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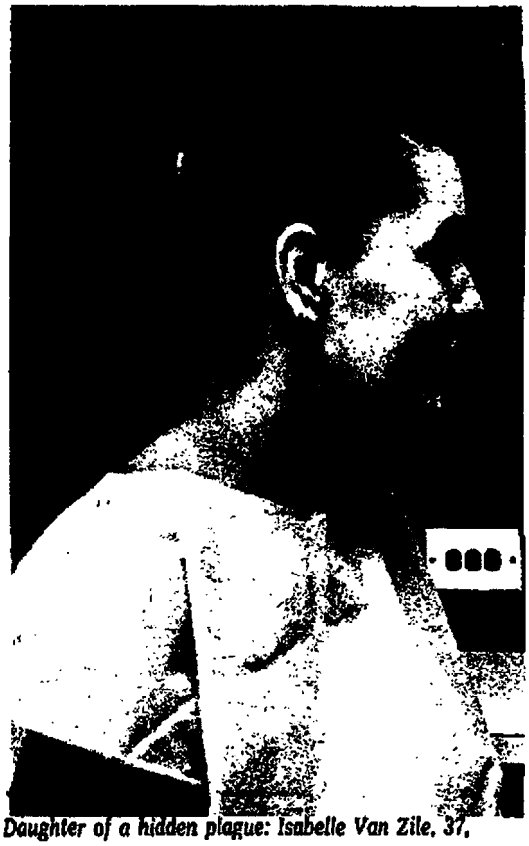
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By Alan Anderson Jr.
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Even the families
of some workers are endangered
by occupational diseases.

The hidden plague



Daughter of a hidden plague: Isabelle Van Zile, 37, victim of a lung tumor associated with exposure to



Now a paint factory, the plant of the Union Asbestos Rubber Company (above) in Paterson, N. J., was the scene of an angry 1954 demonstration (below) by workers citing the health hazards of handling asbestos.



By Alan Anderson Jr.

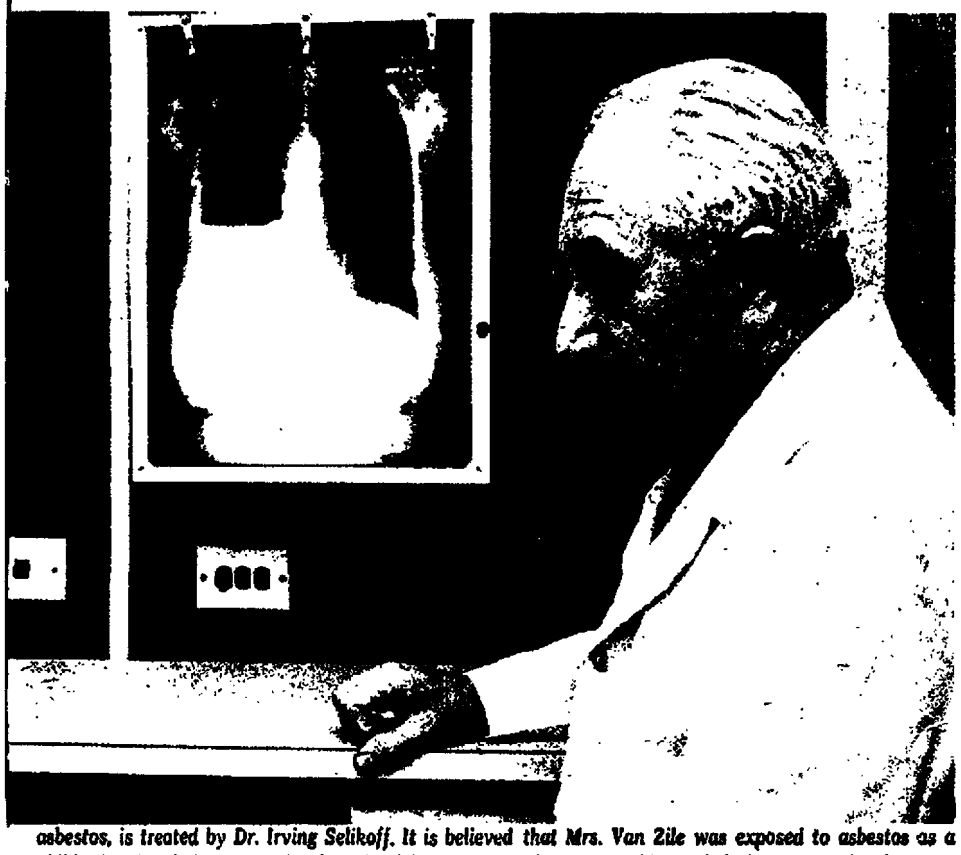
Imagine this in your history books:

In October, 1974, amid much fanfare, a revolutionary process burst upon the typewriter industry when a research engineer for the Teletouch Corporation finally invented the ribbonless typewriter. He found that type blocks made of the metal pantalonium could "burn" an imprint into specially treated paper, obviating the need for ribbons and cutting manufacturing costs by 8 per cent. The following spring, a mysterious epidemic arose throughout the country, characterized by shortness of breath, chest pains, insomnia, dizziness, and, in seven to 10 days, pulmonary failure and death. Amid the chaos, epidemiologists—medical sleuths who trace the origin of disease outbreaks—quickly found that the victims were all typists, secretaries, journalists and others who had used the new typewriters. Investigating the chemistry of the typing process, they discovered that each time a letter was seared onto paper, traces of a volatile petrochemical were released into air. Tests demonstrated that this chemical caused irreversible lung changes in laboratory animals after a lag time of several weeks, and in humans after several months. A national furor ensued, during which the officers of the typewriter company went to jail and the inventor himself was kept in protective seclusion. After a trial that dragged on for two years, the officers were all acquitted: No laws could be found regulating nonconsumable chemicals.

Unfortunately, there is at least as much reality as fantasy in this tale. The reality is that more than 100,000 persons die annually of occupational diseases, according to the President's Report on Occupational Safety and Health of 1972, and 390,000 more contract disabling occupational diseases. The fantasy is that such statistics make

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asbestos, is treated by Dr. Irving Selikoff. It is believed that Mrs. Van Zile was exposed to asbestos as a child when her father, returning from his job at Union Asbestos, put his workclothes in the family wash.



Asbestos miner: His work and the smoking habit are likely to lead to lung cancer.

any impression on the public. The carnage occurs in "slow motion," hidden behind the walls of the several million workplaces of this country's 89 million workers. Most chronic diseases—especially cancer—do not become apparent for many years after first exposure. The victims often die at home, long after becoming too sick to work; when death comes, it does not appear to be job-related. "It's like a major war," notes Nobel-winning biologist George Wald. "The casualties, however, aren't fighting, but just trying to make a living."

The enemies are largely unidentified, hidden among the 50,000 or so chemicals currently in use by industry. The Government regulates the use of only about 450 which have, in haphazard fashion, proved dangerous to man. Even for this small group, which include asbestos, uranium, mercury and other by-now obvious health threats, there is no rational system for setting maximum exposure levels. Each year another 3,000 new substances are introduced, whose effect upon humans is untested. Belatedly, and often by accident, epidemiologists are discovering that many of them cause cancer, both in experimental animals and in humans. The World Health Organization estimates that at least 75 to 85 per cent of all cancers are triggered by environmental agents such as industrial chemicals. Since World War II, the variety of these agents has increased dramatically in what might be considered a second industrial revolution based largely upon a bewildering variety of plastics and other petroleum-based chemicals.

These chemicals, when they cause cancer, typically require 20 to 40 years to produce tumor growth. Significantly, industrialized nations such as the United States are now passing the 20-year mark from the beginning of the great plastics boom of the nineteen-fifties. This correlation was brought home in frightening fashion earlier this year by the revelation that vinyl chloride, a simple petrochemical byproduct used to make the plastic polyvinyl chloride, is carcinogenic, or cancer-causing. Breathing air contaminated with small amounts of vinyl chloride (VC) causes, after a long latency period, an extremely rare form of liver cancer which is invariably fatal. "VC was the first of the large-scale chemical materials that were introduced by the petrochemical industry after the war," says Dr. Irving Selikoff of the Mt. Sinai College of Medicine in New York. "Because of the long latency period of occupational cancers, we are just seeing the first deaths to be caused by VC. There are going to be many more."

Selikoff, who has earned an international reputation for his role in exploring and publicizing the carcinogenic nature of asbestos, has rather suddenly found himself at the center of a dozen or so occupational-disease investigations of unprecedented scale. He has created, under the title of the Environmental Sciences Laboratory, a medical empire of sorts, centered around his own considerable reputation and a brilliant team of occupational epidemiologists. In a field traditionally short on both funds and prestige, Selikoff has secured millions of dollars in Federal grants and the open admiration of other health researchers. "He's at the center of the action," says a colleague. He both pushes and pulls his team with the relentless energy of a man confronting a mountain of unfinished business. "We have a backlog of uninvestigated health threats from as far back as the nineteen-twenties," says the 59-year-old Selikoff. "Which do we take first—the old problems like coal-mine dust and lead, or the new chemicals like vinyl chloride? We hardly know where to begin."

In both the diversity of its talent and sophistication of its technology, the lab itself is unique in the United States, and probably in the world (the only comparable facility is the Pneumoconiosis Research Unit of Great Britain's Medical Research Council). Selikoff's team includes six clinical physicians, six field epidemiologists, one industrial hygienist, two pulmonary physiologists and 15 mineralogists. The mineralogy lab, headed by Dr. Arthur Langer, is crucial to Selikoff's operation: Pinpointing the source of mineral-health threats, such as asbestos and talc, is possible only after precise identification of crystal fibers found in the lungs. Langer's analysis of complex crystals may be called for as legal evidence, as in the recent trial involving a Minnesota iron refinery accused of dumping asbestos fibers into Lake Superior.

A typical Selikoff investigation begins with a suggestion of danger—often from a labor leader concerned about working conditions, or from animal studies with a certain chemical. The next step is to find a high-risk group that has been exposed to the threat—for example, members of a union local who worked with vinyl chloride between 25 and 20 years ago. If the investigators are able to obtain lists of names, they then attempt a "sample trace," trying to find 10 per cent of the working group. If this proves reasonably easy, they follow with "a little P. R.," as a Selikoff investigator puts it, explaining to workers why they must conduct the tedious interrogations, physical exams and pulmonary tests. Then a physician and a field epidemiologist are assigned to the case, and the study branches into two parts: (1) a mortality survey to determine the cause of death of those who have died, and (2) a clinical study to examine all those still alive. The process commonly takes several years, and follow-up studies continue indefinitely.

The procedure was dramatically accelerated in the case of vinyl chloride, both because it threatens so many thousands of workers and because the evidence against it burst so suddenly into the open. We had to drop everything we were doing when vinyl chloride hit," recalled a bleary-eyed member of Selikoff's team a few months ago. Rarely has a case been proven so quickly and precisely in the notoriously imprecise field of epidemiology. On Jan. 22, 1974, the B. F. Goodrich Chemical Company broke the news that, since September, 1971, three of its employes in a vinyl-chloride plant in Louisville, Ky., had died of angiosarcoma of the liver. For such a rare disease —in 30,000 consecutive au- (Continued on Page 23)

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topsies at Bronx Veterans Administration Hospital no cases appeared—this was a miniepidemic. In a crisis atmosphere, the Department of Labor held hearings Feb. 15 and heard more bad news from Dr. Cesare Maltoni, director of the Institute of Oncology at the University of Bologna. Maltoni, for more than a year, had been inducing cancer in rodents by using low levels of vinyl chloride gas—250 parts per million, lower than that found in some working conditions. Since those hearings, angiosarcoma has been induced by only 50 p.p.m., and lower dosages are being tried. "It is obvious," says Selikoff, "that no threshold yet exists."

The National Institute for Occupational Safety and Health (N.I.O.S.H.) has been keeping tabs on VC deaths, which now stand at 27. Recorded cases are growing not only in number but also in kind. At first, all deaths were detected among the 6,500 workers directly involved in the manufacture of the vinyl-chloride gas or its conversion into plastic resin, polyvinyl chloride (PVC). More recently, however, deaths have been reported further along the line among workers who make some of the thousands of derivative consumer products. One angiosarcoma victim had loaded VC in pressurized cans for use as a spray propellant; another made PVC dictabelts; still another wrapped electrical wires in PVC. Six men who made plastic floor tiles in Germany have precursor symptoms of angiosarcoma. A woman in Niagara Falls who, since the end of World War II, lived four blocks downwind of a PVC plant has died of a liver cancer. Many other plants exude measurable amounts of VC, and the Environmental Protection Administration is trying to trace the 200 million pounds of gas that escape into the atmosphere each year. Further evidence has implicated VC in other cancers and in birth malformations. "I suspect," said J. William Lloyd of N.I.O.S.H., "that this is going to be the occupational disease of the century."

Materials used in fireproofing such clothing as children's pajamas (often required by law) may combine with urine and prespiration to give off cancer-causing fumes.

Were vinyl chloride a more exotic chemical whose use could easily be limited, the problem might be manageable. Unfortunately, VC has, until recently, been used widely as an aerosol propellant for hair sprays, garden pesticides and other sprays; and PVC is the second most widely used plastic (after polyethylene) in the country, fashioned into food wrappers, blood bags, water pipes, toys, dentures, shower curtains, phonograph records, furniture coverings and thousands of other products. In 1973, some 5.3 billion pounds of VC gas were produced, almost all for conversion to plastic. "The importance of PVC production" according to Albert C. Clark of the Manufacturing Chemists Association, "is measured by the almost universal dependence of nearly every branch of industrial and commercial activity upon products and components fabricated from this plastic." The most disturbing aspect of the VC scandal is that the chemical has traditionally been regarded as inert and innocuous—and there is no regulatory mechanism to test this false assumption.

Another unusual aspect of the trial and conviction of vinyl chloride is that, as in the case of the fictitious typing ingredient, the prosecution had an open-and-shut case against it. In epidemiology, causes and effects easily blend invisibly into the forest of public-health statistics. Had VC caused a more common disease, such as lung cancer, it might never have been "caught." "It is extremely difficult to prove anything in this field," says Dr. Selikoff. "We suspected that asbestos causes lung cancer for 30 years before we were able to prove it with laboratory animals. We still are not sure how cigarette smoke produces cancer. We think it is benzapyrene, but the average roofing worker inhales as much benzapyrene from tar fumes as may be obtained by smoking about 700 cigarettes a day. You would think they would be falling off the roofs with lung cancer, but they're not. Every problem has to be done separately here—there are no shortcuts and no assumptions. The social consequences are too important to allow any assumptions. There is no substitute for shoe-leather epidemiology."

Shoe-leather epidemiology? I had heard the term around the lab and Selikoff suggested I ask his colleague Dr. Henry Anderson what it meant. Anderson, soft-spoken and boyish in appearance, has been involved in the complex studies of both asbestos and VC. "You can't start with a group of people and wait for them to get sick," he began. "In the case of both angiosarcoma of the liver and mesothelioma of the lungs, caused by asbestos, it usually takes 20 or 30 or even 40 years to develop cancer. Unless you are willing to wait 20 or 30 years, and we aren't, the next best course is to pick a group that worked at a particular job 20 or 30 years in the past—and 'follow' them to the present. We call this a cohort—a group that marches together through time.

"Unfortunately for us, a cohort doesn't march in lockstep. Some quit the occupation, some move away, some die. That's where the shoe-leather comes in. If our study is to be valid, we want to find all of those people—or 95 per cent anyway. The Paterson study is a good example of this."

I had read about the Pater-

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A relati[illegible] lung-functions monitored at Dr. Irving Selikoff's laboratory.

son case, often cited as a classic model of epidemiological sleuthing. Several years ago, Dr. Selikoff studied the mortality experience of 933 men who had worked between 1941 and 1945 at the Union Asbestos Rubber Company (U.N.A.R.C.O.) in Paterson, N.J., comparing their health histories between 1960 and 1971 with standard mortality tables. During that period, 47 deaths would have been expected; instead, there were 105. Two or three deaths from lung cancer would have been expected; there were 25. Deaths from cancer of the stomach, colon and rectum were three times the expected figures.

"We're extending this study," Dr. Anderson continued, "to include others who seem to be at risk. For example, we have found that even the families of asbestos workers are endangered by dust brought home on the workers' clothing, hair or car. We've examined the families of 210 of these men, and found that 38.4 per cent of the immediate family members have abnormal X-rays compatible with asbestosis. This is quite high and represents a big problem. Now we are moving out into the neighborhood around the Paterson plant to see what effect the airborne fibers have on the nonworking public. The problem is like a pyramid: We move from the apex, which is the highest exposure group, downward to those who receive lower exposure. When we stop finding deaths, we stop moving downward.

"The ideal cohort," Dr. Anderson went on, "is a stable work force with a nonmobile population. What we would really like is a group of workers who stay in one job for 35 years and then retire in their home town on a pension. More commonly, there is a lot of movement. Workers typically try a job for six months and then disappear. Then we have to track them down, starting only with an address that may be 20 years out of date.

"Tracing these people is kind of like doing a crossword puzzle. Each person you find gives you an extra chance at finding someone else. He'll say, 'Oh, yeah, Joe Doe, he's up at the penitentiary,' or, 'He got married and went to Canada.' We go to neighborhood bars and grocery stores and barber shops. We also use pension lists, the police, the post office, the City Directory, the phone book, house guides, the gossip page of old union newspapers. If we get desperate, we sometimes have to resort to quasi-legal sources such as the Motor Vehicle bureaus, police records or Social Security lists. You really should talk to some of our tracers about this."

The next day I called on Mrs. Shirley Levine, a smiling, energetic former newspaperwoman who has been tracking down asbestos workers in Paterson since Selikoff set up a field office there six years ago. Her knowledge of the area, acquired during her reporting days, has proven invaluable. "A lot of this work is literally knocking on doors," said Mrs. Levine. "That's why Dr. Selikoff calls it shoe-leather epidemiology. At the Paterson asbestos plant, a lot of the workers were blacks from Columbia and Camden, S. C., many of them related. But to find them, you had to know their 'street' names. If you go asking about George Smith, you may get a few guesses; if you ask for Streaky, you're more likely to get him right away. . . . If someone limps or squints or has three eyes, it makes it easier to find him, of course, but you'd be amazed at how many lost people we get in the end. When I read stories in the paper about someone looking for a lost sister from Czechoslovakia, I get tempted to try to find her. I know I could do it in a minute, but I just don't have any spare minutes."

Another seasoned tracer, Mrs. Sylvia Blustein: "Every trace is done differently; I'm tracing 900 men who built the third tube of the Lincoln Tunnel [including movie actor Warren Beatty, but he's easy to find]. Caisson workers, or sandhogs, as they're called, get bone diseases from the compressed air and silicosis from breathing rock particles. I found one of them through a letter he'd sent from Vienna asking the post master in Livingston Manor, N.Y., where he had lived, for money, and saying he was moving to Argentina. Well, the post master told me about it, and I found the man's name in an Argentine phone book at the New York Public Library. Everyone was very helpful on that case. The only uncooperative group is the Social Security Administration. They have a small staff and say they can't be bothered. If they would help us, we'd save a lot of time and money. I'm telling you, I'd almost be willing to have an affair with the head of it if that would help!"

Selikoff got into this fast-moving business—his offices, without walls or doors, resemble a newsroom where the air crackles with tips on fast-breaking epidemics and clues for the tracers—through his expertise in thoracic diseases. A native New Yorker, he graduated from Columbia University and earned his M.D. at Royal Colleges, Scotland. He interned at Newark Beth Israel Hospital and first came to suspect the insidious nature of occupational diseases when some of his chest patients in Paterson, where he has been associated with Barnert Memorial Hospital since 1947, showed an alarming incidence of asbestosis, lung cancer,

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gastrointestinal cancer and mesothelioma. He knew that many of these patients were asbestos workers and, suspecting the dark significance of this coincidence, he decided to keep in touch with 17 of them as they "marched together through time." Today, 15 of them are dead, all but one from some form of cancer. The occupational link became more obvious with time; and through the nineteen-sixties, Selikoff, having failed to enlist the support of industry, began turning more and more to labor leaders in carrying out his mission of building and "following" cohorts of workers.

After a slow start, labor leaders began to realize the extent of such industrial menaces as asbestos, and to solicit the help of independent health researchers. Today, Selikoff's group is cooperating with the unions of firemen (who breath toxic fumes given off by burning plastics), painters (who breathe a variety of toxic solvents and fungicides), roofers (who breathe benzapyrene, a potent carcinogen in animals), printing pressmen (who breathe such solvents as benzene, known to cause leukemia in man), textile workers (who get brown lung, or byssinosis, from inhaling cotton dust), sandblasters (who breathe rock particles which cause silicosis), typographers (who breathe lead and other trace metals), dry-wall tapers and floor-tile workers (who breathe asbestos), and so on. The Mt. Sinai team is continuing to trace several cohorts of asbestos and vinyl-chloride workers, moving "down the pyramid" from primary workers to those who fashion consumer products to the consumers themselves.

Moving down the pyramid in this way takes time, and there is as yet little hard information on threats to consumers. Vinyl chloride has been used for years as a aerosol propellant for such products as hair spray, insecticides and room deodorants. One of the most worrisome discoveries is that toxic levels of the gas can accumulate indoors after less than a minute's spray. Equally ominous are the 3,000 or so products in which asbestos is used, from fire-proofed clothing to, until recently, papier mâché used by schoolchildren. Other materials used in fireproofing clothing such as children's pajamas (often required by law) may combine with urine, perspiration or other acids to give off carcinogenic fumes. Talc, composed of harmful silica particles, is used widely — and indiscriminately — in talcum powder and abrasive soaps. Compounds responsible for "permanent press" cloth, such as organophosphates and mercury, are highly toxic if released. When furniture padded with foam rubber (urethane) is burned by a dropped cigarette or another heat source, it gives off poisonous hydrogen-chloride fumes and phosgene, a nerve gas used in World War I.

The most recent health menace to emerge—and it is emerging farther down the pyramid than either asbestos or VC did at first—is fibrous glass. First introduced in 1936 and best-known under the trade name Fiberglas, fibrous glass has traditionally been considered biologically innocuous. During the postwar chemical boom, when the stuff found almost universal application as insulating material and was also woven into fire-proofed cloth, the fibers were large enough (about three microns, or millionths of a meter, in diameter) to be trapped by the upper respiratory tract. Then, in the nineteen-sixties, industry realized that insulating efficiency of fibrous glass rises with the number of dead-air spaces between fibers and, adopting a "smaller is better" philosophy, reduced fiber diameters to the one-tenth micron range. These microfibers elude the body's outer defenses, lodging deep in the lungs.

As the dangers of asbestos became known, fibrous glass, thought to be harmless, began to be used in its stead, especially to insulate metal air ducts in offices, schools and homes. Industry found it cheapest to spray the insides of such ducts before they were hung, and even to make entire ducts out of fibrous glass. When such ducts are damaged and, as they age, small numbers of fibers do escape into human environments.

"Early in the nineteen-seventies," says Dr. William Nicholson, a senior member of Selikoff's group, "workers at the National Cancer Institute took a variety of these fibers and implanted them in the pleural surfaces of rat lungs; other researchers in Germany did the same thing with the peritoneal membrane that encloses the lung. Both groups showed that any fibers —regardless of their chemical nature—are carcinogenic in animals. *Any* fibers! So far, industry's response to the threat has been to ignore it by say-

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ing there is no demonstrated health hazard. Of course, these small fibers have only been in use for about 10 years, and on the basis of our experience with occupational cancers, we would not expect any disease to have appeared yet. Even with asbestos, lung scarring doesn't show up for at least 10 years."

If supposedly inert substances such as vinyl chloride, asbestos and fibrous glass can cause cancer, what is the effect of working in an atmosphere laden with chemicals known to be highly reactive and volatile? Some oil refineries, for example, turn out more than 5,000 petrochemical products, many of which find their way into humans. "In general," says Selikoff with a shake of the finger, "chemicals are used in industry because they are chemically active. This means they tend to be biologically active as well. Anything that reacts with our lungs isn't going to do us any good."

Selikoff is particularly upset at the apparently accelerating effect of exposure to two or more toxic chemicals. "I have a theory," he announced one day in his office. "It is that most human cancers are caused by multiple factors. If this is true, it could be that cancer is produced by very low levels of several carcinogens, even though any one by itself would have no effect. We have already shown, with Dr. E. Cuyler Hammond of the American Cancer Society, that in the case of asbestos workers two carcinogens are more than twice as bad as one. Asbestos workers who smoke cigarettes get lung cancer at a rate eight times higher than smokers who do not work with asbestos, and 92 times higher than people who neither smoke nor work with asbestos! In the case of refinery workers, or urban dwellers who breathe city air, the combinations may be much more complicated."

Even when such health workers as Selikoff find their way through the complications to achieve a chemical indictment, a maze of complications remains. It is not easy to induce, or even coerce, industry to give up a profitable process, or to spend money on air-filtration systems. Although industry has come a long way since the days of sweatshops and child labor, management is still loathe to accept outside intervention in plant processes. "I think industry is changing," says Selikoff, "but there are still some bad actors around." He is being diplomatic. "One of our biggest problems," says Henry Anderson, "is that the plants won't let us see their health records. Industry will say the records are private or they have disappeared, and we have to rely upon the unions for almost all of our information."

The best—or worst—recent example of industry's attitude has been the decision by the Pittsburgh-Corning Corporation to shut a polluting asbestos plant in Tyler, Tex., rather than clean it up — a story relentlessly documented in Paul Brodeur's book "Expendable Americans" (Viking/Compass). Even today, the Johns-Manville Corporation, the free world's largest producer of asbestos (output in the Soviet Union is somewhat higher than in the U.S.) seeks to dilute the impact of Selikoff's findings, which have shown for 10 years the carcinogenicity of even very low levels of asbestos dust.

"Dr. Selikoff is very often held up as the one authority in asbestos-health research," said a Johns-Manville spokesman recently. "I think that in the industry and in the field you will find there are a lot of others." The two names offered by the spokesman were those of J. Corbett MacDonald of McGill University, whose work has long been supported by the asbestos industry, and George Wright, who is an employe of Johns-Manville. Both men have consistently sought to play down the threat posed by asbestos to the 200,000 workers presently exposed to it and the 800,000 who have been exposed in the past.

The role of the Government in the war against occupational cancer dates only from April, 1971, when the Occupational Safety and Health Act went into effect. The act created the Occupational Safety and Health Administration (O.S.H.A.) to guarantee a "safe and healthful workplace" for all workers, and set up N.I.O.S.H., which is charged with researching health problems and recommending safety standards. The effectiveness of these measures has already been blunted by lack of funding. There are so few health inspectors that at the rate they were able to visit the nation's workplaces during the first eight months of the act, they would need 230 years to inspect them all. O.S.H.A.'s enforcement of health-and-safety rules has

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The World Health Organization estimates that 75 to 85 per cent of all cancers are triggered by environmental agents such as industrial chemicals. Since 1945, these agents have increased dramatically.

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been less than vigorous; fines for violations have averaged a mere $18 so far, an amount any business would rather pay than contest, and many would no doubt rather pay than comply with the regulation they are charged with violating. Selikoff himself is limited as an industrial researcher to making his data available to O.S.H.A. and the unions, and to providing expert testimony in court cases. Having done so, he is then left to hope someone else will convert his medical evidence to administrative action. "The enforcement situation in general," says Sheldon Samuels of the A.F.L.-C.I.O.'s Industrial Union Department, "is putrid."

Even so, industry has battled vigorously against the act, and against strict controls of asbestos and other health threats. As of the beginning of 1974, there were 76 bills before Congress to amend the act and three to repeal. In her forthcoming book "Muscle and Blood" (Dutton), Rachel Scott describes labor's disillusionment with the law, quoting an article by Bob Kason, editor of a Teamster publication: "Within O.S.H.A. itself, there has been no sense of mission or dedication to the implementation of the act on behalf of the workers it was intended to protect. Rather, there is a steady and prevailing attitude in the top echelons that shows priority compassion for problems and inconveniences of management."

If 100,000 typists died on the job within a week of each other, it would be impossible to ignore the imminent danger of occupational disease. As indicated, however, most industrially caused illnesses develop not in one week but over many years at an imperceptible pace. The victim is slowly rendered unable to work through conditions typically described by company doctors as "asthma" or "tuberculosis." When death comes, it is seldom linked with occupation in any records. "Getting sick isn't enough," declares Dr. Susan Daum, who is now studying byssinosis among textile workers with the Mt. Sinai team. "Government and industry say you have to be able to count the bodies in the street. They don't take into account the workers who lose their health, who are forced to retire early, who die young. The textile industry is particularly hard to deal with, because it is difficult to prove mortality from byssinosis. It is not hard to prove sickness, but that doesn't have the same impact as a stack of bodies."

An increasing number of scientists in this field are beginning to reach a common conclusion: If occupational health standards are to be raised, the workers themselves must raise them. Until recently, labor leaders have largely ignored the prickly thickets of epidemiology in favor of the more obvious issues of wages, hours and vacations. Now, however, a number of unions, led by the Oil, Chemical and Atomic Workers, are turning aggressively to independent medical experts such as Selikoff, supplying them with the union lists that make cohort studies possible, and teaching their members to collect air samples and other data in the workplace.

Toward this end, Drs. Daum and Jeanne Stellman, a physical chemist, have written a volume titled "Work Is Dangerous to Your Health" (Pantheon), designed to "translate the relevant medicine, biology, and industrial hygiene into the English that people use every day," and to explain the operation of such essential tools as air-sampling devices. Selikoff himself is firm in the conviction that workers must learn to save themselves. "People who work in a factory or in a mill can see what is going on around them better than we can," he says. "Our mission is to help them clean it up." ■

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