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*REPORT TO THE
COMMITTEE ON LABOR
AND PUBLIC WELFARE
UNITED STATES SENATE*

Slow Progress Likely
In Development Of Standards
For Toxic Substances And
Harmful Physical Agents
Found In Workplaces

B-163375

Department of Health, Education,
and Welfare

Department of Labor

*BY THE COMPTROLLER GENERAL
OF THE UNITED STATES*

~~713696~~ **093402**

SEPT 28, 1973



COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D C 20548

B-163375

The Honorable Harrison A. Williams, Jr.
Chairman, Committee on Labor and Public Welfare
United States Senate

Dear Mr. Chairman

This is the second of a series of reports in response to your letter of June 22, 1972, requesting us to review selected activities being carried out under the Occupational Safety and Health Act of 1970 by the Occupational Safety and Health Administration, Department of Labor, and the National Institute for Occupational Safety and Health, Department of Health, Education, and Welfare. This report concerns the problems and progress of the Institute in developing and recommending health and safety standards to the Secretary of Labor for toxic substances and harmful physical agents in various occupational environments.

Because of the Institute's slow progress, we recommend that the Secretary of Health, Education, and Welfare consider the adequacy of the Institute's resources to effectively carry out its responsibilities under the act.

We are also recommending that your Committee should consider asking the Congress to amend the act to allow the Secretary of Labor more than the 6 months now specified in the act to promulgate a permanent standard after issuing an emergency temporary standard.

As requested by your office, the Departments of Health, Education, and Welfare and Labor have not been given an opportunity to formally examine and comment on the report

We did discuss the contents with officials of these Departments and incorporated their views where appropriate.

Copies of this report are being sent to the Director, Office of Management and Budget, the Secretary of Health, Education, and Welfare, and the Secretary of Labor.

This report would be of interest to committees, other Members of Congress, and agency officials. Therefore, as you agreed, we are distributing copies of this report.

Sincerely yours,

A handwritten signature in black ink, appearing to read "James B. Stacks". The signature is written in a cursive style with a large, prominent initial "J".

Comptroller General
of the United States

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ABBREVIATIONS

GAO	General Accounting Office
HEW	Department of Health, Education, and Welfare
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PHS	Public Health Service

COMPTROLLER GENERAL'S
REPORT TO THE COMMITTEE
ON LABOR AND PUBLIC WELFARE
UNITED STATES SENATE

1000 1 11 27 08
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HARMFUL PHYSICAL AGENTS
FOUND IN WORKPLACES
Department of Health, Education, and
Welfare
Department of Labor B-163375

D I G E S T

WHY THE REVIEW WAS MADE

This is the second in a series of reports requested by the Committee Chairman on the administration of the Occupational Safety and Health Act of 1970.

This report concerns the problems and the progress of the Department of Health, Education, and Welfare (HEW) in developing and recommending health and safety standards to the Secretary of Labor for toxic substances¹ and harmful physical agents² in various occupational environments

BACKGROUND

As agreed with the Committee, GAO discussed matters in this report informally with Department of Labor and HEW officials. Their views are included.

One of HEW's responsibilities under the act is developing health and safety standards for toxic substances and harmful physical agents. HEW develops data for the standards primarily by conducting research relevant to occupational safety and health. These and other responsibilities are carried out within HEW by the National Institute for Occupational Safety and Health. The Institute began operations on June 30, 1971.

Although the Institute recommends standards for toxic substances and harmful physical agents, the Secretary of Labor is responsible for considering the standards, obtaining the views of interested parties, publishing them, and enforcing compliance by workplace inspections.

FINDINGS AND CONCLUSIONS

The health of millions of American

¹A "toxic substance" is one which demonstrates the potential to induce cancer, to produce long-term disease or bodily injury, to affect health adversely, to produce acute discomfort, or to endanger the life of man or animals through exposure via the respiratory tract, skin, eye, mouth, or other routes

²A "harmful physical agent" is a source of energy--noise, heat, ultraviolet light, etc.--which demonstrates the potential to cause any of the adverse effects in footnote 1.

workers may depend on how well and how fast the Institute develops recommended standards for using dangerous or toxic substances and harmful physical agents in workplaces. In attempting to do so the Institute faces formidable tasks.

About 400 substances and physical agents are covered by national consensus standards or established Federal standards promulgated under the act. However, Institute officials stated some of these standards are based on incomplete or questionable data. (See p. 17.)

The Institute's 1971 annual list of toxic substances contained about 8,000 items, some duplicative. The 1972 list contained about 13,000 items, again with some duplication. Institute officials estimate there are about 25,000 toxic substances--to which American workers may be exposed--which need to be identified (See p. 18)

Once its list of existing toxic substances is completed, the Institute must determine

--the toxicity of new substances which are being introduced into industrial use at the rate of 500 to 600 annually and

--relatively harmless substances which may become toxic when combined or used with other relatively harmless substances. (See p 18.)

Institute officials and faculties from universities' departments of occupational medicine estimate that from 1,000 to 2,000 substances and agents could have serious harmful effects on large numbers of workers and require comprehensive permanent standards.

The Institute has developed a priority list of 113 toxic substances and harmful physical agents and has identified another 417 substances and agents which may be added to this list. It is working to obtain data and develop methods for improving the assignment of priorities. (See pp. 19 to 22.)

The act requires the Secretary of HEW to determine--upon request of any employer or employees' representative--the toxicity of substances in a workplace. The Institute received 95 valid requests from August 1971 to January 1973, however, it has made determinations and prepared final reports for only 27 of the requests as of January 1973. (See p. 22.)

Developing comprehensive standards to be recommended to the Secretary of Labor for each substance and agent is a large task.

All literature describing research and findings on the substance or agent must be located and evaluated, and needs for additional research must be identified. Once all research is completed--which might take 3 to 5 years or more--and a draft recommended standard is prepared, it is widely reviewed. Institute officials expect that about 12 to 14 months will generally be required from completing research to recommending a standard to the Secretary of Labor. (See pp 24 to 26.)

The Institute has been hindered in developing recommended standards by HEW restrictions on hiring professional staff and maintaining a high average grade level.

Due to the magnitude of its task and limited funding, plus the HEW restrictions on staffing, the Institute has progressed slowly in developing

and recommending comprehensive standards. From June 30, 1971, through March 31, 1973, the Institute has developed and forwarded only six comprehensive standards.¹ (See p. 45.)

Its officials estimate that, beginning in fiscal year 1974, they will be able to produce only 20 to 30 comprehensive recommended standards and work-practices recommendations per year for the 1,000 to 2,000 substances and agents requiring standards. But since the Institute has had staffing and funding problems, it may not be able to fulfill these estimates by 1974. (See p. 45.)

A work-practices recommendation has all the components of a comprehensive recommended standard, including labeling and placarding, except for the environmental limits based on dose-effect information. This recommendation contains less information than the comprehensive recommended standard but recommends work practices (operating procedures) to protect workers' health.

The act requires that the Secretary of Labor establish an emergency temporary standard if he determines that employees are in grave danger from exposure to substances or agents determined to be toxic or physically harmful and an emergency standard is necessary to protect employees from such danger.

An emergency temporary standard takes effect immediately upon publication in the Federal Register and remains effective until superseded

by a permanent standard which must be established within 6 months after publication of the emergency temporary standard.

Only three emergency temporary standards--for asbestos, organophosphorus pesticides, and 14 carcinogens--have been issued so far by the Secretary. The emergency standard for asbestos was issued in December 1971 and the Institute was able to meet the 6-month timetable for a comprehensive permanent standard because HEW had researched asbestos.

In most cases HEW had not researched new substances and physical agents suspected of being harmful to employees. The other two emergency temporary standards for pesticides and carcinogens were issued in May 1973. (See p. 58.)

Institute officials also informed GAO that the Institute's planned annual output of 20 to 30 comprehensive recommended standards and work-practices recommendations is contingent upon obtaining some relief from current personnel and grade point restrictions and increased funding. (See p. 61.)

To speed progress, the Institute reprogramed about \$600,000 in fiscal year 1973 from other important functions--particularly research--to documentation of comprehensive standards. In the long term, however, the Institute believes this lost research time will inevitably decrease the annual rate of recommended standards developed.

¹The Institute has subsequently submitted comprehensive recommended standards to the Occupational Safety and Health Administration for four additional toxic substances

Institute officials said the issuance of an emergency temporary standard by the Secretary of Labor does not necessarily commit the Institute to developing a criteria document and, therefore, does not necessarily obligate the Institute to meet the 6-month timetable for a comprehensive permanent standard.

The officials advised GAO, however, that more than 6 months may be needed for developing a comprehensive permanent standard and this would allow the Institute to make a more meaningful contribution to the standards-setting process. (See p. 59.)

If the use of emergency standards is to be optimized, the Institute will need more time to develop the recommendations for the permanent standards. Also, more time would allow the Secretary of Labor to await the recommendation of the Institute on a comprehensive permanent standard, evaluate the recommendation, and

more thoroughly consider opposing points of view before promulgating the permanent standard (See p. 62.)

RECOMMENDATION

Because of the Institute's slow progress in developing and recommending comprehensive standards and work-practices standards for toxic substances and harmful physical agents, HEW should consider the adequacy of the Institute's resources to effectively carry out its responsibilities under the act. (See p. 62.)

MATTER FOR CONSIDERATION
BY THE COMMITTEE

The Committee should consider asking the Congress to amend the act to allow the Secretary of Labor more time to promulgate a permanent standard after issuing an emergency temporary standard. (See p 62)

CHAPTER 1

INTRODUCTION

Occupational safety and health has concerned us for a long time. Since 1961 the Department of Labor injury frequency rate for manufacturing industries (i e., the number of disabling injuries per million employee-hours worked) has risen from 11.8 to 15.2 in 1970, the last year for which data is available, an increase of nearly 29 percent in 10 years.

Of the 83 million employed persons in today's civilian labor force, the National Safety Council estimates that more than 14,000 are killed and 2.2 million suffer disabling injuries each year because of accidents on the job. There are no reliable figures on the number of employees who suffer minor, nondisabling injuries or become ill after being exposed to hazardous conditions. Research on such substances as asbestos and cotton dust is continuing to reveal how toxic some commonly used materials can be.

The 83 million American employed men and women spend almost 25 percent of their time in the workplace. The deterioration in health quality which occurs as a result of exposure to hazards in the workplace and the incidence of occupational disease are not well known. Recent HEW estimates, however, indicated that

--over 390,000 new cases of disabling occupational disease occur each year and

--as many as 8,000 die each year from occupationally caused disease.

Occupation-related health deterioration results from hazards ranging from such acute diseases as lead and mercury poisoning to the insidious, delayed effect of noise that causes partial or total hearing loss and to dusts that produce fibrosis (scarring) in the lungs.

Further, exposure to some toxic substances may cause, promote, or contribute to the development of cancer, hasten the onset of other disease, or otherwise shorten the lifespan.

THE OCCUPATIONAL SAFETY AND
HEALTH ACT OF 1970

A growing awareness of the scope of the problems involved with occupational safety and health and increased concern for the environment helped create support for the Williams-Steiger Occupational Safety and Health Act of 1970 (29 U S C. 651), which the President signed on December 29, 1970, and became effective April 28, 1971.

The Congress, in enacting the act in December 1970, declared its intent to " * * * assure so far as possible every working man and woman in the Nation safe and healthful working conditions * * *."

This statute covers about three-fourths of the civilian labor force, or almost 60 million employees in about 5 million establishments. It also covers about 3 million Federal civilian employees.

The Secretaries of Labor and Health, Education, and Welfare were each given certain responsibilities under the act. To carry out these responsibilities the Occupational Safety and Health Administration (OSHA), Department of Labor, and the National Institute for Occupational Safety and Health (NIOSH), Department of Health, Education, and Welfare (HEW), were established on April 28, 1971. NIOSH, however, did not begin operations until June 30, 1971.

This is our second report¹ on the administration of the act and it is primarily directed toward NIOSH's responsibility for developing recommended occupational safety and health standards.

HISTORICAL PERSPECTIVE

Federal concern with occupational health in this country dates back to 1914 when the Office of Industrial Hygiene

¹The first report was "More Concerted Effort Needed by the Federal Government on Occupational Safety and Health Programs for Federal Employees" (B-163375, Mar. 15, 1973)

and Sanitation was established in the Scientific Research Division of the Public Health Service (PHS) During the next two decades, this Office engaged primarily in research, both in the field and in the laboratory Studies involving granite, pottery, cement, cotton, textile, and mining industries were conducted during this period.

Reorganizations of PHS in 1937 combined the Office of Industrial Hygiene and Sanitation and the Office of Dermatitis Investigations into the Division of Industrial Hygiene. This Division was placed in the National Institutes of Health in 1939. In 1953 HEW was established, and the Division of Industrial Hygiene became the Occupational Health Program in HEW The Occupational Health Program was designated in 1968 as the Bureau of Occupational Safety and Health In 1969 the Bureau began to carry out HEW's responsibilities (except for black lung benefits) under the Federal Coal Mine Health and Safety Act of 1969 When the Occupational Safety and Health Act of 1970 became law, HEW reorganized the Bureau as NIOSH within the Health Services and Mental Health Administration A reorganization effective July 1, 1973, transferred NIOSH to the Center for Disease Control of HEW, Atlanta.

NIOSH RESPONSIBILITIES

NIOSH, established by section 22 of the Occupational Safety and Health Act, is responsible for performing the functions of the Secretary of HEW in sections 20 and 21, namely

- conducting (directly or by grants or contracts) research, experiments, and demonstrations relating to occupational safety and health, including studies of psychological factors involved, and relating to innovative methods, techniques, and approaches for dealing with occupational safety and health problems,
- collecting and analyzing records and statistics on occupational safety and health necessary to recommend new or improved mandatory occupational safety and health standards to the Department of Labor,

- conducting (in-house as well as through grants and contracts) special research, experiments, and demonstrations relating to occupational safety and health as are necessary to explore new problems, including those created by new technology in occupational safety and health, which may require ameliorative action beyond that which is otherwise provided in the operating provisions of this act;
- conducting research into the motivational and behavioral factors relating to the field of occupational safety and health,
- making toxicity (poisonous quality) determinations on request by employers or employee groups;
- establishing research programs of medical examinations and tests that may be necessary for determining the incidence of occupational illnesses and the susceptibility of employees to such illnesses,
- publishing an annual listing of all known toxic substances and the concentrations at which toxicity is known to occur,
- conducting directly or through grants and contracts educational and training programs aimed at providing an adequate supply of qualified personnel to carry out the purposes of the act;
- conducting and publishing industrywide studies of 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;
- developing informational programs concerning the importance and proper use of adequate safety and health equipment;
- developing specific plans for such research, demonstrations, and experiments as are necessary to produce criteria, including criteria identifying toxic substances, and on the basis of such research, demonstrations, and experiments and any other available

information, developing and publishing at least annually such criteria; and

- developing criteria dealing with toxic substances and harmful physical agents which will describe exposure levels safe for various periods of employment, including but not limited to the exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work and furnishing the Department of Labor with recommended standards for toxic substances and harmful physical agents.

According to NIOSH officials, a "toxic substance" is one which demonstrates the potential to induce cancer, to produce long-term disease or bodily injury, to affect health adversely, to produce acute discomfort; or to endanger the life of man or animals through exposure via the respiratory tract, skin, eye, mouth, or other routes

NIOSH officials define a "harmful physical agent" as a source of energy--noise, heat, ultraviolet light, etc.--which demonstrates the potential to cause any of the above adverse effects.

RESPONSIBILITIES FOR SETTING STANDARDS

Although NIOSH must conduct the research necessary for developing recommended standards for toxic substances and harmful physical agents, the Secretary of Labor must promulgate the standards. Section 6 of the act authorizes him to promulgate three types of occupational safety and health standards.

- Emergency temporary standards.
- Established Federal standards and national consensus standards.
- Comprehensive permanent standards.

Emergency temporary standards

Section 6(c) requires that the Secretary establish an emergency temporary standard if he determines that

- employees are in grave danger from exposure to substances or agents determined to be toxic or physically harmful and
- an emergency standard is necessary to protect employees from such danger.

An emergency temporary standard takes effect immediately upon publication in the Federal Register and remains effective until superseded by a permanent standard, which must be established within 6 months after publication of the emergency temporary standard.

National consensus standards and established Federal standards

A "national consensus standard" is any occupational safety and health standard which has been (1) adopted by a nationally recognized standards-producing organization, (2) formulated in a manner which afforded an opportunity for diverse views to be considered, and (3) designated as such a standard by the Secretary of Labor after consultation with other appropriate Federal agencies.

An "established Federal standard" is any operative occupational safety and health standard contained in a previous act or established by a Federal agency.

Comprehensive permanent standards

Under the act NIOSH develops and recommends occupational safety and health standards for using toxic substances and harmful physical agents. Such recommended standards are to be developed to enable the Secretary of Labor to meet his responsibilities for promulgating comprehensive permanent standards under the act.

The act requires that comprehensive standards for toxic substances or harmful physical agents include, where appropriate, provisions for

- labeling or other forms of warning necessary to insure that employees are informed of all hazards to which they are exposed,
- relevant symptoms and emergency treatment,
- proper conditions and precautions of safe use and exposure,
- suitable personal protective equipment,
- environmental control procedures,
- monitoring or measuring employee exposure, and
- clinical tests and medical examinations

OSHA RESPONSIBILITIES

The Secretary of Labor was given responsibility for administration of the Occupational Safety and Health Act. He delegated this responsibility to the Assistant Secretary of Labor for Occupational Safety and Health, a position authorized under the act, by creating OSHA on April 28, 1971. OSHA is a decentralized organization with two-thirds of its manpower in 10 regional offices, 49 area offices, and 2 maritime district offices, in major cities across the Nation.

OSHA has responsibility

- To promulgate, modify, and improve mandatory occupational safety and health standards.
- To enforce the act--with authority to enter factories and other workplace areas to inspect and investigate working conditions, equipment, and materials--and to issue citations and impose penalties.
- To prescribe regulations requiring employers to maintain accurate records and reports concerning work-related injury, illness and death, and employee exposure to potentially toxic substances or other such records as considered appropriate, in cooperation with HEW.
- To develop and maintain a system of collecting, compiling, and analyzing occupational safety and health statistics, in consultation with HEW.
- To establish and supervise programs for educating and training employees and employers in recognizing, avoiding, and preventing unsafe or unhealthful working conditions covered by the act, in consultation with HEW.
- To make grants to States to assist in identifying their needs for developing plans and to enforce the administration of the Federal occupational safety and health standards or equivalent State standards.

FUNDING

The total NIOSH budget for occupational safety and health activities is composed of appropriations authorized under the Public Health Service Act, the Federal Coal Mine Health and Safety Act of 1969, and the Occupational Safety and Health Act of 1970. The following table shows (1) expenditures for these occupational safety and health activities of NIOSH for fiscal years 1971 and 1972, (2) estimated expenditures for fiscal year 1973, (3) the amount requested for fiscal year 1974, and (4) expenditures for its predecessor for fiscal years 1965-70.

<u>Fiscal Year</u>	<u>Public Health Service Act</u>	<u>Occupational Safety and Health Act</u>	<u>Federal Coal Mine Health and Safety Act</u>	<u>Total</u>
(millions)				
1974	\$0.1	\$21.1	\$5.6	\$26.8
1973	0.1	20.3	5.3	25.7
1972	0.2	19.4	6.1	25.7
1971	0.5	12.0	5.2	17.7
1970	7.6		2.8	10.4
1969	7.5			7.5
1968	7.9			7.9
1967	6.8			6.8
1966	5.8			5.8
1965	5.2			5.2

BEST DOCUMENT AVAILABLE

The schedule below shows the NIOSH expenditures by activity for fiscal year 1972, estimated expenditures for fiscal year 1973, and the proposed budget for fiscal year 1974.

	<u>1972</u>	<u>Percent</u>	<u>1973</u>	<u>Percent</u>	<u>1974</u>	<u>Percent</u>
	(000 omitted)		(000 omitted)		(000 omitted)	
1 Surveillance	\$ 1,128	4	\$ 1,297	5	\$ 1,474	6
2 Criteria documentation	918	4	1,737	7	2,649	10
3 Industrywide studies	2,569	10	3,108	12	3,641	14
4 Laboratory research and services	8,490	33	8,442	33	9,004	35
5 Federal Coal Mine Health and Safety Act research	6,138	24	5,317	21	5,561	21
6 Technical assistance	2,704	11	2,599	10	2,671	10
7 Manpower development	2,919	11	1,900	7	600	2
8 Program direction	843	3	1,270	5	1,204	4
Total	\$25,709	100	\$25,670	100	\$26,804	100

To carry out its responsibilities under the Occupational Safety and Health Act of 1970, OSHA received \$15.1 million in fiscal year 1971, \$36.4 million in fiscal year 1972, and \$68.7 million in fiscal year 1973. OSHA has requested \$69.8 million for fiscal year 1974.

CHAPTER 2

MAGNITUDE OF THE TASK

NIOSH's research programs to protect American workers from health and safety hazards must consider a complex array of millions of workers distributed over millions of workplaces and engaged in thousands of activities. These programs must include, as one of their most important management and scientific tools, accurate descriptions and analyses of the population they are to protect and the conditions they must control.

Basic questions to be answered by NIOSH's research include

- When and where are people becoming ill or injured?
- How many people are becoming ill or injured?
- What causes the illness or injury?
- How many people are exposed to what hazards?
- Where and in what industries are they located?
- What industries have health and/or safety programs?
- What dose-response relationships need to be developed between the chemical or physical agent and the exposed workers?
- What is the mechanism for toxic action?
- What procedures and equipment need to be developed and tested for the evaluation of the environment?
- What engineering and medical control procedures need to be developed for worker protection?
- Are these programs effective?

This information must be available if Government and private programs are to direct their efforts effectively

The health of large numbers of American workers may be dependent on how well and how fast NIOSH develops recommended standards for using toxic substances and harmful physical agents in workplaces. But NIOSH faces some formidable tasks in fulfilling its responsibilities under the act, including

- Completing work on existing standards. About 400 toxic substances and harmful physical agents are covered by national consensus standards or established Federal standards promulgated under the act, however, NIOSH officials stated that some of these standards are based on incomplete data
- Identifying toxic substances. NIOSH officials estimate American workers may be exposed to about 25,000 toxic substances.
- Identifying and evaluating new toxic substances. NIOSH said, eventually, it will also have to evaluate the toxicity of the 500 to 600 new substances introduced into workplaces each year
- Establishing priorities. The Director of NIOSH and faculties from universities' departments of occupational medicine estimate that the potential harmful effects of 1,000 to 2,000 of the toxic substances and agents are significant enough to currently require Federal standards.
- Making health hazard evaluations NIOSH received 95 valid requests for health hazard evaluations from August 1971 to January 1973. As of January 1973, NIOSH had made determinations and prepared final reports for 27 of these requests, had drafted 11 additional health hazard evaluations, and was investigating most of the remainder.
- Developing and submitting to OSHA comprehensive recommended standards and work-practices¹ recommendations for toxic substances and harmful physical agents

¹A work-practices recommendation has all the components of a comprehensive recommended standard, including labeling and placarding, except for the environmental limits based on dose-effect information. This recommendation contains less information than the comprehensive recommended standard but recommends work practices (operating procedures) to protect workers' health.

These tasks and the status of NIOSH efforts on the tasks are discussed below.

NEED TO COMPLETE WORK ON EXISTING STANDARDS

One of the many tasks facing NIOSH is the need to complete work on the existing established Federal and national consensus standards already promulgated by the Secretary of Labor.

Section 6 authorizes him to establish, promulgate, and enforce mandatory occupational safety and health standards to insure safe and healthful working conditions.

After the act became effective on April 28, 1971, one of OSHA's first tasks was to develop and publish occupational safety and health standards. OSHA promulgated the occupational safety and health standards in the May 29, 1971, Federal Register. The adopted standards included many previously established Federal and national consensus standards.

The standards incorporated (1) construction standards first promulgated on April 17, 1971, under the Contract Work Hours and Safety Standards Act (40 U.S.C. 333 et seq.), (2) maritime standards which first became effective on March 21, 1960, under the Longshoremen's and Harbor Workers' Compensation Act (33 U.S.C. 941 et seq.), (3) general industry and agriculture standards which were basically national consensus standards developed by the American National Standards Institute and by the National Fire Protection Association, and (4) established Federal standards from the Walsh-Healy Act (41 U.S.C. 35 et seq.)

The above publication set standards for approximately 400 toxic substances and harmful physical agents included in items (3) and (4) above. However, NIOSH officials stated that some of these standards are based on incomplete or questionable data. Most of these standards are based on an 8-hour time-weighted average, although some specify the maximum allowable concentration (or ceiling value) to which workers may be exposed. They do not contain other elements of a comprehensive standard, such as symptoms of overexposure, emergency treatment, and environmental control procedures.

NIOSH officials believe that the existence of this type of a standard for a particular substance or agent should not affect the priority given to research necessary to develop and recommend a comprehensive permanent standard for that substance. They point out that most of these standards are based on informed opinions rather than on critical analysis or reasonably complete scientific research.

IDENTIFYING TOXIC SUBSTANCES

The act requires that the Secretary of HEW publish within 6 months of enactment, and at least annually thereafter, a list of all known toxic substances. NIOSH fulfilled the initial requirement by publishing "Toxic Substances--Annual List 1971" which included about 8,000 substances. NIOSH officials informed us, however, that this list included many synonyms and some duplications. NIOSH's 1972 list included over 13,000 toxic substances, of which an estimated 3,000 to 4,000 were synonyms or duplications, according to the Chief of NIOSH's Toxicity and Research Analysis Branch. This official informed us also that much research will be needed to eliminate synonyms and duplications on future lists.

However, NIOSH officials advised that the use of some synonyms will continue in the list so that a particular substance can be located under several commonly used names.

More significant, however, was the NIOSH official's estimate that the annual list will eventually include over 25,000 toxic substances (excluding synonyms and duplications). Furthermore, once this list is completed, NIOSH must determine the toxicity of (1) new substances which are introduced into industrial use at the rate of 500 to 600 annually and (2) relatively harmless substances which may become toxic when combined or used with other relatively harmless substances

The Director of NIOSH and faculties from universities' departments of occupational medicine estimate that comprehensive standards for 1,000 to 2,000 of the estimated 25,000 existing toxic substances and harmful physical agents need to be developed and recommended. The Director informed us that this estimate is based on the relative insignificance of most of the substances in terms of their toxicity, the number of persons exposed, and the quantities used.

ESTABLISHING PRIORITIES

To allocate its limited resources, NIOSH has developed a priority listing of toxic substances and physical agents

Initially, priorities for recommended standards were based in part on a priority system developed by the staff of NIOSH's predecessor organization in anticipation of increased occupational health activities. This system assigned five indexes to each substance or physical agent. These indexes, rated on a scale of 9 to 1 by the Washington staff and field industrial hygienists, consisted of

- a population index of workers exposed,
- a relative toxicity index comparing a substance which can produce mild transient effects to a substance which produces permanent disability,
- an incidence index showing the number of employees affected from exposure to the substance or hazard,
- a quantity index indicating (1) the amount of a substance produced annually or (2) the number of sources of physical agents, and
- a trend index estimating expected future usage

The 5 indexes were used to establish a numerical rating for approximately 100 toxic substances and harmful physical agents which had been identified to be among the more severe occupational health problems.

NIOSH officials began to revise this list in 1971 by applying the most recent exposure data available from NIOSH's Office of Health Surveillance and Biometrics. This data was obtained through an occupational health survey of the Chicago metropolitan area sponsored by the predecessor organization beginning in 1968.

The surveyors cataloged hazards observed in the work environments during walk-through inspections. The data obtained from these inspections indicated the number of employees whose health may have been endangered by exposure to various substances and physical agents. The survey

identified the top 10 potential hazards based on the number of workers exposed

NIOSH was also able to use this exposure data as the basis for adding various substances to arrive at a proposed 1972 priority list. The revised list was then distributed to occupational health experts representing trade unions, trade associations, universities, and other governmental agencies for review, evaluation, and comment. NIOSH officials reviewed the comments and revised the list. The list was finally coordinated with the National Advisory Committee on Occupational Safety and Health and Labor's Occupational Safety and Health Administration.

NIOSH's official 1972 priority list for 113 toxic substances and harmful physical agents (see app. I) was divided into 3 main groups. The first group included a list of toxic substances and physical agents for which a criteria package had been developed at that time. The second group included those substances and physical agents for which the NIOSH Office of Research and Standards Development had initiated, or was completing, some aspect of the criteria development mechanism. The third group presented 19 groups of 5 toxic substances and physical agents each arranged by order of priority. NIOSH officials did not attempt to evaluate the priority of the elements within each group. The substances and physical agents within each group of five are considered as having equal priority.

In addition, 417 substances and physical agents appear as an appendix to the official priority list. These substances were identified during 1972 by various NIOSH mechanisms, such as (1) hazard evaluations requested by employers or employees, (2) State surveys of exposure to toxic substances and harmful physical agents, and (3) research performed by occupational health experts. These substances have not undergone NIOSH's full-priority analysis and are not presented in an order that represents their priority for investigation. The analyses on these items and others will be reflected in a 1973 priority list.

Additional data being gathered for refining and updating priorities

As described above, the current priority rating was based in part on data obtained from a survey of plants in

the Chicago metropolitan area and not from data applicable to the United States in general. No adequate information exists which reflects a truly representative cross-section of in-plant environmental conditions across the country. For this reason, NIOSH began a 2-year survey in January 1972 to acquire basic descriptive information on the working environment in all nonfarm industries covered by the act. To accomplish this task, NIOSH has a team of 20 specially trained engineers surveying a sample of about 5,600 plants.

Each plant survey consists of a brief interview with plant management and a walk-through inspection of the plant premises. The teams are trained to observe and classify exposures to chemicals and physical agents, placing primary emphasis on the more subtle and difficult to recognize potential health hazards. Exposures enumerated in the survey are potential and/or observed exposures; but since measurements are not taken, except in the case of noise, it is not possible to assess the actual degree of risk that the exposed employee incurs. As the data is collected, it is sent to NIOSH headquarters for transcribing and computer processing

NIOSH believes that once completed, the survey will provide NIOSH with a description of the in-plant environmental conditions of the working population. The primary type of information which will be made available consists of (1) the type of substances or physical agents workers are exposed to tabulated by industry type, (2) the occupations of exposed employees, and (3) the form of the exposure.

NIOSH expects the data obtained from this survey to be invaluable in refining and updating the priority listing. By using the survey data, NIOSH will be able to more accurately quantify two indexes--population and quantity used--used in computing the priority ratings. As a result, NIOSH hopes to be able to establish more meaningful priorities than those previously established largely on the basis of opinions of occupational health experts.

Long-range plan for identifying and determining priorities

As new information regarding toxic substances and physical agents becomes available, NIOSH officials expect to continue to revise and extend the priority list. In

this regard, data to be obtained from NIOSH industrial hygiene surveys in cooperation with State agencies will be of particular importance, according to the Acting Director of NIOSH's Office of Health Surveillance and Biometrics.

NIOSH also hopes that research to be conducted by experts in the Federal, State, and private sectors of occupational health will serve as a continuing source of information on which NIOSH can base decisions to expand, refine, and revise its priority list in the future.

PROGRESS IN MAKING HEALTH HAZARD EVALUATIONS

NIOSH had made determinations and prepared final reports for 27 of 95 health hazard evaluation requests received as of January 1973.

Section 20(a)(6) of the act states in part that the Secretary of HEW shall:

"* * * determine following a written request by any employer or authorized representative of employees, specifying with reasonable particularity the grounds on which the request is made, whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found, and shall submit such determination both to employers and affected employees as soon as possible." (Underscoring supplied.)

The Assistant Chief of NIOSH's Hazard Evaluation Services Branch said 95 valid requests for health hazard evaluations were received from August 1971 to January 1973. Most of these were received in calendar year 1972. The status of these requests as of January 17, 1973, is summarized below.

Final reports completed	27
Draft report prepared	11
Investigator assigned and field investigation in process	44
Investigator assigned but no investigation initiated as yet	8
Investigator not assigned and field investigation not initiated	<u>5</u>
Total	<u>95</u>

NIOSH expects such determinations will (1) be an additional source of data for revision and extension of the priority list on toxic substances and (2) develop new information for inclusion in the annual toxic substances list.

NIOSH officials also advised us that, if a hazard evaluation is done on a substance for which no standard has been promulgated and it is found to be hazardous in the workplace, NIOSH must develop a recommended standard and forward it to OSHA. These officials said that through this procedure several additional criteria documents could be added each year to the list of those planned by NIOSH.

DEVELOPING COMPREHENSIVE RECOMMENDED STANDARDS

Developing comprehensive standards for recommendation to the Secretary of Labor is for each toxic substance and harmful physical agent a large undertaking and includes a multitude of tasks.

Each comprehensive recommended standard contains a critical evaluation of all known prior research and knowledge on the particular substance or agent and a recommended standard based on this evaluation. NIOSH includes in this recommendation

- a historical analysis of the use and toxicity or harmfulness of the substance or agent,
- a summary of the properties of the substance or agent and properties of related substances or agents under study which are pertinent to the problem,
- a critical evaluation of data concerning the biological effects of the substance or agent on humans and animals, including available epidemiologic evidence, and
- a biological standard specifying values for blood, urine, or breath if applicable.

Developing the comprehensive recommended standard involves three phases, first, reviewing the data available to develop the standard, second, performing research to develop missing and needed data, and third, preparing the criteria document and submitting the recommendation for the standard to the Department of Labor.

Following is a description of key events in developing criteria for recommended safety and health standards.

Phase I--research analysis on developing criteria or identifying research gaps

Locating and reviewing all past literature describing research and findings on the substance or agent is in itself

a formidable task. The literature search is especially important because current information concerning the particular substance or agent must be adequate and complete for a comprehensive recommended standard to be written. This phase involves:

- Preliminary subjective evaluation of literature, to determine gaps, by professional occupational safety and health personnel.
- Evaluation of literature and preliminary evaluation of information received by NIOSH staff.
- Review of unpublished data submitted to NIOSH through requests published in the Federal Register
- Evaluation of information received from above by NIOSH staff to determine ability to produce criteria for a comprehensive recommended standard or a work-practices recommendation. If complete criteria for a standard cannot be developed but sufficient information is available to develop work-practices criteria, then the development of a work-practices recommendation begins.

This task usually takes from 6 to 12 months.

Phase II--research to produce data
necessary for criteria development

When gaps exist in the information, NIOSH must initiate a directed research program to obtain the necessary information before developing a recommended standard. This phase usually involves:

- A NIOSH program review to determine various research plans available for criteria development. These plans compete for resources available for research considering cost of research, time to completion, and the protection afforded the worker. This presents the available alternative for directed research.
- Contract negotiation phase.
- Research directed to fill recognized information gaps necessary to develop criteria.

Research programs designed to provide sufficient information for a comprehensive recommended standard might take as long as 3 to 5 years and in some cases as long as 20 years or more.

Phase III--criteria developed

Once the research is completed and a draft recommended standard is prepared, it is widely reviewed within NIOSH and by outside consultants to insure its scientific accuracy and reasonableness.

The process includes

- Review of the draft recommended standard by NIOSH staff.
- Review of revised criteria document by consultants.
- Review by selected professional societies and selected Federal agencies of revised document.
- Final NIOSH review.
- Review by general counsel of HEW.
- Final criteria and recommended standards submitted to the Department of Labor.

NIOSH officials expect that about 12 to 14 months will generally be required from the determination that adequate research has been performed until a recommended standard is submitted to OSHA.

CHAPTER 3

TOXIC SUBSTANCES

To better understand the task facing NIOSH and the various types of toxic substances, we selected five substances that according to NIOSH officials represent good examples of the magnitude of the task facing NIOSH in developing the comprehensive recommended standards. These situations help to demonstrate the harmful effects to workers by continual exposure to these substances, the status of the research done on these substances, and the various stages in NIOSH's development of the comprehensive recommended standards for the substances.

The five substances selected--parathion, proteolytic enzymes, wood dust, vanadium, and iron pentacarbonyl--are described in greater detail below. Parathion and vanadium are already covered by established Federal standards adopted by the Secretary of Labor. The other three substances are not covered by any existing Federal standard.

NIOSH has established a priority ranking for 113 of the more significant toxic substances and harmful physical agents (see app. I) and has established an appendix to this list which contains 417 additional substances and agents which are significant but not ranked. The priority list showed criteria documents had been developed for 6 substances and agents and criteria documents were in progress for 12 substances and agents. The remaining 95 substances and agents on the priority list are in groups of five and are not ranked within each group

Parathion is listed near the top of NIOSH's ranking of the more significant toxic substances. Iron pentacarbonyl is listed in the 17th group on the list and proteolytic enzymes is listed in the 19th group.

Wood dust and vanadium are on NIOSH's list of 417 substances and agents included as an appendix to the ranked priority list.

PARATHION

Parathion, which was originally developed by Germany in the 1930s for use as a nerve gas, is an insecticide registered with the Environmental Protection Agency for use on a number of crops, including apples, peaches, tobacco, grapes, oranges, and cotton. Parathion is a very effective insecticide but is also very toxic to man and animals.

Parathion was first used as an insecticide during the late 1940s, in recent years, as DDT production declined, parathion production greatly increased. In 1971, for example, some 60 million pounds of parathion were manufactured and large amounts were used on cotton crops especially in the lower Rio Grande Valley of Texas. Commercially obtained parathion is a dark-colored oily liquid usually used in a spray, or it may be mixed with inert dust and used as a dry insecticide.

Employees may be exposed to parathion

- while it is being manufactured and formulated,
- while it is being mixed (see picture A-1 on p. 30) and used, or
- while they are doing agricultural fieldwork after parathion has been used.

Employees exposed to parathion during any of these processes may suffer toxic effects through ingestion, inhalation, or absorption. Absorption of parathion through the skin, however, is the most common cause of poisoning.

Parathion poisoning may have

- mild effects, such as nausea, headache, and general weakness,
- moderate effects, such as blurred vision, muscle incoordination, diarrhea, excessive sweating, and dyspnea (painful and labored breathing), or
- severe effects, such as collapse, coma, areflexia (absence of reflexes), flaccid paralysis (paralysis with loss of natural muscle contraction), and death.

Poisoning occurs because parathion indirectly causes the inactivation of cholinesterase--an enzyme which regulates normal neuromuscular responses of the body.

The inactivation of cholinesterase in the body causes an inability to relax contracted muscles. As a result, breathing becomes painful and labored and death may occur from a lack of oxygen due to

- bronchial constriction,
- an accumulation of excess fluids in the respiratory tract,
- paralysis of the respiratory muscles, or
- complete failure of the respiratory system. (See picture A-2 on p 30.)

Literature on parathion indicated that most fatal cases of parathion poisoning have not been connected with industrial use. For the most part, death was due to ingestion in suicides and homicides. However, one fatality was reported in South Carolina in 1971 when an employee mixed parathion with his hands and through absorption contracted parathion poisoning. Fortunately, in most cases, when diagnosed quickly, the effects of parathion poisoning can be relieved with certain medicines.

The Secretary of Labor has promulgated an established Federal standard specifying an 8-hour time-weighted average concentration for parathion to which employees may be exposed. Parathion also ranks high on the NIOSH priority list primarily because NIOSH officials expect that, with restrictions on the use of DDT, more parathion will be produced and used, resulting in the greater potential for large numbers of employees being exposed.

NIOSH expects to issue a recommended standard on parathion to OSHA by September 1973

PARATHION



A 1 Worker handling parathion with no safety clothing

NIOSH PHOTO

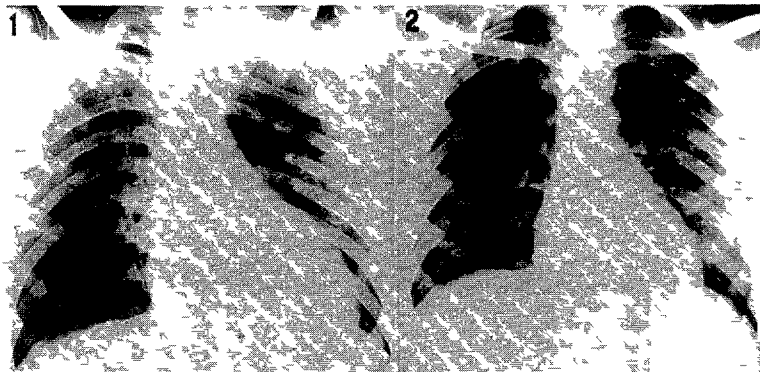


FIG. 1. CASE I. On admission an anteroposterior supine film obtained with a mobile unit showed fluffy-coalescent densities in both perihilar areas.

FIG. 2. Case I. Twenty-four hours after admission a postero-anterior film showed resolution of edema.

A 2 Acute pulmonary edema associated with parathion poisoning

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PROTEOLYTIC ENZYMES

Common soaps and laundry detergents often are not effective in removing stains from dirty clothing and other laundry. The removal of certain stains is made difficult by the proteins they contain which act as binding agents causing the stains to adhere to fabric fibers. To enhance protein stain removal, proteolytic enzymes have been added to many laundry products. These enzymes cause proteins to dissolve, loosening stains from the fibers thereby resulting in better stain removal.

Scientific studies by physicians in the United States, England, and other countries have established that workers in the detergent industry who come into contact with the fine powder containing proteolytic enzymes may develop (1) dermatitis or (2) acute respiratory difficulties.

Employees who handle raw enzymes or who come into excessive contact with the product during any phase of its production may develop dermatitis due to the primary irritant effect of the enzymes. The dermatitis on the hands and fingertips is characterized by a red, moist glistening appearance and may be associated with some degree of discomfort. (See picture A-3 on p. 33.)

More serious, however, are the reports of acute respiratory difficulties caused by inhaling dust containing proteolytic enzymes. Symptoms reported by employees include fatigue, shortness of breath, wheezing, and cough. These symptoms usually appear several hours after completion of the work shift while the employee is lying down or resting.

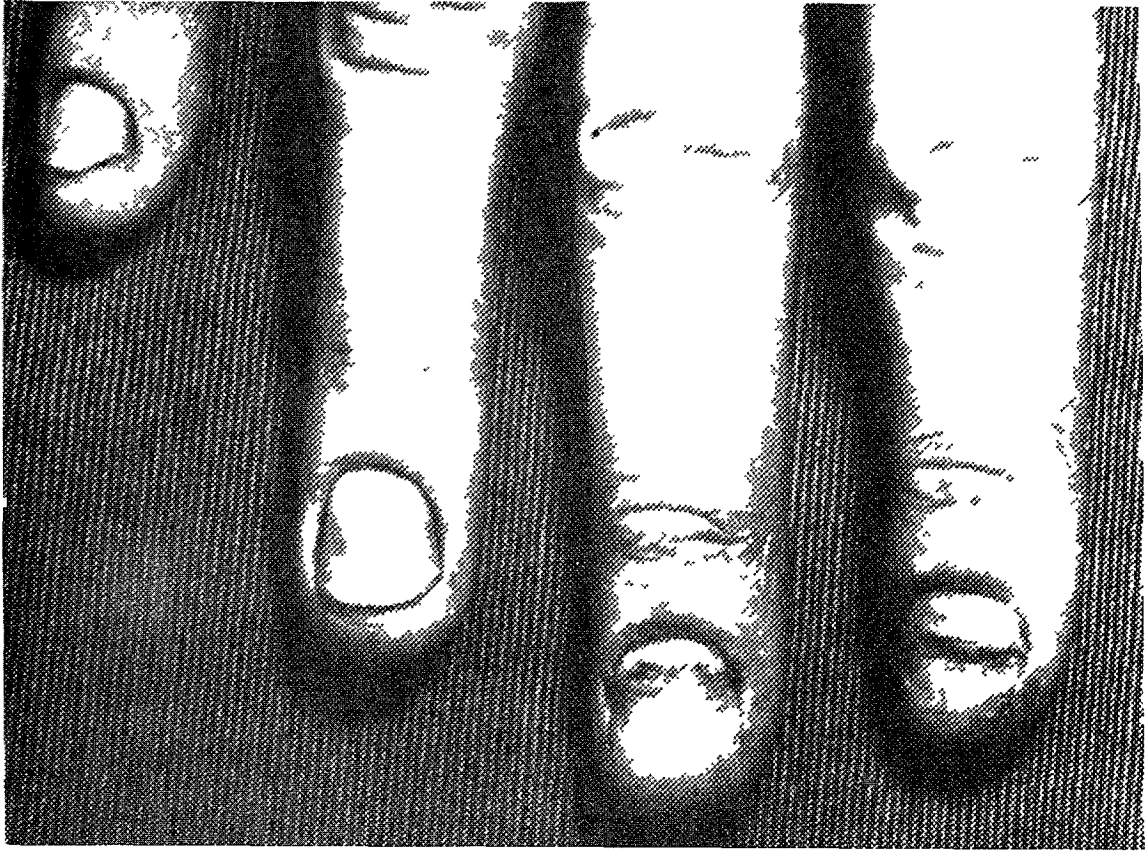
Physicians have reported that employees inhaling dust containing proteolytic enzymes may suffer from any of a number of acute respiratory diseases, such as

- rhinitis and pharyngitis, which cause inflammation of the mucuous membranes of the nose and throat and flu-like conditions manifested by shortness of breath, tightness in the chest, cough, malaise, loss of appetite, headache, and fever, and
- asthma, a respiratory disease marked by recurrent attacks of shortness of breath, wheezing, and cough

These acute respiratory conditions are often accompanied by reduced breathing capacity especially when the worker has become sensitized to the enzyme dust. Sensitization--an abnormal response--to proteolytic enzyme dust may occur among different workers at varying levels of exposure. As a result, certain workers may suffer relatively severe respiratory insufficiency at very low levels of exposure to enzyme dust. Conversely, other workers may be free of respiratory discomfort at relatively high levels of concentration and exposure to the dust.

The Secretary of Labor has not promulgated any standard for proteolytic enzymes. NIOSH, however, has placed them in the 19th group on the ranked priority list

PROTEOLYTIC ENZYMES



A 3 Fingernails after use of an enzyme detergent

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WOOD DUST

Throughout the world, the lumber and furniture industries employ large numbers of persons. Employees in almost every capacity--from a debarker in a lumber mill to a fine craftsman in a furniture factory--are exposed to respirable dusts and spores from wood (See picture A-4 on p 35)

Studies indicate that most cases of wood-dust-related disease can be classified as toxic, irritant, or allergenic. Affected organs include the skin, mucous membranes, and lungs.

According to the literature on wood dust, inhalation or exposure may cause acute conditions, such as

- dermatitis, a skin disease characterized by sores or splitting of the skin,
- maple bark disease, which is caused by the inhalation of spores that grow beneath the bark of maple trees, is characterized by shortness of breath, cough, fever, and chest pain,
- asthma, a respiratory disease marked by recurrent attacks of shortness of breath,
- rhinitis, a disease characterized by an inflammation of the mucous membranes in the nose, and
- sequoiosis, an inflammation of the lung due to inhaled redwood dust which causes coughing and shortness of breath.

Wood dust also causes chronic effects. Studies in England have shown, for example, that the frequency of adenocarcinoma (a form of cancer) of the nasal cavities and sinuses among furniture workers from 1956 to 1965 was 1,000 times greater than in the normal male population. The wood involved is hardwood and physicians believe that the cancer is almost certainly caused by inhalation.

Suberosis--a pneumoconiosis caused by the inhalation of cork dust--has been diagnosed among cork workers. Pneumoconiosis is a chronic reaction of lung tissue to inhaled

dust. The complications of suberosis are most frequently bronchitis, spontaneous pneumothorax (an accumulation of gas or air in the cavity in which the lung is situated which results in a lessening of air intake capacity), and tuberculosis, which usually evolves slowly over a long period of years. In advanced stages pneumoconiosis may cause disability and death. Physicians have found no specific treatment for this disease.

The Secretary of Labor has not issued a standard regulating exposure to wood dust, however, it is listed in the appendix to NIOSH's ranked priority list. The American Conference of Governmental Industrial Hygienists has recommended a standard which would allow no more than 5 milligrams of wood dust per cubic meter of air for an 8-hour time-weighted average work shift. They believe that enforcement of such a standard would greatly minimize the risk but might not necessarily prevent all forms of wood-dust-related disease.

WOOD DUST



A 4 Worker using spindle sander is exposed to respirable wood dust particles

NATIONAL ARCHIVES PHOTO

VANADIUM

The metallic element vanadium in combination with iron is widely used in the manufacture of hard steel alloys. Other compounds of vanadium are used as color-fixing agents in dyes and ink, as accelerators in the drying of paints and varnishes, in insecticides, in photographic chemicals, and in glass manufacturing. It is estimated that more than 5,000 tons of vanadium are used annually in the United States, usually in combination with other substances. Also, in certain instances 65 percent of the residual ash from large oil-fired boilers may be vanadium compound (See pictures A-5 and A-6 on p 38.)

Various scientific studies have shown that exposure to vanadium compounds is hazardous to workers. For example, studies conducted in other countries concerning the toxic effects of vanadium and its compounds in both powder and gaseous form indicated that exposed employees may suffer from

- chronic bronchitis,
- an accumulation of fibers in the lungs,
- irritation of the eyes, nose, and throat,
- an increased incidence of cough,
- a greenish discoloration of the tongue,
- shortness of breath,
- skin pallor,
- tremors of the extremities,
- hypertension,
- abnormally increased heartbeat on exertion,
- eczema (an inflammatory disease of the skin attended by itching and the appearance of lesions), and
- mucous membrane irritation.

Also a report on the effects of acute exposure to heavy concentrations of pure vanadium pentoxide (a compound consisting of vanadium and oxygen) in a U.S. factory indicated that employees suffered from

--respiratory tract irritation,

--rapidly developing mild inflammation of the delicate membrane that lines the eyelids and covers the exposed surface of the eyeball,

--severe irritation of the upper throat, and

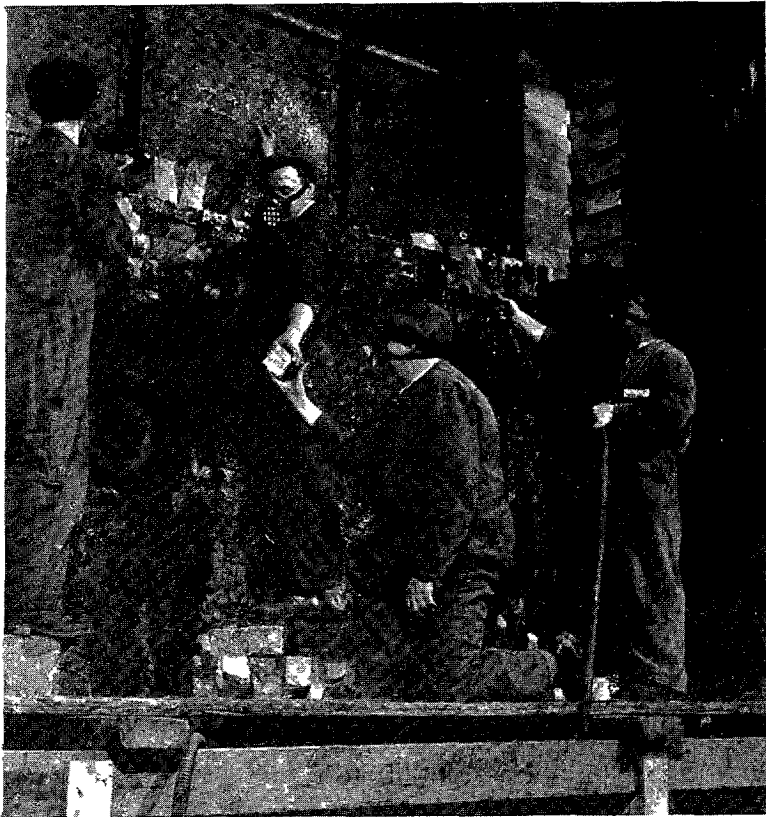
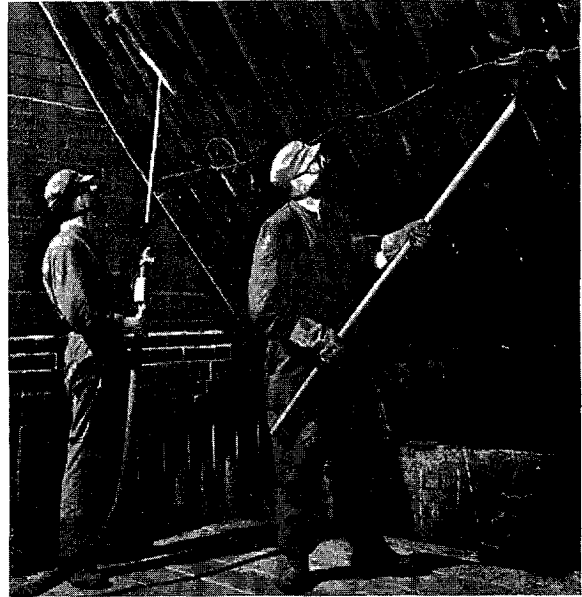
--a dry persistent cough followed by abnormal respiratory sounds and spasms of one of the larger air passages in the lung.

These symptoms occurred despite the use of engineering controls and personal protective equipment designed to safeguard employees' health from less toxic powders and gases.

In May 1971 the Secretary of Labor promulgated separate established Federal standards specifying the maximum allowable concentrations of the gaseous and powder forms of vanadium pentoxide to which employees may be exposed. These standards, if enforced, are expected to provide some protection for employees working with and around vanadium. Vanadium pentoxide is listed in the appendix to NIOSH's ranked priority list. NIOSH officials, however, said it is difficult to estimate when a recommended standard for vanadium will be forwarded to OSHA.

EXPOSURE TO VANADIUM DURING BOILER CLEANING

A 5 Boiler cleaners demonstrating methods of dislodging soot from generator and superheater tubes. The one on the left is using a compressed air lance, and on the right the cleaner is tapping the tubes with a rod.



A 6 Bricklayers dismantling a firebrick wall and being exposed to vanadium. The man on the right is spraying the bricks with water to provide some protection.

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IRON PENTACARBONYL

Iron pentacarbonyl is, under normal conditions, a highly flammable yellow-brown liquid. Its existence is widespread and it may be produced as a byproduct when

- Gases containing high concentrations of carbon monoxide come into contact with iron or steel vessels.
- Gas is being manufactured and steps for its removal are required to eliminate soot formation when the gas is burned
- Gas containing carbon monoxide passes through iron pipes.
- Gases containing carbon monoxide are stored under pressure in steel cylinders.
- Water gas and coal gas are stored underground. Water gas is a poisonous fuel gas produced by forcing steam over incandescent coke or coal. Coal gas is a poisonous fuel gas produced by distilling or burning coal.

Traces of iron pentacarbonyl have also been found in refinery gas. Further, iron pentacarbonyl is used as an antiknock agent in some gasolines.

Little research has been performed on the toxicity of iron pentacarbonyl. However, the few toxicological studies that have been performed indicate that overexposure to iron pentacarbonyl may cause many of the same symptoms caused by overexposure to nickel carbonyl--a related substance for which a number of toxicological studies have been performed--such as giddiness and headache occasionally accompanied by shortness of breath and vomiting. Removal from exposure removes these symptoms, but shortness of breath returns in from 12 to 36 hours, accompanied by fever, cyanosis (a bluish discoloration of the skin due to a lack of oxygen transfer from the lungs to the bloodstream), and cough.

Overexposure to iron pentacarbonyl, in either liquid or gaseous form, may also cause other serious conditions such as

--pneumonia,

--hepatization, a condition in which part of one or both lungs becomes nonfunctional for a time, and

--vascular injury and degeneration of the central nervous system.

In fatal cases death occurs from the 4th to the 11th day with pneumonitis and injury to the kidneys, liver, and brain. Iron pentacarbonyl is also suspected to be a cancer-causing agent. In fact, on the basis of the known carcinogenicity of nickel carbonyl and the present implication of iron as a possible cocarcinogen (a substance which causes the body to become more susceptible to cancer development), the American Conference of Governmental Industrial Hygienists has recommended a standard of not more than 0.01 parts of iron pentacarbonyl per million parts of air.

The Secretary of Labor has not promulgated a standard for iron pentacarbonyl. It is also unlikely that a criteria document on iron pentacarbonyl will be issued in the near future since NIOSH has placed iron pentacarbonyl in the 17th group on the ranked priority list.

CHAPTER 4

PERSONNEL PROBLEMS HINDERING PERFORMANCE OF TASKS

NIOSH officials said NIOSH had encountered problems in completing its tasks because of the restrictions on hiring and on average grade level. They stated that an easing of the average grade level restrictions would enable NIOSH to hire needed research scientists and other professional staff and thus enable it to speed up its research efforts and development of recommended standards. Some relief from these restrictions is available through personnel hired as PHS commissioned officers. NIOSH officials, however, have encountered problems in their attempts to fully use the PHS Commissioned Officer Corps as a source of professional staff.

RESTRICTIONS ON HIRING AND AVERAGE GRADE

NIOSH, as a research-oriented agency, must hire research scientists, industrial hygienists, physicians, and other highly trained professional staff. Personnel with the necessary training and experience require relatively high civil service grades. NIOSH officials believe that a realistic approach to the staffing needs of NIOSH--to include maximum use of available commissioned officers--would require a civil service grade average of 9.5.

Information furnished us by NIOSH indicated that, when NIOSH's final organizational location was determined, a supplemental appropriation for fiscal year 1971 and an amended fiscal year 1972 appropriation request were pending. These appropriations increased the annual resources of the new organization from \$13.8 million to \$26.5 million with increases in personnel from 375 to 745. On June 30, 1971, NIOSH's onboard strength totaled only 443.

Immediately after passage of the fiscal year 1972 appropriations in August 1971, however, an HEW administrative restriction--which was part of a general reduction within HEW--was placed on hiring, and it was not until February 1972 that NIOSH was given permission to hire or replace employees above grade GS-9. In addition, the NIOSH personnel budget was reduced to 708 in fiscal year 1973, and a further reduction to 610 is scheduled to be made by the end of fiscal year 1974.

When the restriction was imposed, NIOSH had an average grade level of 7.81. Along with the restriction on hiring, NIOSH officials also were instructed to attain an average grade level of 7.7 by June 30, 1972, and 7.64 by June 30, 1973. These restrictions still remain in force, and as a result, NIOSH has not been able to expand its civil service staff and hire professionals at the grades it considers necessary to operate a research organization such as NIOSH.

USE OF COMMISSIONED OFFICERS

The PHS corps has, in the past, been a prime source of professional staff, according to NIOSH's Assistant Director for Administrative Management.

The following table indicates the extent to which NIOSH officials have used PHS commissioned officers since September 1, 1970

NIOSH "Professional Personnel" (note a)			
	<u>9-1-70</u>	<u>9-1-71</u>	<u>9-6-72</u>
Civil service personnel			
GS-16 and above	2	5	5
GS-15	3	5	8
GS-14	12	24	28
GS-13	16	26	32
GS-12	8	26	32
GS-11	<u>13</u>	<u>22</u>	<u>26</u>
Total	<u>54</u>	<u>108</u>	<u>131</u>
PHS commissioned officers			
0-6 and above	13	22	21
0-5	10	13	17
0-4	19	26	32
0-3	31	38	49
0-2	<u>13</u>	<u>29</u>	<u>56</u>
Total	<u>86</u>	<u>128</u>	<u>175</u>
Total PHS and GS-11 and above	<u>140</u>	<u>236</u>	<u>306</u>
Total NIOSH personnel	277	453	625
PHS and GS-11 and above as percent of total NIOSH	51	52	49
GS-11 and above as percent of total NIOSH	20	24	21
PHS as percent of total NIOSH	31	28	28

^a Defined as all commissioned officers and all GS personnel grade 11 and above

A NIOSH official informed us, however, that the abolition of the draft has recently made the corps less popular with such professional personnel and that relatively few applications for positions have been filed. As a result, NIOSH officials have been unable to use the corps to effectively solve its professional staffing problems. The officials said this is unfortunate especially because commissioned officers are not included in the determination of an agency's average grade level.

In addition, the officials said many problems have arisen because young corps members often wish to transfer from the commissioned officer personnel system and remain in the Government after completing their obligated tours of active duty. The current restriction on NIOSH's average grade, for example, makes no allowance for the situation in which a commissioned officer is continuing in his same capacity and only changing to the GS personnel system. NIOSH officials informed us that many commissioned officers left the Government or went to other governmental agencies during the past year because they could not stay with NIOSH above grade GS-7

POSSIBLE EFFECTS OF PERSONNEL SHORTAGE ON DEVELOPING RECOMMENDED STANDARDS

NIOSH officials advised us that the planned output of comprehensive recommended standards and work-practices recommendations for 20 to 30 substances and agents annually is contingent upon NIOSH obtaining (1) some relief from the current personnel and grade point restrictions, as discussed above, and (2) increased funding. The officials clearly indicated that these output levels cannot be attained at NIOSH's present level of staffing and funding--except at the expense of other important NIOSH programs, such as manpower development and hazard surveillance.

NIOSH officials also explained that, to quickly (12 to 14 months) produce recommended standards for certain extremely toxic substances and harmful physical agents, they found it necessary to reprogram staff efforts from other NIOSH responsibilities into development of recommended standards. As a result, some research scientists were required to assume responsibility for part-time contract administration. This led to the loss of laboratory research time. NIOSH officials believe that, in the long run, this lost research

time will inevitably decrease the annual rate of recommended standards developed.

PERSONNEL SHORTAGE MAY HINDER
RESEARCH CONTRACTS PROGRAM

NIOSH has channeled a portion of its monetary resources into research contracts and agreements with private organizations and other governmental agencies. At the end of fiscal year 1972, however, it had not expended \$800,000 of its total appropriation for that year and it had not expended an estimated \$600,000 at the end of fiscal year 1973, despite the magnitude of its problems. NIOSH officials said these funds could have been directed into contracting but were not because the lack of personnel prevented any further development and monitoring of contracts.

CHAPTER 5

SLOW PROGRESS LIKELY

NIOSH has made slow progress in developing and recommending comprehensive standards for toxic substances and harmful physical agents. Through March 31, 1973,¹ NIOSH had developed and forwarded only six comprehensive recommended standards--for asbestos, beryllium, carbon monoxide, noise, inorganic lead, and ultraviolet radiation--to the Department of Labor. (See pictures A-7 to A-12 on pp. 47 to 49 for examples of toxic substances and harmful physical agents.)

All these substances or agents had been covered by established Federal standards or national consensus standards issued by the Department of Labor in May 1971. NIOSH-recommended standards include lower maximum allowable concentrations for asbestos, noise, and carbon monoxide than had been in effect under the earlier standards. The criteria document on beryllium recommended that the existing exposure limit be retained

Of the six NIOSH-recommended standards, the standard for asbestos is the only one that has gone through Labor's review process and public hearings and is now a comprehensive permanent standard.

NIOSH officials originally estimated that, beginning with fiscal year 1974, they would be able to produce only 20 to 30 comprehensive recommended standards and work-practices recommendations per year for the 1,000 to 2,000 substances and agents currently requiring standards. NIOSH determined, however, that with available funds it will not be able to reach this planned production level for fiscal year 1974, and output will probably be slightly under 20

To speed progress, NIOSH reprogramed about \$600,000 in fiscal year 1973 from other important functions, particularly research, to the documentation of comprehensive recommended

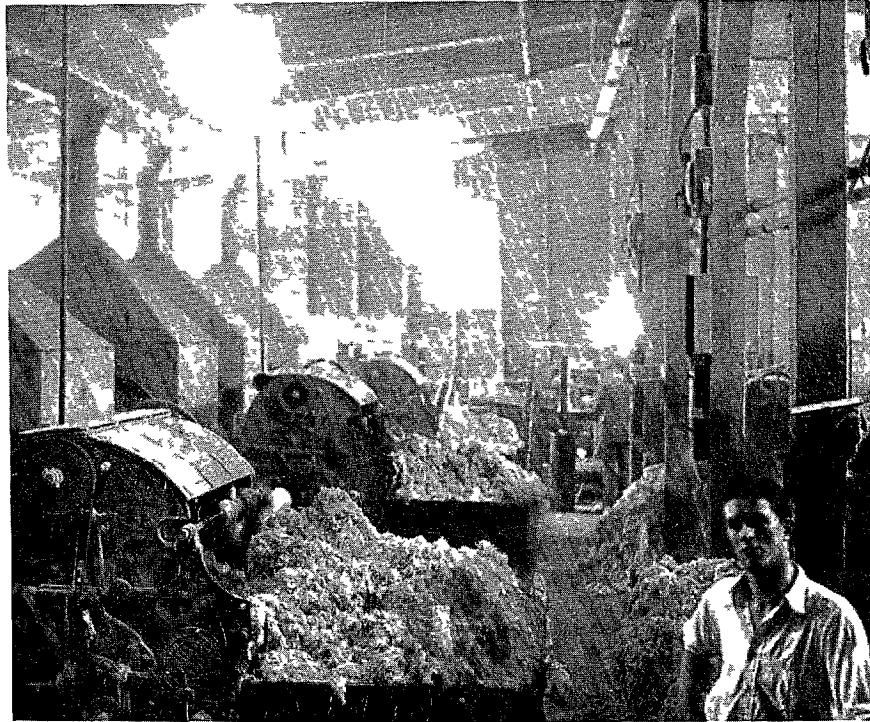
¹ NIOSH subsequently submitted comprehensive recommended standards to OSHA for four additional toxic substances--chromic acid, toluene, toluene diisocyanate, and trichloroethylene

standards NIOSH believes that, in the long term, this lost research time will inevitably decrease the annual rate of recommended standards developed.

NIOSH and Labor officials have taken other steps to provide some protection to American workers as soon as practicable. These include issuance of emergency temporary standards, work-practices recommendations, and use-permit system recommendations that would contain less information than comprehensive standards but would provide some safety for employees despite a lack of complete knowledge of the subject toxic substances and harmful physical agents.

HAZARDS CAUSED BY TOXIC SUBSTANCES

ASBESTOS



A 7 Worker exposed to asbestos fibers which can cause lung damage

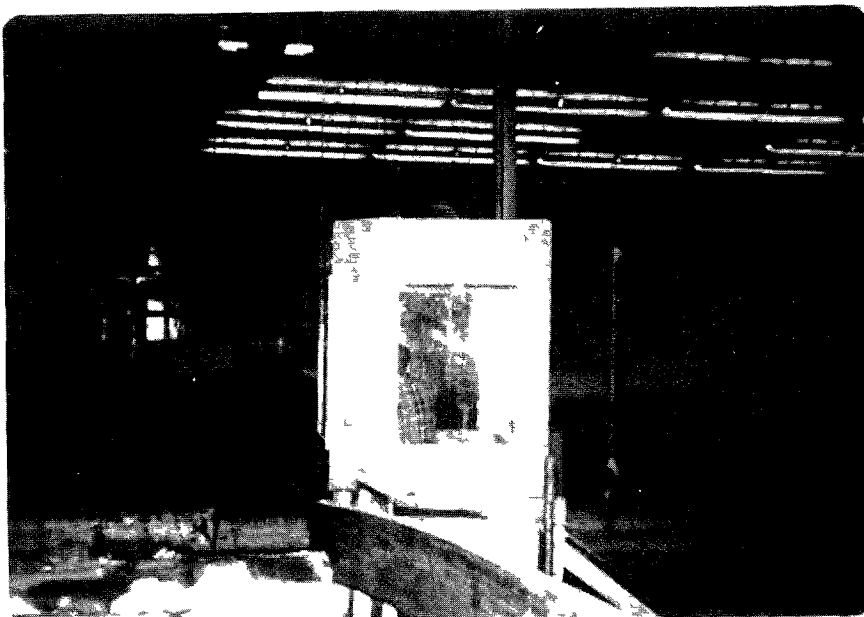
BERYLLIUM



A 8 Workers handling beryllium pebbles in open system Workers are exposed to beryllium dust which can cause serious lung changes

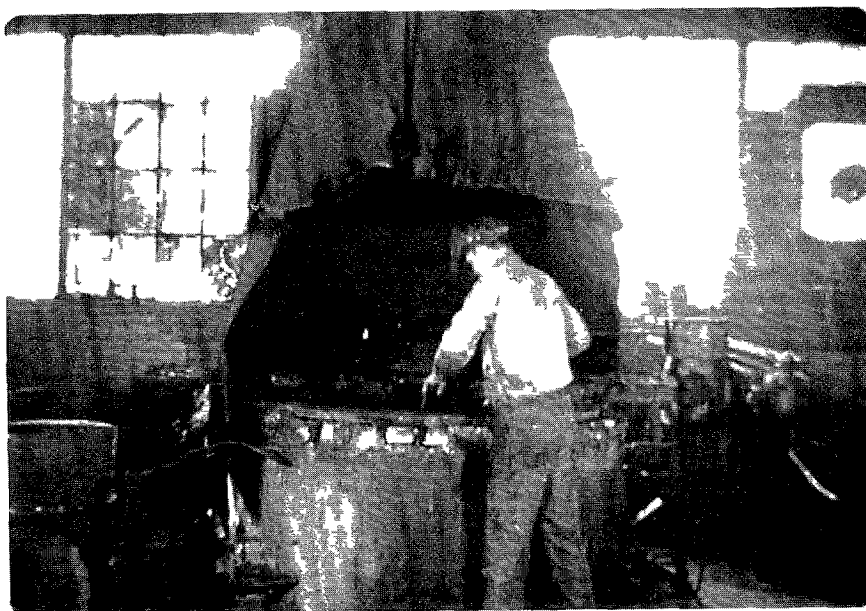
NIOSH PHOTOS

HAZARD CAUSED BY HARMFUL PHYSICAL AGENT
NOISE



A 9 Worker is enclosed to protect him from noise

HAZARD CAUSED BY TOXIC SUBSTANCE
LEAD



A 10 Worker is filling molds from a lead melting pot. He is protected from inhalation of fumes by a ventilation hood and from spattering lead by a face shield

NIOSH PHOTOS

HAZARD CAUSED BY HARMFUL PHYSICAL AGENT
ULTRAVIOLET LIGHT



A 11 Welders exposed to ultraviolet light and harmful gases during welding operations

HAZARD CAUSED BY TOXIC SUBSTANCE
CARBON MONOXIDE



A 12 NIOSH employee is sampling for carbon monoxide emitted from a forklift truck. Low level exposure to carbon monoxide can cause dizziness. High level exposures can be fatal.

NIOSH PHOTOS

WORK-PRACTICES CONCEPT

To increase the output of recommended standards while maintaining scientific acceptability and keeping within the confines of the act, NIOSH officials have decided to supplement the annual output of comprehensive recommended standards with work-practices recommendations. NIOSH states that the comprehensive recommended standard includes an environmental limit and a method of judging compliance with the limit for a toxic substance or harmful physical agent and demonstrates the technical feasibility of achieving the limit. A work-practices recommendation has all the components of a comprehensive recommended standard, including labeling and placarding, except for the environmental limits based on dose-effect information. This recommendation contains less information than the comprehensive recommended standard but recommends work practices (operating procedures) to protect workers' health

Under this work-practices concept, many of the more costly and time-consuming components of comprehensive recommended standards initially are omitted.

The Director of NIOSH's Office of Research and Standards Development believes the concept of work-practices recommendations provides NIOSH with a very important option during the initial phases of recommended standards development. Specifically, he said that, once a search for existing literature on a substance or agent had been completed and the information gathered had been analyzed and evaluated, NIOSH had previously been faced with deciding among three alternatives which included

- developing a comprehensive recommended standard if relatively complete research information was available,
- attempting to obtain through grants, contracts, and in-house research the additional data needed to develop a comprehensive recommended standard, or
- deciding to pass over the substance due to large gaps in available research information (This alternative would have to be exercised regardless of toxicity or number of workers exposed unless a work-practices standard could be developed.)

As a result of the development of the concept of work-practices recommendations, NIOSH officials can now develop a recommendation based on incomplete information. The officials realize, of course, that they will need to supplement such recommendations with the data needed to formulate a comprehensive recommended standard. However, they believe that, where feasible, work-practices recommendations should be developed when enough information is available to provide protection to affected workers and when data necessary for a comprehensive permanent standard would be unobtainable for a long time. The officials believe that, in this way, NIOSH can provide some protection to a large number of workers during the time--sometimes years--required for the additional research needed to support comprehensive recommended standards.

NIOSH has submitted two work-practices recommendations to OSHA. The first, covering heat stress was submitted to OSHA in June 1972, and the second, covering coke-oven emissions was submitted in February 1973.

Work-practices recommendation
on coke-oven emissions

Occupational health researchers have determined in several studies that coke-oven emissions cause a high rate of lung cancer among exposed employees. The researchers, however, have not yet been able to isolate the specific cancer-causing agent or agents in coke-oven emissions. One reason why the causative factors involved have not been isolated is that epidemiologic data on coke emissions is sketchy. Moreover, the accumulation of such data through research in a systematic, scientific manner might take years. Full epidemiologic information may not be available until researchers determine the causes and mechanisms of cancer.

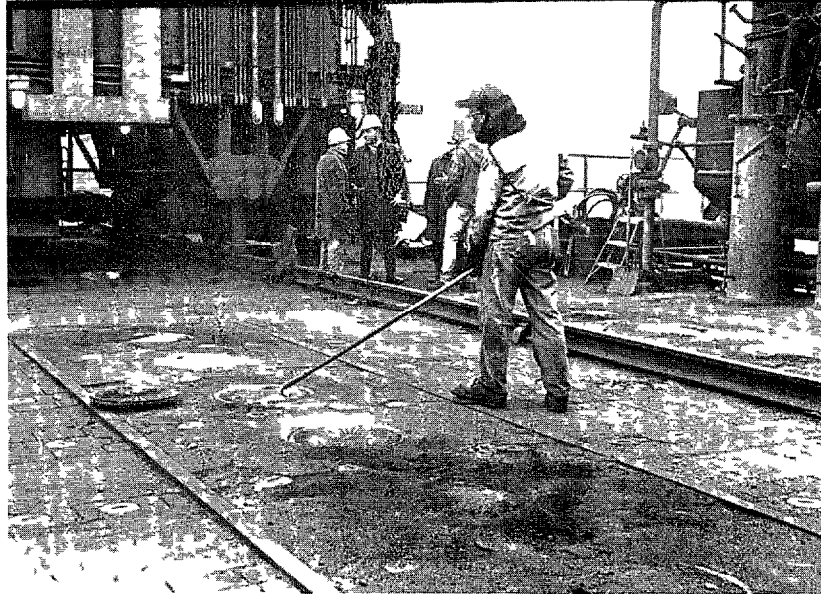
Because complete data on the potential harmful effect of coke-oven emissions was not available, NIOSH officials were faced with a dilemma in that an obvious need existed for a recommended standard regulating exposure to the cancer-causing agent(s) but the desired scientific data and research identifying and supporting a recommended standard for such agents was lacking. NIOSH officials elected to solve this dilemma by developing and transmitting to OSHA a work-practices recommendation on coke-oven emissions in general in February 1973. In this way, the officials believed they could provide some safety to employees exposed to coke-oven emissions while fulfilling their scientific and legal responsibilities. In addition, the officials decided to continue to support research on coke-oven emissions to provide OSHA with a comprehensive recommended standard in the future.

In the work-practices recommendation submitted to OSHA, NIOSH recommended that engineering controls, medical surveillance, labeling, and respiratory measures be adopted to control employee exposure to coke-oven emissions. NIOSH, however, declined to make a recommendation limiting employee exposure to coke-oven emissions because of an absence of reliable data.

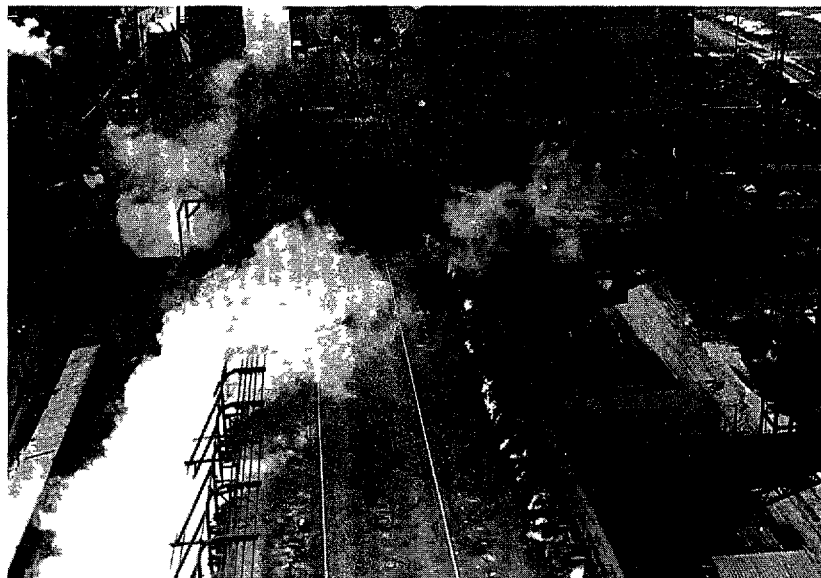
The Secretary of Labor has not yet issued work-practices standards on the recommendations for coke-oven emissions and heat stress forwarded by NIOSH. (See pictures A-13 and A-14 for examples of workers exposed to coke-oven emissions, and picture A-15 for example of a worker exposed to heat stress.)

HAZARD CAUSED BY TOXIC SUBSTANCE

COKE OVEN EMISSIONS



A 13 Worker on top of a coke oven wears protective equipment to minimize exposure to coke oven emissions, heat, and gases rising from the furnace

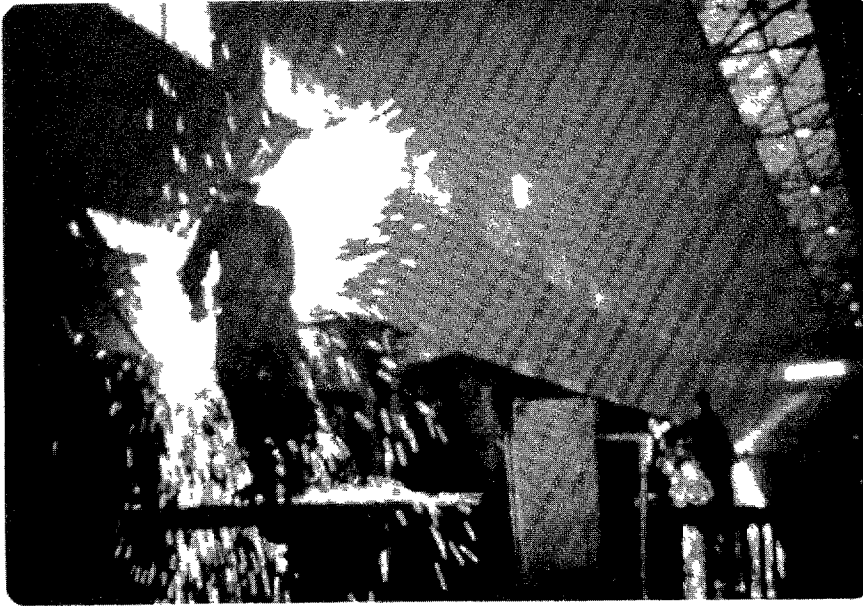


A 14 Aerial view of a coke oven Coke oven emissions are escaping through pressure valves in pipeline system used to extract gases from the furnace

NIOSH PHC

HAZARD CAUSED BY HARMFUL PHYSICAL AGENT

HEAT STRESS



A 15 Worker is exposed to heat and harmful gases during a flame cutting operation

NIOSH PHOTO

USE-PERMIT SYSTEM RECOMMENDATION ON
14 CANCER-CAUSING AGENTS

The Director of NIOSH advised us that NIOSH elected to recommend a use-permit system recommendation for 14⁽¹⁾ substances (see app. II) proven to be cancer-causing agents (carcinogens) but believed to be produced and used in very limited quantities in the United States. NIOSH's recommendation was based on the carcinogen control system already employed in Great Britain and in Pennsylvania.

The use-permit system recommendation, as proposed by NIOSH, would require prior written approval from the Department of Labor for any employer using or producing any of the 14 carcinogens. The system would also require:

--Each employer to submit a written request for the use of the carcinogen indicating (1) the intended use of the substance and the nature of the process involved and (2) a detailed description of the medical and industrial hygiene control measures to be used to prevent exposure to the substance.

--Labor to approve the use of the carcinogens if:

1. The substance is essential to its intended use and no other substance is suitable for the intended purpose.
2. The control measures set forth in the request are effective in preventing exposure to the substance.
3. Adequate medical and industrial hygiene surveillance will be maintained.

The information that was available to NIOSH concerning the names and number of businesses using these substances

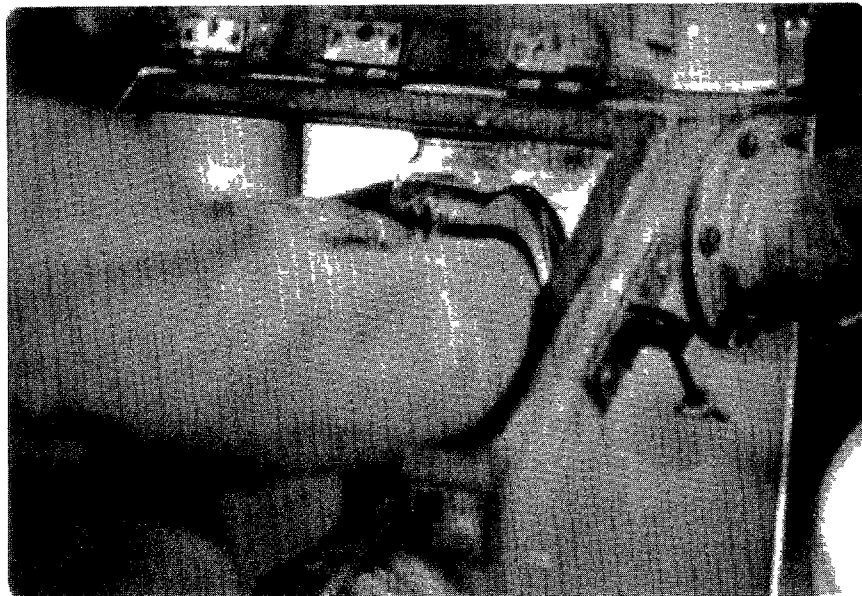
¹ NIOSH originally included a 15th substance, dimethyl sulfate, on the list of carcinogens submitted to OSHA in July 1973. NIOSH officials, however, deleted dimethyl sulfate from the list because of the questionable animal evidence that dimethyl sulfate is a carcinogen.

industrially and the number of workers exposed to the substances was fragmentary. (See following examples of carcinogens in pictures A-16 and A-17.)

The Director informed us that NIOSH has requested information concerning these substances from numerous sources and has also initiated contracts for the acquisition of available data from published sources. He pointed out, however, that the results will not be available for immediate comprehensive standards development and, when they are available, they may not provide an adequate basis for the development of suitable comprehensive criteria for standards

Although NIOSH officials did not have all the information needed for developing a comprehensive recommended standard, they did have scientific evidence of the cancer-causing properties of the substances. The officials elected, therefore, to develop a use-permit system recommendation for a standard designed to provide some safety to employees being exposed to these substances. This use-permit system recommendation was transmitted to OSHA on July 14, 1972.

**CANCER-CAUSING AGENT
BENZIDINE**



A 16 Worker is ignoring glove box (below arms) to remove jar filled with benzidine because he could not see through protective shield that covered the opening into which he is reaching

NIOSH PHOTO

CANCER-CAUSING AGENT
DICHLOROBENZIDINE



A 17 Exposure to dichlorobenzidine produced in an open system

NIOSH PHOTO

On December 31, 1972, the Health Research Group and the Oil, Chemical and Atomic Workers International Union asked OSHA to place an emergency temporary standard on 10 of the 14 carcinogens included in the NIOSH use-permit system recommendation. This type of request is authorized by section 6 of the act. The petitioners specifically requested that Labor require complete prohibition of the use of these 10 substances in all processes except where an employer obtains a use permit for a system in which no human exposure occurs. The petition also indicated that some of the carcinogens were more widely produced and used than previous information had shown.

The type of regulations and controls requested by the petitioners is the same as those provided in the NIOSH use-permit system recommendation. The petitioners also recommended that OSHA employ an emergency temporary standard.

On May 3, 1973, Labor issued an emergency temporary standard on the 14 carcinogens.

NEED TO CONSIDER REVISING 6-MONTH
REQUIREMENT IN THE ACT

Since the act was passed in December 1970, only three emergency standards--for asbestos, organophosphorous pesticides, and 14 carcinogens--have been issued by the Secretary of Labor.

Section 6(c) of the act requires him to establish an emergency temporary standard if he determines that employees are in grave danger from exposure to toxic substances and harmful physical agents and the emergency temporary standard is needed to protect them. The act also requires that an emergency temporary standard be superseded by a comprehensive permanent standard in 6 months.

The first emergency temporary standard for asbestos was issued in December 1971 by Labor. As required by the act, the emergency temporary standard was superseded 6 months later in June 1972 by a comprehensive permanent standard. As stated on page 57, Labor issued an emergency temporary standard for 14 carcinogens in May 1973.

The third emergency temporary standard, prescribing safeguards to be taken regarding the exposure of fieldworkers to certain organophosphorous pesticides, was issued by OSHA on May 1, 1973. The standard was to be effective June 18, 1973. However, because of protests from growers associations and other organizations, the standard was suspended on June 15, 1973, by OSHA.

A revised emergency temporary standard--which deleted some of the previously covered pesticides and revised some of the prescribed safeguards--was issued on June 29, 1973. The revised standard was to take effect on July 13, 1973. On July 10, 1973, however, a Federal court issued an injunction blocking implementation of the revised standard pending further judicial review of the standard.

NIOSH officials explained that it is virtually impossible to develop and promulgate a comprehensive recommended standard within the required 6 months, except in the few cases in which adequate research has already been performed. The officials said NIOSH had been able to meet the 6-month timetable for asbestos only because substantial research had

previously been conducted by its predecessor organization. For new substances and physical agents suspected of being harmful to employees, little or no research will have been performed in most cases.

The Director of NIOSH's Office of Research and Standards Development informed us that, when Labor issued the emergency standard on asbestos, NIOSH already had prepared a draft of the proposed comprehensive recommended standard. Furthermore, the draft had already been reviewed internally by NIOSH officials and externally by NIOSH consultants and other interested persons and organizations. As a result, NIOSH was able to forward the comprehensive recommended standard to Labor about a month after the emergency standard was issued.

NIOSH officials advised us that it would not have been possible to develop and issue to Labor a scientifically accurate comprehensive recommended standard within 6 months, had not the necessary research on the toxicity of asbestos already been made.

Further, Labor officials advised us that they require at least 4 months to process a comprehensive recommended standard received from NIOSH. Processing entails (1) requesting recommendations from an advisory committee, (2) reviewing and evaluating the recommendations received, (3) publishing the proposed comprehensive permanent standard in the Federal Register, (4) considering objections to the proposed standard and possibly holding a public hearing on such objections, and (5) issuing the comprehensive permanent standard.

It is doubtful, therefore, that emergency temporary standards will be extensively employed because of the 6-month requirement in the act. Labor officials informed us that increasing the time permitted to develop a permanent standard after issuance of an emergency standard is not necessary and may increase the use of the emergency standard procedure far beyond the intent of section 6(c) of the act.

NIOSH officials advised us that more than 6 months may be needed for developing a comprehensive permanent standard, this would allow NIOSH to make a more meaningful contribution to the standard-setting process. NIOSH officials believe that the concept of the emergency standard could be made effective by

- eliminating the requirement that a permanent standard be issued within 6 months of the time an emergency standard is issued,
- requiring the Secretary of Labor to specify, when an emergency standard is issued, how much time will be needed to develop and promulgate a permanent standard, and
- increasing the maximum specified time to 2 years.

NIOSH officials also informed us that the issuance of an emergency temporary standard does not necessarily commit NIOSH to developing a recommended standard, and, therefore, does not necessarily obligate NIOSH to meet the 6-month timetable for a comprehensive permanent standard.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The health of many American workers may depend on how well and how fast NIOSH develops recommended standards for using toxic substances and harmful physical agents in workplaces. NIOSH's research programs to protect the American workers from health and safety hazards must consider an array of millions of workers distributed over millions of workplaces and engaged in thousands of activities. Thus, NIOSH faces some formidable tasks in fulfilling its duties and responsibilities under the act.

The magnitude of the tasks is illustrated by the fact that between 1,000 and 2,000 toxic substances and harmful physical agents currently require Federal standards and little scientific information is available about toxicity or effects of many of them. Moreover, NIOSH's job is likely to remain large and difficult because of the unknown properties of the new substances, new combinations of existing substances, and new physical agents introduced into the workplace each year.

Due to the magnitude of NIOSH's task and problems in obtaining professional staff, NIOSH's progress in developing recommended standards for using toxic substances and harmful physical agents in American workplaces has been slow and it is likely to remain slow. Even at the planned pace of 20 to 30 comprehensive recommended standards and work-practices recommendations per year, substantial progress toward the needed 1,000 to 2,000 standards will not be achieved for several years.

Moreover, NIOSH officials said NIOSH's planned output is contingent upon its obtaining (1) some relief from current personnel and grade point restrictions and (2) increased funding.

The actions taken by NIOSH to provide maximum protection to workers--establishing priorities, recommending standards, and reprogramming resources from other functions to criteria document development--may provide more protection

initially, but reprograming involves reductions in resources for some activities--primarily research--which in the long run may decrease the annual rate of recommended standards developed.

Emergency temporary standards could be used to provide protection for workers exposed to toxic substances and harmful physical agents. It is doubtful, however, that such standards will be used extensively because the act requires that a permanent standard be established within 6 months after publication of the emergency standard. Except in the few cases in which adequate research has already been performed, NIOSH will almost invariably be unable to develop a comprehensive recommended standard in 6 months. In most cases, little or no research will have been performed on new substances and physical agents determined potentially harmful to employees.

If the use of emergency standards is to be optimized, NIOSH must have more time to develop the recommendations for the permanent standards. Also additional time would allow the Secretary of Labor to await the NIOSH recommendation on a comprehensive permanent standard, evaluate the recommendation, and more thoroughly consider opposing views before promulgating the permanent standard.

RECOMMENDATION TO THE SECRETARY OF HEW

Because of NIOSH's slow progress in developing and recommending comprehensive standards and work-practices standards for toxic substances and harmful physical agents, we recommend that the Secretary of HEW consider the adequacy of NIOSH's resources to effectively carry out its responsibilities under the act

MATTER FOR CONSIDERATION BY THE COMMITTEE

We recommend that the Committee should consider asking the Congress to amend section 6(c)(3) of the act to allow the Secretary of Labor more time to promulgate a permanent standard after issuing an emergency standard.

CHAPTER 7

SCOPE OF REVIEW

We reviewed NIOSH's problems and progress in developing recommended standards for toxic substances and harmful physical agents which exist in various occupational environments. We also reviewed

--The basic legislation which created NIOSH and OSHA.

--Five toxic substances.

--The funding and personnel resources available to NIOSH.

--NIOSH's work-practices concept for increasing the output of recommended standards.

Our review was made at NIOSH headquarters in Rockville, Maryland, the National Library of Medicine in Bethesda, Maryland, and OSHA Washington headquarters. We interviewed NIOSH and OSHA officials and examined their instructions and guidelines relating to the development of recommended standards and issuance of temporary and permanent standards.

NIOSH PRIORITY LIST FOR CRITERIA
FOR TOXIC SUBSTANCES AND HARMFUL PHYSICAL AGENTS, 1972

Criteria Developed

Carbon Monoxide
Noise
Heat Stress
Beryllium
Asbestos
Coal Dust¹

In Progress

Arsenic
Benzene
Cadmium and Compounds
Chromic Acid Mist
Cotton Dust
Fibrous Glass
Lead
Mercury
Parathion
Silica
Trichloroethylene
Ultraviolet

Priorities

Bis (Chloromethyl) Ether
Coal Tar Pitch Volatiles
1. 2-Naphthylamine
Toluene Diisocyanate
Radioactive Products of Uranium
Mining (Gaseous and Particulate)

Benzidine and Its Salts
Carbon Tetrachloride

¹According to NIOSH, this criterion was developed in conjunction with the Bureau of Mines, Department of the Interior, in implementing the Federal Coal Mine Health and Safety Act of 1969.

APPENDIX I,

2. Ozone
Sulfur Dioxide
Tin and Compounds

Chromium Compounds
Dichlorobenzidine
3. Oxides of Nitrogen
Sodium Hydroxide
Sulfuric Acid

Carbaryl
Chloroform
4. 4-Dimethylaminoazobenzene
Nitric Acid
Toluene

Ammonia
beta-Propiolactone
5. Epoxy Resins
Methylene Chloride
4-Nitrodiphenyl

Asphalt Fumes
Ethylene Dichloride
6. Fluoride and Hydrogen Fluoride
Polychlorinated Biphenyls
Tetrachlorethylene

2-Acetylaminofluorene
Chlorobenzene
7. Methylene Bisphenyl Isocyanate (MDI)
Phosgene
Trichloroethane

Acetone
4-Aminodiphenyl
8. Dieldrin
Malathion
N-Nitrosodimethylamine

Aniline
Copper and Compounds
9. Cyanides
Styrene
Zinc and Compounds

- Chlorine
- Formaldehyde
- 10. Manganese and Compounds
- Phenol
- Platinum and Compounds

- Acrolein
- Aluminum and Compounds
- 11. Carbon Disulfide
- Methyl Ethyl Ketone
- Vinyl Chloride

- Creosote
- Methyl Chloride
- 12. Nickel and Compounds
- Phosphorus and Compounds
- Tetrachloroethane

- Acrylonitrile
- 2, 4-Dinitrophenol
- 13. Magnesium and Compounds
- Methyl Alcohol
- Paraffin

- Ammonium Nitrate
- Cold Stress
- 14. Dioxane
- Fluorine
- Microwaves

- Hydrogen Chloride
- Ethyl Benzene
- 15. Nitroglycerin
- Vibration
- Xylene

- Methyl Butyl Ketone
- Mineral Spirits
- 16. Oil Mists
- Selenium and Compounds
- Turpentine

APPENDIX I

- Arsine
- Gasoline
- 17. Kerosene
- Iron and Compounds
- Petroleum Naptha

- Barotrauma
- Cresol
- 18. Paraquat
- Portland Cement
- Talc

- Carbon Black
- Coherent Energy (Laser Radiation)
- 19. Ethylene Oxide
- Impact Noise
- Proteolytic Enzymes

Source: NIOSH.

USES AND EFFECTS OF 14 CANCER-CAUSING SUBSTANCES

2-acetylaminofluorene was patented for use in the United States as an insecticide in 1940. Studies of its toxicity, however, showed it to be carcinogenic in rats and this precluded the commercial insecticidal use of acetylaminofluorene, although it was used briefly as a drug. The chemical is currently employed in investigating the mechanisms of cancer production. Scientific studies have shown that experimental animals develop tumors of the urinary bladder and liver following continued ingestion of acetylaminofluorene.

4-aminodiphenyl (PAB) is an intermediate in the dye industry and was formerly important commercially as a constituent of plastics and rubbers, and in resins and solvents.

PAB is frequently produced as an impurity during the manufacture of diphenylamine, which is used primarily in the manufacture of dyes and explosives. It is also used as a detection tool for sulfates and in cancer research. Production of diphenylamine has increased greatly in the last 30 years.

PAB has been associated with the development of bladder cancers in employees exposed to it.

Benzidine is important in the chemical and dye industries, more than 250 dyes are derived from it. Hospitals and laboratories employ benzidine in blood tests and as a stain in microscopy. Benzidine sulfate is used in organic synthesis, benzidine yellow is employed in the production of printing inks, linoleum and floor tiles, plastics and rubber.

In 1966 four manufacturers in the United States were responsible for the production of 1,251,000 pounds of benzidine hydrochloride. Investigators have found that the incidence of bladder tumors in employees exposed to refined benzidine was significantly higher than those found or expected in the general population. Other studies also present evidence that benzidine has caused bladder tumors among employees exposed to it.

Bis (chloromethyl) ether (BCME) is widely used in the laboratory for organic syntheses, in the treatment of textiles, the fabrication of polymers, in the preparation of resins, and as a solvent for polymerizing reactions. Scientific studies have shown that BCME causes tumors to develop in the lungs of experimental animals.

Chloromethyl ether is used industrially as a methylating agent and is known to cause skin and lung cancer in experimental animals.

3,3'-dichlorobenzidine is a grey to purple crystalline solid which is used as an intermediate in the production of dyes. Also, dichlorobenzidine is a useful detection tool for gold. According to the U.S. Tariff Commission, 3,365,000 pounds of 3,3' dichlorobenzidine base and its salts were produced in the United States in 1970.

o An investigator has reported high incidences of bladder tumors in employees exposed to dichlorobenzidine, although these workers were also exposed to benzidine.

4-dimethylaminoazobenzene, a dye known as "Butter Yellow", was formerly listed as a food color by the Food and Drug Administration. It is currently used as an indicator to detect hydrogen chloride in gastric juice, as an indicator for acids, alkalies, and peroxidized fats, as well as to detect neutralized milk. Numerous scientific reports have clearly established the cancer causing property of this substance for experimental animals. These studies caused the Food and Drug Administration to disallow the continued use of 4-dimethylaminoazobenzene as a food color.

Ethyleneimine and its derivatives have numerous uses as industrial alkylating agents. Scientific studies have shown that this substance produces pulmonary tumors in experimental animals.

4,4'-Methylenebis (2-Chloroaniline) is a scientifically proven cancer causing agent in experimental animals. Lung cancer and liver cancer usually occur in experimental animals exposed to this substance.

Alpha-naphthylamine is an isomer of the more potent beta-naphthylamine and has produced several different tumors in experimental animals.

Beta-naphthylamine (BNA) is used in the production of dyes and is commonly present as an impurity in them. BNA was used in England until the 1950's. Use of the chemical in the United States was not abandoned until April 1972.

The hazard associated with the manufacture and use of BNA is probably one of the best known and well documented in the field of industrial hygiene. Statistical and scientific proof exists which shows that BNA produces a significant incidence of bladder tumors among employees exposed to it. Investigators have also concluded that the manufacture of BNA is the most hazardous occupation in the dyestuffs industry. Switzerland, Great Britain, and the State of Pennsylvania have banned manufacturing of BNA although Pennsylvania has now instituted a permit system for its manufacture in closed systems.

4-nitrodiphenyl is a dye intermediate used in the production of 4-aminodiphenyl. It was important commercially as a constituent of plastics and rubbers. This substance has definitely been proven to have produced bladder cancer in humans.

N-Nitrosodimethylamine (DMN) is used in rubber vulcanization, in the preparation of textile fibers and in the synthesis of 1,1-dimethylhydrazine (a rocket fuel).

The World Health Organization reports that there are patents for the use of DMN as a solvent in the fiber and plastics industry, as an antioxidant, a softener for copolymers, an additive for lubricants and in condensers and as a nematocide.

DMN has been found to produce tumors of the liver, kidney, and lungs of experimental animals.

Beta-propiolactone (BPL) is used in synthetic chemical reactions and for modification of carbohydrates. BPL also has been demonstrated to have strong virucidal, bactericidal, and fungicidal properties, and for these reasons it is used to disinfect operating rooms, hospital rooms, and

APPENDIX II

research-animal cages Also, it is used to sterilize grafts, plasma, and surgical instruments and is added as a virucidal or inactivating agent to certain vaccines.

Scientific studies have shown that BPL produces skin tumors in experimental animals

Source NIOSH.

GAO note On May 3, 1973, the Secretary of Labor issued a temporary standard for all the cancer-causing substances listed above.

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