than a minute. He paused just long enough to say that the object of the game was to see how many times you could shoot down OSHA.

"See you on the follow-up," I said.

Within the fifteen-day time limit, Levy filed an appeal, contesting the violations as well as the amount of the penalties.

By the time of the follow-up, a Republican governor was in office and had replaced the entire top management of the California OSHA system with his own appointees. The previous management of the state OSHA system, appointed by a Democratic governor, had pro-

fessed a belief in strong enforcement and in issuing tough regulations. The former executives made sure none of the field people were shy about issuing fines and frequently got involved in the bigger cases. (The OSH Act leaves some room for different enforcement policies, though not as much as many administrators and field supervisors, on both state and federal levels and on both political sides, exercise at times.) Now, with a new governor in office, there was some apprehension that policies and enforcement styles would be more relaxed, and there was some indication that the new deputy chief of OSHA expected more cooperation with the business community that came under OSHA sanction. In a recent memo to OSHA staff, he had lambasted a staff member for an error. Going beyond constructive criticism, the deputy chief had used the opportunity to set a tone of conciliation toward cited businesses. Through such memos and examples of "wrongdoing" by staff, changes in policy can be subtly and progressively effected, and in a manner that produces change without the strong criticism that surely would be generated in a press conference that outlined the new administration's goals.

As the new deputy chief accompanied me and my supervisor and my supervisor's boss, the regional manager, to the demolition site for the follow-up inspection, I could sense their uneasiness about how to handle Malbuc, the demolition contractor. Should they ease off and let the contractor "get the job done"? Field supervisors, like my boss, would be the first to face any change in the wind and would be the most susceptible to pressure, including possible transfers to undesirable locations.

The tour with the deputy chief included all of the carcinogenic attractions at the site: the asbestos ponds, the manufacturing buildings, and the asbestos burial sites. We even watched asbestos removal in progress.

Stopping in front of the boiler room, where the front wall had been removed, the tour group watched a rip-out job. One hundred feet away, a crew stripped insulation from numerous steam pipes. I was a little amused when, on leaving the area, the deputy chief walked right through a contaminated area, placing his shiny black shoes on patches of asbestos insulation.

After the tour, the deputy chief acknowledged the high potential for asbestos exposure. He gave little indication, at least to me, of his expectations for enforcement at the site.

The follow-up ended without any violations being observed.

About a month later, I initiated a second follow-up. Our office intended to keep a close eye on the project, or as best we could without being accused of harassing the contractor. We had grounds for being suspicious. Our suspicions, unfortunately, proved justified.

On walking the site with Levy, I found more uncontrolled spills than I had during the inspection that had led to the shutdown. There was asbestos-containing debris on the roadway, a busted barrel of 100 percent asbestos fibers with the gray fluffy material spilled out on the ground, and steam pipe insulation on the floor of one of the buildings. There was one other notable pile. In the concrete pit where the autoclaves in the pipe-manufacturing building once stood was a mound of stripped asbestos insulation, a volume estimated to be *160 cubic yards!*

More than interested, I asked Levy to explain what had happened. He related that the crew first began stripping the autoclaves by hand, using four workers suited up in protective equipment, but that he had found it was taking too long and costing more money than he wanted to spend. With so many autoclaves to strip, each nearly a hundred feet long and ten or more feet in diameter, they had tried something else. He explained that they had found that using a front-end loader with a large tractor bucket was far more efficient. They had simply cut loose an autoclave from its support brackets with torches, hooked a cable to it, and dragged it out of the pit with the front-end loader. The loader was then used to strip the insulation by running the cutting edge of its bucket along the top surface of the steel tube, breaking the metal retaining bands and stripping free the bricks of insulation. The asbestos bricks were then pushed into the rectangular autoclave pit, where the debris piled up. To control the dust, they applied water with a fire hose during the stripping. With the stripping now done, he hoped to leave the asbestos in the pit or to dump it all into Johns-Manville's waste pond. The massive steel autoclaves were thus cleansed of asbestos, one at a time.

Standing back from the pile of debris, I could see the last autoclave from the pit being cut into transportable pieces. The front-end loader used in the stripping was parked next to Levy's newly formed hazardous waste site. The loader showed evidence of its dirty work. Chunks of asbestos hung on the lower portions of its frame, and there were patches of white on the tires, as if they had driven through snow.

I asked Levy to wash the debris from the tractor into the pit before using it again.

"Oh, yeah. We plan to do that," he replied.

I was not very concerned about his particular removal method since it probably produced the least amount of exposure. Rather than having a crew of four labor directly with the material for weeks, he had one man in a tractor do it in a couple of days. It was a better method from a business standpoint and for worker protection. Levy was innovative, if not concerned about asbestos health hazards. Nonetheless, the remaining mess had to be cleaned up. He was supposed to have bagged or placed the debris in a plastic-lined dumpster while it was being stripped. The regulation was clear about that, and having been cited on this item, he knew it. The alternative—dumping the waste into the asbestos ponds—was not acceptable to Johns-Manville since the mess in the ponds also had to be removed sometime later.

During the walkaround, one of the workers caught up with me when I was alone. Requesting confidentiality, he said that the contractors had been talking about hauling the voluminous asbestos waste out at night and dumping it somewhere free of cost, illegally. The aim was to save money by not having to contain the asbestos or hire a licensed hauler to carry it away.

"You really think they would do it?" I asked.

"Yes. You don't know these people. I believe they would. They've been lying to you, doing as they please out here."

I asked him to keep me posted.

Concluding my walkaround for the second follow-up, I then held an exit conference with Levy and again explained that the asbestos waste was supposed to be cleaned up as crews worked or at the end of the day. I added that he would probably receive more citations and a fine.

Levy stood in front of me, a wild look on his face and a suspicious white stain on his cowboy boots. "I don't want to hear about any more fines," he said. "We've been trying our hardest out here. We're just trying to finish this job and be done with it. I hate this place, and I hate asbestos. Last night I dreamed that my kid was eating the stuff." Levy continued on about how he had not counted on the expense of the asbestos. He concluded our conference by saying that he might subcontract out much of the remaining work because his crews were "not efficient enough."

It did come down to efficiency or, what he actually meant, money. If he tried to handle the asbestos by protecting his workers and carefully controlling the cleanup to prevent the least amount of

contamination and uncontrolled waste, Levy would surely go bankrupt and lose the sizable bond Johns-Manville required for the job. If he tried to comply minimally with the current California OSHA regulation, he might not go bankrupt, but the profit he had counted on before starting the job would be significantly reduced.

A few days later, the laboratory reported that all eight samples I had collected during the follow-up inspection were in fact positive for asbestos. The samples varied in concentration from a low of 4 percent to a high of more than 50 percent. The high values were for samples taken from the remains of the autoclaves. Once the laboratory reported the values, citations were drafted.

Before issuing the citations, it was decided that the regional manager, my supervisor, and I would tour the area again. The closing conference would then be held and the citations issued.

During our tour we found another "surprise." Walking around a large building, little more than a steel frame soon to be scrapped, we discovered hills of dirt grown over with weeds.

"That's where we buried cement pipe that was flawed or unusable," the plant manager said, pointing to the hills of dirt on the acre or more of land that formed the western end of the site. He added that they had broken the rejected asbestos-containing pipe into small pieces for more compact burying.

Based on the size of the area, it was going to be quite a job to remove it, should the material ever have to be removed. I wondered who would buy the site with asbestos debris buried under the ground.

In front of the mounds covering the broken pipe, and of more immediate interest, were a couple of twenty-foot-high piles of mixed unsalvageable debris, most of it broken panels of asbestos cement siding. The contractor had used an unsafe shortcut method to remove the outside wall panels.

"I'm going to require these piles to be cleaned up and disposed of as asbestos waste, like the rest of the asbestos spills we've seen today," I said.

"But this material is not friable. It's not posing a hazard," replied the plant manager.

"When it's broken up like this, it's spreading around asbestos; it's friable," countered the regional supervisor.

The argument continued for about five minutes over what was friable asbestos (i.e., whether or not the material was in a form that

could release hazardous amounts of asbestos fibers into the air or on the ground to be later resuspended). Steam pipe insulation is clearly friable; it crumbles in your hand and, when so disturbed, can release harmful levels of asbestos fibers. But asbestos bound in cured cement, as in the sections of wall material in the piles, is not truly friable; it does not crumble and release fibers easily unless it receives harsh physical treatment, such as hitting with a sledge hammer or smashing with a bulldozer, as apparently had happened.

The contractor jumped into the argument as it heated up, raising his voice in support of the plant manager, who said that the material posed no problem. The contractor had a vested interest, in that handling the material as hazardous waste would take money out of his pocket. As one of Malbuc's partners had earlier lamented to me, asbestos disposal and gentle handling were not part of their bid. They had not figured the cost of dealing with so much asbestos-containing material.

The debate reached its boiling point.

"That's it, you're on my property, and I want you all out of here," the contractor said. "You're trespassing. I'm getting tired of you guys telling us what to do. I want you off our property, NOW!"

The contractor meant business, and without a warrant, we were obliged to leave.

"Okay, fine. We'll mail the citations to you," replied the regional supervisor.

My boss did not want to be so accommodating. On the half-mile hike back to the entrance gate, he said, with an anger I had never seen before, "You got any tags?" referring to the yellow tags used to shut down an operation. By now, he had heard all the "good faith" he could stand.

"Maybe you should reconsider shutting them down. We don't really have any high air levels of asbestos recorded," I said to my boss.

"I DIDN'T ASK WHETHER WE SHOULD SHUT THEM DOWN. I ASKED IF YOU HAD ANY TAGS!"

"Uh, . . . yeah, Dave, I have the tags, wire, order to prohibit use, and a pen, all you need," I replied.

In a meeting between the three of us at the parking area, cooler, but not necessarily wiser, heads prevailed. A decision was made to issue a serious citation as quickly as possible through the mail, ordering prompt cleanup of the mess we had seen that day. At the same

time, we would get our legal staff to obtain a warrant as fast as possible so we could check on compliance with the citations and take air samples as needed.

At this point, with the constraints of the law, we could only shake our heads, issue the citations and a \$2,000 fine, and get the warrant so we could not be thrown off the site again.

The warrant was soon drafted and prepared to be taken to the superior court for the signature of a judge. Our attorney had put in a fine effort in providing the rationale for why OSHA should have access to the demolition site to inspect for safety and health violations. Included with the warrant were copies of past citations, as well as my observations regarding the problems at the site. The attorney had even included one of the contractor's comments I had recorded, that before Malbuc had taken over the site, Johns-Manville had left the floors so clean "you could eat off them." No more.

Before we had the time to get the warrant signed and served, Levy's father called and notified us that there had been a misunderstanding. The partner who had thrown us out was not in charge, he assured us. "We don't do business that way," he said.

"Welcomed" back, the regional manager, my boss, and I held a meeting with the younger Levy. We met at the site and discussed the recent citations. Levy partly defended himself and partly admitted to wrongdoing. He had to admit to some wrongdoing; the evidence was overwhelming. To deny everything would have caused a complete loss of credibility and squelched the desperate hope we had that the situation could get better. It was part of Levy's strategy to play on the hope that is part of human nature. He also promised to do better. He had a plan, he said, repeating his earlier statement that he was going to subcontract out the work to more efficient crews.

No one was being exposed to the contaminated areas, Levy argued, and he could rope off the areas to prevent access. He would just as soon make one grand cleanup rather than take time to clean up individual piles. He planned to bring in some dumpsters at a later date.

I countered with a review of his past history and the argument that all the existing waste needed to be cleaned up right away. To leave it would set a precedent at odds with the standard and allow Levy to contaminate areas his crew worked. I was already having a hard time keeping an account of Levy's demolition derby. It would become impossible if he was allowed to make asbestos piles as he went and to

clean them up "at a later date," which could mean never. The potential for spreading the contamination was too great, and, besides, how was he going to keep the piles wet and the workers out of them?

The regional manager, who in earlier controversies had impressed me as a tough enforcer, ruled in favor of Levy, commenting that "they have to be able to get this job done." He ruled that the current piles in the buildings and in the autoclave pit could remain but that they would have to be cleaned up later. He rationalized that the contractor had a big job to do and that for the demolition to proceed, it was necessary to allow the uncontained asbestos to be stockpiled.

I felt certain that this concession, in light of Levy's poor practices and bad faith, was an attempt to toe the line of the new administration, particularly since Levy had accused OSHA of causing him financial loss and interfering with his right to conduct business. It would have been difficult for the regional manager to come down hard on the contractor when the new OSHA executives, appointed by the newly elected governor, were beginning to send out messages that they were loosening their policies. Perhaps the manager thought it was not a good time to push too hard. After all, his work location and work pressure were sensitive to the whims of upper management.

Soon after the meeting with Levy, subcontractors were brought in, as Levy had said. My hopes for improvement were completely dashed, however, when I found out that the subcontractor was a cousin of Levy's.

Within the first two weeks after I heard this news, I initiated an inspection of the demolition site. The foreman at the site was pleasant, and I had renewed hope for cooperation. But the hope lasted less than an hour. I soon learned that, although the foreman would be running the job, Levy's cousin was expected to be going to jail soon; his sentencing was the following week. Also, I soon discovered that the cousin had hired illegal aliens from Mexico, whom he was paying lower-than-average wages.

I closed my inspection by saying that the cousin was following the minimum requirements of the standard. My sampling showed that the air levels for the outdoor work and wet-work practices were again low, at least while I was there. But even this minimal level of compliance did not last long.

In a follow-up inspection about three months later, the cousin's company was issued two serious citations with a \$2,000 fine for improper cleanup and disposal. "I didn't know it was asbestos," complained the foreman during the closing conference. It was a poor excuse for leaving asbestos pipe insulation and an asbestos-containing gray dust over the entire work area. The pipe insulation was obviously vintage asbestos, and what should have been equally apparent was that the gray dust also contained asbestos. The same gray material abundantly coated the insides of the duct work the crew was demolishing, and given that the duct work was once part of the asbestos pipe-manufacturing process, it should not have been difficult to surmise that the dust would contain asbestos. Unfortunately, the cutters were required to work unprotected in the midst of the dust without any concern by the foreman.

Levy's cousin reacted angrily to the citations, but his attitude soon turned to one of indifference. As soon as this job was done, he and his crew would vanish. By this time, it was clear that the threat of fines meant little to Levy or his relatives. By this time, I was also beginning to wonder whether the OSHA penalty structure and its administrative process were adequate for this job. Part of the problem was that appeals are scheduled nine to twelve months after a citation date. With such long delays, a temporary job can be completed and a contractor have a new name and address long before action can be taken. And, while the citation is under appeal, the contractor is not liable for repeat citations, which carry higher penalties. Furthermore, in this case, the state agency responsible for collecting unpaid fines may have been less than eager to do its job well, given the desires of the governor's office to maintain a cooperative relationship with the business community. The setting and issuance of fines, the appeals process, and the collection process must all occur within a reasonable amount of time and with surety for enforcement to be effective. It is a large task to ask of the present system.

In the meantime, an out-of-state construction company had been hired to remove the nonasbestos-brick manufacturing building, piece by piece. The building was to be reconstructed at another site.

Because the work was some distance from their homes and the job would last several months, the crew members brought their entire families. Many of the families were related since the company was owned and operated by two brothers who freely hired their relatives and in-laws. On their arrival, they all drove in and parked their

campers and trailers on the Johns-Manville site, next to the building they would be working on. Soon after setting up camp, their children were playing in areas probably contaminated with asbestos. A county health inspector paid a visit and gave the brothers twenty-four hours to get their families out. Although I was unsuccessful in explaining to the bewildered brothers that it was best not to have their families living in an area with such a high potential for incidental asbestos exposure, they were taken aback and hurt by what they felt was the strong-arm approach of the county in ordering their families off the job site.

Once the families had gotten off the site and the company was into its work, I initiated an inspection. Unfortunately for the already "government-terrorized" brothers, I found that their crews were working unknowingly on a fine layer of asbestos-containing dust, which covered the entire cement floor of the building they were working in. The workers, in removing the building's steel frame and taking off the wall panels, had knocked down asbestos dust left from the previous manufacturing operation, contaminating the floor and undoubtedly their lungs. I found one worker dry-sweeping the dust. I had warned the brothers before they began the job that there was possibly asbestos residue on the steel frames and walls. When I handed them the citation requiring prompt cleanup, work practices that would prevent further contamination, and a \$1,000 fine, they did not understand the regulatory action and were very upset. One of the brothers cried. They were very religious, good, honest people, and the amount of work they were doing was a quantum leap beyond what Levy's crews had done. Unfortunately, asbestos-induced diseases do not take into account a person's morals or values. The brothers complied with the citations, however, and managed to dismantle the building without further trouble.

After four months of inspecting and issuing repeat citations in a near-vain attempt to control the cleanup, time-out was called. One fine summer day, officials from the city arrived at the site, and, backed by armed representatives of the police department, shut down the operation. The contractor had not taken out a city building permit, they said. But of course it was more than that.

Earlier in the demolition, city officials had become curious about the project and had made inquiries with the OSHA office and the local air pollution agency. Their concern had grown with each tele-

phone conversation and meeting. In one meeting, I had flatly admitted that I expected Malbuc to make another mess and be issued another round of citations. "Can't you stop them?" a city official asked my supervisor and me.

As best we could, we had explained the limitations of the state OSHA law, which provided authority for shutdowns only when there were imminent serious hazards. The problem was whether asbestos exposure could legally be considered an imminent hazard. In that the risk increases with length of exposure, and the possible injury is a delayed one, occurring ten to forty years after initial exposure, the risk was not by definition "imminent." OSHA has disregarded this distinction when the asbestos exposure is high and the exposure is completely uncontrolled, as was the case during my very first inspection of the site. Under such severe circumstances, OSHA believes it can defend its actions in court. The only other method we could have pursued but did not because it would have posed a greater legal challenge was to seek a temporary injunction.

City officials had also contacted the local air pollution agency. Levy had not paid much attention to the agency's regulations either, they were told.

Once the city officials learned that both OSHA and the local air pollution agency were issuing repeat citations and that Johns-Manville and Malbuc had done little to no advanced planning to control the asbestos at the site, the city took action, shutting down the operation. LIABILITY was written all over the few remaining walls at the site. The city had communities downwind, and anyone who bought the land might get upset about the asbestos and file a whopper of a lawsuit. Understandably, the city officials did not want to be sued or to have their council members or themselves appear as "guests" on "60 Minutes."

The city was also sincerely impressed by the danger the asbestos presented and by its duty to the community. Adding to that impression were strong recommendations by a consulting firm the city had hired. The consultants made sure that the city was aware of all the asbestos dangers, including the importance of the consultants' services. The consultants were architects and engineers and, more recently, experts in the increasing asbestos abatement business. Their \$20,000-plus bill for a report warning of the terrible liability the city faced, and which justified their services, was later billed by the city to Johns-Manville.

The OSHA office participated in all the meetings the city held in its attempt to organize an orderly demolition of the site. The city had contacted nearly everyone who would have an interest in the demolition, including city officials, the county sheriff, the local air pollution agency, OSHA, the county building and safety agency, the county fire department, the state hazardous waste department, and the county health department. The meetings were a little crowded but proved useful in coordinating the agencies.

Not to be left out, Levy and representatives from Johns-Manville were invited to some of the meetings, which were held in a face-the-agencies format at a table filled with accusing bureaucrats. From the contractors' point of view, it probably looked as though the agencies were ganging up on them, as, in a sense, they were.

In one meeting, Levy and his defenders were asked to explain how they were going to clean up the contaminated areas and conduct their demolition in the future. The discussion was heated and accusatory, and, not surprisingly, Levy complained about the numerous regulatory bodies he had to deal with to complete the demolition.

I was unsympathetic. It was time for Levy and company, as part of their punishment for creating the asbestos disaster, to satisfy fully the agencies that had been played the fool once too often.

In response to the bold demands made by the agencies at the meetings, and to the city's shutdown, Levy and his attorney put together a well-devised demolition plan that made old promises look new. They urged agency representatives to tour the site and to discuss with them exactly where the problems were. They placed the blame for their troubles not on the people running the project but on the inefficient work crews they had hired. Writing in the abatement plan, Levy's attorney stated that "[the contractor, Malbuc] has terminated fifteen members of its previous crew, leaving only one continuing employee. Said employees were terminated for failure to follow company and/or OSHA rules and regulations. [Malbuc] intends to impress upon all new employees the importance of complying with the regulations."

A month later, the city was ready to allow Malbuc to go back to work. Levy had completed a lengthy environmental impact statement for the city, something he should have done before starting any demolition project of this magnitude, and had again detailed his work practices and employee protection plan for OSHA and the air pollu-

tion control agency. He had also obtained permits and appropriate variances from the Department of Hazardous Waste. The plan called for a cleanup of all existing asbestos piles before any further demolition could take place and then cleanup as work progressed, as was required by the state OSHA standard. I was not optimistic that this was the end of the violations.

The one obvious solution was to force Malbuc off the job and require Johns-Manville to bring in a firm that could handle the asbestos. But no agency had the legal authority to require this. Malbuc had its legal rights and much money invested in the deal; the company had paid Johns-Manville \$465,000 for salvage rights to existing equipment and structures, a bid that had been calculated to earn profits for Malbuc. Malbuc had also posted a \$400,000 performance bond, which it could lose if it did not complete the job successfully. The stakes were high on both sides. The only thing preventing further disaster was enforcement of the then-existing regulatory laws, which, although less than adequate, were far better than no laws at all.

The demolition and cleanup proceeded for a couple of months with some problems but none significant enough to cause a shutdown.

Then, on a Monday during an inspection of the site, an OSHA industrial hygienist, accompanied by an air pollution inspector, noticed that the giant outdoor autoclaves were gone, after recalling that they had been there the previous week. Like the indoor autoclaves, they had been wrapped with asbestos insulation. On closer examination, the inspectors found white-gray insulation scattered about where the autoclaves had been. There was a lot of insulation, but just a fraction of the amount that would have wrapped the autoclaves. Some of the debris was suspiciously forming two curving lines with a constant distance between them, about the width of a car, or, more accurately, of the bucket on Levy's front-end loader. The path, outlined with chunks of asbestos, curved away from the autoclave site and down the road. The inspectors followed. The path led right to the far western end of the dry asbestos pond. On the dirt near the pond's edge were the track marks of the front-end loader and, at the end of the path, a large pile of asbestos insulation partly covered with dirt. The OSHA inspector took pictures and samples, as did the air pollution inspector. An interview with some of Levy's people pointed the finger at Malbuc.

The reaction could not have been worse when the news got back to the inspectors' offices and the city. Our office prepared serious/repeat/willful violations with \$20,000 of fines proposed and then tagged-out the whole site. The city issued a stop-work order, and the air pollution agency went to court and obtained a temporary restraining order. Malbuc and any remaining friends were "locked out." Malbuc deserved it all, or at least most of it. Not only had Malbuc dumped the stuff in the pond, but, more important, the crew had left considerable amounts of asbestos debris scattered over the site.

Levy fought back, not just with lawyerly rhetoric, but with more experienced finesse—Levy, Sr.

Levy, Sr., was not new to the project or to its problems. From the beginning, he had been involved in the demolition. Although Levy, Jr., had made the day-to-day decisions, Levy, Sr., periodically stopped by to visit and help his son.

Now, with the additional help of Levy, Sr., another written proposal was prepared challenging OSHA's authority even more boldly. The proposal set out conditions by which a different contractor would clean up the existing asbestos and proceed with a planned and orderly demolition. The new contractor would be helped by a "third-party consultant knowledgeable in the handling and disposal of toxic waste" and by a Johns-Mansville representative, assigned to supervise the new contractor. The plan went into great detail, noting who would supervise each step to ensure compliance with all regulations. But those named did not sound very knowledgeable. The third-party consultant turned out to be not an asbestos demolition expert, or even an environmental or industrial hygiene consultant, but the owner of the containers Levy, Jr., had used to haul out some of the waste. But the real insult was the identity of the new contractor. In a portion of the written proposal challenging OSHA and the air pollution agency's actions was the following statement: "Rather than litigate these issues on the merits, [Malbuc] is willing to pull off the job in favor of a contractor of its choosing. After consulting with the bond company and meeting with the representatives of Johns-Manville, [Malbuc] has elected to retain the services of [R. J. Levy, Sr. Construction Company, Inc.] to complete its contractual requirements." Levy, Sr., was the "new" contractor! Since the first shutdown eight months earlier, he had had the authority to change the course of the demolition at any time. Could the agencies expect anything different now?

By now, the power had changed hands. The agencies took their time in deciding the fate of the demolition project and of Malbuc. They now had enough evidence of bad faith to hold up under court challenge and political pressure from within their own agencies. Regulatory agencies can be slow to act, particularly if they have a grudge. So word by word Levy's twenty-four-page proposal was joyously criticized. The inspectors could finally release their pent-up frustrations. The beneficiary of this arduous process was the bank account of Levy's attorney.

The agencies asked for and rejected several redrafts of the proposal. As a result, the project remained at a standstill for more than a year until Johns-Manville, eager to complete the demolition and sell the land, stepped in and consented to hire a new contractor to finish the project, with the help of a recognized and qualified consultant.

Conveniently, Levy and company had dropped from the scene. A Johns-Manville investigator was assigned to the case and attempted to find Levy and his relatives. The investigator mentioned one day at the OSHA office that he suspected that Johns-Manville's corporate agent and Malbuc were involved in a kickback scheme since much of the demolition had proceeded at a much lower cost than it would have been had a qualified asbestos demolition company done the work from day one.

In retrospect, the agencies did their jobs as well as could have been expected, given the limitations of the laws they were empowered to enforce. At times there was some loss of backbone, and there were some bad judgments. But the multiple inspections did prevent a major disaster at the site, which would have left a monstrous bill for the taxpayers and exposed the workers to even more hazardous levels of asbestos.

Laws with known penalties are supposed to provide the motivation necessary to prevent problems. And, in cases when companies fail to comply, issuing citations, setting abatement dates, and imposing monetary fines for serious infractions are supposed to ensure that the immediate problems are corrected and future compliance assured. For those who repeatedly or willfully fail to comply, higher fines are supposed to make it prohibitively expensive not to comply.

In this case, the laws, or more appropriately their administration, did not prevent Malbuc from consistently trampling on the agencies'

rules. Citations could be appealed, delaying the issuance of repeat citations and higher penalties for almost a year. Payment of penalties could be delayed or reduced through negotiation with OSHA or by presenting a well-devised case to an administrative law judge in the appeal. Fly-by-night companies, which have proven to be the worst violators of OSHA regulations, may never have to pay, even after losing appeals. They can avoid the weak state collection agency by changing the names of their businesses and by refusing mail from the state. Unfortunately, the tenacity of many government agencies, other than perhaps the Internal Revenue Service, can be minimal to nonexistent in taking on the really bad offenders, who know how to fight the system. But, in spite of the problems with the agencies and their appeal and penalty collection processes, beneficial enforcement can still be effected.

This case would have had a different outcome had current regulations for asbestos been in effect. The new regulations are more comprehensive and are based on a much lower exposure limit. The requirements and complexity of the asbestos standard and the degree of protection specified essentially mandate that a specialty contractor perform major asbestos demolition work. The probable result in this case would have been the awarding of a subcontract for asbestos removal and cleanup to a competent asbestos abatement contractor, either before the start of the job or right after the first shutdown.

3. SOLVENTS

Like oil, many industrial solvents are "organic," meaning they are in a class of chemicals based on carbon atoms. Such solvents have physical characteristics similar to oil, so that they hold true to the chemical law "like dissolves like" and are capable of dissolving and mixing with oil. Not surprisingly, many industrial solvents are themselves derived from carbon-rich petroleum or coal tar, a distillate of burning bituminous coal.

The synthetic organic solvents, preferred over the natural organic solvents for many industrial uses, are also capable of dissolving oil-like compounds. Synthetic solvents mimic the chemistry of the petroleum and coal tar solvents through the substitution of other atoms, usually chlorine and fluorine, for the hydrogen atoms on the backbone of the carbon. In most cases the use of chlorine and fluorine atoms makes the synthetic solvents noncombustible, an important advantage for many industrial processes.

Both the natural and synthetic solvents are used in large quantities to help make the numerous consumer products derived from oil and coal tar. The manufacturing processes for these products rely extensively on the solvating properties of industrial solvents. Paints, resins, inks, and glues use great quantities of solvents as carriers and diluents for the active ingredients. Solid plastics are shaped and molded into desired forms by solvents, which soften and dissolve and are later removed by drying. The synthetic chemicals used in consumer and industrial products from drugs to fabrics are manufactured using solvents that help bring together diverse chemicals into a single solution so that they may react and unite. In many applications the solvents are purposely consumed in a reaction; single molecules function as building blocks for larger chemicals or polymerize

into the long-chain polymers prevalent in so many useful products. Solvents also make outstanding cleaning agents for removing paint, other oil-based products, and grease and grime. Solvents are used to clean a range of items, from fabrics to the outsides of jet aircraft.

All industrial solvents have the potential to cause harm. Most have the ability to extract the skin's natural oils, causing a dryness and roughness that can cause dermatitis if there is chronic exposure. A few solvents are more destructive and can actually destroy the skin on initial contact. Still others can pass through the skin and be absorbed into the bloodstream, causing systemic toxicity.

The vapors of the solvents can also be harmful. The type and extent of the toxicity depends on the chemical structure of the particular solvent and on how much is inhaled. Almost all industrial solvents have an effect on the nervous system, similar to that of narcotic drugs, when the vapors are inhaled in excessive concentrations.

Because of their ability to dull the senses, some of the more volatile solvents were used as surgical anesthetics in the mid- and late nineteenth century. One such solvent was carbon disulfide. The side effects were found to be so serious, however, that its use as an anesthetic was discontinued. Later, in the early part of the twentieth century, the solvent was popular in industry, but it earned disfavor again when it was found to cause poisoning among exposed workers, one effect of which was insanity. More recently, carbon disulfide has been used in the manufacture of viscose rayon, though not without some problems. Until improvements in the control of the vapors were made, overexposure caused workers to suffer serious neurological and cardiovascular effects. The limit for worker exposure to carbon disulfide is now set at a level far below that needed to prevent acute effects and is designed principally to protect workers who are chronically exposed from cardiovascular disease or reproductive dangers.

The vapors of the solvent carbon tetrachloride were also used in the nineteenth century as an anesthetic, but, like carbon disulfide, it produced serious health effects. More surprising, the solvent had a popular use at that time as a waterless shampoo. Carbon tetrachloride was used in this century in coin-operated dry-cleaning machines until many consumers who cleaned their sleeping bags hit the sack for the last time, inhaling fatal doses. The solvent was also used in fire extinguishers during the 1950s until one too many fire fighters inhaled the very toxic chemical that results when the solvent is burned.

The solvent was also popular as a general cleaning solution in the 1950s and 1960s in both homes and factories. Because of its toxicity and the availability of safer solvents, carbon tetrachloride is now rarely used in industry or in the home. In addition to its narcotic properties and toxic effects on the liver and kidneys, more recently it has been found to cause cancer in animals.

Two other solvents that contain chlorine—tetrachloroethane and chloroform—have been rejected as cleaning agents but were once used widely in industry. Tetrachloroethane, used in the aircraft industry between World War I and World War II, was responsible for many poisonings. This once-popular solvent is now extinct.

Chloroform also has some negative history. It was one of the first anesthetics used in the nineteenth century and was used up to about the time of World War II. When safer anesthetics became available, it was discontinued because it caused death from liver toxicity in some patients. Its use in pharmaceutical preparations was banned in 1977 by the Food and Drug Administration.

Chloroform also had wide use as an industrial solvent years ago, resulting in liver damage in overexposed workers. Modern science has found both chloroform and tetrachloroethane to be reproductive hazards, and chloroform is further suspected of being a carcinogen. A controversy still rages over the presence of trace amounts of chloroform in chlorinated drinking water and over its alleged carcinogenic risk to the public.

Benzene, a coal tar- or petroleum-based solvent, was used before World War II as a fuel-octane booster for automobiles. The chemical is now found in gasoline in far lower concentrations (less than 5 percent of the fuel). Benzene was used as a solvent in airplane dopes during World War I and in paint and varnish remover, but its ability to cause leukemia and debilitating blood diseases among those who repeatedly inhale small amounts of the vapor, or absorb the liquid through the skin, has increasingly limited its use. The chemical is now used principally as a building block for industrial and consumer chemicals that require its unique structure of six carbon atoms in a nearly flat ring. The aromatic solvent, so described because it was originally obtained from a smelly distillate fraction of coal tar, is still used in fantastic tonnages each year. Benzene is currently produced from oil by the petroleum industry, and, not surprisingly, this industry has challenged OSHA's attempts to lower the exposure limits for the chemical.

OSHA's first exposure limit for benzene was established in 1971 at 10 parts per million (ppm) for an eight-hour workday. Although the limit offered workers some protection, health researchers at the time believed it was not low enough to prevent many cases of blood disease. In 1977, OSHA sought to lower the exposure limit to 1.0 ppm as a temporary emergency measure, but a lawsuit by the American Petroleum Institute and other groups successfully stayed the standard. OSHA attempted to lower the standard permanently to 1.0 ppm in 1978 but was again challenged by industry groups. The case eventually reached the Supreme Court, which ruled that OSHA had not provided sufficient documentation that workers were truly at risk. The lower limit was thrown out. Finally, in 1987, in a belated reaction to a petition by unions and interest groups in 1983, OSHA successfully adopted a more protective comprehensive standard. The exposure limit for benzene is now 1.0 ppm for an eight-hour workday.

Other petroleum-based solvents, such as hexane and n-butyl ketone, were used as specialty solvents for many years, with concern only for their narcotic properties, until they were discovered to produce neurological disorders. The discovery of more serious toxicity eventually resulted in the substitution of other solvents.

The current popular industrial solvents include toluene, the xylenes, methyl ethyl ketone, naphtha, the mineral spirits, methylene chloride, perchloroethylene (dry cleaners' solvent), methyl chloroform, the acetates, the glycol ethers, and the fluorinated hydrocarbons, which include the "freons." For the most part, these modern-day solvents are much less toxic than their forebears. Nonetheless, overexposure can cause varying degrees of respiratory irritation and narcotic effects and, with greater exposure, fatal or disease-producing damage to the heart, lungs, liver, and brain. Recent evidence indicates that long-term subacute exposure can result in permanent damage to the nervous system, including a decrease in emotional reactivity and impaired memory and psychological performance.¹ In addition, a few of the glycol ethers were recently found to be associated with risks to the reproductive system, and methylene chloride was recently found to cause cancer in animals.²

In many industrial settings, however, the solvents are used without harmful effects, and, unlike the earlier solvents, those used today need to be inhaled in much larger doses for severe *acute* effects to occur.

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There are no guarantees that scientists will not find more toxic effects associated with the solvents in use today. But science has come a long way since the early testing of anesthetics in the nineteenth century. Industry has also come a long way in controlling hazardous exposure, though there is room for improvement.