

The View from NIOSH: Make It Safe

On January 22, 1974, Dr. Maurice Johnson, environmental health director for B. F. Goodrich, called on Marcus Key, director of the National Institute of Occupational Safety and Health. Johnson had a discovery to report. Three workers in Goodrich's Louisville polyvinyl chloride plant had died from angiosarcoma of the liver since 1971. Key summoned his top aides, who agreed that they had an emergency on their hands. Two days later a small army led by NIOSH Standards Development chief Vernon Rose, invaded the Louisville plant to conduct the first of many "walk-through" inspections.

Within a week, Rose's task force had a list of recommendations for reducing worker exposure to vinyl chloride:

- protective coveralls, shoes, and gloves for workers exposed to PVC.
- airtight suits and respirators for reactor cleaners.
- daily showers for exposed workers.
- a 50 parts per million suggested ceiling on vinyl chloride monomer exposure.

Normally, writing a criteria document—NIOSH's for a recommended standard—is an eighteen-month process involving exhaustive study. In this instance, however, Rose relied on guesswork and precedent. Assuming that vinyl chloride causes cancer through inhalation and skin contact, he modeled his standards on those used earlier by NIOSH for industrial carcinogens.

Aiming for a mid-March deadline, NIOSH organized a hectic series of meetings and studies. By the end of February, its toxicology group had been unable to determine the carcinogenicity of VCM below 50 ppm. The medical group had suggested a battery of liver tests for PVC workers,

but industry and labor had split over the exposure ceiling. Industry urged 50 ppm, which it knew it could achieve; labor advocated "no detectable level," refusing to treat workers as guinea pigs.

In this situation, Rose simply toughened and expanded on his earlier recommendations. Most important, he decided that the ceiling for vinyl chloride be set at "no detectable level"—the only exposure he knew to be safe. "It is doubtful," he conceded in a memo to Key, "that *any* plant can show workroom levels of non-detected." To meet it, respirators would have to be worn at all times. He wasn't sure this was practical, but he was certain it was safe.

On March 11, Dr. Key submitted NIOSH's recommendation to Assistant Labor Secretary John Stender. When OSHA proposed its permanent standard two months later, it incorporated most of the NIOSH text verbatim, including the "no detectable level" provision.

The View from Firestone: Make It Practical

To Todd C. Walker, the towering, outspoken president of Firestone Plastics, OSHA's proposed standard was as much a crisis as the Goodrich bombshell had been to NIOSH. He was determined to resist the standard with "the maximum information" at the OSHA hearings in Washington, D.C., this summer.

Walker assembled four task forces—legal, engineering, financial, and medical—to develop a Firestone-recommended standard on a crash basis. Four alternatives were to be studied: the interim 50-ppm standard, "non-detectable," and two intermediate levels chosen arbitrarily—10 ppm maximum with a time-weighted average (TWA) of 25 ppm, and a 15-ppm ceiling with a TWA of 10 ppm. For each level the questions were: is it safe and is it feasible?

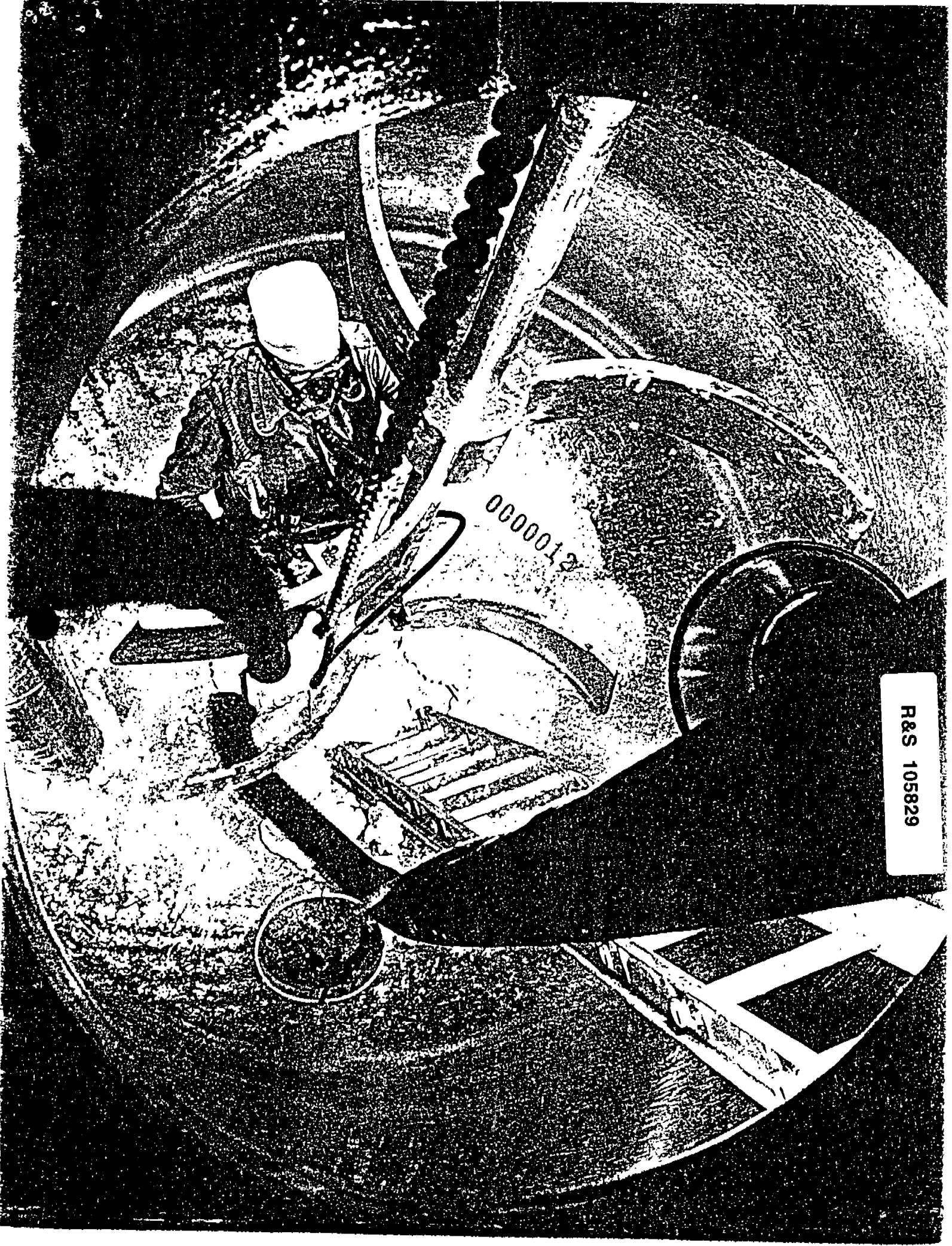
Weeks later, the medical group was unable to say positively that any of the levels was unsafe. An epidemiological study of Firestone's rubber and PVC workers showed no significant differences, suggesting that 50 ppm was not relatively unsafe.

The engineering group reported that the nondetectable level was unattainable. It also forwarded a critique of OSHA's proposed work practices. Protective clothing for all workers was unnecessary, it said, because PVC dust is not a carcinogen. VCM gas, which is, could be kept away from the skin only by air-tight suits, which would be "hot, cumbersome, expensive, and dangerous." OSHA's provision for air-supplied respirators for all exposed workers was also ill advised. These would be uncomfortable ("an instrument of torture"), fatiguing, probably hazardous, and would interfere with work. One portable type weighs twenty-eight pounds and would have to be changed three times an hour. Nonportable respirators could be

used, but workers would be attached to air hoses (themselves a workplace hazard) and confined to a radius of less than fifty feet.

The financial group reported that capital investment would have to double to attempt reaching a nondetectable level. The legal staff concluded that OSHA's proposed standard was unfeasible and therefore illegal.

When it came to deciding what level he *would* recommend, Walker had a problem. His medical evidence showed the three levels above nondetectable to be equally safe. His engineers said that the feasibility of the lowest of these (15-ppm ceiling with a 10-ppm TWA) was uncertain, and Walker ruled it out. Left with a choice between the two higher levels, he opted for the 40-ppm ceiling with a 25-ppm TWA to show that Firestone was willing to do more than the minimum. Thus, with a practicality reminiscent of NIOSH's decision to recommend a level it *knew* was safe, Firestone ended up recommending a level it *knew* it could achieve.



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workers is balanced against the increased cost to the plastics industry and society as a whole. Unfortunately, this task has remained largely unacknowledged.

OSHA probably will end up compromising on the degree of exposure to the gas it will allow; its decision is apt to be announced this month. But the agency has been under terrific pressure to view the issue before it in absolutist terms, as if its only legitimate concern were the preservation of absolute security for the vinyl plastics industry, or the achievement of perfect safety for vinyl chloride workers.

For a while, it seemed a foregone conclusion that OSHA itself would opt for perfect safety. On May 10, it formally proposed that the new standard for vinyl chloride be set at "no detectable level," i.e., that no plant would be allowed to operate so long as any of the gas could be found in the air or in contact with workers. The industry replied, in effect, that any such standard would be technically impossible and economically disastrous, and that if OSHA went through with it, the polyvinyl chloride industry would be put out of business.

OSHA's final decision will affect more than this single industry and its customers. The vinyl chloride issue may be viewed as the first major test case for a new movement in government regulation. The leaders of the movement are three of the newest federal regulatory agencies, all created since 1970: EPA, CPSC, and OSHA. One general idea behind all of these agencies is that business can no longer promiscuously pass on to society all the indirect costs of running a modern economy. As Sheldon W. Samuels, health director of the Industrial Union Department of the A.F.L.-C.I.O., put it, "The free ride on social costs is at an end. In the plastics industry you're seeing a manifestation of social costs."

With jurisdiction over virtually every product and substance, these agencies, together with the FDA, are beginning to use their sweeping powers to reduce the public's risk of chronic disease, especially from industrial products. Some of the agencies are subjecting new substances to rigorous pretesting before they are allowed on to the market. And with the vinyl chloride case, they have tackled the first of a long list of basic substances on which our industrial economy is already built.

It could put you to sleep

During the first decades of its commercial existence, vinyl chloride seemed a most unlikely candidate for the role of heavy in a historic regulatory drama. Put into full-scale U.S. production in 1939, polyvinyl chloride was hailed as a "miracle" material: cheap, stable, fire-resistant, and able to assume an extraordinary range of soft and hard forms. Its major applications now include coated fabrics (like those used in automobile seat covers), wire insulation, floor tiling, pipe and conduit, phonograph records, and medical supplies, e.g., blood-storage bags.

In the beginning the vinyl chloride gas seemed to be

virtually harmless. The only apparent dangers were of explosion (at concentrations beginning around 36,000 parts per million) and narcosis. In fact, during the 1940's the gas was tried out as a medical anesthetic, but doctors abandoned it when it was found to cause heart arrhythmia. With low prices providing little incentive for conservation, producers paid no particular attention to workplace exposure levels so long as they were safely below the point of fire and explosion.

And yet exposure levels in plants producing the gas itself were probably not very high even in the early years. Vinyl chloride is synthesized from chlorine and petrochemical feedstocks (usually ethylene) in a continuous closed process. The plants, which resemble oil refineries (and in some cases are attached to them), are open to the air. Historically, the heavy exposures have occurred in the plants where vinyl chloride is polymerized into PVC, the whitish powdery resin from which actual plastics are made.

It could make you "high"

Polymerization is a batch process: vinyl chloride monomer (VCM) and other substances are put into a pressurized vat, heat is applied, and hours later, when polymerization is completed, the vat is emptied, opened, and cleaned for the next batch. The process is full of leaks. In most of the early plants the gas could be smelled almost constantly (VCM has a faintly sweet odor that seems to be detectable at concentrations above 2,000 parts per million), and workers occasionally got "high" from the fumes. It is widely agreed that in this early period, lasting into the 1950's, exposures of several thousand ppm were common.

During the 1950's, as the vinyl industry grew, a trickle of little-noted and often inconclusive medical reports began to raise doubts about the monomer's presumed harmlessness. In 1949 a Russian group found a hepatitis-like condition in more than one-fourth of seventy-three PVC workers examined, and over the next ten years European researchers encountered other symptoms: skin lesions, a circulatory disorder, gastritis, and dermatitis, to name a few. By the mid-1960's these had been confirmed and were described collectively as "vinyl chloride disease." Later in the 1960's, acroosteolysis, a disease involving a degeneration of the finger bones, was identified among workers who clean polymerization vats.

As these findings accumulated, producers began to reduce exposure levels. In 1961 the American Conference of Governmental Industrial Hygienists, a voluntary standards-setting organization, had put the maximum safe exposure at 500 ppm. During the 1960's industry began working to get much lower than that, and by the early 1970's exposure levels were generally in the 100-to-200-ppm range, with short-term "excursions" to levels many times higher.

In this general downward movement, Dow Chemical

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policy action, like a stone dropped into a pool, sets off ripples of reaction. Since the economy responds with varying lags, a second stone is often dropped before the ripples from the first are still roiling the economic waters. When this "stabilization" exercise is repeated often enough, the result is greater instability.

There are also technical objections to using a full-employment budget to justify federal deficits, as the Nixon Administration did in 1972. Such a budget no longer measures the true impact of government spending and lending on the economy. Federal activities totaling tens of billions of dollars annually—among them the farm credit agencies, the Export-Import Bank, and the Federal National Mortgage Association—have been spun off into independent corporations.

A better yardstick

Another defect is even more serious. "Full employment," a concept intended to measure economic slack, is still defined solely in terms of joblessness. Last year, unemployment averaged 4.9 percent, and the federal budget showed a surplus on the full-employment basis, suggesting that there was still room for fiscal stimulus. Yet shortages of all

kinds, notably in basic materials, plagued the nation. Full employment ought to be measured in terms of our total capacity to produce, including labor, plant, and capital. If such a yardstick had been in use a few years ago, we might have had more timely warning of today's raging inflation.

Despite such problems, Jim Tobin clearly believes that the new economics is still the road to millennium, provided that we adopt a number of fiscal and monetary reforms. Two have been put into effect since the book was written. By setting the international value of the dollar free to float, the Nixon Administration gave the Federal Reserve freedom to pursue a more flexible monetary policy. And Congress at last has created budget committees to set overall guidelines for spending.

But Tobin also demands changes that have little chance of adoption. For instance, he would give the President power to adjust appropriations to fit budget targets. And he wants Congress to separate tax reform from bills to raise or cut taxes, so that temporary surcharges or credits can be enacted speedily to stabilize the economy.

If adopted, such proposals would only

lead the government back to fine tuning with "macro," or broad gauge, economic policies. That is like using a shotgun where a rifle would be more appropriate.

At comparatively small cost, we could open-end the duration of unemployment insurance, a step that would aid mature, trained workers. There should be, as Chairman Arthur Burns of the Fed has suggested, a much enlarged public employment program when the jobless rates go up. It would help mostly young people and those without the skills to compete in a modern economy. Putting 800,000 people on a government payroll at \$5,000 a year would cost about \$4 billion, but it might reduce unemployment by a fifth (i.e., from 6 to 5 percent). In Tobin's program, public-service employment is only an adjunct of much more ambitious—and expensive—macro-economic policies.

In today's changed economic environment, the new economics has become the old economics. The old solutions are not only inflationary, but of dubious help to the people who need it most. Broad-gauge policies for economic stability should be stable themselves. There is no need to change them to offset each wiggle on economists' charts. END

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was far and away the leader. In 1961 it had conducted an animal experiment showing liver effects at levels as low as 100 ppm and had decided to get its own plants below 50 ppm. By the early 1970's, Dow had achieved average exposures in the neighborhood of 25 ppm in its copolymer plants (one of which produces resins for Saran Wrap).

In 1970, Dr. Pierluigi Viola, an Italian physician studying acroosteolysis for Solvay, a major European PVC producer, reported an unexpected discovery. After twelve months' exposure at 30,000 ppm, many of his experimental rats had developed cancers. Doubts about Viola's procedures led Montedison and other European producers to commission Dr. Cesare Maltoni to undertake a large-scale animal experiment to see if this carcinogenic effect could be replicated at lower exposure levels. By the end of 1973 Maltoni's well-executed study had shown that levels of VCM as low as 250 ppm induced a variety of cancers in rats, including angiosarcomas of the liver. In June, 1974, he reported angiosarcomas at 50 ppm.

American producers began to join the inquiry into vinyl chloride and cancer in 1973. Early that year the Manufacturing Chemists Association decided to commission two massive studies. One was an animal study somewhat like

Maltoni's (it has since confirmed his findings). The other was an epidemiological analysis of the morbidity and mortality history of American vinyl workers.

In December, Dr. John L. Creech, a Louisville, Kentucky, surgeon who is plant physician for B.F. Goodrich's massive PVC installation there, received a report that one of the workers had died of angiosarcoma of the liver. Remembering that another worker had died of the same cause two years earlier, he notified a superior. In mid-January, 1974, while a systematic mortality study of Goodrich workers was being organized, Creech received a report of a third angiosarcoma death. On January 22, B.F. Goodrich announced the three deaths and their cause. To date, a total of eight persons employed at the Louisville plant have been found to have contracted this disease.

They blew the whistle themselves

As of January, 1974, literally all the information linking vinyl chloride to cancer had been developed by the industry on its own initiative. As Ralph L. Harding Jr., president of the Society of the Plastics Industry, observed, "This is a unique situation. Industry financed the studies, and industry blew the whistle on itself."

But this was quickly forgotten in the furor that arose during the weeks following B.F. Goodrich's

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announcement. Within days, regulators, public-health doctors, and union officials had begun to dominate public discussion of the vinyl problem. Within weeks, the Louisville *Times* initiated a series of stories alleging that industry had engineered a Watergate-style cover-up of the angiosarcoma discovery, which it abandoned only when it saw that the information was about to leak anyway. This charge was symbolic of the manner in which the initiative passed out of the hands of industry.

It was seized, rapidly, by a loose but not uncoordinated network of regulatory agencies, government research institutes, academic medical teams, labor unions, and other groups united by a common commitment to eradicate environmental causes of disease. This "regulatory-medical complex" is largely the creation of a decade's federal legislation in the medical and environmental fields. Its unofficial leader is Dr. Irving J. Selikoff, professor of community medicine at the Mount Sinai School of Medicine in New York City.

The one-man power elite

White haired, gracious, and preternaturally energetic, Selikoff is best known as the man who explored the hazards of asbestos and who fought for many years to get them reduced. But a glance at his credentials shows him to hold so many other distinctions and positions that he constitutes a virtual power elite all by himself: a recipient of the Albert Lasker Award of the American Public Health Association, he is also director of Mount Sinai's Environmental Sciences Laboratory, governor and past president of the New York Academy of Sciences, editor in chief of *Environmental Research*, president of the Society for Occupational and Environmental Health, and consultant to the A.F.L.-C.I.O. as well as to an almost endless list of medical organizations and government institutes. He seems personally as well as professionally close to nearly everyone who matters in government occupational medicine, and has excellent contacts in the press, which he uses skillfully. Though he insists that he is only a scientist, Selikoff is also a crusader and reformer, and the weapons he takes into battle, aside from his many personal talents, are research and publicity.

Within a month of B.F. Goodrich's announcement, half of Selikoff's staff was working on a series of medical and epidemiological studies of workers at three older PVC plants. Researchers from the Harvard School of Public Health began an analysis of morbidity and mortality in Goodrich's Louisville plant. The National Institute of Occupational Safety and Health, which does research and standards development for OSHA, began a major epidemiological study of workers at four older plants, and together with OSHA sent out numerous teams to conduct "walk-through" inspections of PVC production facilities across the nation. In May, Selikoff convened in New York City a large international working

group on vinyl chloride, held under the auspices of the New York Academy of Sciences. As Dr. Joseph K. Wagner of NIOSH described the position of the many researchers who entered the field, "'Seek and ye shall find' is where we're sitting right now."

What they found was a great deal of information that linked vinyl chloride ever more closely to a variety of diseases, and this information in turn generated newspaper copy. To an attentive reader, the cumulative impression conveyed was of a hidden crisis slowly uncovered. With each passing week, the discovery of yet another angiosarcoma case or the release of a new report seemed to show the crisis to be graver and more widespread than it had been the week before. The tacit message was that industry had failed, and that government would have to step in and do something fast.

Federal regulators were quick to respond. By early February NIOSH and OSHA were actively at work on the problem of workplace exposure. (See the report on page 152.) By the beginning of April OSHA had issued an emergency temporary standard of 50 ppm and in May it proposed "no detectable level" as a permanent standard.

But during the summer, the plastics industry, which had maintained a low profile during the preceding months, reassumed the initiative under the leadership of S.P.I.'s Ralph Harding and Jerome H. Heckman. The burden of the industry position was that OSHA's proposal was not required on medical grounds and was technically and economically unfeasible. In its place S.P.I. advocated a phased reduction to 10 ppm as an average and 25 ppm as a ceiling by 1976. The industry case was set forth in considerable detail and with much documentation during the OSHA hearings that began on June 25.

Making policy in a desert

It was clear at the hearings that, in the end, the vinyl chloride decision was going to be made in an informational desert relieved by only the most occasional oasis of knowledge. It was established that vinyl chloride causes cancer and other diseases. It was also established that, over the course of two decades, industry had reduced exposure levels in its plants by a factor of something like 50 without experiencing notable hardship or burdensome expense. But beyond that almost everything was uncertain.

One large area of uncertainty concerns the shape of the so-called "dose response" curve for vinyl chloride between 0 and 50 ppm—the range within which, presumably, OSHA will set the permanent standard. To date, no animal experiments have been completed at exposure levels below 50 ppm, and since historic exposure levels in most existing plants have been above that level, it is extremely unlikely that epidemiological studies can reveal anything about human response below the level. The data for Dow Chemical's Midland, Michigan, copolymer plant,

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where exposures have been monitored for upwards of a decade, are difficult to interpret. Dow's own studies suggest no adverse health or mortality effects for workers at exposures below 200 ppm; however, Dr. Selikoff's group reports a significant incidence of abnormal symptoms even among Dow workers.

Where data are unsatisfactory, one must fall back on inference and theory—but these have proved even less satisfactory, and much more subject to dispute. At the theoretical level, there is disagreement over how cancer is caused. Advocates of the "no detectable level" argued for the so-called "one-hit" theory of cancer causation, which holds that there can be no such thing as a risk-free exposure to a carcinogen. The theory implies that *any* identifiable exposure to vinyl chloride is certain to cause angiosarcoma, at however low a rate.

But there is another theory of cancer causation, which emphasizes the role of the body's immune system in combating cancer. According to this theory, cancers appear when the immune system breaks down. If what a carcinogen does is to weaken the immune system, and if the weakening process requires a certain level of dose, then it is possible that there is a risk-free level of exposure.

At the present time, there is no definitive way to evaluate the truth of these competing models. Thus when OSHA chooses a standard, it will do so in almost total ignorance of the different rates of cancer and other diseases to be expected at different exposure levels.

Th t of approaching zero

The agency will be just as uncertain about the other major point in dispute—the level below which it is not economically feasible for industry to reduce exposure. "No detectable level" advocates point to the huge exposure decreases that industry has already achieved, to the fact that many producers got below 50 ppm soon enough after the emergency standards were issued on April 5, and that not a few were far below that. To many regulators, it seemed obvious that industry could get to a near-zero level if it really wanted to.

Industry representatives argued vehemently that a nondetectable level simply could not be attained. "Even a system that doesn't leak, leaks," thundered Todd C. Walker, president of Firestone Plastics, at the OSHA hearings. The companies also argued that efforts to approach zero would be extremely expensive. Firestone, for instance, detailed every capital expenditure that would be necessary if it tried to reach "nondetectable" exposure levels and concluded that the total cost would equal the entire value of its existing plant. Even then, Firestone insisted, it would not ultimately achieve a "nondetectable" exposure and would be forced to go out of the plastics business.

By the end of the summer, it appeared that even the OSHA staff felt the standard might be unjustified. An August, 1974, report by the agency's Division of Program

Evaluation and Research observed: "First, it is not clear that it is technically feasible to comply with the proposed standard without a shutdown of the entire vinyl chloride industry. Second, it is not clear from existing experimental and other historical data that a 'no detectable level' standard is justified. And third, it is quite clear that compliance with the proposed standard will require substantial capital investments and lead times."

They'd call it a sellout

If these findings should lead OSHA to compromise—to set an exposure standard of, say, 25 ppm—the agency should not expect to be praised for its moderation. It may even be assailed for violating its charter. The Occupational Safety and Health Act of 1970 states that OSHA, in regulating toxic materials, "shall set the standard which most adequately assures, to the extent feasible, on the basis of the best available evidence, that no employee will suffer material impairment of health or functional capacity even if such employee has regular exposure . . . for the period of his working life."

Members of the regulatory-medical complex would surely insist that a compromise was incompatible with these words—and would see it as an unprincipled sellout, sacrificing lives for dollars. Industry, meanwhile, is apt to view whatever level is allowed as an arbitrary intervention, reflecting political emotionalism rather than reason. And whatever the level, it is hard to believe that the new vinyl chloride standard will do much to end the confusion and uncertainty that currently prevail in many different industries subject to regulatory power.

The vinyl chloride hearings have made it clear that practically nobody in government, industry, or labor is willing to discuss these regulatory issues in trade-off terms. "We don't equate lives with dollars and cents—not at the Department of Labor," John Stender, Assistant Secretary of Labor in charge of OSHA, declares.

Even spokesmen for industry seem unwilling to challenge Stender's formulation head-on. "If we know we're exposing our workers to a known health hazard, we get out of the business," says Dr. Ben Holder of Dow. In the course of the long argument about vinyl chloride standards, businessmen have shied away from asserting that some level of mortality might actually be "worth it." Instead, they have tried to smuggle some practical considerations into the discussion by pointing to problems of "engineering and economic feasibility"—as if feasibility were an absolute.

One reason for the general reluctance to think in cost-benefit terms is to be found in the language of the Occupational Safety and Health Act itself. But another reason lies in the ethos of the regulatory-medical complex, which has something more on its mind than the rate at which people get sick or die. It is committed as well to a larger conception of the good society.

In this society the idea of health is central. Ever more

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remote causes of disease would be eliminated. The role of medicine in this society would be different; it would no longer merely cure, but would actively redesign the environment and ways of living to prevent disease. Inevitably, it would be a society in which doctors, by virtue of their expertise, possessed considerable power. The role of markets would be sharply curtailed, inasmuch as they often lead people to make decisions contrary to their best medical interests. In this sense the regulatory-medical complex is a political movement. As such it perceives in issues such as the vinyl chloride standard a symbolic importance that transcends the particular merits involved.

They don't like business

And, of course, it is an antibusiness movement in its underlying commitment. American regulatory agencies seem to reflect the times in which they were founded; the new regulation was established in an era of intense conflict and hostility to business, and there is little prospect of the movement's suddenly acquiring another personality. For all its unattractive implications for regulatory equity and consistency, this fact is not entirely without its redeeming aspects. By pressing industry hard, these agencies will hasten economic modernization. It is clear that they have long since achieved immense success in raising health consciousness in industry and labor alike. As Dr.

Ralph Langner, an industrial hygienist at Dow Chemical, says, "Vinyl chloride is to industrial hygiene what Rachel Carson was to the environmentalists."

In any case, if Americans are now going to assume the responsibility of deciding what is a "socially acceptable risk," and thus of implicitly putting a price on human life, surely it is desirable that the critical decisions not be left entirely to business—or to any one group or center of authority. A process of indeterminate struggle between business and antibusiness forces, yielding decisions more political than rational, seems preferable to a system in which a single cooperative establishment coolly announces the exact going rate at the close of every business day.

Even so, it seems clear that the process of consciousness-raising could usefully flow in the other direction as well. The regulatory-medical complex would not be any the worse if it had a clearer sense of the novelty of the concept of health it is promulgating and of the uneasiness of its relationship to the existing economic system. And it could take more fully to heart the potential consequences of its regulatory interventions for ordinary living standards. As G.J. Williams, vice president of Dow Chemical, remarked recently, "You could probably not find a single thing in the world that's essential, but they all go towards making life pleasurable. You can do without almost anything, but not without everything." **END**

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cooperation. Ironically, there's a good chance that the U.S. will be leading the trend to unilateral action.

Interpretations of innocence

Because of the diversity of its interests in the sea, the U.S. had been expected to play a keystone role in locking together a compromise among all the divergent points of view represented at Caracas. In fact, however, the conference was one of the first manifestations of a remarkable reversion in the international posture of the U.S. From a preoccupation with the politics of peace, we have moved to a preoccupation with resources and revenues. The clash between this new U.S. stance and the ideological preoccupations of the less-developed nations brought the sea-law negotiations to a standstill at Caracas.

To be sure, American economic concerns originally began the erosion of

the freedom-of-the-seas principle. In 1945, President Truman unilaterally declared the U.S. to be sole owner of the mineral resources on its underwater continental shelf, where oil and gas had recently been discovered. This move was quickly followed by a rash of unilateral claims by other nations, not merely to offshore resources but also to territorial waters wider than the traditional three miles. In most cases, the new limits were set at twelve miles, but some countries, beginning with several in Latin America, claimed absolute sovereignty over areas extending as much as 200 miles to sea.

At that point, the U.S. woke up to what it had set in motion, in particular the implications for shipping and aviation. Traditional maritime law recognizes the right of "innocent passage" through any nation's territorial waters but has always been vague as to what the term meant. With the advent of new kinds of traffic, including airplanes, missile submarines, nuclear-powered ships,

and supertankers, various states have adopted their own interpretations of innocent passage—such as prohibiting aircraft overflights, requiring advance notification of warship passage, making submarines travel on the surface, or forbidding passage to tankers in order to avoid the danger of oil spills.

Planners in sore straits

When combined with the almost worldwide adoption of territorial limits greater than three miles, these constraints on innocent passage had serious implications for all maritime nations, but they especially worried the U.S. Navy and its Soviet counterpart. The heart of the problem was the "straits issue": with even twelve-mile limits, more than 100 important international straits fall entirely within national jurisdiction. Cold-war military planners were appalled by the prospects of emergency ship and aircraft deployments being held up by a straits nation or of ballistic-missile submarines being obliged to