CHAPTER 47

SAFETY

Frank E. Bird, Jr.

HISTORICAL PERSPECTIVE

Neil Armstrong's first step on the lunar surface on July 20, 1969, climaxed the stunning success of one of the greatest scientific achievements ever accomplished by man to that date. What made the Apollo XI program possible was a combination of loss control disciplines and engineering skills that brought about the design and assembly of the most reliable flight products ever produced. Of all contributions to this success, the application of a system approach was probably the overriding key. At all stages of design, manufacture and operation, the man-machine-environment sub-systems were considered as interrelated, interdependent components of the overall system.

The meaning of safety in aerospace no longer represented the simple "freedom from hazard for man" as defined by Webster in the intercollegiate dictionary. Safety had come to mean "freedom from the man-machine-media interactions that result in: damage to the system, degradation of mission success, substantial time loss or injury to personnel." In effect, the desire to insure the gross safety of the system and the ultimate mission's success brought about a level of total safety confidence never before realized in the annals of industrial management.[1]

With the accomplishments of space safety achievements well known, it is appropriate to take a brief look backward at the occupational safety movement to understand in part the direction taken in the past. The compensation-oriented specialist, largely influenced by attention focused on the appalling rate of death and disability associated with machinery and equipment, concentrated his attention on the man sub-system, with traumatic *injury prevention* as his primary target. To the early safety practitioner, the terms "accident" and "traumatic injury" were almost synonymous. While occupational disease, fire and property damage control were philosophically associated with industrial safety, actual accident prevention practices were largely devoid of these considerations.

Without doubt, the injury-oriented safety approach, with its concentration on the sources of trauma, brought about a tremendous reduction in death and disabling injury over the years, as discussed in the next section of this chapter. However, failure to recognize the total safety interrelationships of the occupational system's man-equipment-material-environment components has created other major problems, resulting in unprecedented pressures and controls on industry by external agencies. Products liability, air, stream, and noise pollution are some of today's major problems highlighting the need to put loss control programs in tune with technological advances of our space age.

With this historical perspective in mind, let us set the stage by discussing the terms "safety" and "accident" as they are considered by an ever increasing number of safety leaders today. The word "safety," as used by loss control specialists, has broadened considerably in recent years because of the space age influences mentioned earlier. It has more appropriately come to mean "freedom from man-equipment-material-environment interactions that result in accidents." Similarly, the practical application of the term "accident" has also evolved to the broader meaning of "an undesired event resulting in personal physical harm, property damage or business interruption." The meaning of physical harm in this definition includes both traumatic injury and disease as well as adverse mental, neurological, or systemic effects resulting from workplace exposures.[2] Attention has been focused on the need to consider the "accident" as a "contact" with a source of energy (electrical, chemical, kinetic, thermal, ionizing radiation, etc.) above the threshold limit of the body or structure; or contact with a substance that interferes with normal body processes.[3]

Advocates of this view point out that the term "accident" is purely descriptive and has little etiological connotation in its use, while association with the word "contact" as used above gives more specific direction to control methodology. Utilizing this line of thinking, safety program activities can be directed at the PRE-CONTACT, CONTACT or POST CONTACT stages of accident or loss control. For optimum results, the modern safety specialist will design his program to include considerations at all three levels of the control process, with a logical concentration of effort at the PRE-CONTACT stage. As we consider the broader implications of these newer meanings of "safety" and "accident" we more clearly see the important relationship of the safety and environmental health disciplines and the increased import of interface between related specialists.

THE LOSS PROBLEM: THE HUMAN SIDE

Death and Disability

While accidental injury rates in American industry have decreased through the years, the death and disability loss problem remained gross enough as late as 1970 that our nation selected occupational safety as a major legislative target.

In 1970, occupational accidents claimed the lives of 14,200 workers and injured 2,200,000 people to the extent they were unable to return to work the day following their injury.

To express the general trends over the past 35 years, the death and disabling injury rates from 1945 to 1970 are shown in Table 47-1.

TABLE 47-1.
Statistics on Work Fatalities and Disabling Injuries

Year	Employed Labor Force (millions)	Fatalities	Fatalities Per 100,000 Workers	Disabling Injuries	Injuries Per 100,000 Workers
1945	53	16,500	32	2,000,000	3,788
1950	60	15,500	27	1,950,000	3,211
1955	63	14,200	23	1,900,000	3,055
1960	66	13,800	21	1,950,000	2,964
1965	71	14,100	20	2,100,000	2,954
1970	80	14,200	18	2,200,000	2,824

THE LOSS PROBLEM: THE ECONOMIC SIDE

Injury Costs

The National Safety Council estimated that wage losses of workers due to accidents in 1970 were $1,800,000,000, while related insurance administrative costs were approximately $1,300,000,000 and medical costs, $900,000,000. In addition, other costs such as the money value of time lost by workers (other than those with disabling injuries) who are directly or indirectly involved in accidents, and the value of the time needed to investigate accidents and write up accident reports amounted to the tidy sum of $4,000,000,000.[2]

Other Costs

The number of legal suits involving accidents of people on the premises of the businessman, and product defects that resulted in injury, mushroomed in the past five years, presenting management with another big loss drain that exceeded $885,000,000 in 1970.

Sources such as industrial associations and insurance records available on limited types of property damage, lead to the conservative estimate that building damage, tool and equipment damage, product and material damage, production delays and interruptions resulted in over $4,500,000,000 during 1970. Fire property damage alone added another $1,100,000,000 making a total property damage loss of $5,600,000,000 for 1970.[4]

Total Accident Costs

The economic drain from accident losses is summarized in Table 47-2 as conclusive evidence of the tremendous loss problem faced by industrial America.

THE LOSS PROBLEM: SOURCE OF WORK INJURIES

The majority of injuries that cause workers to lose time but do not result in death, permanent total, or partial disability are referred to as temporary total injuries. State labor departments report that nearly half of this large group of compensable work injuries result from two major sources — handling objects and falls. On the other hand, machinery accidents account for only 6 percent of the temporary total injuries, but give rise to 19 percent of the injuries that cause permanent partial disability. This fact clearly indicates why emphasis on mechanical safeguarding and the elimination of catch points on moving machinery should be given emphasis in any safety program. The motor vehicle is as much a culprit on-the-job as it is off-the-job, and accounts for 18 percent of fatal, permanent total cases but only a very small percent of the permanent partial and temporary total injuries.

The chart below reveals the major sources of work injuries by their severity types.[5]

TABLE 47-2.
1970 Accident Losses

Workers' loss of wages	$1,800,000,000
Insurance administrative costs	$1,300,000,000
Medical Costs	$ 900,000,000
Other costs related to above (time lost, investigation time, etc.)	$4,000,000,000
Liability costs	$ 885,000,000
Property damage costs (including fire loss)	$5,600,000,000
Total loss	$14,485,000,000

TABLE 47-3.
Source of Compensable Work Injuries

Source of Injury	All Cases % of Cases	Fatal Permanent Total % of Cases	Permanent Partial % of Cases	Temporary Total % of Cases
Total	100.0%	100.0%	100.0%	100.0%
Handling objects, manual	22.6	13.9	9.6	28.5
Falls	20.4	17.4	18.5	21.2
Struck by falling, moving objects	13.6	9.3	19.3	11.1
Machinery	10.2	3.1	19.2	6.3
Vehicles	7.1	20.7	7.1	6.9
Motor	5.0	18.0	4.3	5.2
Other	2.1	2.7	2.8	1.7
Stepping on, striking against objects	6.9	2.3	5.6	7.6
Hand tools	6.1	1.5	8.1	5.3
Elec., heat, explosives	2.5	7.7	2.2	2.6
Elevators, hoists, conveyors	2.2	3.6	3.8	1.5
Other	8.4	20.5	6.6	9.0

Source: Reports From State Labor Departments
Tables 1, 2 and 3 from National Safety Council "Accident Facts" 1972, Chicago, Illinois.

THE PRE-CONTACT STAGE OF ACCIDENT CONTROL

In considering the "accident" as a "contact" with a source of energy above the threshold limit of the body or structure, it is logical that sufficient effective action at the pre-contact stage of accident control could prevent most accident contacts from happening. Such action would eliminate the very potential for personal harm or property damage.

Recognizing that it is neither economically feasible nor practical to prevent all exposures to accident sources, action at this stage of loss control could include considerations to reduce or minimize the effects of such contacts at other stages in the loss process if and when they were to occur. A well-organized modern safety program would place great emphasis on such activities as good facility inspections, safety rules and regulations, group safety meetings, supervisory training, general promotion, hiring and placement practices, job analysis, job observation, skill training, personal communications, work standards, design engineering and maintenance and purchasing standards.

Since space does not permit a discussion of each of these and other important pre-contact stage program activity areas, the author has chosen the representative few that follow. They indicate well the need for a close inter-relationship of the safety and environmental health disciplines, and clearly highlight the enormous benefits of extended efforts at the pre-contact stage of accident control.

Facility Inspection

Why Inspect for Hazards? Every piece of equipment will wear out in time. Even with ideal care and usage, normal deterioration is inevitable. Materials and tools may be placed in unsafe positions or they may be abused and damaged.

While one can speculate that a perfect preventive maintenance engineering program should negate these problems, the question is, "Who has one?" Unless hazardous conditions are steadily "drained off" by regular hazard inspections, the average plant is continually "flooded" with hazards or sources of accidental contacts that have potential for personal harm and property damage.

The Occupational Safety and Health Act of 1970 has the purpose ". . . to assure as far as possible every man and woman in the nation safe and healthful working conditions and to preserve our human resources . . ." The Act also says that each employer ". . . shall furnish to each of his employees employment and a place of employment which are free from recognized hazards . . ."

It would seem appropriate at this point to define the word "hazard" as a *potential source of harmful contact*. The word harmful in this context includes traumatic injury and occupational disease exposures; adverse mental, neurological or systemic effects; and property damage.

While inspections may be of the FORMAL or INFORMAL variety, the formal type provides management with the most effective tool for the systematic detection and correction of hazardous conditions.

What to Inspect. Although every plant has different operations, equipment and physical layouts, there are certain important items that are quite common to most and deserve special mention. The following list presents the major categories of items that one should generally consider in making a safety inspection.

1. Atmospheric Conditions: Relates to dusts, gases, fumes, vapors, illumination, etc.
2. Pressurized Equipment: Relates to boilers, pots, tanks, piping, hosing, etc.
3. Containers: Relates to all objects for storage of materials, such as scrap bins, disposal receptacles, barrels, carboys, gas cylinders, solvent cans, etc.
4. Hazardous Supplies and Materials: Relates to flammables, explosives, gases, acids, caustics, toxic chemicals, etc.
5. Buildings and Structures: Relates to windows, doors, aisles, floors, stairs, roofs, walls, etc.
6. Electrical Conductors and Apparatus: Relates to wires, cables, switches, controls, transformers, lamps, batteries, fuses, etc.
7. Engines and Prime Movers: Relates to sources of mechanical power.
8. Elevators, Escalators and Manlifts: Relates to cables, controls, safety devices, etc.
9. Fire Fighting Equipment: Relates to extinguishers, hoses, hydrants, sprinkler systems, alarms, etc.
10. Machinery and Parts Thereof: Relates to power equipment that processes, machines or modifies materials, e.g., grinders, forging machines, power presses, drilling machines, shapers, cutters, lathes, etc.
11. Material-Handling Equipment: Relates to conveyors, cranes, hoists, lifts, etc.
12. Hand Tools: Relates to such items as bars, sledges, wrenches, hammers as well as power tools.
13. Structural Openings: Relates to shafts, sumps, pets, floor openings, trenches, etc.
14. Transportation Equipment: Relates to automobiles, trucks, railroad equipment, lift trucks, etc.
15. Personal Protective Clothing and Equipment: Relates to items such as goggles, gloves, aprons, leggings, etc.[6]

Detection System Components

The specific hazards and unique aspects of each industrial operation require the safety specialist to adopt a system of formal hazard detection that best meets his specific requirements. While there may be tremendous variation in his methods, he should attempt to fulfill two essential objectives. The first is to see that certain special items or parts are inspected at a frequency in accord with the criticality of the item to prevent hazardous conditions of significant severity. These special items or parts are frequently referred to as *critical parts* and could include such items as:

gear covers	shafts
workpoint guards	chains
railings	cables
safety valves	wires
limit switches	handles
stand-up switches	eyebolts
speed controls	lifting lugs
gears	grind wheels
cables	drill points
foundations	cutting points
belts	steps — rungs
drives	brackets

Special inspections of critical parts are usually much more frequent than general inspections and may be handled differently, even within the same plant. Frequently there are several different forms and inspection methods to meet the unique problems associated with the use and application of items being inspected.

The second important objective in any good program is to conduct regular, thorough general inspections of the entire facility. Several key guideposts essential to accomplishing this goal are as follows: (1) the critical parts inspection program for an area, or a checklist of hazards common to the area, should be reviewed before starting; (2) previous inspection reports should be reviewed carefully to help familiarize an inspector with all related problems in the area; (3) a good inspector will look for off-the-floor and out-of-the-way items as well as those right on the beaten track; (4) the good inspector will be methodical and thorough, and his notes will clearly describe specific hazards and their exact location; (5) a good inspector will classify each hazard by its "potential and loss severity" to aid management in its remedial decisions (see hazard classification below); (6) the good inspector will lend appropriate emphasis to those hazards (class "A") with imminent chance for loss of life or body part, seeking intermediate temporary remedy for these "critical" hazards immediately and diligently following up their permanent remedy promptly after his inspection is complete.

Hazard Classification

While a system of hazard classification has been used successfully by fire engineers for many years, application of this specific technique in general industry is relatively new. The extensive successful use of this tool in the aerospace program has unquestionably provided the motivation for its rapid adoption by an increasing number of companies in general industry. Since hazards do not all have the same potential for causing harmful effects, it is logical that a system for classifying them by their degree of probable loss severity potential can have considerable value. The following simple classification system has proven quite successful and is very similar to the one used by OSHA inspectors to assist them in establishing the gravity of violations:

Class "A" Hazard — A condition or practice with the realistic potential for causing loss of life or body part, permanent health disability, or extensive loss of structure, equipment, or material.

Example 1: Barrier guard missing on large press brake used for metal shearing operation.

Example 2: Maintenance worker observed in unventilated deep pit with running gasoline motor servicing large sump pump.

Class "B" Hazard — A condition or practice with potential for causing serious injury or illness resulting in temporary disabilities, or property damage that is disruptive but less severe than class "A".

Example 1: Slippery oil condition observed in main aisleway.

Example 2: Broken tread at bottom of office stairs.

Class "C" Hazard — A condition or practice with probable potential for causing non-disabling injury or illness or nondisruptive property damage.

Example 1: Carpenter without gloves observed handling rough lumber.

Example 2: Worker complained of strong odor from rancid cutting oil circulating in large lathe at north end of shop.

Classifying hazards into these three categories helps to put remedial planning in proper perspective, aids in motivating the action of others on the more serious conditions, and focuses hazard control attention on the critical areas requiring the greatest concentration of time, effort and resources.

Job Analysis

Job analysis[7] is a tool that enables the supervisor to teach and direct his employees systematically in order to obtain optimum job efficiency. Since efficiency demands maximum use and control of the men, equipment, machines and environment involved in any job, the potential sources of traumatic injury and environmental health exposures are evaluated along with all other factors associated with production and quality control. Once completed, a good job analysis provides the blueprint to teach any worker how to do a critical job the safe, productive way. The actual preparation of a job analysis provides another enormous opportunity to *detect* actual or potential sources of occupational injury or health problems at the pre-contact stage of accident control.

Methodology. Jobs that are determined to be serious risks to safety, quality or production become the "critical few" first targets for analysis. Selection may be based on the frequency or severity of past loss history or the potential for loss. The regular maintenance and updating of the analysis is an important aspect of any job analysis program. A job analysis is best prepared by actual observations of a worker or workers doing the job. When infrequently performed jobs prevent the observation method of conducting a job analysis, the technique of group discussion can be employed as an alternative.

The four basic steps in conducting a job analysis are: (a) determining the job to be analyzed, (b) breaking the job down into a sequence of steps, (c) determining key factors related to each job step, and (d) performing an "efficiency check." The final step involves determining that each step of the job is done in the best and most efficient way. This final step frequently involves a job procedure or methods change, a job environment change or a technique to reduce the number of times the job must be done. The savings alone that result from the accomplishment of this step have consistently proved to be justification for introduction of the program.

JOB ANALYSIS Instruction Standard	DIVISION: Engineering	JOB ANALYZED: Painting a Chair
	DEPARTMENT: Maintenance	DATE EFFECTIVE: Nov. 1, 1970
	OCCUPATION: Painter	CODE NO. EM-72

SEQUENCE OF STEPS (NOT TOO FINE OR TOO BROAD)	KEY QUALITY OR PRODUCTION FACTORS (CLEARLY TELL WHAT TO DO AND WHY)	KEY SAFETY FACTORS (CLEARLY TELL WHAT TO DO AND WHY)
1. Select work area.	1. Should be as dust-free as possible to prevent dust from sticking to painted surface while wet. This can damage finish, requiring re-work.	1. Area should be well ventilated so that toxic fumes do not accumulate, possibly causing serious illness.
2. Bring tools and supplies to work area.	2. Have all needed tools at hand before starting to avoid delay.	2. Be sure all cans of thinner, paint remover, and paint are tightly closed when not in use to minimize the dangers from fire or explosion.
3. Prepare work area.	3. Place chair on newspapers to avoid delays caused by cleaning up spills.	3. Use at least six layers of paper to absorb spilled paint remover and paint. Both of these can cause extensive damage to the floor.
4. Remove old paint from chair with paint remover.	4. Be sure all paint is removed from cracks and crevices so final finish will be uniform. Otherwise, re-sanding may be necessary to smooth out rough surfaces.	4. Follow directions on paint remover container and do not allow smoking or open flame in area to prevent fire or explosion.
5. Sand chair with sandpaper.	5. Sand all surfaces with 00 sandpaper until smooth to the touch for best results. Wipe off dust. Dust left on surface will make finish rough, requiring re-sanding.	5. Gloves should be worn while sanding to prevent abrasions and splinters.
6. Apply first coat of paint.	6. Coat of paint should be light and applied with even strokes to minimize brush marks for most attractive results.	6. Follow directions on paint container. Same as #4, NO SMOKING OR OPEN FLAME.
7. Apply second coat of paint.	7. Same as #6.	7. Same as #6.
8. Clean up area and tools	8. Clean brushes thoroughly in paint thinner; then shake out thinner. Paint left in brush can ruin brush for further use if it is allowed to harden.	8. Dispose of all papers and wipe any spilled paint from floor or other surfaces. Papers left on floor can present fire or tripping hazards.
9. Store tools and supplies.	9. Brushes should be hung up by the handle to keep weight off the bristles. The weight of the brush on the bristles can deform them and ruin the brush.	9. All paint, thinner, and remover must be tightly sealed both to preserve them and to prevent escape of fumes which could cause fire or explosion.

International Safety Academy, Macon, Georgia.

Figure 47-1. Job Analysis — Instruction Standard (Form)

There are two basic approaches in doing a job analysis. One that has been used extensively in the past is the "Job Safety Analysis" technique that produces an end product dealing purely with safety. While there are unquestionable merits for treating this important subject in this manner, the author personally favors the complete approach referred to as "Proper Job Analysis," "Total Job Analysis" or just plain "Job Analysis," as the individual plant designates. This latter approach seems to have more appeal to management people at all levels, since it is based on the new concept of safety as one of the many inseparable parts of the supervisor's job. Figure 47-1 is an example of this approach.

Benefits. While there are many benefits that come with a Job Analysis program, none is more important than the peace of mind that a concerned management group has in knowing that it has provided a tool to insure that the actual potential sources of traumatic injury and environmental health exposures have been carefully analyzed and evaluated for all critical jobs.

Where complete elimination of hazards detected is not economically feasible or practical at the time a job analysis is accomplished, the completed job analysis provides the guidelines to accomplish the job safely by following the clearly defined method of procedure.

Engineering Controls

Most hazardous conditions can be predicted or anticipated at the design, purchase, maintenance or work-standard development stages of plant operation. Unsafe conditions, such as inadequate guards and devices, inadequate warning systems, fire and explosion hazards, projection hazards, congestion and close clearances, hazardous atmospheric conditions, and inadequate illumination or noise are good examples of the more common causes of accidents that can be prevented by effective engineering at the pre-contact stage of accident control.

Control Points. The design engineer naturally becomes a key to the control of hazardous conditions in any plant. Local standards that require the interface of engineers with safety and environmental health specialists at all stages of facility or equipment design and development provide the best avenue to prevention or control of potential injury or health problems at the point of optimum effectiveness. Additional local standards requiring the approving signature of safety and environmental health specialists on all drawings or plans increase the possibility that proper consideration was given this important subject.

In addition to all other guides suggested or required by the state, local government, associations, and local plant establishments, the Occupational Safety and Health Act of 1970 provides the engineer with a comprehensive source of minimum required standards.

The person(s) or department responsible for the purchase of materials/products/equipment also plays a major role in hazard prevention and control. Again, closely organized formal contact between purchasing personnel and those responsible for safety and health management at all stages of purchasing, planning and acquisition becomes a very important key to accident control. The required use of safety data sheets by suppliers on all materials with potentially hazardous properties can be an effective guide to decision-making in purchases, as well as provide local specialists with valuable information to develop safe-practice guides when the use of such potentially hazardous material cannot be avoided.

Maintenance and industrial engineering personnel are also among the vital few who play so important a role in the creation and control of a safe and healthful industrial environment. Local standards requiring safety and health considerations in all phases of related work activities must be designed into the job commitments of these key people. Safety and health personnel can maintain control of such standards by periodic audits and required approvals on such items as work permits and job standards being created.

Minimize Loss by Energy Control. Engineering considerations at the precontact stage can be directed toward the control of the energy exchange that could cause personal harm or property damage. Some of the various avenues open to prevent injurious loss through this means are:

1. Eliminate a potential injurious energy type by substitution or use of an alternative source; e.g., use of electrical motors instead of shafts and belts in powering machinery, or use of a solvent with a higher TLV than the one proposed.
2. Reduce the amount of energy used or released; e.g., reducing the temperature of a hot water system to reduce the danger of scalds to personnel in shower rooms, or slowing the speed of vehicles in a plant by periodic bumper pads in the road.
3. Separate the energy from persons or property that could be exposed by time or space; e.g., barricaded and locked safety space provision around radioactive isotope usage, or placing electric power lines outside of a building in a less accessible location.
4. Interpose barrier between energy and people or property potentially exposed; e.g., personal protective equipment, bumper guard on loading dock, cement base guard on column, or insulation on noise-emitting machine.[8]
5. Modify the contact surfaces of materials or structures to reduce injurious effects to people or property; e.g., placement of shock absorbing material on low ceiling point of stairway to minimize risk of head injury.
6. Strengthen the animate or inanimate structure to support the energy exchange; e.g., program of weight control and physical conditioning for railroad conductors to prevent spraining ankles while getting on and off moving cars, or reinforcing railroad cars to resist loads dropped on cars accidentally during crane handling.[9]

THE CONTACT STAGE OF ACCIDENT CONTROL

The safety or health specialist must be constantly alert to needs and applications of the principles of deflection, dilution, reinforcement, surface modification, segregation, barricading protection, absorption and shielding at the contact stage of accident control. While many applications of these principles are visually anticipated and provided for through effective engineering at the pre-contact stage, many others will escape the average system's design considerations. One must also keep in mind that the energy exchanges involved with normal wear and tear, as well as abnormal usage, will require continual repair and replacement of related materials, structures or equipment. The use and application of personal protective equipment provides one of the best examples of safety countermeasures at this stage of accident control.

Personal Protective Equipment

Four important considerations deserve special attention when the decision has been made that a need exists for personal protective equipment.

1. Selection of the proper type of protective device.
2. Employee fitting of the equipment and instruction on its proper use.
3. Enforcement of standards created.
4. An effective system of equipment sanitation and maintenance.

Proper selection involves a determination of the degree of protection desired, the practicality of its application for the job, the acceptance by the worker, as well as the elements of maintenance and cost. Of course, we must always be conscious that equipment selected meets the required standards of performance. Manufacturers whose products meet the standards of the Bureau of Mines and/or N.I.O.S.H., the National Fire Protection Association, American National Standards Institute and other standards organizations, will usually include an approval marking or label on the product.

To assure proper use, one should make sure that workers understand why protection is necessary, so they will *want* to use it. In addition, special attention should be given to the ease and comfort with which it can be used, so that it *will* be used. Personal protective equipment can be misused or disused to varying degrees depending on a variety of program factors. It, therefore, behooves the safety and health specialist to constantly recognize that this approach to hazard control should always be secondary to a sincere effort to eliminate the exposure. For additional coverage of this subject the reader is referred to Chapter 36 on "Personal Protective Devices."

Eye and Face Protection. Eye and face protection is required by the Occupational Safety and Health Act of 1970 ". . . . where there is reasonable probability of injury that can be prevented by such equipment." Some of the typical operations where eye hazards exist are the pouring or handling of molten metals or corrosive liquids, cutting and welding, grinding, milling, chipping, sand blasting and electric welding. It is not only necessary for the operator to wear such protection, but it may also be required by any person near the operation, including other workers, supervisors, or visitors. The ANSI Standard Z87 gives specifications for design as well as functional requirements. Specifications are given for types providing impact protection against flying objects, those providing protection against fine dust particles or liquid splashes, and those providing protection against glare, injurious radiation and impact.

Respiratory Protection. The Occupational Safety and Health Act of 1970 (OSHA) requires respiratory protection for the control of occupational hazards caused by breathing air contaminated by harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors which cannot otherwise be kept from contact with people. The potential extent of health problems that occur from misuse or disuse of respiratory equipment is so severe that every engineering means possible should be exhausted to avoid personal contact with harmful air contaminants.

When necessary, selection of respirators should be according to the guidance of the American National Standard Practices for Respiratory Protection Z88.2-1969. Some respirators are used to purify the air from contaminants, while others are used to supply fresh air to the worker. Selection involves the nature of the operation or process and the nature of the air contaminant, its concentration, and its physiological effects upon the body. One should also remember that some air contaminants can affect the skin, too, providing a double hazard. Other factors to consider include length of the exposure and the length of time the protective device must be worn.

Work in hazardous locations (such as tanks) requiring respirators to supply fresh air requires special safety precautions. For instance, in the event of equipment failure, it is essential to know the time required for escape, and the procedure for emergency escape. Standards also include the requirements for additional men to be present for special communication arrangements, and for the availability of rescue equipment and personnel in areas where self-contained breathing apparatus is used in atmospheres immediately hazardous to life or health.

Other Protective Devices. OSHA states that "Helmets for the protection of heads of occupational workers from impact and penetration from falling and flying objects and from limited electric shock and burn shall meet the requirements and specifications established in American National Standard Safety Requirements for Industrial Head Protection Z89.1-1969" and that "Safety toe footwear for employees shall meet the requirements and specification in the American National Standard for Men's Safety Footwear Z41.1-1967."

The Occupational Safety and Health Act also refers to ANSI Standards for rubber insulating gloves, rubber matting to be used around electrical apparatus, rubber insulating blankets, and rubber insulating sleeves to protect people working around electricity.

A wide variety of additional protective devices of special material is available and includes aprons, jackets, leggings and coats for protection against heat and splashes of hot metal in operations such as steelmaking and welding. Special protectors have been designed for almost all parts of the body, to protect against cuts, bruises and abrasions. Many types of hand and arm protectors are available. The material used in gloves depends upon what is being handled.

Impervious clothing is available to protect against toxic substances, dusts, vapors, moisture, and corrosive liquids. It ranges from aprons, bibs and gloves to full garments containing their own air supply. Natural rubber, neoprene, vinyl and other plastics are used to coat material used in this equipment.

By taking all the necessary steps to select, fit, enforce and maintain an effective personal protective equipment program, the safety or health specialist will have taken another giant step at the contact stage of accident control to prevent traumatic injury and environmental health problems.

THE POST-CONTACT STAGE OF ACCIDENT CONTROL

There is a tremendous reservoir of information to prove that the severity of losses involving physical harm and property damage can be minimized by the application of one or more countermeasures at the post-contact stage of accident control. These could include prompt first aid and rehabilitation in cases of physical harm, and prompt reparative action and salvage in cases of property damage.[10]

In addition to these countermeasures, the prompt investigation of any accident loss provides a significant opportunity to prevent similar future losses by remedying the causes involved. Emergency care and accident investigation are briefly discussed below, and represent two major post-contact measures to control accident losses.

Emergency Care

The logic of utilizing prompt emergency care as an effective countermeasure to reduce death and disability in industry is supported by many occupational medicine specialists. There is no way of knowing how many lives might have been saved last year had this care been more readily available. When we consider that one in every four disabling injuries involved some permanent loss of body part, the importance of this vital subject becomes even more evident. Expert consultants returning from Viet Nam have publicly asserted that, if seriously injured, their chances of survival would be better in the zone of combat than in most American cities. Excellence of prompt emergency care proved to be the major factor in the phenomenal decrease of death rates for battle casualties who reached medical facilities from 4.5% in World War II to less than 2% in Viet Nam.[11]

The author suggests that the size of the death-and-disability problem in American industry justifies a much greater concentration of attention by everyone on this important post-contact accident control countermeasure. The emergency care requirements listed below are suggested as *minimum* for any general industrial establishment.

1. The existence of a properly-equipped central first aid area for the treatment of all general injuries.
2. The presence on all shifts of certified first aid attendants or medical professionals.
3. The existence and organization of a plan for handling serious or unusual cases.
4. The provision for assistance of a medical specialist to treat specific types of injuries.
5. The existence of an established, trained rescue or ambulance team on each shift.
6. The existence of an in-plant training program for key employees in urgently-necessary first aid cares.
7. Adequate distribution on the premises of "critical" first aid supplies to meet needs required by special exposures.

Authoritative sources give strong indication that a soon-to-be-released comprehensive study of first aid training and its effects on safe behavior, made in Toronto, Canada, will prove a significant correlation between the two. In effect, it is believed that this research will reveal that first aid training has significant value in the prevention of accidents and should be employed as a strong motivational factor in pre-contact accident control.

Accident Investigation

An accident investigation report is basically the supervisor's analysis and account of an accident, based on factual information gathered by a thorough and conscientious examination of all factors involved.

The time for accident investigation is always *as soon as possible.* The less time between the accident and the investigation, the better and more accurate the data which can be obtained. Facts are clearer, more details are remembered, and the conditions are nearest those at the time of the accident. Accident investigation report forms may differ from company to company, but the information they seek is fairly standard. An increasing number of companies use forms that provide a selection of numbered choices in the causal and remedial sections. Forms such as these are designed to minimize the amount of writing by the supervisor and to facilitate computerization of the data for analysis. The form displayed in Figure 47-2 at the end of this chapter is representative of the more common ones. The author would like to emphasize that many forms captioned "Accident Report" are really injury investigation reports. Their very design prohibits their use as a tool to gain valuable information on other accidents resulting in costly property damage that under slightly different circumstances could also have involved personal injury.

Obtaining Good Data

Reporting Cooperation Essential. No matter how conscientious a front line supervisor might be, he cannot investigate an accident unless he is aware of it. Since most accidents do not result in the dramatic "big loss," it is not difficult for workers to hide a large quantity of valuable data that

SUPERVISOR'S ACCIDENT INVESTIGATION REPORT

COMPANY OR BRANCH: Eastern Packing Company	DEPARTMENT: Shipping
EXACT LOCATION: Bldg-H, South side, West loading dock	DATE OF OCCURRENCE: 3-7-69 · TIME: 2:45 ☒ AM ☐ PM · DATE REPORTED: 3-7-69

PERSONAL INJURY	PROPERTY DAMAGE
INJURED'S NAME: Paul F. Riley	PROPERTY DAMAGED: Lift truck
OCCUPATION: Lift truck operator · INJURED PART OF BODY: right arm	ESTIMATED COSTS: $650. · ACTUAL COSTS: $785.90
NATURE OF INJURY: Fracture of upper arm	NATURE OF DAMAGE: Mast & steering column bent
OBJECT/EQUIPMENT/SUBSTANCE/INFLICTING INJURY: Lift truck	OBJECT/EQUIPMENT/SUBSTANCE/INFLICTING DAMAGE: ground
PERSON WITH MOST CONTROL OF OBJECT/EQUIPMENT/SUBSTANCE: Paul F. Riley	PERSON WITH MOST CONTROL OF OBJECT/EQUIPMENT/SUBSTANCE: Paul F. Riley

DESCRIPTION

DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED: ATTACH ACCIDENT DIAGRAM FOR ALL MOTOR VEHICLE ACCIDENTS.

Paul was backing lift truck #26 North to clear aisleway in order for truck #22 to pass. He backed into bumping block without applying brakes causing block to break off dock resulting in his truck moving backward off dock to ground 6 ft. below on North side 35 feet from East end. Riley struck arm on truck as he attempted to jump free. He landed clear of truck on ground 6 ft. below dock.

ANALYSIS

WHAT ACTS, FAILURES TO ACT AND/OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT?

Riley reported defective brake on Operator's Report form at start of turn on 3-7-69. He removed truck from garage and operated it from 11 a.m. with defective brake. Operator was using bumping block as stopping mechanism for truck. The bumping block on the dock was in unsafe condition. Condition of block was reported on inspection reports of 1-5-69 and 2-20-69.

WHAT ARE THE BASIC OR FUNDAMENTAL REASONS FOR THE EXISTENCE OF THESE ACTS AND/OR CONDITIONS:

Employee was not properly motivated to recognize seriousness of unsafe brake condition. Garage personnel did not properly follow up condition on Operator's report form. Maintenance control failed to effect prompt corrective action to bumper block. Area supervisor failed to properly follow up unsafe bumper condition.

LOSS SEVERITY POTENTIAL			PROBABLE RECURRENCE RATE		
☒ Major	☐ Serious	☐ Minor	☒ Frequent	☐ Occasional	☐ Rare

PREVENTION

WHAT ACTION HAS OR WILL BE TAKEN TO PREVENT RECURRENCE? PLACE X BY ITEMS COMPLETED.

x Personnel dept. has been requested to assist in establishing lift truck operators' training course. Lift truck rules will be reviewed with all operators by 10-6-69. Riley will be included in both programs when he returns to work. x A statement of policy on handling of safety work orders has been issued by Vice President Matthews. x Maintenance control has issued a hazard classification coding system for use on all safety work orders. x All operators have been properly instructed not to operate equipment considered to be unsafe. x A follow-up system for inspection report items is being developed by Ad Hoc Committee headed by investigator.

INVESTIGATED BY: Ralph B. Jones	DATE: 3-7-69	REVIEWED BY: Frank K. Roberts	DATE: 3-8-69

International Safety Academy, Macon, Georgia.

Figure 47-2. Supervisor's Accident Investigation Report (Form).

could provide effective insight to prevention and control of major accident problem areas. There are many reasons why people do not report these accidents that could provide valuable and usable data. Investigators have discovered that fear of medical treatment, red tape involved with the investigation of even minor incidents, concern about spoiling the company's safety record, or fearing the wrath of irate supervisors whose group record has been blemished are some of the more frequent reasons given for hiding accident information.

Guideposts to Good Investigation. The limited coverage of this important subject precludes a discussion of many important aspects regarding the actual investigation process. Several key guideposts essential to the process of completing a thorough job of investigation are:

- The scene of an accident should be kept as undisturbed as possible.
- Whenever possible, the initial phase should be at the scene of the accident, and as promptly as possible following its occurrence.
- As applicable, someone should take photographs and/or make drawings or measurements.
- All witnesses should be interviewed, one at a time and separately, as soon as practical.
- The real purpose of the investigation should be given each witness.
- No attempt should be made to fix blame, or fault-find during the investigation.
- The investigation should be objective and avoid questions that lead to biased answers.
- Data should be recorded accurately.

Benefits

Investigation Benefits and Data Use. The primary purpose and benefit of investigation could be expressed simply as PREVENTION AND CONTROL. Proper investigation, followed by effective remedial action, eliminates causal factors that could result in future injury, damage and lost production time. Prompt and thorough investigation of all accidents is concrete evidence of concern for the worker's safety and well-being, and can be a major contribution to improved group morale.

MEASUREMENTS OF PROGRAM EFFECTIVENESS

Measurements of safety program effectiveness can be placed in three categories. The first and most familiar would be "measurements of consequence." This could include major, serious, reportable, minor or other classifications of personal injury or property damage in terms of frequency and severity rates. Measurements of consequences could also be expressed as: (a) actual loss rates, as the above would be considered, or (b) potential loss rates. An example of a measurement of potential loss would be an incident or near-loss (near-miss) accident rate.

In considering the widely used and accepted measurements of consequence, it must be remembered that these are "after-the-fact" . . . in most cases, "after-the-loss." Complete reliance on this one category of measurement frequently relegates safety program activity to one of reaction rather than preaction. There is no question that results the program is achieving must be known, but that management output is a direct result of management input must also be recognized. Measurement of both can be used effectively in a prevention and control effort. The need for good measurements of consequence must be accepted. A continual effort is required to broaden the statistical base of accident study by including an ever-enlarging group of injury, property damage and near-miss accidents. As program sophistication permits, this base should grow to include near-loss accidents (incidents) that could have resulted in the consequence of injury or damage.

"Measurements of cause" can be considered a second major category, and could take the form of actual or potential cause rates. The typical loss analysis of accident causes related to acts, conditions, or management deficiencies that resulted in loss, would best represent actual cause measurements. The results of sampling techniques applied to physical conditions or employee behavior could be classified as potential cause measurements. Any safety program activity based purely on measurement of actual causes is after-the-loss and reactive. The use of measurements of potential causes would be of substantial value, since resulting preventive activity could be instituted without the need for actual loss history.

The third classification that will receive enormous attention in the immediate future is "measurements of control." The first step in utilizing this important measurement class is to clearly define all activities in the safety program to which management gives input. Work activity areas could include hiring and selection, skill training, supervisory training, safety meetings, job analysis, job observation, engineering controls, etc. Management's safety work would vary from plant to plant, depending on the degree of program sophistication.

Assuming that a local standard or policy has been established for management's input into each of these activities, the remaining key step is to establish a method to quantify the degree of management effort in each activity area. For example, consider a hypothetical department of a plant that requires front line supervisors to investigate every accident that results in personal harm. A check at the first aid area indicates that 100 occupational injuries were treated during the previous month, and that investigation report forms were received on 69. By this actual count and comparison technique, it can be properly assumed that 69% of the required investigations were made during that month.

Measurement of control enables the safety specialist to provide his management team with a clear picture of its effectiveness in safety work activities that prevent or control loss. He is using measurements more easily understood, not necessarily dependent upon losses, suitable for inter- and intra-plant comparisons, more statistically reliable, less biased and certainly more inferential from a prevention and control standpoint.

While advantages and disadvantages can be cited for each category of measurement, the progressive safety specialist will probably use all three from time to time as cross checks and barometers of his program effectiveness.

References

1. MILLER, C. O.: *The Role of System Safety in Aerospace Management.* Institute of Aerospace Safety and Management, University of Southern California, Los Angeles, California (August 1966).
2. ANSI Z16.2-1962. American National Standards Institute, Inc., New York.
3. HADDON, W., JR., M.D.: "The Prevention of Accidents." *Preventive Medicine Book.* Little, Brown and Company, 34 Beacon St., Boston, Mass. 02106 (1967).
4. BIRD, F. E. and G. L. GERMAIN.: *Damage Control.* American Management Association, 135 W. 50th St., New York City 10020 (1966).
5. *Accident Facts.* National Safety Council, Chicago, 1972 Edition.
6. ENINGER, M. U., Ph.D., *Accident Prevention Fundamentals,* IAPA, Toronto, Ontario.
7. *Job Analysis.* Instructional booklet, International Safety Academy, Macon, Georgia (1971).
8. RYAN, G. ANTHONY, M.D.: *The Aetiology of Accidental Injury.* Australian Safety News (May-June 1972).
9. HADDON, W., JR., M.D.: "On the Escape of Tigers: An Ecologic Note:" *Technology Review,* Mass. Institute of Technology, Cambridge, Mass. 02139 (May 1970).
10. *Accidental Death and Disability: Neglected Disease of Modern Society.* Commission on Emergency Medical Services, A.M.A., Chicago (1970).
11. *Safety Training Manual.* International Safety Academy, Macon, Georgia (1971).

Preferred Reading

1. *Accident Prevention Manual for Industrial Operations (6th Edition),* The National Safety Council, Chicago, Illinois (1969).
2. BLAKE, ROLAND P. (Ed.).: *Industrial Safety.* Prentice-Hall, Inc., Englewood Cliffs, N.J. (1963).
3. DeREAMER, RUSSELL.: *Modern Safety Practices.* John Wiley & Sons, Inc., New York (1958).
4. GILMORE, CHARLES L.: *Accident Prevention and Loss Control.* American Management Association, 135 W. 50th St., New York City 10020 (1970).
5. HEINRICH, H. W.: *Industrial Accident Prevention: A Scientific Approach (4th Edition)* McGraw-Hill Book Co., New York (1959).
6. PETERSON, DANIEL C.: *Techniques of Safety Management.* McGraw-Hill Book Co., New York (1971).
7. SIMONDS, ROLAND H. and JOHN V. GRIMALDI. *Safety Management: Accident Cost and Control.* Homewood, Illinois: Richard D. Irvin, Inc. (1963).

CHAPTER 48

DESIGN AND OPERATION OF AN OCCUPATIONAL HEALTH PROGRAM

Jon L. Konzen, M.D.

GENERAL COMMENTS AND OBJECTIVES

An occupational health program has as its chief goal the preservation and, if possible, the improvement of the health of the work force. This work force includes everyone from the chief executive officer to the newest unskilled worker.

Such a program must contain the basic elements of prevention, acute clinical care, rehabilitation and counseling. The scope of an individual program will depend on the size of the business or industrial organization, its geographic location, the potential hazards inherent in the operation, and the philosophy of management and labor.

It is important that the scope of a program be defined in writing. This is true whether the plan is for a small single establishment involving only a few workers or a large multi-plant corporate program. The scope should include the basic objective of the program, the duties, authority and reporting relationships within the organization. Above all, the scope should clearly indicate that management understands and fully supports the program. Without the complete understanding, philosophical and financial support of management the best conceived program has little chance of success.

Occupational health programs involve multiple disciplines including occupational medicine, occupational health nursing, industrial hygiene, safety and health physics. These health professionals who are members of management must work closely not only with each other, but must have an effective relationship with other management members. This is especially true when working with members of the personnel and labor relations groups. This can be accomplished if the primary objective — the health of the worker — is continually kept in mind. This will have a positive effect not only on the worker, but it will favorably influence personnel and labor relations in such areas as workmen's compensation, sickness, absence and group insurance.

Two additional objectives are frequently being assigned to or closely coordinated with the health program in industry. One is to determine and make recommendations regarding possible effects of facility operations on the surrounding community. The second objective is to determine the health effects of the products on the consumer. The extent of the health involvement in these latter objectives will be dependent on the size, scope and level of the operation.

PRESERVATION OF EMPLOYEE HEALTH

Administration

General. Management plays a major role in any health program in industry, whether this be at the corporate level or at the plant level. The management must be fully aware and agree with the program, realize that it is preventive in nature and understand that it is not simply a tool to reduce compensation costs or improve the safety record. Management must be willing to give both the authority and the responsibility for carrying out the program to the chief health professional in the organization.

Position of Health Professionals in the Management Hierarchy

1. The physician should report to a senior member of management at both the plant and corporate level. The plant physician should report to the plant manager. The medical director at the corporate level should report either to the president or a senior vice-president.
2. The occupational health nurse, if there is a full-time physician, should report both administratively and technically to the physician. If the physician is associated with the company on a part-time basis, the nurse should report to him functionally on technical matters, but may report to the personnel manager administratively.
3. The industrial hygienist may report both at the plant and at the corporate level to the medical organizations or directly to the same reporting level as the physician. The reporting relationship is best determined on an individual company basis with consideration being given to the needs, philosophy, expertise and the full or part-time status of the personnel involved.
4. The safety professional has traditionally reported to the Personnel Department. As safety activities expand in the plant and the community, the reporting relationship must be re-examined and, if necessary, realigned to meet modern requirements.
5. The first aid personnel would report technically to the plant physician and administratively to the Personnel Department.
6. Para-medical personnel, who are also called physician's assistants, would report directly to the plant physician both technically and administratively, since a majority of such personnel are employed in plants with a full time physician.
7. The reporting relationships of other health professionals such as the health physicist and the psychologist should be determined in a similar

manner as outlined for the industrial hygienist.

It must be emphasized that whatever the reporting relationship, each health professional must be responsible for planning, justifying and administering his own budget.

There is a close interface among the disciplines of occupational medicine and nursing, industrial hygiene, safety, psychology and health physics. These disciplines may best serve the company and its employees through consolidation under one health professional, both at the local and corporate level.

Basic Concept of the Program

Pre-placement Health Evaluation. The pre-placement health evaluation should be an evaluation rather than "an examination." It has been traditional in many companies to carry out a pre-employment physical examination which consists of "seeing the doctor," a chest X ray and a urinalysis. This examination was frequently used to "weed out" hernias, bad backs or other obvious physical disabilities. The examination frequently had no other use.

A more rational approach to the pre-employment evaluation is to consider it a placement evaluation for intelligent assessment of the health status of the individual. In this era of wide medical coverage most job applicants have a reasonable knowledge of their health status. For this reason either an automated or a check-off type history will give the reviewing medical personnel sufficient information to categorize the man's health status without further examination.

Another approach to pre-employment evaluation is to combine the health questionnaire with a selected battery of tests to monitor specific organ systems such as cardiopulmonary, hemotologic and urinary systems. Paramedical personnel frequently can carry out at least part of the pre-placement evaluation. The results from such programs suggest that these types of pre-employment screening are as effective as the traditional doctor/applicant encounter in delineating health status of the applicant and in determining his physical capabilities to perform a job.

In industry where there are known hazards, it may be prudent to carry out in addition to the questionnaire and screening tests on selected organ systems, the traditional encounter with the physician so that a man's health can be further categorized. The examination will be used for job placement and as a baseline for further periodic health examinations based on work exposure.

Selective Job Placement. Practically no worker comes to a place of employment without some physical defect. Therefore, the pre-employment examination results should play a major role in the intelligent placement of a worker. If the physical requirements of the job are considered in relation to the physical limitations of the worker, it will frequently prevent accidents, ill health and increase productivity. Blanket policies should not be established for accepting or not accepting applicants with certain physical conditions. The individual's physical capabilities should be matched with the work he is expected to perform. This will permit utilization of a willing worker with some physical defects.

Periodic Health Evaluations Based on Job Exposure. The purpose of the periodic examination should be clearly defined and a program developed with the approval of management. The purpose of the periodic examination is to evaluate the health condition of the individual with emphasis placed on specific "target organs" which may be affected by actual or potential environmental exposures. Such a periodic health monitoring program will rely heavily on a carefully planned check-off questionnaire, selected tests such as audiometry for noise, spirometry for airborne particulate, and blood determinations for specific metals and/or chemicals. If all of the test parameters are normal, the physician may eliminate the personal examination and only review the record. Such a procedure lends itself to multiphasic screening.

A reasonable alternative is to broaden the scope of the periodic examination to make it a complete health appraisal of all body systems with emphasis on organ systems which may be harmed by the environmental exposures. The complete health appraisal is the more ideal approach; however, it may not be possible to carry out an in-depth health appraisal on all personnel.

Environmental Hazards in the Work Environment. Almost any environment has either potential or actual environmental hazards that need to be recognized, measured and monitored. Management and the health professionals must have a high index of suspicion in order to identify potential or actual environmental hazards. Physical agents, airborne particulate and vapors alone, or in combination, even at low concentrations, may be hazardous. First, one must consider the raw materials, the level of exposure to the worker and their potential to do harm. Next, consideration must be given as to how these raw materials are modified through intermediate steps and the exposures created. Finally, the finished product must be reviewed to determine possible effect on the worker. Each step from raw material to finished product must be evaluated under normal conditions and also under emergency conditions, such as spills, bursting or breaking.

An effective industrial hygiene baseline and periodic monitoring program can be developed by the industrial hygienist based on the above considerations.

It is important to assess the exposures in relation to the severity and length of the exposure. On this assessment, a rational approach to control by engineering methods can be undertaken. If it is demonstrated that the environment can be hazardous to health and that good engineering control cannot be effected, then an effective personal program must be initiated. Such a program must take into consideration the proper protective equipment, educational program to instruct the worker with regard to the hazards, and the necessity of wearing the protective equipment consistently and properly.

Integration of Environmental and Physical Ex-

amination Data. After in-plant environmental control has been achieved through engineering measures, or the much less desirable method of personal protective devices, continued surveillance of both the environment and the worker is necessary. The environment should be sampled periodically or, if necessary, continuously to provide an adequate characterization of breathing zone and general work area exposure concentrations. It is not adequate simply to measure the work atmosphere and on that basis conclude that there is no hazard to health "because the exposure is below the TLV."

The environmental exposure data must be integrated with the physical status data in a manner that considers length of exposure, average concentrations and peak exposures. The medical surveillance must evaluate the individual's physical condition in light of naturally occurring disease and the possibility of normal transitory physiological alterations in certain function studies. The periodic medical surveillance will generate considerable data on the exposed workers with emphasis on organ systems most likely to be affected by a given exposure.

We must characterize the exposures and physical findings in terms of the individual and the group. This characterization may be simple for the small operation with few potentially hazardous exposures. In large complex operations the characterization may involve a computerized, epidemiologically coordinated system. This system would utilize industrial engineering to characterize a worker's location and movements, continuous industrial hygiene monitoring to characterize the atmospheric exposures and multiphasic screening methods to examine the worker.

Personnel

Duties of the Health Professionals.

Plant Physician — The physician is the medical officer of the plant. In this capacity, he is responsible for advising management concerning the health condition of the workers, the health hazards that may exist in the plant and the safeguards to protect the health of the worker. In order to do his job effectively he must be fully cognizant of what the plant makes, how it is made, what raw materials are utilized, the potential and actual health hazards associated with this manufacturing and the physical requirements of the various types of jobs. The physician must have this information so he can adequately carry out the pre-placement health appraisals, periodic health examinations and the health education programs.

Most physicians who practice clinical medicine require additional orientation in the area of preventive occupational health programs. Sources of additional information for the development of a good occupational health program can be obtained from the organizations noted in the preferred reading list at the end of this chapter. Information concerning specific hazards, including the necessary industrial hygiene and medical monitoring as well as the required control measures can be obtained from the standards published by the Department of Labor in the Federal Register, the ten regional offices of the Occupational Safety and Health Administration (OSHA), U. S. Department of HEW's National Institute for Occupational Safety and Health (NIOSH) regional offices, the company's insurance carrier, the firm supplying the particular chemical or material and private consultants in occupational medicine and industrial hygiene.

The plant physician, whether part or full time, should tour the plant a minimum of once a month to review the in-plant environment and the effectiveness of environmental control. He should direct the attention of management and, if there is one, the corporate medical director to conditions which may cause adverse health effects to the work force. The doctor should follow up until adequate controls are effected. The physician, as the chief health officer of the plant, is responsible for determining the significance of occupational and environmental sources of disease.

The plant physician is not expected to render any specialized treatment such as major surgery, treatment of severe eye injuries or other conditions beyond his field of training or experience. These cases should be referred to recognized medical specialists preferably those certified by the boards of the various specialties. However, all cases of occupational injury or disease should be examined by the plant physician at frequent intervals regardless of who is rendering the actual treatment.

Employees' physical impairments or diseases which are non-occupational are also an important phase of the plant physician's responsibilities. The physician should consult with the employees who seek his advice regarding non-occupational conditions, but should confine treatment to that which is necessary to relieve the emergency condition or to enable the employee to finish his shift. These employees should be referred promptly to their family physician. In some isolated areas the plant physician may care for both occupational and non-occupational related health conditions of the workers and possibly their families. In these situations there must be clear ground rules established between the physician, the company and the local medical society regarding delivery of health care.

It is the plant physician's responsibility to notify the local health department in cases of reportable communicable diseases.

All pre-placement, periodic, transfer and reentrance health examinations are to be conducted or reviewed by the plant physician. All examinations should be conducted in privacy with only the patient present. Employees should not be examined "en masse." All female employees should be examined in the presence of a third party, preferably a nurse.

The plant physician should arrange and participate in First Aid courses for key plant personnel given under the auspices of the American Red Cross or other similar service organizations.

The plant physician should be responsible for and supervise the keeping of accurate, complete and legible medical records. The records of each individual employee are confidential. The local company physician, in accordance with applicable policy, should determine the nature and amount of medical information that can be released to others. Medical personnel should not discuss an applicant's or an employee's health or medical records with other personnel except as required in the performance of their duty. Specific medical records of injury or occupational disease must be made available under the 1970 Occupational Safety and Health Act, and in cases involving workmen's compensation. Portions of the medical records dealing with occupational illness and injury must be discussed with the plant safety supervisor in order that he can carry out his functions.

The physician's opinions and recommendations should be based entirely upon the facts as determined by careful investigation of each incident, case or condition. Any biased judgment or opinion which might be used to further the company's or the employee's interest at the expense of the other party is considered unprofessional and highly inappropriate.

Occupational Health Nurse — The occupational health nurse is a part of the management team. As a health professional it is important that she be objective in all of her professional duties. The nurse should be trained, and if appropriate, certified to conduct the specialized in-plant testing required in the program. Her duties can be grouped in the areas of prevention, treatment, rehabilitation and education.

In the area of prevention, she plays a vital role in the pre-placement and periodic health examination programs by conducting preliminary testing and assisting in the completion of medical questionnaires. Her duties may include preliminary review of test results to screen out the obvious normal findings. This will permit the doctor to better utilize his time in reviewing the abnormal findings.

A good industrial nurse can handle many of the minor accidents and injuries which occur in any industrial setting. These treatments are carried out under the direction and written orders of the physician. It is most important that every health facility have a set of written orders defining the limits and responsibilities of the nurse with regard to treating the patient, and that the occupational health nurse is currently licensed to practice in the state in which she is employed.

The nurse plays a key role in rehabilitation of the injured worker by supervising appropriate exercises, whirlpool or heat treatments in the unit. This rehabilitation will aid in the early return to work of the injured employee.

The nurse plays a vital role in the educational program to inform the employee of potential health hazards of work and the signs and symptoms of over-exposure. Frequently she fits and instructs the worker in the proper use of personal protective equipment.

The nurse can serve as an effective health counselor for personal physical and mental health problems. She can be especially effective in the areas of alcohol and drug abuse.

The keeping of good clinical medical records as well as the records prescribed under the Occupational Health and Safety Act fall largely to the nurse. She must have knowledge of the in-plant environment so she can intelligently assess complaints. This will permit proper recordkeeping and assist in early recognition, and prompt medical management of occupationally related health conditions.

Small plants frequently employ only part-time nursing service. The nurse coverage should be scheduled to cover more than one shift in a multishift operation. Her period in the plant should be long enough to accomplish all her duties. In most operations, each plant visit should be at least two hours in length.

Industrial Hygienist — The industrial hygienist in most companies will be located at either the central office or at a divisional office location. A few organizations have a qualified industrial hygienist located at the plant level. Many companies must rely on outside industrial hygiene consultation through their insurance carrier, state agencies or private consulting firms.

The duties of the industrial hygienist are to make the corporate management aware of potential in-plant environmental hazards, measure these hazards, recommend appropriate engineering control and periodically monitor the controlled environment. The industrial hygienist, physician and nurse must work closely together to achieve the proper control of the environment and maintain it. The industrial hygienist's specialized knowledge in the area of toxicology will be of great benefit to the physician and the nurse. He will often act as a liaison between the medical group and the actual plant production people in areas of common concern.

Safety Coordinator — The safety coordinator has the prime responsibility for the safety program of the plant. The two major areas of this responsibility are employee education in safe work practices and property safety.

The safety supervisor must work closely with the Medical Service of the plant to review all accidents and illnesses so unsafe conditions can be corrected and the affected employees be re-educated promptly to prevent further accidents.

First Aid Personnel — In all plants, and especially those without full nurse coverage, employees should be selected and trained as first aid personnel to provide emergency first aid when trained professionals are not present in the plant. These employees should attend and obtain certification from an approved first aid course such as is given under the auspices of the American Red Cross or other similar service organizations. The course must meet the standards for first aid training under the 1970 Occupational Safety and Health Act. The coordination of training these employees is the responsibility of the plant physician.

Other Health Professionals — Other health professionals who may be involved in plant operations from time to time include the health physicist and the doctor's assistant. The need for these personnel will be governed by the size and type of operation. The use of a physician's assistant must be governed by the availability of proper physician supervision.

Facilities

The location, size, layout and equipment of an in-plant medical facility should be based on the size of the operation, the number of employees and the activities of the plant. It is especially important in new plant design to plan for possible future expansion.

The medical facility should be located on the first floor of a multi-floor complex with consideration given to proximity of elevator service which will accommodate a wheeled stretcher. An electric cart to serve as an in-plant ambulance may be necessary if the plant is unusually large. The medical facility should be located within easy access to the work areas. There should be a second entrance to a driveway which is free of architectural barriers where an ambulance can readily load an ill or injured employee.

The size of the unit is governed by the extent of the in-plant program. There are various formulas for determining unit size, but a reasonable rule of thumb is to include approximately 1 to 1.5 square feet for each employee up to 1000 employees. Over 1000 employees, the square footage per employee can be appropriately reduced.

The layout of the unit should permit wheeled stretchers to negotiate all turns and enter all rooms. It is important to remember that these units serve several functions: prevention, treatment and rehabilitation. In large units where there is one or more full time nurses as well as a full time physician, the floor plan should be designed to separate the preventive activities from the treatment activities. Various layouts have been devised for this purpose. There is no one best layout.

Privacy in an in-plant medical unit should equal that of the private physician's office. Privacy can be accomplished even when examining large numbers of pre-placement or periodic applicants. One commonly used method is to have two or three small dressing cubicles adjacent to the examining room. Each one of these cubicles has two doors. One door leads from the hall into the cubicle. The second door opens into the physician's examining room. The patient enters the cubicle, closes the hall door, locks it, disrobes and awaits the physician. The physician controls the movement from the cubicle into the examining room since no door knob is placed on the cubicle side of the door.

The larger units may have specialized rooms for minor treatment of illness or injury, a special room where minor suturing can be carried out under good aseptic conditions and a ward for observation of patients. It is most important that if there is more than one bed in a room that each bed be enclosed entirely by a cubicle curtain. All units, regardless of size, must have facilities for hand washing, toilet rooms and storage. In very small plants where there are fifty or less employees, the medical unit which is to serve primarily for first aid and health counseling may consist of only one room. The room requires a sink, dressing cabinet, industrial treatment chair, examination table, desk and files for maintaining the confidential medical records. All other preventive, treatment and rehabilitative activities would be carried out at a nearby medical facility.

For a plant of 200 individuals or less, a three-room unit consisting of a doctor's office/examining room, minor treatment room and nurse's office/waiting room would be suitable. The doctor's office/examining room would also be used as a major treatment room for a severely injured patient prior to transport to the hospital. Each treatment and/or examination room should have running water, adequate lighting and ventilation.

In a small plant which employs less than 200 workers, where the physician does not come to the plant for other than monthly inspections, it may be appropriate for the nurse to carry out the preliminary health testing at the plant. The results would be forwarded to the physician's private office for completion of the examination. Most equipment commonly used in preliminary testing such as the mechanical sight screener, spirometer, audiometer and audiometric booth are not usually found in the average physician's private office. Blood can be drawn either at the physician's office or in the plant. X-ray studies would be made at an outside facility.

The effectiveness of the occupational medical program is usually increased by carrying out as much of the preventive, rehabilitative and educational program as possible in the plant. This would include all parts of the examination with the possible exception of X ray. Such a program would require frequent plant visits by the physician.

The training, background and length of time that the medical personnel are at the plant should determine the type and sophistication of emergency and therapeutic medical equipment and drugs that will be maintained on the premises.

Records

The medical records which must be maintained on an individual must characterize his health at the beginning, periodically throughout and at termination of employment. A record of all occupational injuries, illnesses and treatments must be maintained.

It is customary to have a pre-placement health examination form which includes a check-off health questionnaire that reviews the patient's past environmental exposures, family history, personal medical history and provides a section to record the objective medical findings. In designing such a form it is important to consider the educational status of the average applicant so that the history portion can be completed by the applicant with a minimum of assistance from the medical personnel. Newly designed forms should be computer compatible even if there are no immediate plans to use data processing equipment for storage, retrieval or use of the records.

A similar questionnaire and selected testing procedure approach may be used for the periodic health evaluation.

The forms should be designed with sufficient room so that all data can be entered easily and reviewed at a glance. The abnormal findings should stand out. There should be sufficient area for comment and elaboration of all abnormal findings. Laboratory and other testing data may be displayed in tabular form.

Internal Statistical Reports. It is useful to have internal statistical reporting covering the costs, patient load and the various tests that are performed. An objective review of this data will permit an evaluation of the effectiveness of the program, enable determination of accurate costs for medical services and assist in realistic budget development.

Occupationally Related Accidents and Illness Investigation Reports. Early determination of the causes of occupational injury and illness is assisted by an intelligent accident or illness report that is completed jointly by the first-line supervisor, the plant safety coordinator and the medical service.

If each of these disciplines intelligently and accurately complete their portion of the report, unsuspected problem areas may be identified and controlled. They will assist in reducing accidents by making the entire plant more aware of the in-plant environment. It will also demonstrate to the employees that the company takes the matter of their health and safety seriously. Such reports with certain modifications can be used as workmen's compensation reports and the Occupational Safety and Health Administration Form #101.

Records for Compliance with the 1970 Williams-Steiger Occupational Safety and Health Act. The Occupational Safety and Health Act of 1970 states that all illnesses and injuries which require more than simple first aid must be recorded within six days after the illness or injury becomes known. OSHA Form 100 or an equivalent form or method approved by the Secretary of Labor may be used. The law further requires that an accident report be completed on each recordable injury or illness. OSHA Form 101 is provided for this purpose. Annually a summary which can be completed on OSHA Form 102 must be posted in a conspicuous place for not less than thirty days. This form must be posted not later than the first of February of the year following the covered period. Some selected plants will be requested to complete OSHA Form 103 for submission to the Department of Labor. This is a more detailed summary of the information reported on OSHA Form 102. The details for recordkeeping requirements are summarized by the Department of Labor in the booklet RECORDKEEPING REQUIREMENTS UNDER THE WILLIAMS-STEIGER OCCUPATIONAL SAFETY & HEALTH ACT OF 1970.

Industrial Hygiene Records. Industrial hygiene sampling records must be available for review by the Secretary of Labor or his representative. The samples should be taken in sufficient numbers and locations to characterize in-plant exposure to people.

Industrial hygiene reports which are made to management should be more than a list of numeric values. The report should interpret the data from the standpoint of ceiling values, time weighted exposures and excursion peaks. The reports should discuss the corrective action which would be appropriate in relation to the exposures. It should be emphasized that the acceptable exposure concentration used in industrial hygiene, commonly called threshold limit values, are guidelines for reasonable exposures and are not absolute safe or unsafe limits. These levels should be discussed in terms of the standards which have been and are continuing to be published by the Secretary of Labor. The Federal Register should be consulted on a continuing basis for published changes.

Industrial Hygiene

There are three basic types of industrial hygiene surveys from a physician's standpoint. These include baselining of an operation, periodic monitoring of an operation and emergency monitoring of an operation. Baselining is an in-depth evaluation to characterize exposures throughout the manufacturing facilities. To carry out such a survey it is usually appropriate for the hygienist and frequently the physician to make a preliminary walk-through survey of the facilities to review raw, intermediate and end products of a manufacturing operation in order to identify actual and potential exposures under normal and abnormal conditions. After the walk-through has been completed and evaluated, the industrial hygienist will move in with the appropriate equipment and complete the baseline survey. Periodic monitoring of the plant is carried out in essentially the same way except the initial walk-through may be eliminated and the number of individual samples required usually can be reduced. The third type of industrial hygiene survey is the emergency survey. Medical review of the first-line supervisor's accident report may require immediate evaluation and sampling to determine if a particular operation or exposure is creating a hazardous condition. Such emergency surveys can be kept to a minimum if the baseline and periodic surveys are well planned and executed.

It is most important that the physician and industrial hygienist be consulted during initial planning and pilot stages of a new process or operation so that necessary environmental control and medical monitoring can be included in the economic feasibility study. It is possible that when the environmental concerns are considered, a product line may be unprofitable. Environmental and occupational health are necessary costs of doing business.

There should be a procedure by which the plant or corporate engineering coordinates with the medical and industrial hygiene services so that sufficient environmental consideration is given to a process change and to the purchase of new products and equipment. This will assure that engineering controls will be added or modified in order to control any potential environmental hazards. It is an old axiom that minimal changes in the process can cause maximal environmental problems.

Safety

Safety must play a major role in a well rounded health program (see Chapter 47). A safety program should cover not only property, machine guarding, fire safety and the like, but must include the education of management as well as the work force in safe working procedures. The safety program begins when the worker is first employed. It is important to have on-the-job training programs that are directed to the individual to inform him of safety hazards in his particular job, as well as an indoctrination in the general aspects of safe work practices. This will require that a comprehensive job safety analysis be performed on all operations. Further, there must be a systematic inspection of new, revised and existing production and safety equipment to identify potential safety hazards and to assure compliance with governmental requirements. Another important task of the safety supervisor is a systematic accident investigation program coordinated with first-line supervision and the medical service.

Special Programs

Programs Directed at Specific Hazards. The preplacement and periodic examinations mentioned earlier in this chapter are important but not all inclusive parts of special programs to protect workers from specific hazards in the work place. The examinations are limited to assisting in identification of workers who should not be exposed to certain hazards and reveal early adverse health effects. Special programs will vary in number and complexity depending on the hazard, type of exposure and number of workers involved. All the special programs have certain things in common which include recognition of the hazard, measurement of the hazard, control of hazard by engineering or personal protective devices, medical monitoring of the workers and education of the employee with regard to the health and safety implications presented by the hazard. It cannot be stressed too vigorously that the educational part of the program and its resulting motivational influence is one of the most important parts of any special program. If the worker cannot be properly motivated to cooperate in the protection of his health, costly industrial hygiene engineering, control devices, personal protection equipment and medical monitoring will have only limited effectiveness. The employee does have specific responsibilities under Public Law 91-596 (OSHA) to achieve and maintain safe and healthful working conditions.

Some of the more common specific hazard control programs include hearing conservation against noise; eye protection against flying particulate; respiratory protection against such airborne agents as lead, silica, asbestos, cotton and solvent vapor; thermal stress protection against heat or cold; and dermal protection against skin sensitizers or irritants (see Chapter 34). Immunization programs directed at such job related diseases as tetanus and in certain industries, typhoid, are often indicated. A well rehearsed and frequently reviewed tank entry program which incorporates segments of other hazard control is a common requirement in industry.

Medical Disaster Control. Medical disaster, either man-made or natural, can occur. All office complexes and plants should have plans which will permit rapid evaluation, effective first aid, evacuation and transportation of injured personnel to a definitive treating facility. The elaborateness of the disaster control plan will depend on the size of the operation.

Alcohol and Drug Abuse. Programs to combat alcohol and drug abuse are important and necessary. These specialized programs require an interdisciplinary effort between personnel and medical departments and the community. Such programs should clearly define company policy, and include the detailed procedure for handling personnel involved in these abuses. These programs should be designed to treat drug and alcohol problems in the same manner as other chronic diseases.

Consultation to Management on Group Insurance Benefits. Management should review the group health insurance benefit plan with the medical service. Medical expertise will be of assistance in formulating the most comprehensive plan for the least amount of money.

Absentee Control. Absentee control is a by-product of a good medical program. Early recognition of job-related and non job-related conditions can assist in rapid treatment and early return to the job.

A day-to-day evaluation of sickness absence takes a careful, well thought out form to obtain the necessary confidential medical information and establish a good rapport between the private physician and the company medical service. The program will aid in preventing unwarranted and excessively long sickness absences. It will assist the plant physician in intelligently placing the returning worker if job change is necessary.

Occupational Mental Healtht. Mental health is an area of increasing concern of industry today. An emotionally affected worker who is troubled by home or work problems is not an efficient or safe worker. It is most important that the medical service programs train first-line supervision to recognize symptoms of emotional ill health, and refer employees promptly to the medical service. This will permit professional evaluation and counseling. If necessary, prompt referral to specialized mental health care can effectively be carried out by the medical service. It should be emphasized that the first-line supervisor should not try to diagnose or "treat" emotional illness, but should promptly refer the employee. Evaluation and counseling take time in the medical facility, but this service can render great dividends in terms of the individual as well as his value to the company.

Possible Health Effect of the Facility Operation on the Community

Effluents from a Facility. Effluents which are emitted from a plant to the atmosphere, to waste water, or by solid waste disposal must be monitored for legal reasons and to protect the health of the community. It is important to sample these effluents at the source of emission, as well as in the community since many materials may undergo a chemical change which would render them either more or less hazardous. Frequently emissions may be relatively unique to a particular facility operation. For this reason, there must be close cooperation between the environmental engineering group and the medical group so that representative samples are obtained, and meaningful evaluation of the samples are carried out. At times by using toxicological consultation, the physician may be able to advise on the health effect of materials. At other times, it may be necessary to carry out animal studies or, in extreme cases, to evaluate the health effect on the community by epidemiological studies.

Social Impact of Opening or Enlarging Operations in a Community. The social impact of a plant on the community, particularly if it is a small community, may be appreciable. The medical service should be consulted during the initial planning stages of a new or enlarged facility to assist in the determination of adequate medical coverage for the in-plant operations and to assess the impact of the influx of a work force on the local medical support. In particularly small or isolated communities, it may be necessary to work with the local medical society in order to either encourage, and at times financially support expansion of local medical services, or offer comprehensive medical service to the employee and his family through the company.

Possible Health Effect of Products on the Consumer

Health Evaluation of New or Modified Products. For years many large progressive companies have carried out a joint effort with toxicologists and medical personnel to conduct studies on new or modified products from the conceptional stage through final product marketing. It is becoming increasingly clear that such procedures will have to be incorporated in product development programs of still more industries. Possible health effects must be considered as part of the normal product development process. The possible health effect evaluations of new or modified products may take place within the company or may be contracted to a variety of institutions who are equipped to carry out toxicological literature reviews, animal studies, human studies and limited field testing.

Whether evaluations are carried out within the company or through consultants, it is most important that a team within the company representing medical, technical and toxicological expertise be established to determine the need, scope and design of any research study.

Evaluation of Present Products. At times it is necessary to carry out a critical health effect evaluation of products which have been marketed for various periods of time. These health effect evaluations will utilize the same techniques as used for new or modified products. In addition, the health history of employees exposed to the finished product would be of value in assessing the health effect. An additional important tool in determining health effect on the consumer is an objective and representative analysis of customer complaints from a health standpoint. It is important when using customer complaints to carefully document the adverse health effects in relation to the use or misuse of the product. It is also important to develop mechanisms which will surface customer complaints effectively in all areas where the product is marketed.

Preferred Reading

1. ALCOHOLICS ANONYMOUS WORLD SERVICES, INC.: Box 459, Grand Central Post Office, New York, N. Y. 10017 (see Publications List).
2. AMERICAN ACADEMY OF OPTHALMOLOGY & OTOLARYNGOLOGY: *Guide for Conservation of Hearing in Noise,* 15 Second Street, S.W., Rochester, Minn. 55901 — 1969.
3. AMERICAN ASSOCIATION OF INDUSTRIAL NURSES, INC.: "Guide for Training Courses for Audiometric Technicians in Industry," *Occupational Health Nursing* (official Journal of AAIN), 79 Madison Avenue, New York, N. Y. 10016 — 1967 (see Publications List).
4. AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS: *Documentation of Threshold Limit Values,* P. O. Box 1937, Cincinnati, Ohio 45201 — Revised edition, 1971.
5. AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS: *Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment With Intended Changes for 1972.*
6. AMERICAN INDUSTRIAL HYGIENE ASSOCIATION: *Hygienic Guides of American Industrial Hygiene Association,* 66 South Miller Rd., Akron, Ohio.
7. AMERICAN MEDICAL ASSOCIATION, COUNCIL ON OCCUPATIONAL HEALTH: *Archives of Environmental Health,* 535 North Dearborn St., Chicago, Ill. 60610 (see Publications List).
8. AMERICAN NATIONAL STANDARDS INSTITUTE, INC.: *American National Standards List,* 1430 Broadway, New York, N. Y. 10018.
9. AMERICAN PUBLIC HEALTH ASSOCIATION: *American Journal of Public Health* ("Local Health Officer's Guide to Occupational Health") 1015 18th St., N.W., Washington, D.C. 20036.
10. INDUSTRIAL HEALTH FOUNDATION: *Industrial Hygiene Highlights,* Volume 1, 5231 Centre Avenue, Pittsburgh, Pa. 15232 — 1968.
11. INDUSTRIAL HEALTH FOUNDATION: *Industrial Hygiene Digest* (Medical Series Bulletins), 5231 Centre Avenue, Pittsburgh, Pa. 15232 — 1968.
12. INDUSTRIAL MEDICAL ASSOCIATION: *Journal of Occupational Medicine,* 150 North Wacker Drive, Chicago, Illinois 60606 — September, 1971 (see Publications List).
13. JOHNSTONE, R. T. and S. E. MILLER: *Occupational Diseases and Industrial Medicine,* Saunders, Philadelphia, Pa. — 1960.
14. LEVINSON, H. ET AL: *Men, Management and Mental Health,* Harvard University Press, Cambridge, Mass. — 1966.
15. MAYERS, M. R.: *Occupational Health — Hazards of the Work Environment,* The Williams & Wilkins Co., Baltimore, Maryland — 1969.
16. NATIONAL COUNCIL ON ALCOHOLISM: Suite 1720, Two Park Avenue, New York, N. Y. 10016 (Catalog of Publications).
17. NATIONAL SAFETY COUNCIL: *Accident Prevention Manual for Industrial Operations,* 425 North Michigan Avenue, Chicago, Illinois 60611 — 6th Edition, 1969.
18. NATIONAL SAFETY COUNCIL: *Fundamentals of Industrial Hygiene,* 425 North Michigan Avenue, Chicago, Illinois 60611 — 1971.
19. NEW YORK CHAMBER OF COMMERCE: "Drug Abuse as a Business Problem — The Problem Defined with Guidelines for Policy," 65 Liberty St., New York, N. Y. 10005.

20. PATTY, F. A., Editor: *Industrial Hygiene and Toxicology*, Interscience Publishers, Inc., N. Y., Volume I (General Principle) — 1958; Volume II Toxicology) — 1962.

21. SATALOFF, J.: *Hearing Loss*, J. B. Lippincott Company, Philadelphia — 1966.

22. THE CHRISTOPHER D. SMITHERS FOUNDATION: "Alcoholism in Industry — Modern Procedures 1969," 41 East 57th Street, New York, N. Y. 10022.

23. STEWART, W. W., Editor: *Drug Abuse in Industry*, Halos & Associates, Inc., Medical Book Division, 9703 S. Dixie Hwy., Miami, Fla.

24. U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE, N.I.O.S.H.:
"Occupational Diseases, A Guide to Their Recognition," P.H.S. Publication #1097 — 1964.
"Community Health Nursing for Working People," P.H.S. Publication #1296, Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

25. U. S. DEPARTMENT OF LABOR, O.S.H.A.:
"Compliance Operations Manual," O.S.H.A. #2006 — January, 1972.
"A Handy Reference Guide — The Williams-Steiger Occupational Safety and Health Act of 1970."
"Recordkeeping Requirements under the Williams-Steiger Occupational Safety & Health Act of 1970."
"Guidelines to the Department of Labor's Occupational Noise Standards," Bulletin 334, U. S. Government Printing Office, Washington, D. C. 20402.