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INDUSTRIAL HYGIENE AND MEDICINE

Industry's new plague: Pulmonary disease

Recent technological advances and the widening use of chemical products are posing a serious threat to employees' health.

by JOSEPH D. FAGAN, Chairman
Dept. of Industry, Labor & Human Relations
State of Wisconsin

Five years ago, the words *pulmonary disease* would have brought to mind such occupational diseases as silicosis, asbestosis, tuberculosis. Today, we have to consider the broader term *respiratory infections*, not elsewhere classified because of our present inability to separate the respiratory infections, caused by

the new chemicals and processes, into neat categories. For example, we have the relatively new problem of TDI (toluene diisocyanate) which affects various parts of the respiratory system—sometimes it strikes the nose and throat, sometimes the bronchial tubes and/or lungs, and sometimes it involves the entire respiratory system.

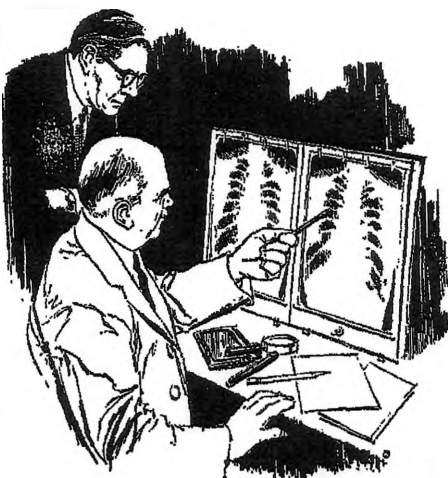
First, let's consider the older, better known pulmonary diseases. In Wisconsin, the law bringing occupational diseases under our Workmen's Compensation Act became effective in 1919. The single most costly occupational disease in Wisconsin has been the pulmonary disease known as silicosis (we include silico-tuberculosis in this category). From 1919 through 1966, over 900 silicosis claims have been adjudged compensable or approved as compromises, with total indemnity and medical expenses of almost seven million dollars.

The spate of silicosis and other occupational disease claims during the depression period, although costly, created an awareness of occupational diseases. This resulted in substantial efforts to control the known hazards. Plant sanitation and medical check-ups became commonplace. In Wisconsin, we have now reached the point where we stress 80 percent education and only 10 percent enforcement.

Major pulmonary diseases

The other major pulmonary diseases that crop up in our workmen's compensation statistics are tuberculosis, pneumonia, pneumonitis, asbestosis, and silicosis (not elsewhere classified).

Our statistical history of tuberculosis, an occupational disease goes back to 1919. There have been no significant variations in the number of



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year to year. Most of the cases have been incurred in hospitals and allied health services. Two hundred claims have been compensated through 1966, with indemnity and medical costs of over \$700,000.

For the other four pulmonary diseases referred to above, our statistical history covers the years 1937 through 1966. The number of cases compensated and total indemnity and medical aid were, respectively: pneumonia, 37 and \$32,767; pneumonitis, 19 and \$6,319; asbestosis, 11 and \$198,784; pneumoconiosis, not elsewhere classified, 8 and \$65,098.

Considering all pulmonary diseases discussed above, the total known number of cases was over 2,000; total known indemnity and medical costs, almost eight million dollars. Silicosis accounted for almost 46 percent of the cases and over 84 percent of the indemnity and medical costs.

The above sounds like a small amount when one considers that in Pennsylvania, where miners disabled by pneumoconiosis are paid from state funds, payments in fiscal 1966 totalled over 27 million dollars.

The common hazards of silica dust and asbestos are pretty well known. However, how many are prepared to measure exposure to crystalline free silica which may be used rather incidentally in an operation at a plant that is not normally considered to be a dusty industry? Silica flour is used, for example, as a filler in some paint mixtures.

Talc and soapstone powders have been found to produce disabling pneumoconiosis in lesser concentrations than dusts made up of silicates, with the result that no more than 20 million particles per cubic foot of air is considered safe. These two materials often have some quartz content, sometimes as high as 20 percent; thus, exposure should be limited to 10 million particles per cubic foot of air.

Exposure to amorphous silica should also be limited to 20 million particles per cubic foot of air. When subjected to a calcining operation, the exposure may have to be limited to 7 million particles per cubic foot of air. It is not my intention to let on threshold limits; the above was mentioned to emphasize the fact that we have a lot to learn even about exposure to silica dusts.

"Not elsewhere classified"

Let's change the subject slightly—what about the respiratory infections, not elsewhere classified by the Statistical Division? From 1937 through 1966, 800 cases cost almost a quarter of a million dollars. The majority of the claims arose from contact with toxic and noxious substances, such as dusts and chemicals.

It will be a different story from now on. We have a backlog of unsettled cases which are costing in millions of dollars—one self-insured employer, alone, has paid out more than one million dollars.



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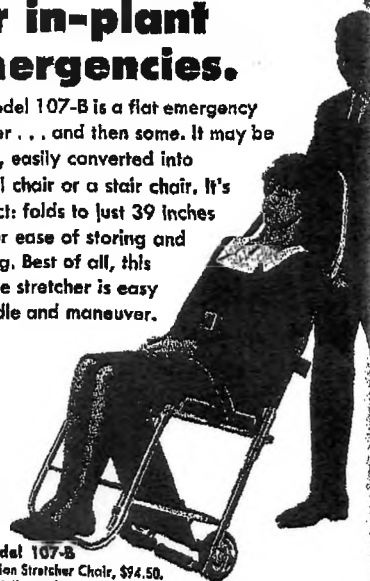
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most impossible to pinpoint in every case the exact of the respiratory system involved; we do know that in many of the cases, the doctors are seeking to find out the long-term effect on the lungs.

New chemicals and processes have brought about this situation. Silica and asbestos have long been recognized as cripplers and killers; but who, five years ago, would have been prepared to listen to a discussion of epoxy resins, methyl ethyl ketone plasticizers, toluene diisocyanate (and other tongue twisters), in conjunction with pulmonary diseases?

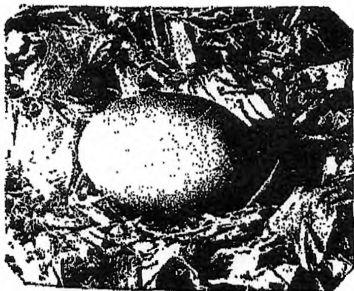
The incidence of silicosis was traditionally limited to a relatively few industries and occupations—in fact, in some industries a hacking cough was a sign that a man had a job. The new hazards can be found in almost any industry, in almost any occupational classification—yes, even in the home. Progress wonderful, but the exotic new chemicals and novel new pesticides are endangering the health and lives—of many of our workers, both on-the-job and off-the-job. As one newspaper article put it: Some people are really allergic to work—and it's not their fault.

For the past few years, an extensive study has been carried out by two doctors from the University of Wisconsin Medical School: Dr. Louis W. Chosy, Instructor of Medicine and Dr. John Rankin, Professor of Medicine. A National Institutes of Health grant supports their research. Working closely with affected Wisconsin employers, they have personally

treated several hundred cases involving respiratory conditions resulting from exposure to glues, insulators, adhesives, foam plastics, etc.

As explained by Dr. Chosy, "These resinous compounds have been developed by modern chemistry. Chemically and simply speaking, scientists developed the new compounds by adding different chemical ingredients to a basic polymer molecule under varying conditions. The materials are highly reactive only while they are first being used. After a glue dries, it is no longer reactive and therefore causes no one any trouble. There are many industrial uses of the new compounds. They are used, for example, in adhesives which can bind metal or effectively encase electrical circuits."

"In almost every case studied," said Dr. Chosy, "the affected persons' ailments were initially diagnosed as sinus trouble, pneumonia, chronic bronchitis, or asthma—all of which may be side effects of exposure to polymer compounds. With added exposure, respiratory problems may become more severe, resulting in ear infections, sinus inflammation, or bronchial pneumonia. The full range of exposure effects is not completely understood. The best treatment for exposure is to keep away from the compounds. This poses a special problem for the workman whose job requires contact with resinous materials. And complete recovery may require prolonged absence from exposure. And, re-exposure, even after 'recovery' starts the problem over again, often quicker than the



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first time."

"These polymers may be encountered by the scientist in his electronics lab, the laborer in a lumber mill, the sportsman repairing his fiber glass boat, or even the captive husband painting the house," he said.

Education and testing

"Largely," said Dr. Chosy, "the answer is education in the dangers of indiscriminate use of these adhesives and resinous compounds as well as urging industry to give closer attention to the potential medical problems of their workers. In well-ventilated plants where resinous compounds are used, workers usually are not affected. Contact with these new materials could conceivably become an increasing problem for the man on the street. These compounds are used in a variety of products—such as epoxy paints, enamels, lacquers and glues—primarily designed for home use."

Our safety inspectors have also been working closely with some of the employers who have had the misfortune of using a chemical process without understanding the medical problems that would ensue. We have the power of increasing workmen's compensation benefits by 15 percent, which the employer himself must pay, but we prefer to work with the employer to help him solve his problems, rather than shaking a big stick at him. This cooperation has in turn brought about more willingness, on the part of the employer, to dig back into the absence records of his employees to see if their absences were due to colds, or due to new production processes.

Our largest workmen's compensation carrier has set up an industrial hygiene laboratory equipped with the latest electronic devices used in chemical analysis. Analytical chemistry has been revolutionized in recent years by the development of instruments which have rendered obsolete the slow, laborious and costly methods of classical quantitative analysis.

Their senior industrial hygienist collects air samples with a midjet impinger, which pulls a measured volume of air through a chemical solution that traps TDI fumes. TDI, an ingredient of the polyurethane foam, can produce respiratory symptoms in very small atmospheric concentrations. He measures the intensity of the dye's color by using a visible light range spectrophotometer, which determines what percent of a beam of light is transmitted by the dye solution. This is an indicator of the concentration of TDI in the solution.

Our workmen's compensation records show that quite a few Wisconsin employers have become aware of the problems of certain new production processes and have corrected the processes. In these plants, the affected workers were given the choice of staying at their old job or transferring to a different part of the plant—many transferred. Some sought jobs elsewhere, on advice of their physicians. Some are still being paid workmen's compensation. We have had cases where a worker who has transferred to another part of the plant comes in contact with others who are working with the "clean" process—in lunch rooms, etc.—and becomes disabled again. Once felled by

TDI, some affected workers cannot stand a whiff of it; one such employee has claimed that other workers bring it out on their clothes and back on her old difficulties.

Not enough doctors are aware that these new materials are causing respiratory problems. If a general doctor sees only isolated cases, he is apt to consider his patient's illness as a chronic one, rather than due to his work.

The most critical problem right now is that millions of workers work for small companies that have neither in-plant services nor an awareness of potential hazards. In the United States, plants that employ less than 500 workers (the kind that usually offer health services) constitute 98 percent of all working establishments, and employ two-thirds of the working force. Services that a 100,000-man company can provide may cost a 500-man company much more per worker. As a result, smaller companies tend to neglect medical services. This is the biggest unsolved problem in occupational health.

The smaller companies have no safety directors, no industrial hygienists. To whom can they turn when they contemplate changing production processes? We are trying to change their thinking of us as an enforcement agency; we urge them to come to us for help. We would far rather pursue preventive measures than wait for our workers to come to us for workmen's compensation.

Inadequate labeling

At the present time, it is not always possible to determine from the label whether or not a potent sensitizer, a corrosive, a primary irritant, or a harmless substance is included in the product. How much does it mean to the ordinary user to read on a label "Use in a well-ventilated area." At home, or in a small plant, one would think it enough to open a few windows and place a few fans around. What is the warning that the products can cause respiratory difficulty or dermatitis?

Unless warnings and precautions are clearly stated on labels, the manufacturers and, under some conditions, the sellers of proprietary chemicals are liable for injuries and property damage that result from their use. However, this means little to the worker who is disabled or fatally injured through improper use of a chemical—improper use because the label did not state clearly what precautions should be taken.

But, we must face the fact that the potential threat to the health and well-being of our workers has never been greater. Although industry is spending unprecedented amounts of money to protect its employees from all known hazards, today's technological advances are creating problems faster than we can handle them.

This is the challenge that faces us now. We must keep abreast of all new developments; we must find a way to help the smaller plants; we must have better labeling; the toxicity of each new chemical or process must be established before it can be put into use.

From an article in *Work Injury Cases Settled Under the Workmen's Compensation Act of Wisconsin*, Nov., 1961.

tests is to measure how well the lungs are functioning by determining how much air is left in the lung's air sacs after a man exhales as much air as he can.

If the air sacs aren't of good quality, possibly because of disease, there's more residual air left.

Certain lung function tests measure how well the membrane of the lungs is doing its job of transferring oxygen to the blood stream and taking waste gases out.

An analysis of a lungful of air exhaled by the worker after he inhales a certain extraneous gas helps determine if the membrane is functioning as efficiently as it should; in other words, if it shows any evidence of being damaged in some way, possibly by industrial dust.

By analyzing the volume of air the man breathes in and exhales, the scientists have been able to detect evidence of lung disease earlier than X-rays can show it.

When the spirometer tests are given, Dr. Shapiro takes an intense personal interest in the way in which they are made. Each test is repeated two or more times, especially if a man seems to be nervous or tense, so that he may not be inhaling as much air as he can, or exhaling all he can squeeze out.

The man sits on a straight-backed wooden chair directly in front of the machine.

The tight-fitting mouthpiece of a breathing tube is pressed up against his lips in such a way that all air exhaled by the worker will go directly into the tube and the measuring device. The worker grips the mouthpiece with his teeth.

A nose clamp is put on his nostrils to close them, so no air enters or escapes through the man's nose.

As the man begins his breathing test, Dr. Shapiro asks him to exhale, "Is it all out?" he asks, "All out? . . . Good. Now inhale."

Dr. Shapiro watches the man inhale. The man's belt is unbuckled to keep it from restricting his breathing. His hands are on his lap.

"Hold it," says Dr. Shapiro. "Hold it. Now . . . Blow it out!" He watches. "Wonderful! That's very good, that's exactly what we want."

Dr. Shapiro takes a partially-inflated bladder looking like a collapsed football from the machine and gives it to Mr. Kirschner for analysis on an electronic device he's operating at the next table.

The next stage for the worker is an electrocardiogram administered by Mr. Wolf. From the readings on the electrocardiogram the scientists can tell if there is evidence of heart strain due to thickening of lung tissue and breathing difficulty.

After the electrocardiogram, the worker gives several tiny samples of blood. Blood samples are being analyzed because they may contain evidence regarding individual sensitivity to lung disease. An unanswered scientific question is why some persons get lung disease and others don't. The entire examination takes about an hour.

One immediate result of the Syracuse program will be a recommendation to Mr. Dwyer for a type of face mask asbestos workers can wear on the job to filter asbestos dust out of the air they breathe.

The lung-testing work of the Division of Industrial

Hygiene in Buffalo a couple of years ago was the achievement that sold the men of Local 30 on the program. Among fewer than 200 asbestos workers tested at that time, the Division located 19 cases of lung disease.

Mr. Dwyer said Local 30 is discussing the possibility of following through on the results of the Syracuse study by establishing a continuing study of its own. The union's primary concern is the health of its men. A continuing lung-testing program in which the men's lungs were tested at intervals would enable the group to discover evidence of illness early.

"Perhaps," said Mr. Dwyer, "this program could be set up through the union welfare fund in cooperation with an institution such as a medical center. We know these are slow-developing diseases that can follow a man through his lifetime. We have to think about how his health is going to be 20 years from now."

Photographs courtesy of the New York State Department of Labor.

Dermatoses (from page 47)

to chemicals that defat the skin. In these cases, using emollients after the final washup of the day is advocated. This applies to those engaged in custodial services as well as to those in industrial work.

Emollients contain lanolin, glycerine, or other substances that make the skin pliable and prevent chapping until the skin itself has had a chance to renew the secretions taken out by industrial exposure. Workers with dry, thin skin who are engaged in occupations requiring frequent immersion of the hands in soap and water or solvents should apply emollients after work.

Education of employees

It is not sufficient to provide workers with protective clothing, protective ointments, and industrial cleaners or cleansers. They must not only be supplied these items freely but also must be taught to use them properly. This can be accomplished in a number of ways.

Posters can be placed in the workshops, washrooms, and toilets that emphasize the importance of protective measures to prevent industrial dermatitis. The posters can be placards that enumerate the hazards and demonstrate how to use the protective clothing, ointments, and cleaners or they can be pictures showing how industrial dermatitis can be contracted if protective measures are not taken.

In addition, at regular safety meetings of department heads, foremen, and workers, prevention of industrial dermatoses should be one of the major topics.

Periodic inspection of workers' hands is also desirable. Inspection not only discovers cases, but also brings to the workers' attention the possibility of contracting industrial dermatitis and the necessity for using the protective devices supplied by management.