

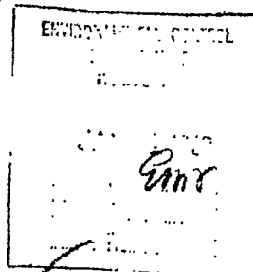
FILE NAME: Rogers Corporation (ROG)

DATE: 1968 Dec 30

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D. L. Monroe
E. M. Fenner,
File



December 30, 1968

Mr. C. M. Gorman, Dir. Purch.
Rogers Corp.
Rogers, Conn. 06263

Dear Mr. Gorman:

A copy of the New Yorker article of last October we discussed
at our last visit is attached.

Regarding dust control, here are extracts from letters written
by J-K Environmental Control Dept.:

"Respirators for protection against fiber dusts should
be Bureau of Mines approved for protection against
toxic dusts, not significantly more toxic than lead
(Bureau of Mines Schedule 21a or 21b).

Our own plant people seem to prefer MSA DUSTFO.. 77.
Other manufacturers of approved respirators include
American Optical and Willson."

"I understand that your company wishes to take every
precaution to insure the safety of your workers en-
gaged in the fabrication of materials containing as-
bestos.

The best protection is mechanical dust control equip-
ment designed to maintain the airborne concentration
of asbestos fibers below the Threshold Limit Value
established by the American Conference of Government-
al Industrial Hygienists. This group establishes TLV's
for airborne concentrations of different toxic sub-
stances which represent conditions under which it is
believed that nearly all workers may be repeatedly ex-



Mr. C. H. Gorman

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posed, day after day, without adverse effect. The newly proposed TLV for asbestos fiber is 2 million particles per cubic foot (2 MPPCF) or 12 fibers per cc (12 f/cc).

Asbestos fiber dust concentrations are measured in accordance with techniques established by the United States Public Health Service. The determination of MPPCF requires collection of samples by an impinger and a subsequent particle count under a 100 power light microscope. The f/cc count is determined by membrane filter coupling and subsequent fiber count under a 430 power light microscope. These techniques are described in detail in literature available from the U. S. P. H. S. If additional information as to sampling and analysis is required, it can be obtained from:

Mr. Howard Ayer
Chief Environmental Activities
Field Studies
Occupational Health Program
Dept. of Health, Education &
Welfare
1014 Broadway
Cincinnati, Ohio 45202

A competent, experienced dust control engineer should be employed by your concern to design the dust control system, including the hoods, duct work, fan and collector. It is essential that your dust control system employ a high efficiency dust collector to prevent external atmospheric dust contamination.

Very truly yours,

H. A. Boisclair

HAB/ev
Attach.



THE
NEW YORKER
23 WEST 43RD STREET
NEW YORK, N. Y. 10036

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A REPORTER AT LARGE

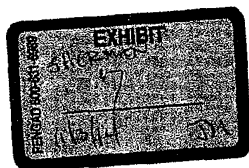
THE MAGIC MINERAL

by PAUL BRODEUR



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Issue of **OCTOBER 12, 1968**



mous industrial importance because of its unique and astonishing physical properties. It appears to be highly combustible, yet it can withstand the fiercest heat. It seems as perishable as grass, but by virtue of being almost immune to the forces of corrosion and decay under almost every condition of temperature and moisture (and of being resistant as well to the action of most acids, alkalis, and other chemicals) it is just about indestructible. It looks extremely fragile, yet its fibres have a tensile strength equal to that of piano wire. Apparently as light and feathery as thistle- or eiderdown, it is actually as heavy and dense as the rock from which it is extracted. In one sense, then, it is a fibre of stone. In another sense, however, it is a mineralogical vegetable whose fibres are so soft and flexible that they can be carded, spun, and woven as easily as fibres of cotton or flax.

Asbestos is the only mineral that can be woven into cloth, and its fibrous structure is, if anything, even more amazing than its remarkable ability to withstand heat. In fact, if it were not for the electron microscope, the extent to which asbestos is fibrous would be difficult to believe, for there are approximately a million individual fibrils lying side by side in a linear inch of chrysotile asbestos, whereas only thirty-eight hundred glass fibrils, such as those found in various insulation materials, or six hundred and thirty human hairs can be aligned along the same distance. Moreover, in addition to their extreme fineness, high tensile strength, unusual flexibility, spinnability, and resistance to heat and the elements, asbestos fibres possess great powers to adsorb and to filter. Small wonder, then, that when asbestos, which had been known to the ancients as "the magic mineral," was, in effect, rediscovered less than a hundred years ago in the age of industrial expansion, it was put to work.

Since that time, the demand for asbestos has risen almost as fast as the stuff could be mined from the earth and milled from its host rock. In 1879, when the world's first commercial asbestos mine was opened at Thetford, in the Province of Quebec, only three hundred tons of the mineral was produced. By 1910, annual world production had jumped to thirty thousand tons; by the middle thirties, it had increased to five hundred thousand tons; and today the total output is more than four million tons a year. Up until a few years ago, asbestos was often called "the mineral of a thousand uses" by those who sold it, but this label has become obsolete, especially in the United States, where it is estimated that asbestos may have as many as three thousand different industrial applications. The United States is the largest consumer of asbestos in the world, importing nearly a million tons a year, mostly chrysotile from Canada, and since fully ninety-five per cent of this amount is used in combination with other raw materials—such as Portland cement, asphalt, and vinyl and other plastics—asbestos is present as an invisible and anonymous ingredient in a myriad of industrial products, many of which are never identified as containing asbestos even though it may constitute up to fifty per cent of their content.

The asbestos-cement industry, which is the principal consumer of the mineral, makes shingles for roofing and siding, sheets for exterior and interior walls, insulation board, clapboard, casings for electric motors, pipes to carry water, sewage, and gas, and numerous other products. Asbestos textiles are used not only in fireproof theatre curtains but also in lagging and other insulating wrapping, in conveyor belting and safety clothing, in pot holders, ironing-board covers, draperies, rugs,

and motion-picture screens, as filters in gas masks and in the processing of fruit juices, acids, beer, and medicines, and in mailbags, prison-cell padding, airplane fittings, stove and lamp wicks, sparkplugs, and fire hose. The electrical-equipment industry has depended for years on asbestos yarn and tape for insulating conductors ranging from fine-gauge wire to heavy cable, and woven asbestos friction materials—such as brake linings and clutch facings—are found in cars, trucks, tractors, power shovels, hoists, and other industrial machines, as are asbestos-cloth packings, seals, and gaskets. Asbestos papers and felts are used for roofing, for piano padding, for lining stoves, heaters, filing cabinets, military helmets, and the mufflers and hoods of automobiles, and they also are found in armored cars, carpets, and car-tridges, and as boiler jackets and radiator covers. Asbestos millboard, which is a heavier version of asbestos paper, is used for acoustical ceilings, as plasterboard and fireproof wallboard, and in electric switch boxes, safes, table pads, stove mats, ovens, and dry kilns. Vinyl and asphalt floor tiles contain anywhere from thirty to fifty per cent, by weight, of short asbestos fibres, and the floor-tile industry has become the second-largest user of the mineral. Since the development of phenol-formaldehyde resins in 1909, asbestos has been used in large quantities as a reinforcement and filler by the plastics industry, and today there are countless plastic products that contain asbestos, ranging from frying-pan handles to rocket nose cones. Asbestos is also an ingredient of many paints and sealants, of compounds used for roof coating and road building, of putties, caulking, and other crack fillers, of clays used for pottery and sculpture, of artificial snow, of plaster and stucco, of fireproof insulation sprayed on struc-

tural steel, and of undercoating sprayed on automobile bodies.

As a result of these multiple and miscellaneous applications, asbestos has become practically ubiquitous in modern society. There is not an automobile, airplane, train, ship, missile, or engine of any sort that does not contain asbestos in some form or other, and it has found its way into literally every building, factory, home, and farm across the land. And, because its minuscule fibres are eminently respirable, asbestos has also found its way into the lungs of man, where, by remaining as indestructible as it does in nature, it can wreak terrible havoc.

THE adverse biological effects of asbestos were observed as early as the first century by the Greek geographer Strabo and by the Roman naturalist Pliny the Elder, both of whom mentioned in passing a sickness of the lungs in slaves whose occupation was to weave asbestos into cloth. Strabo and Pliny were calling attention for the first time in history to a disease that would one day be known as asbestosis—a form of pneumoconiosis (the general term for all dust diseases of the lungs) caused by the inhalation of fine fibres and particles of asbestos—but the ancients were much too awed by the magic of the mineral to be concerned with the possibility that it might constitute a health hazard. Indeed, their attitude toward asbestos sometimes bordered on veneration. Strabo and Pliny noted that the "perpetual" wicks used in the sacred and incense-burning lamps of the vestal virgins were made of asbestos, and Pliny described asbestos cloth, which had been used for centuries in cremations, as the rare and costly "funeral dress of kings." It was generally assumed in ancient times that asbestos was of vegetable origin—Pliny called it "*linum vitum*," and

lungs of autopsied asbestos workers, many of which contained literally billions of them, that they quickly came to be called "asbestos bodies."

The most important investigation of this period was conducted by Dr. E. R. A. Merewether, a medical inspector for the Factory Department of the British Home Office. Between 1928 and 1929, he examined three hundred and sixty-three asbestos-textile workers out of an estimated total of twenty-two hundred asbestos workers employed in Great Britain at the time, and found that ninety-five, or slightly more than twenty-five per cent, showed evidence of suffering from pulmonary fibrosis. He also demonstrated that the incidence of fibrosis increased in direct proportion to the number of years of exposure, reaching eighty-one per cent in the group of workers who had been employed in the industry for twenty years or more. As a result of Merewether's report, Parliament passed legislation in 1931 that made asbestosis a compensable disease, required improved methods of exhaust ventilation and dust suppression in asbestos-textile factories, and instituted periodical medical examinations for workers engaged in particularly dusty processes in the asbestos-textile industry.

After this promising burst of activity, however, progress in the field of asbestosis was depressingly slow, for, as things turned out, the doctors had only begun to scratch the surface of a problem of bewildering complexity. Many investigators assumed that the new regulations would prove effective in controlling the disease, thus failing to appreciate the fact that, once inhaled, asbestos, which is virtually indestructible, continues to react within the lungs for a lifetime, and to heed the warning of Merewether, who, when asked if two years of exposure was sufficient to cause asbestosis in a young girl, replied, "Yes,

if she lives long enough." Moreover, techniques of dust sampling were primitive and inaccurate, and dust levels varied so greatly—not only from factory to factory but from area to area within a given factory—that it would have been almost impossible to establish criteria upon which to recommend a safe level of exposure. But as time went by, the generally lowered dust levels that did result from the regulations of 1931 appeared to be slowing down the attack rate of the disease, at least in Great Britain, and the life expectancy of the average asbestos-textile worker was further increased by the advent of antibiotics, which drastically reduced the death rate from infectious pulmonary diseases that often had to be feared as a complication of asbestosis. The totally unforeseeable consequence of all this was that asbestos workers, instead of dying of asbestosis, began living long enough to develop asbestos-induced cancer.

The first published suggestion of an association between asbestosis and malignant disease was made in 1935 by Dr. Kenneth M. Lynch, professor of pathology at the Medical College of South Carolina, who described the case of a fifty-seven-year-old asbestos weaver who died of asbestosis and in whose lungs cancer was also found. Because the regulations of 1931 required British coroners to conduct autopsies on men who had been suspended from work with asbestos on account of pulmonary disability or when their length of service rendered it likely that their occupation was a contributory cause of death, pathologists in Britain were able to investigate the suggested link between asbestosis and lung cancer much more easily than their counterparts in the United States, where few states had workmen's compensation laws covering dust diseases, and where there were no specific regulations re-

quiring post-mortem examinations of asbestos workers. The British investigations were not made the subject of official comment until 1949, however, when Dr. Merewether, who was then Chief Inspector of Factories, published a review of data that had been accumulated from 1924 to 1946, which revealed that lung cancer was present in thirty-one out of two hundred and thirty-five deaths that were caused by asbestosis or in which asbestosis was found at autopsy. This was an incidence of slightly more than thirteen per cent, and Merewether found it highly significant, for lung cancer, according to its incidence in the general population, should only have been present in approximately one per cent of the cases. At the time, no formal claim of an association between the two diseases was made, but during the next few years an increasing amount of evidence began to establish one. Then, in 1955, Dr. Richard S. Doll, director of the Statistical Research Unit of the British Medical Research Council, completed a study of a hundred and thirteen consecutive autopsies of men with more than twenty years of exposure in a large asbestos-textile factory, which showed that the extent to which they had risked lung cancer over the whole period was eleven times as great as that of men in the general population of England and Wales. From then on, many doctors were convinced that a causal relationship between asbestos exposure and lung cancer had been demonstrated, although almost no part of the vast asbestos industry either acknowledged the relationship or found it advisable to aid the independent researchers who were investigating it.

At this point, many epidemiologists had concluded that the hazards to human health presented by asbestos were limited to the relatively small

group of heavily exposed workers engaged in making asbestos textiles. The trouble was that very few studies had been made of the tens of thousands of workers engaged in other branches of the industry, which was then expanding at an enormous rate all over the world, so that no one really had any way of knowing whether there was any danger from moderate or light occupational exposure—or, for that matter, from indirect, non-occupational exposure. Such studies were under way in a number of countries, however, and when the results began to appear, in the late fifties, it became evident that the hazard posed to man by asbestos had once again been underestimated.

The most dramatic development was the discovery of an association between exposure to asbestos and mesothelioma, an almost always malignant tumor of the pleura, which is the delicate membrane that encases the lungs, or of the peritoneum, a similar membrane that lines the abdominal cavity. Previously, mesothelioma had been so rare that it was considered a pathological curiosity. It was found in only one out of every ten thousand autopsies, it was not listed in most medical books, and it was not even coded separately in the World Health Organization's International Classification of Diseases. In 1956 and 1957, however, sixteen cases of this rare tumor—tantamount to an epidemic—were diagnosed at the Pneumoconiosis Research Unit in Johannesburg, South Africa, by a pathologist named J. Christopher Wagner. Two circumstances led Dr. Wagner and his associates to suggest that asbestos might play some part in the mysterious outbreak: asbestos bodies had been found at autopsy in the lungs of the very first case, and ten of the cases had come from a hospital to which patients suspected of suffering from tuberculosis were referred from a

lioma that had been confirmed by autopsy or biopsy in London Hospital. To no one's surprise, thirty-one of the seventy-six patients had worked with asbestos, but eleven of those who had died had simply lived within half a mile of an asbestos factory, and nine others—seven women and two men—were relatives of asbestos workers. Most of these women had washed their husbands' work clothes regularly. The investigators learned that one of the husbands, a docker, had come home "white with asbestos" every evening for three or four years, and that his wife had brushed him down. Both of the men in this group, when boys of eight or nine years, had had sisters who worked in asbestos-textile factories. One of the sisters had been employed as a spinner from 1925 to 1936, and had died of asbestosis in 1947, at which time it was determined at an inquest that "she used to return from work with dust on her clothes." Her brother, who had apparently sustained no other exposure to asbestos in his lifetime, died in 1956 of a pleural mesothelioma.

Further corroboration of Wagner's findings came from southeastern Pennsylvania, where Dr. Jan Lieben, then head of the Division of Occupational Health at the State Department of Health, in Harrisburg, investigated the backgrounds of forty-two people who had died of mesothelioma between 1958 and 1963. Of the forty-two patients, ten proved to have had definite occupational exposure to asbestos, three were relatives of asbestos workers, eight either lived or were employed in the vicinity of an asbestos factory, and ten others were discovered to have had at least some minor exposure to the mineral. The ten people with minor exposure included a self-employed maker of Swiss cheese who used a five-hundred-gallon boiler covered with

asbestos insulation that flaked off on contact, a salesman who had mixed and applied asbestos-cement insulation to boilers in his home, and a fourteen-year-old boy who at one time had helped his father saw up and install plasterboard during an extensive remodeling of their house.

From an epidemiological point of view, the investigations that tended to support the findings of Wagner and Thomson were weak, because they lacked a defined population as a base against which the data could be measured. On the other hand, the presence of asbestos bodies in the lungs of such a large percentage of consecutive autopsies in so many widely distributed cities of the world was sufficient to indicate that asbestos fibres were probably being inhaled by a majority of urban dwellers everywhere, and the association between asbestos and mesothelioma was striking enough to suggest that a history of exposure to the mineral was likely to be found whenever a positive diagnosis of the tumor was made. As a result, epidemiologists were forced to revise their idea that asbestos was only an industrial hazard, and to give serious consideration to Thomson's prediction that it might prove to be 'dangerous for untold numbers of unsuspecting people in the general community.

IN October of 1964, in order to review the data collected in the past and to discuss the problems awaiting solution in the future, the New York Academy of Sciences sponsored an international Conference on the Biological Effects of Asbestos, at the Waldorf-Astoria. The conference enabled more than four hundred scientists from all over the world to discuss the immensely complicated epidemiological and clinical problems that had appeared in the forty years since Dr. Cooke de-

scribed the first clear case of asbestosis, and its planning was largely the work of one of its co-chairmen, Dr. Irving J. Selikoff, who is head of the Division of Environmental Medicine at the City University's Mount Sinai School of Medicine, director of its Environmental Sciences Laboratory, and a pioneer in the field of modern asbestos epidemiology.

Like many of his colleagues at the conference, Dr. Selikoff became interested in asbestos in a roundabout way. A native of New York City, he interned at Beth Israel Hospital in Newark; did his pathology at Mount Sinai, where he has been a member of the staff since 1947; and became a chest physician at the Sea View Hospital on Staten Island, specializing in tuberculosis. In 1951, he participated in the basic research on isoniazid—the antibiotic drug that, by effectively killing tubercle bacilli, has provided a cure for tuberculosis—for which he received the American Public Health Association's Albert Lasker Award in Medicine. In 1953, Dr. Selikoff founded a medical clinic in Paterson, New Jersey, where, by chance, seventeen of his early patients were men referred for chest-disease consultations who worked in a local factory that had been making asbestos-insulation materials since 1940. When the factory closed down in 1954, the seventeen men went into other work, and at that point Dr. Selikoff decided to continue his observation of these patients with X-ray examinations and pulmonary-function tests in order to determine the history and the natural course of asbestosis in men who would not be subjected to further exposure.

At the time, Dr. Selikoff was chiefly interested in asbestosis because, as he has explained, "I was still unconvinced of the relationship between asbestos and lung cancer. There wasn't much data,

and what there was scarcely seemed to indicate that it would prove to be much of a problem." As things turned out, he changed his mind. In 1954, all seventeen men from the Paterson factory were able-bodied and working. By 1961, however, six of them were dead, and today only six of them are alive. Of the eleven who died, four were victims of lung cancer, three of other cancers, one of mesothelioma, and two of asbestosis. Of the six who are still alive, two are disabled because of respiratory insufficiency caused by fibrosis of the lungs, and one has recovered from surgery for cancers of the lung and larynx. Dr. Selikoff shook his head in describing the fate of these patients, but as early as 1961 their ranks had been thinned out so drastically that, as he said, "I was forced to the awful realization of what could happen to men who were occupationally exposed to asbestos." After the company that owned the factory said it was unable to make its employment records available, he wrote to several other large asbestos manufacturers in the United States, inquiring about the health experiences in their plants, and was unable to obtain information from any of them. Meanwhile, he and Dr. Jacob Churg, chief pathologist at Barnert Memorial Hospital, in Paterson, who had been finding asbestosis and lung cancer in a large number of workers from the Paterson factory, took their data to Dr. Roscoe P. Kandle, Commissioner of the New Jersey State Department of Health, and Dr. Kandle applied to the United States Public Health Service for funds to undertake a study of the Paterson factory and to make a statewide survey to determine how many people were being occupationally exposed to asbestos. However, the request was denied for lack of resources.

Since Dr. Selikoff already knew that

found radiological evidence of asbestosis in fully half of the eleven hundred and seventeen men. The extent of the fibrosis varied directly with the duration of exposure. Of three hundred and forty-six men whose exposure had begun less than ten years before, only ten per cent showed any abnormality, and of three hundred and seventy-nine men who had been exposed for between ten and nineteen years more than half still had normal X-rays; in neither group was there any discernible evidence of cancer. On the other hand, Dr. Selikoff found that among three hundred and ninety-two men with more than twenty years of exposure three hundred and thirty-nine had developed asbestosis, which had by that time become moderate or extensive in more than fifty per cent of the cases; he also found that eleven of the men had developed cancers of the lung or pleura.

Aided by yearly grants from the Health Research Council, Dr. Selikoff has maintained a close watch on the asbestos workers' health, paying particular attention to those men with more than twenty years of exposure by examining them once or twice a year. As a result, he has been able to detect symptoms of illness in many of the men much earlier than they might have been detected and to observe with great accuracy the mortality experience of the three hundred and seventy whom he found in 1963 to be survivors of the original six hundred and thirty-two members of the union in 1942. It continues to be disastrous. Between January of 1963 and March of 1968, fifty deaths would normally have been expected to occur among these men. Instead, there were a hundred and thirteen. Fifteen of them were caused by asbestosis, and, as with the earlier study, the rest of the excess turned out to be caused by cancer of various kinds. Two or three bronchogenic cancers

would have been normal, but twenty-eight occurred, and where the actuarial tables predicted only two gastro-intestinal cancers there were eight. An unexpectedly sharp rise in the number of mesotheliomas was observed. In the earlier study, there had been only four in two hundred and fifty-five deaths; between 1963 and 1968, however, thirteen of these rare tumors were found in a hundred and thirteen deaths. Dr. Selikoff suspects that the latent period for mesothelioma may be longer than that for either asbestosis or lung cancer, but so far he regards the heavy increase of mesothelioma among the insulation workers as something of a mystery.

Dr. Selikoff and Dr. Hammond found special significance in the fact that all twenty-eight bronchogenic carcinomas occurred among asbestos workers who smoked cigarettes regularly. None were found among eighty-seven men who never smoked cigarettes. Dr. Selikoff and Dr. Hammond have reservations about these data, which suggest that asbestos workers who smoke cigarettes are ninety times more likely to die of lung cancer than men who neither work with asbestos nor smoke, because they are based upon the experience of a relatively small number of people. They do conclude from it, however, that an important co-carcinogenic effect exists between asbestos exposure and cigarette smoking, and in a recent article published in the *Journal of the American Medical Association* they recommend "that asbestos exposure be minimized, that asbestos workers who do not smoke should never start, and that those now smoking should stop immediately." It has been suggested in some quarters that asbestos fibres, which are known to be highly adsorbent as well as virtually indestructible, may retain the substance known as benzo [a] pyrene

from cigarette smoke for long periods of time in lung tissue, thus tending to produce lung cancer by a synergistic effect. No one knows for sure, however, and Dr. Selikoff will not hazard a guess about the matter until more information is gathered. He expresses certainty about the effects of asbestos exposure only when he has epidemiological proof. He knows, for example, that one out of every five asbestos-insulation workers who die in the New York-New Jersey metropolitan area dies of lung cancer, and that almost half of the three hundred and sixty-eight deaths he has recorded among these men in the past twenty-five years have been caused by cancer of one type or another. Last March, citing these figures before a House subcommittee on labor, he warned that "if they are projected to the country as a whole, and if no improvement in the health hazards these men face is achieved, we may look forward to perhaps six thousand deaths from lung cancer and to perhaps fifteen thousand deaths from cancer in general among men in this single asbestos trade alone." Considering that the total membership of the International Association of Heat and Frost Insulators and Asbestos Workers is only eighteen thousand men, and that there are about the same number of non-union asbestos workers, his prediction has staggering implications.

I RECENTLY spent several days with Dr. Selikoff in the Environmental Sciences Laboratory at Mount Sinai, where he has assembled a team of thirty men and women to work on various aspects of the asbestos problem. The rooms include laboratories for histology, pathology, electron microscopy, chemistry, and mineralogy, and among the imposing array of equipment they contain is an electron microprobe that is capable of identifying particles of in-

finitesimal size. Dr. Selikoff's office is large and modern. Its walls are lined with shelves and cabinets containing hundreds of bound volumes of research papers and reports on asbestos, and at one end are a large conference table and a blackboard. The place gives an immediate impression of rather cold efficiency, but this is tempered to a great degree by the affability of the director. As we talked, Dr. Selikoff, a large, soft-spoken man in his early fifties, was frequently interrupted by telephone calls and by questions from staff members, but he generally resumed—often with an enthusiastic "Where were we?"—and rattled off statistics about asbestos disease the way some baseball fanatics recite the batting averages of big-league ballplayers. On the day of my first visit, however, he received a call from a doctor in New Jersey who informed him that a lung cancer had just been diagnosed in another of the insulation workers. Dr. Selikoff told the physician that the patient's last X-rays showed moderate asbestosis, that he had had more than twenty years of exposure, and that he smoked a pack of cigarettes a day. When he hung up the phone, he was visibly upset, and fell silent. A few moments later, he told me that he had taken more calls like that than he cared to remember. "I don't relish the role of Cassandra, but I feel we've got to forge ahead on this problem as quickly as possible," he said. "There are about thirty-six thousand insulation workers—union and non-union—in the United States. All in all, including asbestos-textile workers and people engaged in manufacturing other asbestos products, there are probably more than a hundred thousand workers who are regularly and directly exposed. The hazard would be serious enough if this were the only group at risk, but it's obvious that the problem extends further,