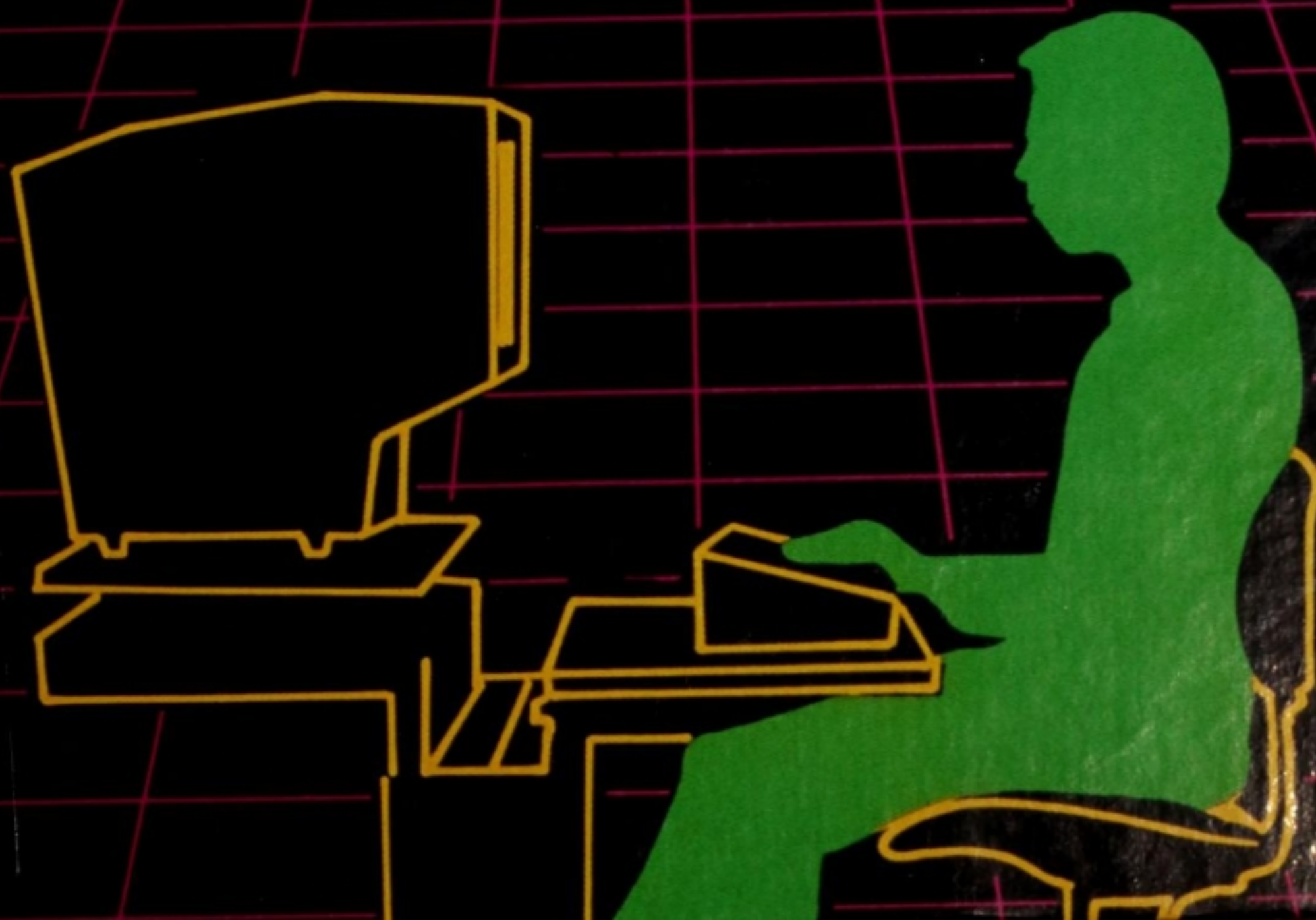


# Accident Prevention Manual for Industrial Operations

Administration and Programs

Ninth Edition





# **Accident Prevention Manual for Industrial Operations**

**Administration and Programs**

# Occupational Safety and Health Series

The National Safety Council's OCCUPATIONAL SAFETY AND HEALTH SERIES is composed of four volumes written to help readers establish and maintain safety and health programs. The latest information on establishing priorities, collecting and analyzing data to identify problems, and developing methods and procedures to reduce or eliminate illness and accidents, thus mitigating injury and minimizing economic loss resulting from accidents, is contained in all volumes in the series:

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# Preface

The ninth edition of the *ACCIDENT PREVENTION MANUAL FOR INDUSTRIAL OPERATIONS* is published in two volumes. The *Administration and Programs* volume encompasses management techniques, governmental regulations, and programs for safety and health professionals. The *Engineering and Technology* volume covers more technical information vital to the safety and health professional. The National Safety Council's *FUNDAMENTALS OF INDUSTRIAL HYGIENE*, third edition, and *INTRODUCTION TO OCCUPATIONAL HEALTH AND SAFETY* are additional volumes needed to complete readers' safety and health libraries. Contact the National Safety Council for more information.

The ninth edition of the *ACCIDENT PREVENTION MANUAL FOR INDUSTRIAL OPERATIONS* is the cumulation of facts and ideas that have become part of the safety movement and should be used to organize and transmit information of value to safety and health professionals—indeed, anyone—committed to preventing accidents and preserving well-being. Covering a broad spectrum of subjects, this *Manual* pinpoints problem areas and directs the reader to the appropriate sources of help.

As used in the *ACCIDENT PREVENTION MANUAL*, the term “accident” means that occurrence in a sequence of events that usually produces unintended injury, illness, death, and/or property damage. Prevention of such occurrences should be the responsibility of employees of every level. A second term, “safety and health professional,” is used to mean all those interested in or affected by occupational safety and health.

## **New material**

The ninth edition has expanded and updated material in every chapter. References in each chapter have also been revised to reflect current sources. Some specific changes are listed below.

Chapter 1—expanded history of the safety movement, including developments in health. Chapter 2—completely updated, with discussions of three new topics: medical access, the right-to-know, and environmental impact. Chapter 3—new material on four topics: explanation and illustration of the assignment of risk assessment code (RAC) or single risk number, a rating method for estimating the relative severity of hazard exposures, hazard control, and productivity improvement; expansion of discussions of off-the-job safety and purchasing. Chapter 4—emphasizes protection of the individual rather than mere compliance with governmental requirements; expands hazard analysis to include “reducing exposure to injury”; more clearly explains Permissible Exposure Levels (PEL) and Threshold Limit Values (TLV); discusses concentration measurement values as an evaluation of all the measurements taken as a whole. Chapter 5—a totally new chapter discussing how the occupational safety and health information systems can be used more efficiently and effectively and the computer programs available; includes a new section on what the safety professional should know about the special hazards of loss control and security in a computer room. Sections in the eighth edition Chapter 5 have been distributed to other chapters in the ninth edition: the sections on machine design and reducing exposure to injury are now in the completely revised Chapter 10, the job safety analysis discussion has been added to Chapter 9, and the section on purchasing is now in Chapter 3. Chapter 6—completely rewritten to reflect OSHA's recordkeeping requirements as of 1987. Chapter 7—new sections on off-the-job injury costs, identifying causal factors and selecting corrective actions, and a new quick reference Guide. On-the-job disabling injury costs are more clearly described and three sample computations have been added. This section complements the program portion of on-the-job injuries that has been enlarged in Chapter 3. Chapter 8—expanded sections on injuries and diseases covered by workers' compensation and medical benefits; includes the latest interpretation of the “exclusive remedy” provision and the protection against termination for workers filing worker compensation claims. Chapter 9—the discussion on job safety analysis has been expanded and moved from the former Chapter 5. Chapter 10—completely



rewritten to incorporate latest research on ergonomics; new sections on identifying ergonomic-related problems, overexertion low back injuries, upper extremity cumulative trauma disorders, and establishing an ergonomics program. Chapter 11—new material on feedback and behavioral management; discussions of motivation and emotion have been expanded. Chapter 23—a new section on legal and social restrictions on hiring; expansion of driver performance measurements. Chapter 24—completely updated and verified by the sources listed.

### Contributors

The *ACCIDENT PREVENTION MANUAL FOR INDUSTRIAL OPERATIONS* is unique—the compilation of the experience and expertise of contributors from all major occupations and industries. Each of the reviewers and contributors is a practicing expert. To assure uniformity and accuracy, the final version of the text was reviewed by William J. Larson, PE, CSP. The National Safety Council and the editors wish to express their appreciation and gratitude to Mr. Larson and each of the contributors who devoted many hours to updating and checking the accuracy of this publication. These contributors to the *Administration and Programs* volume include: A. G. Baker, Eva Barnard, RN, David Brigham, Alan Carpenter, Min K. Chung, Campbell Dewey, Robert Elam, Nigel Ellis, Raymond C. Ellis, Jr., Robert Firenze, Charles R. Goerth, Esq., Gary Hahn, Dr. Harold Holmes, Robert D. Jordan, David W. Klonicke, Thomas R. Krause, Gary E. Lovested, Robert Meyer, William M. Montante, James M. Palmer, John Polhemus, Peter Rickert, Charles Simpson, John Szwarc, Paul Tamburelli, Elliot Tanz, Larry Volin, Harry Von Heubon, and Adrienne Whyte.

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# Occupational Safety: History and Growth

The mission of the National Safety Council is to educate and influence society to adopt safety and health policies, practices, and procedures that prevent and mitigate human and economic losses arising from accidental causes and adverse occupational and environmental health exposures. (Approved by the Board of Directors, October 18, 1983.)

THE GOAL OF THE NATIONAL SAFETY COUNCIL is to work for the well-being of each person on a 24-hour-a-day basis in all environs, both on and off the job. In this context, safety and health can no longer be considered as separate entities. It is virtually impossible to separate occupational illness from occupational injury.

In an imperfect world there will always be risks, but the National Safety Council will continue to strive to reduce the number and severity of those risks—no matter the cause—as much as possible. As the Council works to free persons from those risks that result in accidental death or injury, it seeks ways to provide everyone with a safe and healthy environment.

In this, the ninth edition of the *Accident Prevention Manual for Industrial Operations*, the National Safety Council presents a compilation of facts and ideas that are a part of the safety movement's general heritage. For special information regarding occupational health and industrial hygiene, see two other National Safety Council books: *Introduction to Occupational Health and Safety* and the *Fundamentals of Industrial Hygiene*, respectively.

## PHILOSOPHY OF ACCIDENT PREVENTION

In medieval days, the master craftsman tried to instruct apprentices and journeymen to work skillfully and safely, because he knew the value of high quality and uninterrupted production. However, it took the Industrial Revolution, which began in England during the 18th century, to create the conditions which led to the development of accident prevention as a specialized field.

The industrial safety philosophy developed because the tremendous forces of production which were released resulted in numerous injuries and deaths. Without a deterrent to stop this waste of personnel and resources, the number of accidents and injuries that would otherwise have occurred would have boggled the imagination.

One way to enlighten management to accept responsibility for preventing accidents was to pass workers' compensation laws. This "new" line of thinking held the employer responsible for a share of the economic loss suffered by the employee who was involved in an accident.

It was a rather short step from this to the realization that a large proportion of accidents could be prevented and that the same industrial brain power that could develop ways to produce vast quantities of goods also could be used to develop ways to prevent accidents. Industry soon discovered that efficient production and safety were related. From this beginning grew the safety movement as it is known today.

The progress in reducing the number of accidents and injuries in the relatively short period of time since this movement began has exceeded the highest expectations of the early safety pioneers. The accidental death rate per 100,000 persons in the United States has decreased 59 percent during the last 75 years.

Experience has shown that there is virtually no hazard that cannot be overcome by practical safety measures. To further that

- 1 **Philosophy of Accident Prevention**
- 2 **The Beginnings of Safety and Health Awareness**  
The Middle Ages ■ Mass production appears ■ The Industrial Revolution comes to America
- 4 **History of U.S. Safety and Health Movement**  
Birth of the National Safety Council ■ American Standards Association beginnings ■ Accident prevention discoveries ■ Acceleration of the drive for safety and health
- 7 **Evaluation of Accomplishments**  
The dollar values ■ Industry and nonwork accidents
- 9 **Safety's Resources**  
Know-how ■ The heritage of cooperation ■ Good will ■ Professionalism ■ Advancement of knowledge ■ Summary of achievements
- 11 **Safety Today**  
Small establishments ■ Labor-management cooperation ■ Statistics, standards, and research ■ Safety and the law ■ Safety and Occupational health ■ Psychology and "accident proneness" ■ Summary
- 15 **Current Problems**  
Technology and public interest ■ Political problems ■ Organizational problems ■ A look to the future
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- 16 **References**



belief, the National Safety Council continues its concerted efforts to prevent accidents and occupational illnesses.

In summary, here are five reasons to work hard to prevent accidents and occupational illnesses:

1. Needless destruction of life and health is a moral evil.
2. Failure to take necessary precautions against predictable accidents and occupational illnesses involves moral responsibility for those accidents and occupational illnesses.
3. Accidents and occupational illnesses severely limit efficiency and productivity.
4. Accidents and occupational illnesses produce far-reaching social harm.
5. The safety movement has demonstrated that its techniques are effective in reducing accident rates and promoting efficiency.

## THE BEGINNINGS OF SAFETY AND HEALTH AWARENESS

The written history of health and safety began about the time of the building of the Egyptian pyramids. The *Ebers Papyrus* and the *Edwin Smith Papyrus*, both found in 1862 and dating from about 3000 B.C., were, respectively, collections of household and medical recipes to cope with various traumatic events like crocodile bites, burns, and the removal of foreign objects (splinters); and a "textbook of surgery," which discussed a variety of injuries and treatments involving splints, dressings, and ointments.

About 2000 B.C., Hammurabi, a Babylonian ruler, revised the old laws of the land and produced a Code of some 280 paragraphs. It covered bodily injury and physicians' fees and probably was the first document that included a beginning of what today is known as workers' compensation laws. Two of the clauses that would be of most interest to safety and health professionals are:

"§199. If [a man] has caused the loss of the eye of a gentleman's servant or has shattered the limb of a gentleman's servant, he shall pay half his price."

"§206. If a man has struck a man in a quarrel, and has caused him a wound, that man shall swear 'I do not strike him knowingly,' and shall [be responsible for] the doctor."

Ramses III in about 1500 B.C. hired physicians to care for mine and quarry workers as well as those engaged in the construction of public works such as canals and large temples. His decision was far more to retain a healthy work force than to be loved by his subjects.

Hippocrates, usually called the father of medicine, about 400 B.C., described tetanus. About 200 B.C., the effects of lead poisoning were described by the Greek poet and physician Nicander.

Various Roman writers from 100 B.C. through the second century A.D. described the plague of Athens, the ill effects of their environment on mine workers, and the unhealthful effects of using lead for water piping and containers for blending wine.

As early as the first century A.D., Pliny the Younger mentioned lead poisoning as a disease present among mine slaves. Pliny the Elder wrote about the use of ox bladders as primitive respirators used by workers producing vermillion to keep the mercury fumes out of their breathing zone.

## The Middle Ages

Although workers must have suffered from the ill effects of working with pigments, grinding of metalware, and the silvering of mirrors, their ordinary living conditions so shortened their lives that tuberculosis and the various plagues took their toll before occupational diseases resulted in death.

In the seventh century in ancient Lombardy, King Rothari codified existing laws in 388 chapters, which was probably the origin of the basic principles of compensation for injury.

The edict applied to personal injuries received in brawls, fights, and feuds, and payments for disability and death were established.

In the eleventh century, King Canute, King of Denmark, Norway, and England, stated the principles of compensation for particular injuries. The importance of the loss of a thumb was recognized—the compensation for its loss was twice that for the loss of the second digit and two-and-one-half times that given for the loss of the third digit.

In 1473 Ulrich Ellenbog, an Austrian physician, wrote a tract directed toward goldsmiths and other handlers of metal, warning against the burning of coal in confined spaces and the inhalation of vapor arising from the heating of metals such as lead, antimony, silver, and mercury. This is considered to be the first writing devoted exclusively to industrial metal poisoning.

Six years after the death in 1555 of George Agricola, a Saxon physician, his book, *De Re Metallica*, was published. It emphasized the need to ventilate mines and illustrated various devices that would force air below ground. Other illustrations depicted personal protective devices—gloves, leggings, and masks. The work was of such prominence that it would endure for centuries.

In 1567 Philippus Aurelous, a.k.a. Theophrastus Bombastus von Hohenheim, who later called himself Paracelsus, had a treatise published, *On the Miners' Sickness and Other Miners' Diseases*, in which he distinguished between acute and chronic poisoning. This was the first monograph dealing with the diseases of a specific occupational group. Paracelsus grew up in Switzerland, studied medicine in Italy, and practiced medicine as an itinerant teacher, visiting mines and workshops.

In the early part of the 18th century, Bernardino Ramazzini published the classic *Discourse on the Diseases of Workers*, which still applies today. Ramazzini pointed out that in addition to the standard questions asked of a patient, one more should be added: "What is your occupation?"

Ramazzini, dubbed the father of occupational medicine, summarized the two causes which he believed were responsible for the occupational diseases of workers of his day: "The first and most potent is the harmful character of the materials that they handle, for these emit noxious vapors and very fine particles inimical to human beings and induce particular diseases; the second cause I ascribe to certain violent and irregular motions and unnatural postures of the body, by reason of which the natural structure of the vital machine is so impaired that serious diseases gradually develop therefrom."

## Mass production appears

Until the 1700s, production methods were labor-intensive, with work being done by hand in cottages.

Three developments were to change this way of life: In England in 1764, the spinning jenny was developed and in 1784, the power loom was perfected. In America, Eli Whitney added





**Figure 1-1.** Back in “The good old days,” it was more a problem getting the children to school than it was on teaching them to be safe at school. Here, barefooted children toiled in the mills.

his invention, the cotton gins, in 1792. These and other innovations ushered in what would later be called the Industrial Revolution. What began in Britain in the 18th century and spread to the Continent and the United States transformed the life of Western man, the nature of society, and the relationship between people.

Specifically, the innovations encountered in the processes and organization of production changes included:

- The substitution of inanimate for animal sources of power, particularly steam power through the combustion of coal.
- The substitution of machines for human skills and strength.
- The invention of new methods for transforming raw materials, particularly in the making of iron and steel, and industrial chemicals.
- The organization of work in large units, such as factories or forges or mills, making possible the direct supervision of the process and an efficient division of labor.

Paralleling these production changes were the altered technologies employed in agriculture and transportation.

Initially, this was termed the “factory system,” but later, when it reached a larger and more complex scale, was designated the Industrial Revolution by A. Toynbee (Toynbee, 1884), whose nephew, Arnold J. Toynbee, is described as “the first economic

historian to think of, and to set out to describe, the Industrial Revolution as a single great historical event, in which all the details come together to make an intelligent and significant picture.”

Because these changes in production methods with their concomitant need for masses of workers brought with them hazards never before encountered, the history of occupational safety and health was greatly affected. The increasing need for hazard control was recognized.

### **The Industrial Revolution comes to America**

The effects of the Industrial Revolution were first felt in the United States about a century after it started in Great Britain. Before the 19th century, most families in the United States lived and worked on farms. Some industries had developed, namely printing, shipbuilding, quarrying, cabinetmaking, bookbinding, clockmaking, and the production of paper, chocolate, and cottonseed oil. However, it was the textile industry that saw the beginning of the factory system in America, especially in New England where hundreds of spinning mills shot up (see Figure 1-1). As the Industrial Revolution continued its unbounded growth, the toll on workers began to show. (Felton, 1986.)



## HISTORY OF U.S. SAFETY AND HEALTH MOVEMENT

During the last half of the 19th Century, American factories were expanding their product lines and producing at heretofore unimagined rates. While the factories were far superior in terms of production to the preceding small handicraft shops, they were often inferior in terms of human values, health, and safety.

In terms of human values alone, the 1900 census showed 1,750,178 working children between 10 and 15 years inclusive—25,000 were employed in mines and quarries; 12,000 in making chewing tobacco and cigars; 5,000 in sawmills; 5,000 at or near steam-driven planers and lathes; 7,000 in laundries; 2,000 in bakeries; and 138,000 as servants and waiters in hotels and restaurants. (See Figure 1-1.)

These deficiencies were probably inevitable. The tools of mass production had to be invented and applied before anyone could begin to imagine the problems they would create, and the problems had to be known before corrective measures could be considered, tested, and proved. Deaths and injuries were accepted as being part of "industrial progress."

While this change in the work environment was taking place, the thinking of the public, management, and the law was still reflecting the past, when the worker was an independent craftsman or a member of the family-owned shop. Common law provided the employer with a defense that gave the injured worker little chance for compensation. The three doctrines of common law that favored the employer were:

*Fellow servant rule*—Employer was not liable for injury to employee that resulted from negligence of a fellow employee.

*Contributory negligence*—Employer was not liable if the employee was injured due to his own negligence.

*Assumption of risk*—Employer was not liable because the employee took the job with full knowledge of the risks and hazards involved.

In large industrial centers, the ugly results of industrial accidents and poor occupational health conditions became more and more obvious. Voices of protest were raised. Though there were employers who denied the existence of the problem, wiser management people began to do something about it.

As early as 1867, Massachusetts had begun to use factory inspectors, and ten years later that state had a law requiring the safeguarding of hazardous machinery. During 1877, Massachusetts also passed the Employer's Liability Law that made employers liable for damages when a worker was injured. However, court decisions based on common law often let the employer escape liability.

From 1898 on, there were additional efforts to make the employer financially liable for accidents. In his Presidential message of 1908, Theodore Roosevelt stated: "The number of accidents which result in the death or crippling of wage earners . . . is simply appalling. In a very few years it runs up a total far in excess of the aggregate of the dead in any major war."

His message was echoed when his social legislation passed that year in Congress. That first workers' compensation law covered only federal employees and set a precedent for state laws to follow.

In 1911, the first effective workers' compensation act was passed in Wisconsin and declared constitutional by the Wisconsin Supreme Court within a few months. New Jersey and

Washington also passed laws that year.

While a bill for workers' compensation (the Wainwright Law) had been passed in New York in 1910, it was declared unconstitutional by the New York Court of Appeals on the grounds that the law violated both the federal and New York State Constitutions, "because it took property from the employer and gave it to his employee without due process of law." After the legislature adopted an amendment to the state constitution and it was approved in 1913 at the general election, a compulsory Workmen's Compensation Act finally became effective in mid-1914.

Coincident with the declaration of unconstitutionality of the early act, a fire occurred in a clothing factory in New York City that took the lives of 146 employees. This disaster, called the Triangle Fire, unified the demand for factory legislation and gave force to reform because the fire took place on the same day (March 25, 1911) that the Court of Appeals decision was publicized.

Other such laws were, at first, declared invalid because of conflict with the due process of law provisions of the 14th Amendment. After the U.S. Supreme Court in 1916 declared it to be constitutional in *New York Central Railroad Co. v. White*, 243 U.S. 188, many states passed compulsory laws on workers' compensation.

In the late 1800s and early 1900s, the railroads conquered the West while extracting a heavy toll in human life. It was said that a man was killed for each mile of track laid. By 1907, annual railroad employee deaths had reached 4,353.

Progress was made on the technical side of the problem. The railroads adopted the air brake and the automatic coupler well before the turn of the century. They also worked on guarding and fire prevention.

Next came the recognition that guarding was not the total solution and that people's actions were important factors in creating accident situations.

Insurance companies began relating the cost of premiums for workers' compensation insurance to the cost of accidents. Management began to understand the close relationship between successful production and safe production.

During the first decade of the 20th Century, two giant industries, railroads and steel, began the first large-scale organized safety programs. From this period comes one of the great and historic documents of safety. In 1906, Judge Elbert Gary, president of the United States Steel Corporation, wrote:

"The United States Steel Corporation expects its subsidiary companies to make every effort practicable to prevent injury to its employees. Expenditures necessary for such purposes will be authorized. Nothing which will add to the protection of the workmen should be neglected."

The Association of Iron and Steel Electrical Engineers, organized soon after this announcement, devoted considerable attention to safety problems.

### Birth of the National Safety Council

Nineteen hundred twelve was to be an historic year for accident prevention. The previous year, a request came from the Association of Iron and Steel Electrical Engineers (which had been formed in 1907) to call a general industrial safety conference on a national scale. The result was the First Cooperative Safety Congress, which met in 1912 in Milwaukee. This gathering called for





Figure 1-2. Clippings from October 17, 1913, issue of *The Chicago Tribune*, which give a contemporary description of the newly founded safety movement.

another meeting in New York the following year, and at that meeting the National Council for Industrial Safety was organized. Shortly afterward, the organization's name was changed to the National Safety Council, and its program was broadened to include all aspects of accident prevention and, today, occupational health. Yet it must be remembered that the Council was the creation of industry and that its activities have always been heavily concentrated on industrial safety. (See Figure 1-2.)

The group that met in Milwaukee and New York was composed of a few safety "professionals," some management leaders, public officials, and insurance specialists. Their one point in common was a desire to attack a problem which most people thought to be either unimportant or could not be solved. Because these people were determined, the safety movement as we know it today was designed and built.

Actually the underlying objective when the National Safety Council was formed in 1913 was standardization. The primary purpose of the Council to provide an avenue of communication, an exchange of views, and solutions to common problems in accident prevention was an expression of the need for standards. In 1918 the Council conducted a national survey of state, fed-

eral, and municipal regulations together with a study of insurance recommendations, technical association recommendations, and the practices of industry. The survey depicted utter chaos in industrial safety. The need for unified methods and practices was clear.

Realizing its own limitations, the Council consulted the National Bureau of Standards, which agreed to call a conference to discuss the establishment of procedures for standardizing safety methods and practices. Meeting in Washington, D.C., in 1919, the attendees expressed the feeling that uniformity had become, not only extremely desirable, but almost imperative.

The conference voted to formulate safety standards under the auspices and procedures of the American Engineering Standards Committee (AESC), which had been formed in 1918 by five engineering societies and three governmental departments.

#### American Standards Association beginnings

In 1920, the National Safety Code Program was brought into the AESC. This caused the first reorganization of the Committee and was the beginning of what later was to become the





**Figure 1-3.** One of the first safety committees was formed with mill employees at Kimberly-Clark Co., Neenah Paper Co. The plaque in foreground is dated 1915.

American Standards Association (ASA). A national code committee was organized to suggest the initial safety code projects. This later became the Safety Codes Correlating Committee, the first of the ASA group of 18 standards boards. Bringing manufacturing companies and trade associations into AESC membership also initiated a broader program of engineering standards. As a result, an enlarged national standardization program was launched.

In 1928, recognizing that the extending activities called for a more formal type of organization, the member groups reorganized the AESC as the American Standards Association, now known as the American National Standards Institute (ANSI).

ASA continued to be an important partner in the safety movement. This group handled the “things” of safety (see Figure 1-7) while the National Safety Council has worked with the “people” portion of accident and occupational illness prevention.

### **Accident prevention discoveries**

As industry developed some experience in safety, it discovered that engineering could prevent accidents, that employees could be reached through education, and that safety rules could be established and enforced. Thus the “Three E’s of Safety”—Engineering, Education, and Enforcement—were developed.

Among the breakthroughs made during the 1900-1980 era were the identification and the efforts to control certain occupational health diseases such as mercury and lead poisoning. Asbestos acting in company with cigarette smoke was found to be a carcinogen causing lung cancer, or without smoke,

mesothelioma. Chromium compounds and beryllium also were studied.

There were other discoveries, too. Safety departments had often argued that savings in compensation costs and medical expenses would many times repay safety expenditures. Thoughtful business leaders soon learned that these savings were only a fraction of the financial benefits to be derived from accident prevention work. Newer, more effective techniques have been discovered and are described elsewhere in this volume. See especially Chapters 3 through 7, and 10.

### **Acceleration of the drive for safety and health**

Industrial safety received wide acceptance in the years between the two world wars. Conservation of manpower during World War II intensified the safety growth, and the federal government encouraged safety activities by its contractors. As industry expanded to meet the needs of the war effort, additional safety personnel were hastily trained to try to keep pace. The acceptance of safety as part of the industrial picture did not diminish with the end of the war. By then, the importance of safety to quality production was well established, and the small handful of dedicated people in 1912 had grown to tens of thousands.

In 1948, for example, Admiral Ben Moreell, then president of Jones and Laughlin Steel Corporation, wrote:

“Although safe and healthful working conditions can be justified on a cold dollars-and-cents basis, I prefer to justify them on the basic principle that it is the right thing to do. In discussing safety in industrial operations, I have often heard it stated





Courtesy, Scullin Steel Co.

# No, You Are All Wrong!

## This Gink Wasn't Beat Up By His Wife

## His Blinker Got in the Way of a Piece of Flying Steel

# To Prevent Such Accidents WEAR GOGGLES

National Safety Council  
Chicago



Bulletin Board Series  
Produced by the National Safety Council

**Figure 1-4.** World War I era poster published by National Safety Council. Note the "Universal Safety" emblem.

that the cost of adequate health and safety measures would be prohibitive and that 'we can't afford it.'

"My answer to that is quite simple and quite direct. It is this: 'If we can't afford safety, we can't afford to be in business.'"

A discussion of current federal safety legislation follows later in this chapter under Safety and the Law, and also in Chapter 2, Governmental Regulation and Compliance.

A by-product of organized safety activity has increased interest in safety engineering in colleges and universities. Many schools offer degrees and advanced courses in this subject and are contributing to a higher standard of knowledge among professionals in the field.

The World War II labor shortage dramatically brought home to management the magnitude and seriousness of the problem of off-the-job accidents to industrial employees. The wartime theme of the National Safety Council, "Save Manpower for War-power," focused attention on efficient and safe production.

Today, an increasing number of employers are including off-the-job safety in their overall safety programs. Companies realize their operating costs and production schedules are affected almost as much when employees are injured away from work as when they are injured on the job. Off-the-job safety is an extension of a company's on-the-job safety program and is intended to educate the employee to follow the safe practices he uses on the job in his outside activities. Companies have found that on-

the-job and off-the-job programs complement each other.

From the earliest days of industrial safety, it has been difficult to make a clear separation between health and accident hazards. Is dermatitis an accident or a disease? What about hernias, hearing loss, and heart trouble? Inevitably, safety professionals have become interested in many health problems that are on the borderline between diseases and accidents. In 1939, the American Industrial Hygiene Association was established to promote the recognition, evaluation, and control of environmental stresses arising in or from the workplace.

## EVALUATION OF ACCOMPLISHMENTS

Since the factors are complex, no simple rating scale can indicate all the answers to the question, "What has the safety movement accomplished?" In the absence of such a rating scale, an attempt to answer the question must be made by assembling several kinds of data.

First, the question must be asked, "Has the safety movement, in fact, done anything to prevent accidents?" To that question can be answered a clear "Yes!"

If the annual accidental death rate per 100,000 of population which held in 1912 had continued, over 2,600,000 more accidental deaths would have occurred. Since 1912, the death rate for persons of normal working age—25 to 64 years—declined fifty





**Figure 1-5.** Back in 1910, this was a modern medical facility. Note sterilizer on work table—it looks more like a large coffee maker. (Courtesy Norton Company, Worcester, Mass.)

nine percent while the rate of all ages of the entire population declined fifty two percent. Medical progress accounts for some of this gain, but the larger part is certainly the product of organized safety work.

Since World War II, the number of work-related deaths per 100,000 population, standardized to the age distribution of the population in 1940, has decreased steadily (Figure 1-8). This indicates that the risk of on-the-job death has declined for the population as a whole. Part of the progress made in lowering the overall death rate, however, can be attributed to the rapid growth in recent years of the service-producing sector of the economy with its lower death rate and the decline of some relatively risky parts of the goods-producing economic sector. In 1945, 43 percent of the non-agricultural workforce was in production industries (mining, construction, and manufacturing). By 1985 the proportion had declined to 26 percent.

A clearer picture emerges by looking at the trends on a more detailed level. Table 1-A shows the significant improvement in the death rates of the major industry groups. Death rates in five of the seven private sector groups have been reduced by 50 percent or more over the last 40 years. This clearly indicates, by one criterion, the effectiveness of the organized safety movement.

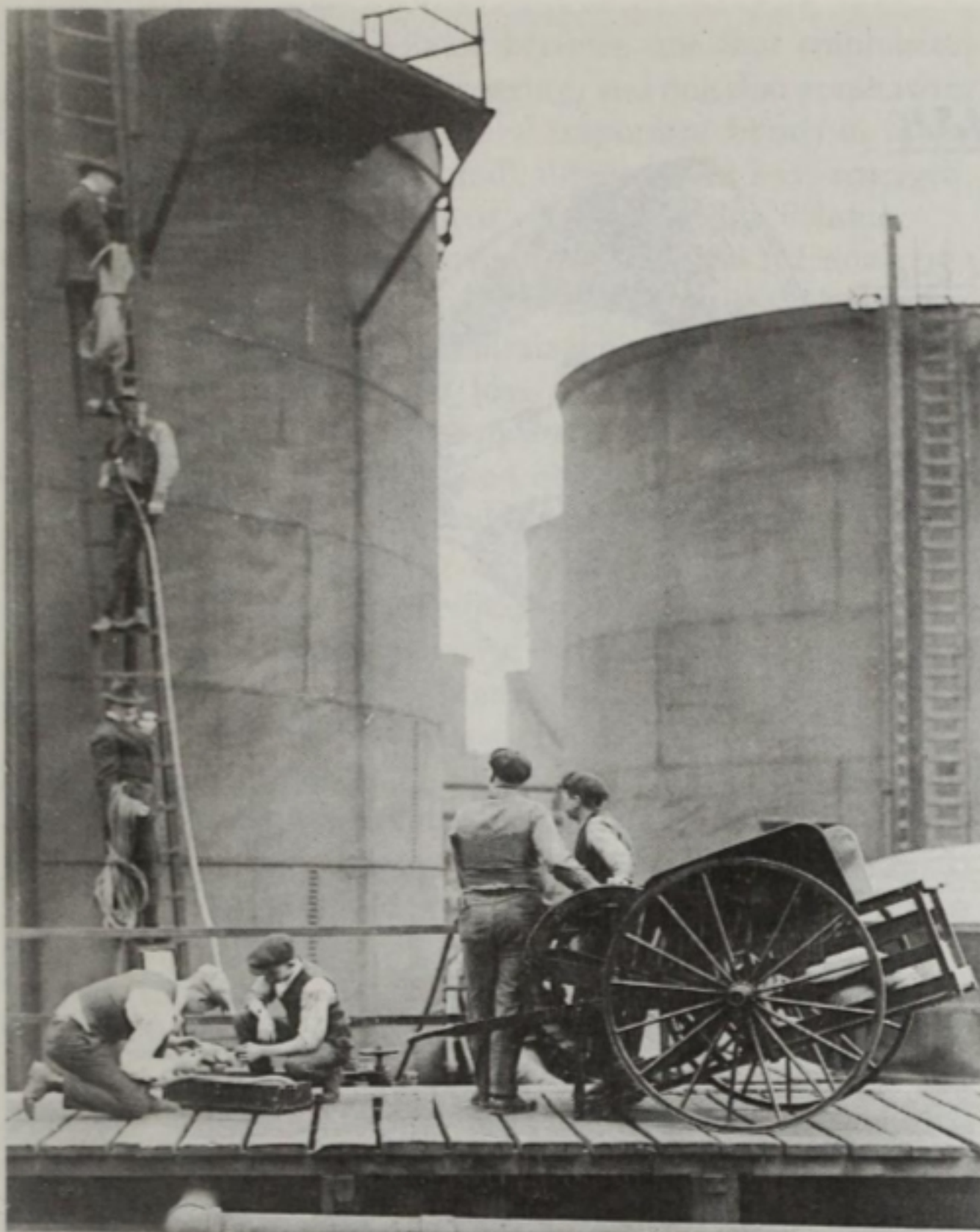
**Table 1-A.** Work Deaths per 100,000 Workers

Industry Group	1945	1985	Percent Change
Agriculture, forestry, and fishing	53	49	- 8%
Mining and quarrying	187	50	- 73%
Construction	126	37	- 71%
Manufacturing	19	6	- 68%
Transportation and public utilities	52	29	- 44%
Wholesale and retail trade	10	5	- 50%
Services	20	6	- 70%

Source: National Safety Council, *Accident Facts*, 1946 and 1986 editions.

Long-term trends in non-fatal occupational injury rates cannot be examined because of a break in continuity of the historical statistical series. Until the early 1970s, injury rates were based on the voluntary *American National Standards Method of Recording and Measuring Work Injury Experience*, ANSI Z16.1. With the passage of the Occupational Safety and Health





**Figure 1-6.** Atlantic Refining Company's fire brigade practices scaling a storage tank. Compare this World War I Era equipment with the modern equipment shown in Chapter 18, "Planning for Emergencies."

Act of 1970, it became mandatory for most private sector employers in the USA to keep occupational injury and illness records in accordance with OSHA recordkeeping requirements. Most employers dropped the voluntary standard rather than keep two sets of records.

A clear trend has not yet emerged in the occupational injury and illness incidence rates published by the Bureau of Labor Statistics since 1972. Business cycles and changes in the distribution of the labor force among industries can mask any short-term changes in rates due to more effective or more intensive safety efforts.

### The dollar values

It has been estimated that the annual cost of occupational accidents in the United States exceeds \$37 billion. If the 1912 accident rates had continued unchanged and if there had been no organized safety movement, this annual cost would have easily been two or three times as great, even in constant dollars.

Against such dollar savings, the relatively small expenditures for safety throughout America provide a striking contrast. Each dollar spent for safety by American industry is probably returning a clear profit of several hundred percent.

### Industry and nonwork accidents

Directly and indirectly, industry is bearing a substantial part of the cost of nonwork accidents and their prevention. While the National Safety Council is the creation of industry and

largely supported by it, the Council as well as state and local safety organizations play a major role in the fight against such accidents. Industry supports a large part of the job of informing the general public on these problems through the press, radio, and television.

The effectiveness of the nonwork accident prevention campaign is shown by the fact that, from the time records were first kept in 1921, both home and public accident death rates have generally declined. (See Figure 1-8.)

If industry has been a large contributor to this successful work, it has also been a heavy beneficiary from it. Disruption of the labor force, worry and hardship among employees, loss of purchasing power by consumers, and heavy tax burdens for the support of hospitals and relief agencies all result, in part, from nonwork accidents.

## SAFETY'S RESOURCES

*Statistics* measure what has been accomplished and *resources* describe the tools, methods, and knowledge that have been developed for use by safety and health professionals to meet future accident and occupational illness problems.

### Know-how

This *Accident Prevention Manual for Industrial Operations*, for example, is an accumulation of facts and experiences that are a part of the safety and health movement. Its purpose is to present key points of specific, as well as general, knowledge to safety-interested people, from students, to those just recently involved in this type work, to advanced and experienced practitioners.

Today, an individual using this Manual can find better answers to a wider range of industrial safety problems than were available to the wisest and best-trained professional safety practitioner several decades ago. Yet, even this Manual can't contain all of the knowledge available to fight the never-ending war against accidents and occupational illnesses.

Other material may be found in numerous pamphlets, books, and periodicals published by safety and health organizations, government agencies, and insurance companies, and in the studies and directives of individual industrial concerns. The literature of various trades and professions is likewise rich in safety information. A list of handbooks is presented in Chapter 19, *Safety Engineering Tables*, of the *Engineering and Technology* volume. At the end of this chapter is a list of the general safety books that are used as sources of questions for the examination for Certified Safety Professional.

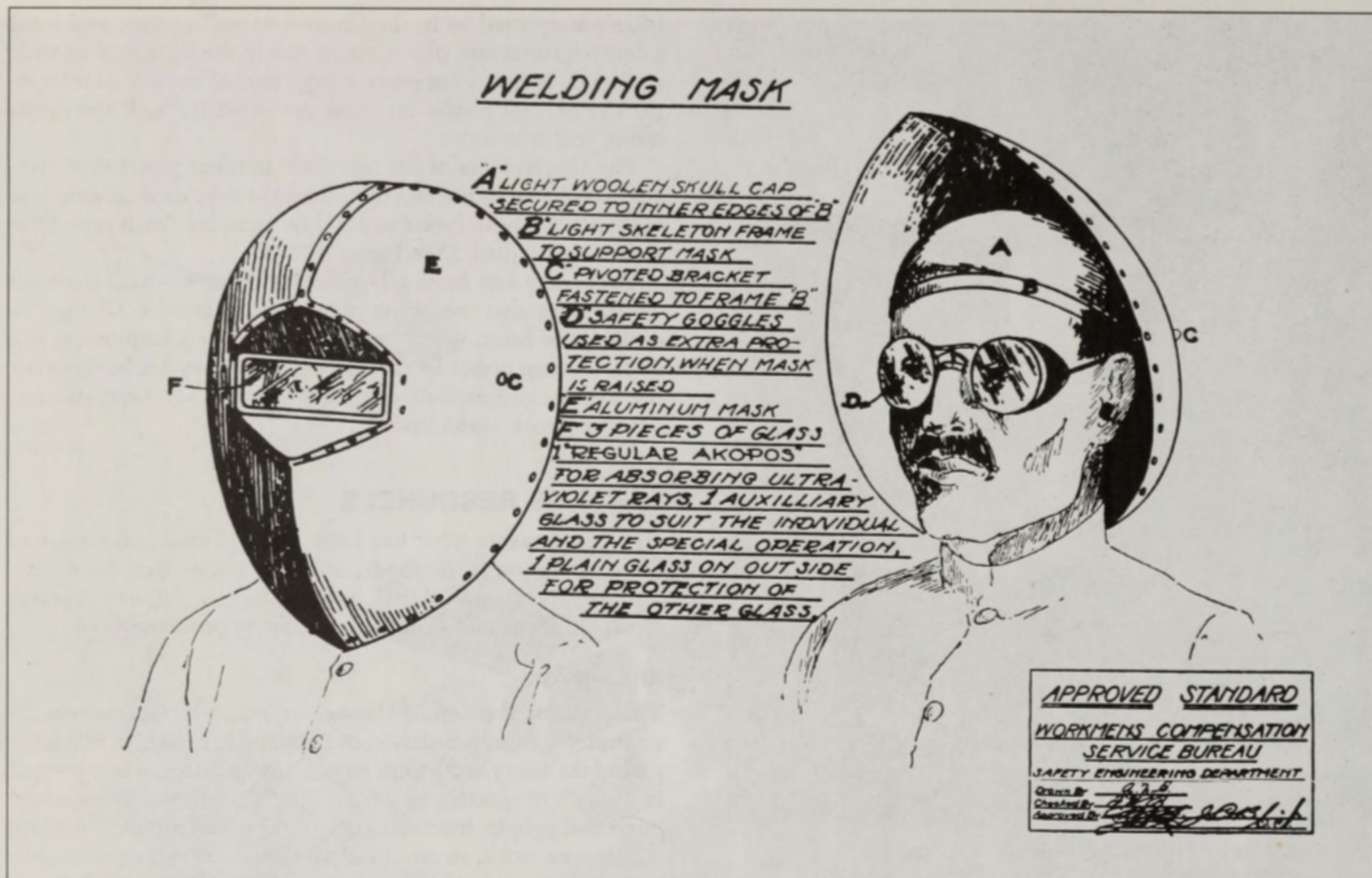
The National Safety Council offers a series of training courses, at both the beginning and advanced levels, for professionals. The Council also offers extensive consulting services.

Finally through conferences, technical seminars, newsletters, and other publications professional safety engineers, executives, supervisors, and rank-and-file employees exchange safety information regularly. The annual Congress and Exhibition, held in alternating years in Chicago and in cities across our nation, is an excellent means of professional development. (See Figure 1-9.)

### The heritage of cooperation

The safety movement would be far less effective if its members had hoarded and concealed their discoveries from their colleagues in competitive companies.





**Figure 1-7.** Workmen's Compensation Service Bureau gave "approval only of the principal" of protective equipment and clothing. Its "Universal Safety Standard," dated 1913, did push for double protection even back then. The National Safety Council publishes no standards; these are left to the American National Standards Institute, which was co-founded with the National Safety Council to handle standards, while the Council worked with people.

It was teamwork that created the safety activities of the Association of Iron and Steel Electrical Engineers. It was broadened teamwork that called for and attended the first Milwaukee Conference which led to the formation of the National Safety Council and other safety organizations.

Effective accident prevention requires cooperation. Through the Council and other safety organizations, safety professionals met to exchange ideas, develop safety publications, and stimulate one another in friendly competition.

The tradition that there should be "no secrets in safety," no denial of help even to a competitor when it involves saving life, is one of the great strengths in the safety movement.

### Good will

In its early days, safety did not have a high priority with management. But today, no small part of the safety professional's capital is the prestige and good will built up for safety proposals and expenditures over the years. Where the pioneers had to battle every step of the budgetary way, safety professionals today have a far more receptive hearing from management.

### Professionalism

Dedicated safety and health professionals continue to be accident and occupational illness prevention's most valuable asset.

Their ranks have grown to the point where, in the mid-eighties, membership in the American Society of Safety Engineers (ASSE) is approaching 21,000. This organization, dedicated to both their interests and their professional development, has approximately 120 chapters in the U.S. and Canada. Individual membership is worldwide.

In addition to the ASSE members, there are many other qualified safety professionals who, together with thousands of specialists and technicians, carry out a limited scope of activities within the field. Numerous others devote less than 50 percent of their time to safety functions.

In 1968, the ASSE was instrumental in forming the Board of Certified Safety Professionals (BCSP). Its purpose is to provide a means of giving professional status to qualified safety people by certification after meeting strict educational and experience requirements and passing an examination. Similarly in the hygiene field, the professional certification of industrial hygienists (CIH) was sponsored by the American Industrial Hygiene Association. Both the ASSE and the AIHA are described in Chapter 24, Sources of Help.

### Advancement of knowledge

The tremendous increase in scientific knowledge and technological advancement since the close of World War II has added to the complexities of safety work.



The approach has oscillated between one that emphasizes environmental control or engineering, and one that emphasizes human factors. From this, several important trends in safety work and the safety professional's development have emerged. All are discussed in subsequent chapters of this volume.

- First, increasing emphasis is developing toward analyzing the loss potential of the activity with which the safety professional is concerned. Such analysis will require greater ability (1) to predict where and how loss- and injury-producing events will occur and (2) to find the means of preventing such events.
- Second, factual, unbiased, and objective information about loss-producing problems and accident causation is increasingly being developed so that those who have ultimate decision-making responsibilities can make sound decisions.
- Third, there is increasing use of the safety and health professional's knowledge and assistance in developing safe products. Applying the principles of accident causation and control to the product is becoming more important because of the increase in product liability cases, the sudden emphasis in law of the entire field of negligent design, and the obvious impact a safer product would have on the overall safety of the environment.

To identify and evaluate the magnitude of the safety problem, safety professionals must be concerned with all facets of the problem—personal and environmental, transient and permanent—in order to determine the causes of accidents or the existence of loss-producing conditions, practices, or materials. From the collected and analyzed information they propose alternate solutions, together with recommendations based upon their specialized knowledge and experience, to those who have decision-making responsibilities.

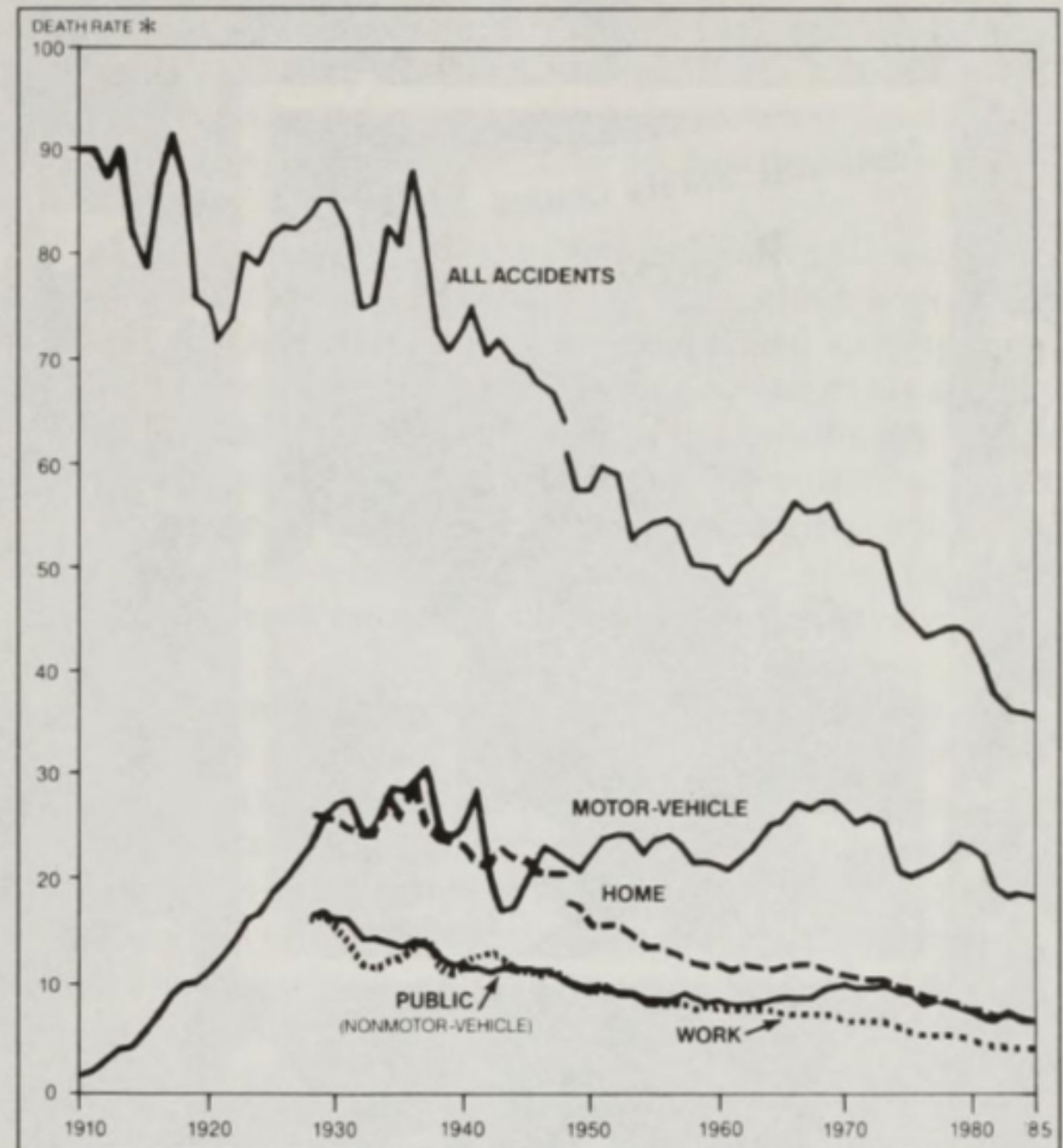
Therefore, application of this knowledge—whether to industry, transportation, the home, or in recreation—makes it imperative that those in this field be trained to utilize scientific principles and methods to achieve adequate results. Of prime importance are the knowledge, skill, and ability to integrate machines, equipment, and environments with people and their capabilities.

Safety and health professionals in performing these functions draw upon specialized knowledge in both the physical and social sciences. They apply the principles of measurements and analysis to evaluate safety performance and are required to have fundamental knowledge of statistics, mathematics, physics, chemistry, and engineering.

They need training in the field of behavior, motivation, and communications and knowledge of management principles as well as the theory of business and government organization. Specialized knowledge must include a thorough understanding of the causative factors contributing to accident and occupational illness occurrence as well as methods and procedures designed to control such events.

Safety professionals also need diversified education and training, if they are to meet future challenges. The population explosion, the problems of urban areas and future transportation systems, the weakening of the family, the decline of respect for authority, and the cloudy economy, as well as the increasing complexities of everyday life, will create many problems and stretch safety professionals' creativity to its maximum, if they are to successfully provide the knowledge and leadership to conserve life, health, and property.

Training for the safety and health professional of the future can no longer be the "on-the-job," one-on-one type, only. It must



**Figure 1-8.** Trends in accidental death rates drop, both on and off the job. Shown here are deaths per 100,000 population, adjusted to the 1940 age distribution. The break in 1948 shows the estimated effect of classification changes.

include specialized undergraduate education that leads to a bachelor's or higher degree.

Training courses, such as those offered by the National Safety Council, will continue to educate a large number of individuals who began performing safety functions and must receive initial training or advanced training in certain specialized areas.

Approximately 200 four-year colleges and universities offer courses in safety and health, and several dozen offer a bachelor's or higher degree in safety. Two-year, community colleges are offering associate degrees or certificates for courses designed for the safety technician or part-time administrator. Governmental agencies and ASSE are also conducting such professional development programs. (See Chapter 9, Safety Training.)

### Summary of achievements

The safety movement has helped save tens of thousands of lives. It is saving industry and its employees billions of dollars a year.

It faces the future with numerous resources for eliminating accidents and occupational illnesses—resources in know-how, teamwork, good will, and education programs that produce trained and dedicated safety workers.

It has, therefore, done much to meet the double challenge presented to it: to deal with accidents and occupational illnesses now and to build soundly for the long-range attack upon these problems in the future.

## SAFETY TODAY

To answer the question, "What has the safety movement accom-





**Figure 1-9.** Main entrance to the Council's annual Congress and Exposition. Photo shows 1986 crowd at morning admission time. Inset shows the Council exhibit; for additional photo, see Chapter 9, Safety Training. At the Congress, ideas are exchanged by speakers, seminars, workshop sessions, and through informal conversations; at the Exposition, registrants find out what goods and services are available commercially.

plished?" we look at continued growth in safety awareness and accident reduction. To answer the question, "How does the safety movement stand today?" we must look at what is wrong, as well as what is right, with the present situation. The answer can be found in an appraisal of how the safety movement stands in relation to how it ought to stand. The first point to be considered is simple and grim:

- Accidents still bleed this country of more than 90 thousand lives a year, cause about 9 million disabling injuries, and account for a total financial loss of more than \$100 billion.
- Work accidents destroy more than 11,000 lives a year, about half these deaths occurring in what is normally considered industry. Work accidents injure about 2 million persons annually and cost more than \$37 billion.

In recent years, the ratio of off-the-job deaths to on-the-job deaths was about 3 to 1 and more than half of the injuries suffered by employees occurred off the job.

In terms of time loss, all injuries to workers, both on and off the job, caused a loss of about 100 million man-days of work.

Within the industrial community, there are very large varia-

tions in accident rates from industry to industry and from company to company.

The wholesale and retail trade, services, and finance, insurance and real estate industries all have occupational injury and illness incidence rates that are below the private sector average. Rates are above average in the construction, agriculture, manufacturing, transportation and public utilities, and mining industries.

Injury incidence rates by size of establishment are lowest for the very small establishments (1 to 19 employees), and rise steadily until they reach a maximum in establishments of 100 to 249 employees. The rates then decline steadily as establishment size continues to increase.

### Small establishments

It has been stated that small businesses, those with 100 to 250 employees, have proportionately more work injuries than large corporations or very small, 1 to 19 employee, companies. However, since many small companies do not accurately record and report their experience, it is difficult to establish any valid data comparing work injury experience. It is safe to say that companies, large or small, that ignore safety and health efforts will,



in the main, have more than their share of accidents and occupational illnesses.

The seriousness of the small-enterprise problem is widely recognized and the National Safety Council has devoted much effort to meeting it. One way has been through the establishment of liaison between the National Safety Council and the trade associations representing many small companies.

Certain aspects of the small-company problem can be stated with assurance:

1. The small establishment may not need or cannot employ specialized safety and health personnel to deal with the accident and occupational health problem.
2. The number of accidents or the financial position of many small companies makes it difficult to convince them that spending the money for proper equipment, layout, guarding, and other elements is important.
3. Managers of small operations deal with a host of problems and seldom have the expertise or time for the proper study of accidents and occupational illnesses and their causes.
4. In small units, statistical measures of performance are unreliable, so it is difficult to produce clear-cut evidence of the cost of accidents versus the effectiveness of accident prevention work. In other words, a small operation may have, by luck, a good or bad accident record over a few years, whether or not its safety program is sound.

These are obstacles to progress—real and serious ones. They are not, of course, excuses for failure to try to prevent accidents and occupational illnesses. The trade association approach offers the best hope for improvement of this group.

### **Labor-management cooperation**

From its inception, one of the prime goals of organized labor has been the safety and health of its members. Many of today's international unions were organized originally to deal with extremely hazardous situations in the workplace, and have a sincere desire to work together with management on methods to prevent occupational injury and illness.

In 1949, the National Safety Council issued a policy statement declaring the common interest of labor and management in accident prevention. Even before this date, representatives of leading labor organizations served as members of the Council's governing boards. In 1955, a Council Labor Department and a Labor Conference (now known as Labor Division) were formally established.

The Labor Division continues to serve as a vital link between industry management and the nation's labor unions. By distributing Council safety and health materials at trade and industry shows, the Division is an invaluable resource for union members.

Labor Division representatives review products, training materials, and policy statements. The division shares information with labor leaders and more than 550 volunteers from international and local labor unions. The combined efforts of these groups reach the nearly 20 million members of organized labor with information to help them improve the quality of their lives, both on and off the job.

Labor has also been instrumental in promoting legislation

such as the Occupational Safety and Health Act of 1970 (OSHAct), described in the next chapter.

Some unions have done extensive safety work and published printed matter and released films of benefit to the safety movement.

Through the auspices of the National Safety Council, the Labor Division and the Industrial Division, along with other affected divisions, frequently have cooperated in preparing Council positions on matters pertaining to standards action, oversight testimony, publicity releases, and other areas which bear on occupational safety and health. As a result of these joint committees, Council positions are being recognized as more representative of all elements of society, allowing them to have even greater impact on administrative agencies and legislative bodies.

Through a program begun in January 1978 with a symposium of leaders from government, industry, and organized labor, the National Safety Council has begun an extensive program to determine causal factors of injuries. Realizing that most past data have only given us the numbers of types of injuries, the focus of this program is to change investigatory and reporting methods, as well as to provide an information exchange bank of the factors that have actually caused injury or occupational illness.

### **Statistics, standards, and research**

Statistical data on industrial accidents have been compiled by the National Safety Council for more than 50 years. Analyses computed annually and published in industry rate pamphlets and the Council's *Accident Facts* are of utmost importance in evaluating leading accident causes. For example, a recent study of the effects of raising the drinking age to 21 in 10 states by the Council's Statistics Department revealed a statistically significant reduction in the fatal accident involvement rate of drivers affected by the legislation.

Staff members also provide continual support for other Council departments, including: a summary and analysis of data on work-related motor vehicle injuries, compiled for a committee of the board of directors; an estimate of the effects of lower gasoline prices on travel and motor vehicle-related deaths for the Highway Traffic Safety Division; tabulations and a summary of data from a survey of truck drivers for the Motor Transportation Division; and tabulations of data from a survey of meat industry safety management attitudes and practices for the Industrial Division. There are more than 300 full-time technical/professional employees at the Council.

Some industries through their trade associations have recorded accident rates for almost 60 years. In most instances, even the divisions of an industry can establish their positions with regard to number and types of accidents and can determine their experience in comparison with national averages.

There are a large number of ANSI and other standards relating to safety. Continuing research has been necessary over the years to keep these standards in line with current industrial development and the development of new products and materials.

Special research projects, such as those making studies of walking surfaces and safety belts, can be and have been financed by private sources and coordinated by the National Safety Council. Recent Council research surveys have been conducted on the training programs for young and/or new drivers and on student reaction to the *Defensive Driver Handbook*. The results of these projects are given as a summary of findings.



## Safety and the law

Early legal action in industrial safety took the form of laws to regulate and investigate. The next phase was largely concerned with workers' compensation payments.

The following years have seen a gradual growth by federal, state, and local governments in regulating industry on safety matters. The Walsh-Healey Act, which deals with companies having supply contracts with the federal government, is an example of such regulation.

In certain industries—notably mining and transportation—U.S. federal government regulation and inspection have been extensive. The Construction Safety Act, which was passed in 1969, deals with the particular problems of that industry.

In 1970, the Williams-Steiger Occupational Safety and Health Act was passed and, for the first time, the United States had a *national* safety law. Every business, with one or more employees, which is affected by interstate commerce is covered by the law. Safety in this country took on a new direction and meaning as a result of the Occupational Safety and Health Act.

Concern with health and safety of workers has become a major priority for management. It goes beyond the obvious benefits of less lost time, reduced costs for worker compensation insurance, and lower medical and administrative expense resulting from disability, death, and impaired productivity. Failure to comply with the federal law's requirements brings citations, which (at the least) result in administrative costs, but could also lead to serious monetary penalties. Gross disregard of the law has also led to criminal sanctions against employers and even against managers individually. The criminal action has not only come from federal and state job safety and health agencies. Local prosecutors have been successful convicting individual managers for murder and aggravated assault as a result of death and injury to workers.

Managements must deal with serious emerging issues in worker health and safety law. They include ways to deal with the special problem of the employee who is at risk in the work environment because of physical condition, language problems, or particular susceptibility to injury or disease. Another issue is complying with the burgeoning paperwork arising from the recordkeeping requirements, the Medical Access Standard, and the Hazard Communication Standard. More details are in Chapter 2, Governmental Regulation and Compliance.

Today industry accepts almost without exception the idea of financial responsibility for work injuries. Not all of industry, however, is convinced of the effectiveness of government regulation of safety procedures.

A recent development in some states has been the establishment of laws making health and accident insurance compulsory to cover employee disabilities from diseases or accidents which originate off the job.

This compulsory insurance might be considered either a drastic extension of the principle of workers' compensation or an extension of social security legislation. It differs from workers' compensation in that it puts a financial burden upon management for diseases and accidents which are products of conditions beyond its control.

Whatever the theory, the result of these laws is to give the employer a direct financial stake in dealing with the off-the-job accident problem. See Chapter 3, Hazard Control Program Organization.

## Safety and occupational health

Even though medical and safety cooperation in accident prevention began during the earliest days of the safety movement, interest in safety on the part of the medical profession and, conversely, interest in employee and public health on the part of the safety professional is increasing.

Part of this interest in workers' health results from concern with occupational disease, noise, radiations, and other problems beyond the former concepts of occupational accident prevention. Part of the interest in protecting the health of citizens of nearby communities comes from such highly publicized events as the 3-Mile Island accident, the Chernobyl, Ukraine, meltdown, and the Bhopal, India, disaster.

**Work environment.** Over time, health and safety professionals became aware of the relationship between physical illness and the job, as workers in certain industries exhibited a higher than normal incidence of such problems as dermatitis, musculoskeletal problems, pulmonary disease, mental illness, and cancer.

The health and safety of today's workers results from a concerted effort by a safety, industrial hygiene, and occupational health team working with a management dedicated to the idea that an organization's primary asset is healthy and safe workers.

For more details, refer to the Council's *Fundamentals of Industrial Hygiene*, part of the Occupational Safety and Health Series, and the *Introduction to Occupational Health and Safety* manual.

**Community environments.** Increasingly in America, the public has demanded a larger role in the management of community environmental risks. Both public and private risk managers realize that providing avenues for public participation is a necessary part of their decision-making process. The problem is *how* both to assure public involvement and improve the quality of decisions.

To help fill the gap in credible risk communication on environmental health and safety issues the National Safety Council established the Environmental Health and Safety Institute. This special-purpose organization is led by a Board of Governors and operates mostly through philanthropic fundings from concerned corporations, foundations, labor unions, and individuals. It will develop accurate and objective information on environmental and public health risks, improve public knowledge about these risks, and disseminate this information to the public.

**Handicapped workers.** The utilization by progressive companies of workers with disabilities and federal and state "equal opportunity" laws has modified the practice of pre-employment examinations to screen out unfit or undesirable prospects. Medical personnel perform a preplacement examination to determine what physical or mental restrictions are appropriate to the prospective employee but do not determine fitness for a specific job. The job description must specify realistic physical and mental requirements to which the medical restrictions can be matched by the personnel department. If possible, modifications in the job must be made to accommodate the handicapped. (See the discussion in Chapter 20, Workers with Disabilities.)

## Psychology and "accident proneness"

Safety professionals who are thoughtfully looking for ways to improve their work encounter a great deal of challenging infor-



mation in modern psychological writing—and also a great deal of careless and misleading generalizations.

Concern about the so-called “accident prone” individual in industry is as old as the safety movement. Statistical information suggests existence of such individuals, though clear and sharp data demonstrating this point are remarkably hard to come by. Too many alleged “proofs” turn out to be statistically deceptive, or based on inadequate samples, or the result of highly subjective diagnoses.

The elusiveness of statistical support for the existence of accident-prone individuals suggests to some thoughtful safety professionals that accident proneness may be a passing phase in the individual rather than a permanent characteristic, or at most, a problem encountered in an insignificant minority.

Realistically, objective analysis might disclose some supervisory deficiency or procedural weakness which may aggravate the hazard of certain operations or performance of individuals or groups of workers.

The same observation applies to psychological tests used as screening devices for new employees. Spectacular claims have been made from time to time for the effectiveness of such tests in predicting accident proneness, but none has established itself to the general satisfaction of the safety profession.

In the past, the work of psychologists like Dunbar and the Menningers aroused great interest among safety professionals. However, contributions to the practical day-to-day fight against accidents tend to come from the disciplines of engineering and behavioral psychology, such as human factors engineering, system safety, and risk management or assessment.

Refer to the discussion in Chapters 9 and 11.

## Summary

The present situation in the field of industrial safety is one of progress and improvement, largely through the continued application of techniques and knowledge slowly and painfully acquired through the years.

There appears to be no limit to the progress possible through the application of the universally accepted safety techniques of education, engineering, and enforcement.

Yet large and serious problems remain unsolved. A number of industries still have high accident rates. There are still far too many instances where management and labor are not working together or have different goals for the safety program.

The resources of the safety movement are great and strong—an impressive body of knowledge, a corps of able professional safety people, a high level of prestige, and strong organizations for cooperation and exchange of information.

## CURRENT PROBLEMS

Some problems of the safety movement are directly related to traditional strengths and weaknesses. Some of these problems are social and political in nature. Still others are essentially organizational.

### Technology and public interest

There is no reason for the safety professional to view the public's interest in product safety, a better environment, and general technological trends with alarm. Emphasis upon automation and more refined instrumentation will probably continue. New specific problems will arise, but they will be of a type that

well-established methods of safety engineering are competent to solve.

The use of new materials and techniques—particularly radioactive materials and lasers—is likely to present more serious difficulties to the safety professional. However, even here, there is considerable experience.

Safety professionals need to stay tuned into the rapid developments in communications and computerization as they impact on their safety field. (See Chapter 5.)

### Political problems

On the political side remains the timeworn problem of industry-government relations. The key issue here is how much government should regulate and which aspects of American life it should regulate.

### Organizational problems

On the national scale, a wide variety of organizations are attacking specific aspects of occupational safety and health problems. The National Safety Council is, of course, the giant in the field—a strong, constructive, and nonpolitical, noncommercial giant. It has repeatedly sought and often achieved cooperative division of labor between itself and other organizations in the safety and health field.

One of the guiding principles of the Council has been that there was work enough and credit enough for all.

It remains to be seen whether the best organizational forms have been found for participation by all businesses in safety and health work. Safety and health professionals should be ready to consider new ideas and work to solve new problems.

### A look to the future

The greatest reasons for intensifying the safety effort are humane and moral. Our neighbors, our friends, our family—their worth cannot be measured in dollars or coded into computer records.

During the coming decade, we will see the American population grow, but more slowly than in the past. By 1990 there will be about 240 million living Americans. The average age of these persons will increase due to longevity thanks, in part, to health care advances. The “Baby Boom” generation will be among those aging adults and the generation crowding the workforce.

The shift from extractive and manufacturing to service field areas of employment will continue. This fact will hopefully contribute to a decline in occupational death rates since the number of people employed in high-risk industry will be lower.

The workforce continues to undergo major changes as minorities and women continue their upward mobility. Safety implications from the increasing employment of women are complicated and a number of difficult choices will still have to be made.

As social conditions, including a high divorce rate, one-parent families, and two-working-parent households continue to mushroom, the effect on the traditional American family is felt. Today there is reduced respect for either parental or social authority, a factor seen and felt in the workplace.

A survey of National Safety Council Board members ranked the major safety and health issues facing the nation. Drinking drivers came in first, followed by occupant restraints, a national uniform minimum age of 21 for drinking, a national 55 mph speed limit, and the transportation of hazardous materials.

These are issues of major importance and will need the exper-



tise and guidance of all of us in the safety and health field. The future is, as it always has been, most uncertain. By working together all those in the safety and health community can take some of the uncertainty out of it by helping to make our workplaces and our off-the-job environs safer, healthier places to be.

**Opportunities for the safety professional.** The 1980s are an exciting time for the safety professions. Safety management, safety engineering, industrial hygiene, occupational medicine, and the new field of holistic medicine are discovering new and compelling reasons for drawing together in ever closer cooperation and opening new areas of employment for the safety and health professional.

Other expanding employment opportunities for safety professionals lie in the safety departments of international (and some local) labor unions, on the staffs of a number of trade associations, and, of course, in government service. Safety consulting has expanded rapidly, both in the form of individuals offering their talents on a contract basis and in the form of consulting service offered by nonprofit associations and by a few industrial concerns.

The availability of advanced education for safety professionals registered a large percentage increase in the '80s, but it started from a small base. The numerical growth remained inadequate to meet the expanding need. The result was that there was a serious shortage of highly qualified safety professionals. At the same time, the population bulge in the prime years of life created a surplus of the less-well-trained people in management. This had two effects on safety positions in companies and in government. One was an increase in the competition for senior safety positions. The other was an increase in the demand for advanced safety training to a degree beyond the immediate capacity of the technical colleges. One of the greatest growth opportunities for highly qualified safety professionals lies, in fact, in the staffing of college courses in safety.

These are the challenges of tomorrow—improved performance on the job and profession, coupled with the necessary education to compete and work effectively in the safety and health field.

## GENERAL SAFETY BOOKS

In addition to this manual, the following are currently available books on the basics of occupational safety and health that are used to obtain the questions on the management aspects section of the examination for Certified Safety Professional qualification.

- Browning, Robert L. *The Loss Rate Concept in Safety Engineering*. New York, N.Y.: Marcel Dekker, 1980.
- DeReamer, Russell. *Modern Safety and Health Technology*. New York, N.Y.: John Wiley & Sons, 1981.
- Ferry, Ted S. *Modern Accident Investigation and Analysis*. New York, N.Y.: John Wiley & Sons, 1981.
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