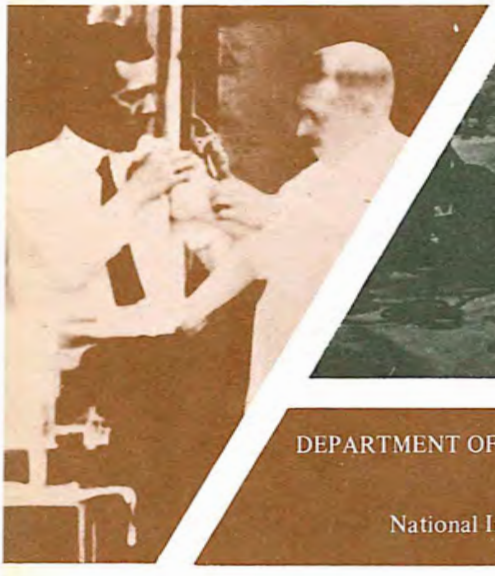
PART OF THE HUMAN CONDITION

Health and Safety Hazards in the Workplace



DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health

This publication describes the program of the National Institute for Occupational Safety and Health in research and prevention of job-related illness and injury. It was prepared by Phyllis Lehman for the 1978 YEARBOOK of the U.S. Department of Labor. Ms. Lehman is a free-lance writer and editor specializing in the field of occupational health and safety.

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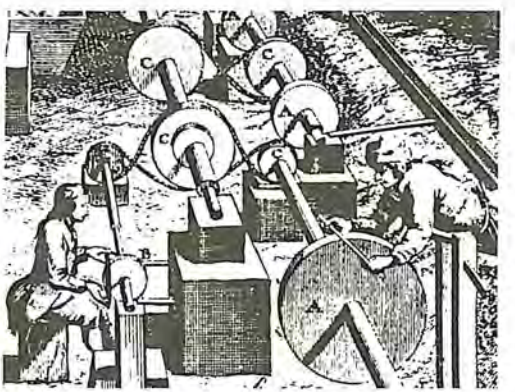
An Old Problem

Getting sick or injured on the job has been part of the human condition since the first caveman cut himself while striking his flint or contracted anthrax while skinning his bison. Sometimes it seems little has changed during man's long trek out of the caves and into the factories.

For instance:
Ancient Roman slaves toiling in mercury mines devised bladder skin masks in a futile attempt to avoid inhaling toxic fumes. In 1976, several workers at a chlorine plant in Linden, New Jersey, were hospitalized with mercury poisoning, and others suffered classic symptoms: weight loss, tremors, and psychological problems. Federal officials ordered engineering and housekeeping improvements with strict use of respirators in the meantime.



Sixteenth century grinders suffered a lung ailment they called "grinders' disease" from inhaling silica dust. Today, in the United States, silicosis is prevalent among sand blasters in the shipbuilding industry. Despite the hazard, this country has chosen not to follow the lead of Great Britain, which banned the use of silica sand in blasting operations more than 25 years ago.

Medieval scribes probably suffered lead poisoning because of the common practice of tipping their quills with their tongues between dipping them into metallic ink solutions. Today, lead poisoning is common among workers in lead smelters and battery plants and some industries routinely administer drugs to lower their workers' blood lead levels. One Illinois laborer told Federal officials he was so afraid of lead poisoning that he took 250 pills every 2 weeks.

In 1775 an English surgeon "discovered" occupational cancer when he noted numerous cases of scrotal cancer among chimney sweeps exposed to coal tar. On the bicentennial of occupational cancer, coke oven workers were (and still are) inhaling the same kind of substances—and dying of lung cancer at a rate 11 times that for other steelworkers.

The grim statistics go on. Each year at least 14,000 persons are killed in work accidents. Another 400,000 get sick from exposure to hazardous substances on the job. About 100,000 die prematurely as a result of those exposures. For some, the odds are overwhelming: Of the 1 million current and former asbestos workers in the United States, between 300,000 and 400,000 can expect to die of cancer. The veteran asbestos worker who smokes cigarettes has up to 90 times greater risk of lung cancer than the average person.

Economically, occupational diseases cost society $20 billion a year in workers' compensation, property damage losses, and law suits.

Do all these depressing facts mean that we have nothing to show for several millenia of experience with occupational disease? Not exactly. Progress has been slow, but there *has* been progress.

Years Of Concern — And Neglect

One of the first scientists to care about the health of the laborer was Georgius Agricola, a 16th century physician in a German mining town. Agricola considered lack of fresh air a particular hazard to miners and proposed such crude ventilating devices as a hand bellows and a wind-operated fan.

The first real occupational health specialist came along about a hundred years later. He was Bernardino Ramazzini, an Italian scientist who studied and described the diseases common to the occupations of his time. He suggested "cautions" that should be taken to protect workers in various trades and recommended that any doctor taking a case history inquire about his patient's occupation — a procedure that unfortunately still is not universal.

In this country, an Office of Industrial Hygiene and Sanitation was first created within the Public Health Service in 1914, a time of growing concern about conditions in the nation's workplaces — from Colorado mines to New York City sweatshops. At about the same time, both industry and

the fledgling labor unions discovered occupational health. In 1913, studies of working conditions and employee health at several of U.S. Steel's Pittsburgh plants persuaded the company to create a medical and sanitary department for the purpose of preventing occupational disease. The International Ladies Garment Workers Union, worried about the high rate of tuberculosis in the sweatshops, took a bold new step for organized labor and set up its own union health center.

The early work of the Public Health Service included investigations of chest diseases among miners, tuberculosis in garment industry workers, and radium poisoning among watch dial painters. In 1931, the first full-scale study of industrial dermatoses was started. During that decade, the program also began to issue periodic reports on the causes and duration of industrial sickness absenteeism. These studies helped stimulate the growth of in-plant health programs in private industry.

Despite evidence that occupational diseases and accidents were a major problem, Federal programs remained at a marginal level until World War II. Then, demands for increased productivity gave new importance to industrial hygiene and occupational medicine. Protecting employee health in government-owned, privately-operated munitions plants was a major activity of the Public Health Service during this period. Disability and death rates from TNT poisoning, the manufacture of smokeless powder and frangible lead bullets, and exposure to X-rays and mercury were greatly reduced.

After the war, interest in occupational health waned, but the problems remained. A classic Public Health Service study of the soft coal mining industry in the early 1960's showed that 1 of every 10 active miners — and 1 of every 5 former miners — had X-ray evidence of pneumoconiosis. It was basically this study which stirred new interest in the health problems of America's workers, although evidence from independent researchers was just beginning to come in that asbestosis might be another problem of considerable magnitude.

Over the years a variety of laws provided limited protection for workers in certain dangerous trades and those working for businesses under Federal contract, but these laws were not vigorously enforced.

In 1968 Congress introduced proposals for a broad occupational safety and health act. However, a major coal mine disaster which took some 180 lives focused national and Congressional attention on this one specific problem. The result was the Federal Coal Mine Health and Safety Act of 1969, which gave the Public Health Service authority to set health standards in the mining industry.

Interest — especially among labor unions and the media — was now aroused about occupational health problems in general, and the following year saw the passage of the Occupational Safety and Health Act of 1970, an historic piece of legislation. For the first time, the Federal government had broad authorities to investigate workplace illnesses and accidents, and to correct them. The Act covers more than 60 million workplaces nationwide. Unannounced inspections, required recordkeeping, the right of employees to complain to the government about working conditions — all have become part of doing business in this country.

It is not surprising that 7 years later, the Act is still the source of much sound and fury, not to mention legal action. Hardly anyone is neutral about the law. To a labor activist,

it's "the most important piece of legislation for American workers since the Wagner Act," which guaranteed workers the right to organize and to collective bargaining. To an irate businessman, the law is "the most dangerous piece of legislation for American business since the Wagner Act."

No one can deny that its effects have been far-reaching. For one thing, the law has directed the attention of the average citizen — and the media — to an aspect of public health that had long been ignored. Suddenly, front page articles on job health are appearing in major newspapers. Half of a television network special on cancer is devoted to occupational cancer. A widely publicized "cancer map" shows that cancer deaths are clustered in major industrial areas, and New Jersey, with its heavy concentrations of chemical plants, wins the dubious title of "cancer alley."

On a cheerier note, this Act has prodded labor and industry to launch cooperative programs to improve working conditions in several major industries, including rubber and auto manufacturing and printing.

The Government's Scientific Conscience

The Act created three new governmental agencies: the Occupational Safety and Health Administration (OSHA) within the Department of Labor, which sets and enforces health and safety standards in the nation's workplaces; the National Institute for Occupational Safety and Health (NIOSH) in the Department of Health, Education, and Welfare, a research agency that might be called the scientific conscience of the Federal occupational health and safety program; and the Occupational Safety and Health Review Commission (OSHRC) which settles disputes arising from enforcement of the Act. NIOSH is headquartered in Rockville, Maryland, just outside the nation's capital. Its research facilities are located in Cincinnati, Ohio, and Morgantown, West Virginia. The Institute also has Regional Offices in 10 major cities throughout the country.

It is NIOSH's job to gather information about injuries and illnesses, analyze and organize that information, and make it available to those who need to know; to recommend new standards; to provide technical assistance to workers or employers concerned about job health hazards; and to help train safety and health professionals.

Looking For The Hazards

The key to knowing what to do about job hazards, of course, is knowing what the hazards are, who is exposed to them, and how serious they are. Gathering information through workplace surveys and laboratory research, then, is the basis of NIOSH's work.

Industry-Wide Studies

A major way in which NIOSH finds out what is happening in the workplace is through industry-wide studies, which are specifically authorized in the Occupational Safety and Health Act. The purpose of these studies, in the words of the Act, is to determine "the effect of chronic or low-level exposure to industrial materials, processes, and stresses on the potential for illness, disease, or loss of functional capacity in aging adults."

NIOSH conducts some 40 industry-wide studies each year on a wide range of occupational groups. Recent investigations have explored the effects of anesthetic gases on hospital operating room employees, of grain dusts on grain elevator workers, of yeast and flour dusts on bakery and confectionery workers, and of a host of substances — including asbestos, silica, talc, and solvents — on painters.

The studies vary in scope and may include an analysis of records to determine causes of death among a group of workers, an industrial hygiene survey of on-the-job exposures, and medical examinations to uncover the health effects of exposure to certain substances.

When a new occupational health emergency arises, NIOSH often follows up its initial emergency investigation with some type of industry-wide study. For example, after B. F. Goodrich announced in January 1974 that several workers at its Louisville, Kentucky, vinyl chloride (VC) plant had died of a rare liver cancer, NIOSH conducted a detailed study of workers at four VC plants. The study confirmed that workers exposed to vinyl chloride for at least 5 years had higher-than-expected death rates from cancer of several organs, including the liver.

In 1976, reports of at least a dozen cases of leukemia among workers at styrene-butadiene synthetic rubber plants touched off fears of another vinyl chloride tragedy. NIOSH conducted an in-depth study of the two Port Neches, Texas, plants where the leukemia cases first came to light. In addition to industrial hygiene surveys, researchers are studying personnel records, job classifications, and causes of death among people who have worked in the plant.

In another big occupational health story, there was no doubt about which chemical was the culprit. Its name is kepone, and its effects are well known, especially to the former employees of the Life Science Products Company in Hopewell, Virginia, where the pesticide was produced under very poor working conditions. A total of 28 workers were hospitalized with significant nerve damage, and about 12 probably will never be able to work again. At least 14 are now sterile, probably permanently.

To keep track of kepone-related problems among workers elsewhere and hopefully forestall further adverse health

effects, NIOSH started a kepone registry in an attempt to locate the 400 to 600 people in the United States who are thought to have worked with the pesticide.

A number of current industry-wide studies are focusing on two of NIOSH's major areas of concern — occupational cancer and hazards to the reproductive systems of workers. Scientists are investigating the possible cancer-causing effects of everything from antimony (suspected of causing lung cancer among antimony smelter workers) to wood dust (which appears to be related to noe and throat cancer among woodworkers).

In are area of reproductive hazards, NIOSH has studied the effects of chloroprene, a chemical used in manufacturing synthetic rubber that Soviet researchers say also causes skin and lung cancer. Under scrutiny as well is a chemical called dimethyl formamide, widely used in finishing operations in the textile industry.

National Occupational Hazard Survey

NIOSH's most ambitious data gathering project is the National Occupational Hazard Survey, a mammoth 4-year undertaking that was designed to find out how many workers are exposed to specific hazards, which industries they work in, and the jobs they hold. After visits and contacts with 5,000 workplaces, NIOSH investigators accumulated data on 4,400 potential hazards in 66 types of industries and 456 occupational groups. Once analyzed, these computerized statistics will give NIOSH a clearer picture of the health problems that need to be attacked first.

The field surveys were conducted by specially trained engineers who interviewed management representatives about plant operations and visited every work site in the plant, listing potential hazards for workers in each job.

Since about 75 percent of the substances reported in the survey were listed as trade name products, an important part of the project was identifying the chemical ingredients behind the trade names. Knowing what these products contain is necessary so that when a new standard is considered, NIOSH will be able to determine which workers are exposed to a particular substance, even if that substance is a brand name product.

Trade names created stumbling blocks in this survey. Tracking down chemicals behind the trade names listed in the survey meant that NIOSH had to contact 10,500 manufacturers to request chemical formulations of some 88,500 products. Frequently, the same trade name was used to refer to several different chemicals and the actual chemicals used in trade name products were constantly changing, so NIOSH had to keep going back to manufacturers for updated information. There were even trade names within trade names. When chemicals in some products were identified, those chemicals often had trade names, which meant that more manufacturers had to be contacted. Many manufacturers were reluctant to tell NIOSH the specific chemicals used in a product because they were afraid their trade secrets might be divulged to competitors.

Research

In addition to surveillance, NIOSH relies on an extensive research program, conducted in its own labs and under contract with universities or private research institutes, for information on which to base recommendations for new health and safety standards.

NIOSH-sponsored research covers a wide spectrum, ranging from how a chemical acts within the body to the psychological effects of a stressful job. Much of the research falls within the following categories:

Animal toxicology studies. "Toxicology" is the study of the effects of poisons, or unwanted substances, in the body. NIOSH studies in which rats and monkeys were exposed to methyl butyl ketone (MBK) — an industrial solvent that caused nerve damage in workers at an Ohio coated-fabrics plant several years ago — confirmed that exposure to MBK at the then current Federal standard can cause damage to the nervous system and can harm the lungs. This research led to a recommendation that the MBK standard be lowered from 100 parts per million parts of air (ppm) to 25 ppm.

In other work, NIOSH scientists found damage to the offspring of rats exposed to anesthetic gases like those used in hospital operating rooms, lung obstruction among animals who regularly inhaled polyurethane foam plastic dust and bituminous coal dust, and lung tumors among rats and mice exposed to coal tar mixtures like those found in coke oven emissions.

New techniques for measuring and analyzing workplace contaminants. Workers may be risking exposure to excess amounts of at least 22,000 toxic chemicals — and those are just the ones we know about. This means engineers and chemists must work constantly to develop more sensitive devices for monitoring worker exposures and for analyzing air samples.

In many cases, NIOSH must devise measurement methods where none exist in order to meet requests for emergency industrial hygiene investigations, to study newly-recognized job hazards, or to monitor compliance wth new standards. It fell to NIOSH, for example, to develop a reliable method for monitoring vinyl chloride when OSHA was considering issuing a strict permanent standard. Other recent breakthroughs include a simpler and cheaper way to analyze the contents of coke oven emissions and a more sensitive method for analyzing small quantities of lead.

Physical stresses. As if the chemical onslaught in the workplace weren't enough, the average worker also encounters a host of physical hazards, including noise, radiation, heat, and vibration. All these, too, are subjects for NIOSH research.

To study the effects of vibration, for example, NIOSH has gone on the road with a mobile van equipped to monitor vibration exposure of such workers as heavy equipment operators at the job site. In the lab, human volunteers are agreeing to be jostled in the vibration chamber to help scientists determine what frequencies of vibration are most harmful to health and performance.

NIOSH is currently working on better methods for monitoring worker exposure to ionizing, non-ionizing, and ultraviolet radiation. Airport workers, the Federal Aviation Administration, and the Airline Transport Association rested easier after a NIOSH study showed that the X-ray hazard to airline employees working with baggage inspection systems was negligible. Now under study is the radiation emitted by several welding processes under various working conditions.

In addition to the typical animal studies on the effects of noise, NIOSH has completed a survey of hearing loss among coal miners. It showed that miners' hearing is much worse than the national average, though not as badly impaired as among some other occupational groups. An investigation of hearing conservation programs in industry produced the conclusion that, while companies are starting such programs, engineering control of noise remains a major problem in many plants.

Since no workers is exposed to just one hazard or form of physical stress, NIOSH is now looking into the effects of combined exposures and is proving once again that the whole is greater than the sum of its parts.

Psychological stress. Some intriguing research is showing that job hazards attack the mind as well as the body. Long-term exposure to low levels of certain chemicals, for example, can affect a worker's nervous system, causing subtle changes in behavior or performance. These changes, scientists recognize, can serve as early warnings of more severe health effects if exposure continues. Such substances as anesthetic gases have been shown to impair eye-hand coordination and performance of certain motor tasks — skills rather crucial in such workplaces as the hospital operating room!

Studies of job stress indicate that the daily psychological stress imposed on some workers — police officers, air traffic controllers, sales managers, mechanics, public relations specialists — makes those people more susceptible to physical and mental illness. Scientists also have uncovered another source of stress that potentially affects more than a quarter of the U.S. work force: shiftwork. NIOSH now is investigating the physical and emotional health, safety records, and job performance of workers in six industries where changing shifts are common.

Although workers are not responsible for nearly the percentage of accidents that some persons claim, the human element in work accidents cannot be denied. Recognizing that machine guards and good housekeeping are not enough, NIOSH is studying the psychological and social factors that contribute to low accident rates in some companies and high rates in others.

In The Real World

All the research and surveillance in the world are useless if they do not translate into safer working conditions. Probably NIOSH's most important reason for being is to use what it learns in the laboratory and in studies of the workplace to inform employees and employers of ways to limit hazards and to recommend to OSHA new standards

that will better protect workers from job hazards. NIOSH recommends these standards in reports known as criteria documents.

Since 1971, NIOSH has sent to OSHA criteria documents on more than 70 substances — metals, chemicals, dusts, radiation, and injury-producing hazards widely found in industry. In the future, however, NIOSH is taking a new tack: documenting hazards by groups of similar substances (pesticides, for example) and by work practices. Such documents will consider the interaction between substances and the combined effects they might have on the health of the worker who is seldom exposed just to one hazard in a working lifetime. Documents will be prepared on a single substance only for special reasons, such as to report in detail on cancer causing or reproductive effects.

The first work practices document was for coke ovens and others, now in preparation, will cover such processes as grain handling and textile dyeing and finishing. The emphasis in these work practices documents wll be not so much on permissible levels of substances in the air as on methods for controlling exposures. As a model, the documents will follow one already completed on anesthetic gases, which outlined the kinds of controls that are technologically feasible right now.

Another major project in standards development was the now completed Joint Standards Completion Program, launched by OSHA and NIOSH in 1974 to develop more complete standards than already existed for all 400 substances now covered by OSHA regulations. These new standards include such things as procedures for informing workers about hazards, for monitoring the workplace, for developing engineering controls, and for setting up medical surveillance and testing programs.

Putting Out The Word

Although its first responsibility is to advise OSHA on standards, NIOSH also puts out the word on job hazards in a variety of forms to a variety of audiences. These include:

Current intelligence bulletins. This rapid alert system is an effective way for NIOSH to inform health professionals in government, industry, organized labor, and universities about a new health hazard or about new data on an old one. Usually only a few pages long, these reports capsulize background information about the hazard and outline recommended action for controlling exposure to it.

Since January 1975, when the first alert was issued on vinyl chloride, NIOSH has sent out over 20 current intelligence bulletins on such things as chloroprene, trichloroethylene, ethylene dibromide, chromate pigments, and the asbestos hazard from brake relining in auto repair shops.

In one recent alert that involved scores of industries, NIOSH warned that cutting fluids used by some 780,000 industrial workers to reduce heat and friction during metal machining operations may be so changed in their structure as to produce significant amounts of the cancer-causing substances, nitrosamines. Most cutting fluids, now largely synthetic, contain both nitrites and amines that are added for such purposes as inhibiting rust. Studies indicate that these two substances may combine in the oils to form "relatively massive amounts" of nitrosamines.

Publication of the *Registry of Toxic Effects of Chemical Substances,* formerly titled the Toxic Substances List, is mandated by the Occupational Safety and Health Act. Chemicals currently found in the workplace may total a mind-boggling quarter million. No one knows what all of them are, but the 1976 edition of this weighty tome does list chemical information and known biological effects for 22,000 of them. In 1975, NIOSH also began publishing a

subfile of the registry listing suspected carcinogens. This subfile currently includes information on nearly 2,000 substances known to cause tumors in humans or animals.

Research reports. Many of the scientific studies conducted by NIOSH or under NIOSH contract are summarized in research reports which are available to the public. A list of current publications and single free copies of the reports themselves may be obtained by sending a self-addressed mailing label to Publications Disseminations, DTS, NIOSH, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

Booklets on good industrial hygiene practices for workers in various occupations. NIOSH has issued a number of booklets containing health and safety rules to be followed by workers involved in such work as foundry operations, metal cleaning, printing, rendering, textile dyeing, and pesticide application.

Health and safety guides for small business. NIOSH has published about 25 of these handbooks, which cover the most common violations of OSHA standards in a particular type of business and contain guidelines for preventing injuries and illnesses. They have been distributed to more than 750,000 small businesses, such as bakeries, grocery stores, gasoline stations, auto repair shops, soft drink bottlers and canners, laundries and dry cleaning plants, and hotels and motels.

The health and safety guides for small businesses and the employee industrial hygiene guides also are available from NIOSH in Cincinnati.

A Helping Hand

NIOSH doesn't share its expertise just on paper. The agency also responds to requests for technical assistance from employers, employees, and Federal, state, and local agencies. Depending on the complexity of the problem, such assistance may range from sending out one or two industrial hygienists from a NIOSH Regional Office to dispatching a team of specialists that includes physicians, nurses, chemists, toxicologists, and engineers.

When six men died after being overcome by fumes at a rendering plant in Ohio, NIOSH cooperated with OSHA, the county coroner, the Ohio Department of Health, and the state Division of Safety and Hygiene in investigating the incident. The cause of the tragedy was identified as a deadly combination of hydrogen sulfide, methane, and carbon dioxide gases. In other cases, OSHA may call in NIOSH to make sure that worker health is not being jeopardized, even if levels of toxic substances are within OSHA standards.

NIOSH's most popular type of technical assistance is the Health Hazard Evaluation, which may be requested, for example, by an employer who wants to know if the ventilation in his plant is satisfactory or by workers worried about the fumes they must breathe.

Many requests are generated by hazards currently in the news, such as vinyl chloride. But many other requests concern things that range from carbon monoxide to a chemical so exotic that there may not be a sampling technique for it.

Many of the problems found in health hazard evaluations are the result of poor maintenance, inadequate ventilation, bad work practices, emphasis on production at the expense of safety, and generally poor housekeeping and facilities that require workers to eat in contaminated areas and take unnecessary risks.

NIOSH usually responds to requests for health hazard evaluations within 2 to 3 weeks. However, industrial hygienists can be mobilized within 48 hours in emergencies, such as the Texas incident in which workers suffered severe nerve damage from exposure to a pesticide called leptophos or as in the mysterious outbreaks of nausea, headaches, and stomach pains among workers at electronics plants in four states. After a health hazard evaluation, NIOSH completes a final report which is then sent to both the employer and the workers in the plant involved, and to OSHA.

Training The Specialists

As new standards are issued and interest in occupational health in general increases, the demand for safety and health specialists will continue to soar. Already there is a shortage. NIOSH estimates that the nation needs 4,000 more industrial hygienists, 4,700 safety professionals, and more than 25,000 nurses. Ironically, while the need increases, the number of training programs has been dropping. It is part of NIOSH's job to help fill the void. For example:

Every year NIOSH offers a variety of courses, lasting from 3 days to 2 weeks, which are attended by some 1,500 people from Federal, state, and local governments, colleges and universities, insurance companies, labor unions, and private industry.

Training grants are awarded to universities, which then offer their own health and safety training programs. For those schools that already have funding, NIOSH offers consultation.

NIOSH extends its training reach by cooperating with such outside groups as the American Industrial Hygiene Association and the American Society of Safety Engineers. NIOSH develops a course package, sometimes complete with equipment needed, and the private groups provide the lecturers who present the training at locations around

the country. By the end of 1977, NIOSH hopes to be offering 10 different courses by such cooperative arrangement.

NIOSH also funds another program designed to improve health and safety training nationwide. One university will be selected in each of NIOSH's 10 regions to serve as a hub for training of physicians, nurses, undergraduate and graduate students, and people already working in the field. NIOSH expects to spend some $1 million on each center, with an eye to establishing it as a permanent source of training and education in occupational safety and health.

Tackling The Thorny Problems

In occupational safety and health, as in any field, certain thorny problems seem to demand special attention and special resources. At NIOSH the focus is currently on the following areas:

Occupational cancer. Of the 600,000 new cancer cases that occur each year in the United States, some 80 to 90 percent are caused by environmental exposures. NIOSH estimates that anywhere from 4 to 25 percent of those may be directly related to the job. Certainly, work exposures increase the cancer risk for people who smoke or who are exposed to carcinogens elsewhere. And as the daily news makes painfully clear, anyone who breathes, eats, or drinks gets a daily dose of carcinogens outside the workplace.

In the 1976 appropriations for NIOSH, Congress earmarked funds for an Occupational Carcinogenesis Program. During the first year of this mini-war on cancer, NIOSH attempted to identify groups of workers who have an unusually high cancer risk and to pinpoint carcinogens that demand top priority in research and standards development.

Studies revealed, for example, a high risk of bladder cancer among leather workers and dairy farmers and genital can-

cers among hairdressers and cosmetologists. Obviously, further investigation is warranted. NIOSH also has been checking into incidences of "cancer clustering" — such as several cases of brain tumors at a steel mill in Wheeling, West Virginia, and pancreatic cancer at a chemical plant in Massachusetts. Industry-wide studies of cancer risk have been launched in the printing, dairy, uranium milling and mining, plywood, pulp, and paper, coal gasification, phosphate fertilizer, aluminum, steel, antimony smelting, beryllium, cadmium smelting, pesticide formulation, and lead smelting industries.

A special carcinogens laboratory, nearing completion in Cincinnati, will make it possible for NIOSH to conduct more animal studies and more research on monitoring carcinogens in the workplace.

NIOSH has compiled a list of high priority chemicals for which it will prepare hazard review documents — junior criteria documents summarizing what is known about health hazards and recommending ways to control worker exposures. These will be distributed widely through trade associations, labor unions, and professional societies.

Nonmalignant respiratory disease. A war on occupational cancer is little comfort to those workers suffering from such other major killers as black lung, brown lung (caused by cotton dust), asbestosis, or silicosis. A former cotton worker who has only one-third of his lung capacity and can barely walk a block is just as tragic a victim of occupational disease as the lung cancer patient.

Many occupational diseases strike the respiratory system. More than 3 million workers are exposed to just a handful of respiratory hazards: asbestos, beryllium, coke oven emissions, cotton dust, silica, sulfur dioxide, sulfuric acid, and toluene diisocyanate. The consequences of long years of failure to control hazards is becoming evident in the coal industry, where black lung disability benefits to miners now

total $1 billion a year and, in the cotton industry, where machinery modifications needed to meet a new standard may cost more than $800 million.

NIOSH has launched a major effort to learn more about the biological effects of noncarcinogenic dusts, fibers, and chemicals and to develop better methods of sampling these substances in the workplace. The focal point for all NIOSH research on nonmalignant respiratory disease are the facilities in Morgantown, West Virginia, which also have responsibility for research and technical assistance for mining health and safety.

Women in the workplace. As more and more women move into a wider variety of jobs, an increasing number of unborn children are also coming to work and are being involuntarily exposed to hazardous chemicals that can cross the mother's womb.

Women now account for 40 percent of the nation's workforce. NIOSH estimates that 1 million of the 16 million working women of childbearing age are exposed to substances that could cause birth defects or miscarriages. Because very few of the 20,000 chemicals commonly found in the workplace have been tested for their effects on the unborn, NIOSH says only about 20 can be linked to birth defects and miscarriages. Some of these chemicals — such as lead, methyl mercury, and benzene — have been known for some time to damage the fetus. More recent studies have implicated such substances as vinyl chloride and the anesthetic gases that escape into the air in hospital operating rooms. Virtually no substances — even the 400 for which OSHA has specific standards — are regulated with the fate of the unborn in mind.

Congress earmarked $1 million in NIOSH's fiscal year 1977 appropriations for the first year of a new program to study the effects of toxic chemicals on the unborn children of women workers. In addition to laboratory animal studies,

NIOSH is studying the incidence of birth defects and miscarriages among women in certain industries, such as the pharmaceutical industry, the electronics industry, and others where such heavy metals as lead and mercury are used. NIOSH also helped sponsor a 3-day Conference on Women and the Workplace, which brought together hundreds of labor, management, scientific, and government experts for the first nationwide meeting on the subject.

The problem of hazards to women workers is especially touchy because it involves the issue of equal employment opportunity. The danger of special requirements for pregnant or fertile women is that they could easily become an excuse for further discrimination against women. Industry nervousness already has resulted in some drastic action. The Lead Industries Association, for example, has recommended against employment of fertile, pregnant, or nursing women in the lead industries "until such time as adequate information has been developed regarding the effect of lead." Such policies can leave working women, many of whom must work to support households, with an incredible choice: their job or their fertility. One Canadian woman already has had herself sterilized so she could keep her job in a General Motors Company lead battery plant.

Often overlooked is the fact that reproductive hazards are not restricted to women. At least 14 of the men poisoned by the pesticide kepone are now sterile. Lead has been linked to sexual impotence in men and can alter production of sperm. Recent NIOSH studies have revealed higher rates of miscarriages and birth defects among wives of men exposed to vinyl chloride and anesthetic gases.

So, while the subject is often referred to as "women in the workplace," the real issue is occupational hazards to the reproductive systems of both men and women. Attention to these hazards could produce some far-reaching results in the area of occupational health.

New energy technology. New technology usually means new hazards, and the search for alternative energy sources is no exception. In 1976, NIOSH and the Environmental Protection Agency signed a 5-year, multi-million dollar agreement for research on health problems that may affect workers who use, extract, or process new energy materials. The agreement is part of a massive research effort in which 16 government agencies will spend about $78 million to determine the health and environmental effects of new energy uses and technology.

NIOSH is particularly concerned about the increased use of coal and the way this affects workers in coal-fired power plants, in coal gasification and liquefaction plants, and even in coal mines.

Coal gasification and liquefaction are methods for converting coal with a high sulfur content into a cleaner burning synthetic gas or liquid, but more needs to be known about the health hazards these processes create. NIOSH is studying records of workers at a coal liquefaction plant in Institute, West Virginia, to determine if any unusual health problems are showing up. Other research is focusing on:

Oil shale workers. Some studies indicate that oil shale can cause skin cancer.

Divers. As the need for oil increases, offshore drilling will increase. Divers, of course, are the critical link between the surface and the undersea oil. NIOSH has been studying the effects of long-term exposure to changing pressures, which, in addition to causing bone disease, may be linked to nerve damage and cardiovascular disease.

Coal-fired steam generating plant workers. In cooperation with the Tennessee Valley Authority, NIOSH will study causes of death among these workers who are exposed to such hazards as sulfuric acid mist, coal dust, hydrocarbons, sulfates, asbestos, and carbon monoxide.

Increasing use of diesel-powered equipment in coal mines. Use of diesel equipment exposes miners to hydrocarbons that are irritants and possible carcinogens. Scientists also worry about the health hazards posed by interaction between diesel fumes and coal dust.

NIOSH also plans to study the health effects of certain energy conservation measures — for example, recirculation of air within workplaces to eliminate constant heating or cooling of air brought in from outside, and the growing emphasis on building insulation that means more workers will be exposed to mineral wool, rock wool, fibrous glass, and asbestos while manufacturing and installing insulation materials.

Control technology. Obviously, the key to preventing the hundreds of thousands of job-related deaths and illnesses each year is eliminating exposures to hazardous substances in the workplace. And that means controls — at best, engineering controls that enclose dangerous processes or, as a last resort until adequate engineering control is installed, use of properly designed respirators and other personal protective equipment to protect workers from contact with hazardous substances. Determining what controls are possible with our present engineering knowledge is called technology assessment.

As part of a major emphasis on control technology assessment, NIOSH is studying in detail three or four industries each year. Currently on the agenda are the non-ferrous smelting industry, the foundry industry (in connection with OSHA's National Emphasis Program to reduce injuries and illnesses in foundries), the plastics and resins industry, and the textile finishing industry.

An assessment has several steps. First, NIOSH scans the literature to identify the special hazards and problem areas within an industry and to find out what controls are available. Then the plant visits are made to see controls in operation. Here the emphasis is on the positive. NIOSH tries to emphasize that controls are feasible by pointing out companies that are successfully controlling hazards. The experts also check to see that adequate personal protective equipment is available to back up developing engineering controls. As an adjunct to these field studies, NIOSH sets up laboratory models of some industrial processes to test control methods and hopefully develop some new ones. Next, NIOSH writes a report on engineering controls that are available, including examples of how they are being used. These reports are distributed to the public, university libraries, major trade associations, and labor unions.

Much of what NIOSH learns in these technology assessments also will find its way into criteria documents and into health and safety guides.

Safety. Job-related accidents, as well as diseases, pose a major threat to the health of American workers.

In an effort to lower the number of accidents, NIOSH has reorganized all its safety research into a new Safety Research Division headquartered at Morgantown, West Virginia. In its future studies, NIOSH will take a "systems approach" to safety — that is, looking at safety not just as an engineering problem but as an area that also involves environmental factors, management attitudes, and worker behavior.

In analyzing and trying to find ways to eliminate injury-producing hazards, researchers are studying both high risk industries — such as caisson and tunnel workers and oil and gas extraction — and high risk jobs that can be found in a number of industries. Besides using the results of safety

research as a basis for recommending standards, NIOSH plans to present its findings in training courses for management and labor in selected industries.

A related activity is the Institute's personal protective equipment testing and certification effort in Morgantown. In this program, researchers are checking equipment advertised by manufacturers as meeting OSHA standards. Included have been hard hats, safety shoes, glass goggles, welding filter plates, respirators, and linemen's rubber gloves. The results are not reassuring: 20 of 21 models of one type of hard hat were substandard in one or more ways; one-third of the safety shoes were deficient; one-half of the glass goggles failed the impact test; more than three-fourths of the welding filter plates did not meet one or more of the standards; and although there is no current standard, many of the respirators did not fit the face.

This research makes it quite apparent that many workers who feel that they have some degree of protection from such equipment are in fact just getting a false sense of security.

Unresolved Issues

The Occupational Safety and Health Act of 1970, is one of the truly great landmark pieces of social legislation in the history of the country. But as with any social law, there are still problems that need to be resolved. A few of them are:

- Given the boundaries of scientific knowledge, can a community of mutual respect be built among industry, labor, and government so that any adversary proceedings develop in ways that truly serve the public interest? Somehow substantive issues must be isolated and focused upon. We may have the legal manpower to get involved in trivial issues, but we certainly do not have the technical manpower.

• What will the risk philosophy be when we are confronted with the need to regulate several hundred carcinogens in the workplace? Can we continue to say there is no safe dose for an industrial carcinogen? Can we afford to take a dose-response approach to single carcinogens without considering the aggregate effect of low-level doses to many carcinogens? How can adverse effects on the reproductive system be controlled? We have been caught off balance as women of child bearing age enter a variety of new work situations. Large numbers of unborn children are coming to work. This poses difficult scientific, moral, and regulatory problems and some of the same issues related to carcinogens also apply here.

• Will we be able to regulate occupational and environmental exposures on an industry-wide basis rather than on an individual agent basis? In the long run, an industry by industry approach has a greater utility. Can we avoid regulating the wrong problems?

• Will we recognize the long-term implications of new industrial facilities? The new plant of 1978 may contribute to chronic disease among our grandchildren in the 21st century because of long plant life and extended latency periods. Would it not be more appropriate to find mechanisms that stimulate the development and deployment of safer, contained industrial processes?

The goal of assuring safe and healthful workplaces is broader than the mission of any single Federal agency and any single piece of legislation.

In the final analysis, it will not be research, scientific information, or enforcement for that matter, that will make the difference in truly controlling hazards. What will make the difference in the long run is a cooperative attitude by both industry and labor in working to achieve this goal.

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