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NATIONAL
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TRANSACTIONS

VOLS. 1-30

1957

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CURRENT SAFETY TOPICS

Volume 1

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GENERAL SESSIONS

*Transactions of the
45th National Safety Congress*

(October 1-25, 1957, Chicago, Ill.)

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NATIONAL SAFETY COUNCIL

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LEARNING TO LIVE . . .

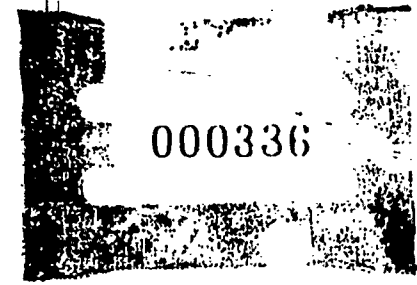
Learning to live—safely—was the drawing card which brought more than 13,000 men and women from the United States and 27 other countries to Chicago for the 45th National Safety Congress. These people gathered to exchange the latest ideas in safe attitudes, safe methods and safe equipment. Through speeches, panel discussions and symposiums, they acquired new ideas for helping others—and themselves—to live, work, and play safely.

This was the reason the National Safety Council was organized less than half a century ago, a time when man's thoughts barely kept pace with the industrial revolution. Since then, man has introduced an atomic age which is bringing the continents closer and has made the earth a smaller world. And now man anticipates inter-space travel!

Through science and technology, man is progressing to increasing speeds in travel and production, and increasing dangers—new dangers never before encountered. These, in addition to the everyday hazards of life, occupied the thoughts of the safety people at the Congress.

To encourage more widespread knowledge of the various fields of safety, the National Safety Council publishes the Current Safety Topics—30 volumes of condensations of Congress speeches and exchanges of ideas. Each volume is a handy reference to different phases of accident prevention. The complete set of volumes are listed on the back page of each volume.

Since the proceedings have been edited and condensed for reference purposes, the complete original manuscripts with any charts or illustrations used, are available in the National Safety Council files. Views expressed at the Congress or in any volume of Current Safety Topics are those of the Congress participants, and not necessarily those of the National Safety Council.



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High flash, low toxicity safety solvents.

Ford Motor Co., Dearborn, Mich.
Ford automobiles, featuring Lifeguard steering wheels, sun visors, seat belts instrument panel padding, and door latches.

Frommelt Industries, Dubuque, Iowa
Portable welding shield and protective heat cloth.

Fyr-Fyter Div., Fyr-Fyter Co., Dayton, Ohio
Fire extinguishers, resuscitators and respirators.

General Fire Extinguishers Corp., St. Clair Shores, Mich.
Quick-Aid fire extinguishers and allied products.

Glendale Optical Co., Inc., Valley Stream, N. Y.
Chippers and welders goggles, face shields, safety spectacles.

Globe Co., Grip-Strut Div., Chicago, Ill.
Grip-Strut grating, stair tread materials.

Grinnell Co., Inc., Providence, R. I.
Fixed pipe fire protection systems.

Gro-Cord Rubber Co., Lima, Ohio
Gro-Cord, Raw-Cord and Neo-Cord soles, heels and taps.

Haws Drinking Faucet Co., Berkeley, Calif.
Emergency eyewash fountains, emergency showers and goggle wash fountains.

Hild Floor Machine Co., Inc., Chicago, Ill.
Explosion-proof vacuum cleaners and floor machines.

Hy-Test Safety Shoes Div., International Shoe Co., St. Louis, Mo.
Safety footwear; also conductive and special types for atomic usage.

Hygiene Research, Inc., New York, N. Y.
Protective ointments and mistproofing cloth for goggles, welding masks, winds.

Industrial Gloves Co., Danville, Ill.
Leather, asbestos, duck, wool, Woven-Gard, Permaproof, and aluminized duck and asbestos finger guards.

Institute of Industrial Launderers, Washington, D. C.
Industrial launderers and cleaners.

Insto-Gas Corp., Detroit, Mich.
Torches and furnaces.

Interstate Rubber Products Corp., Los Angeles, Calif.
Safety Trafficcones for traffic control.

Iron Age Div., H. Childs & Co., Inc., Pittsburgh, Pa.
Linemen's and women's leather and rubber industrial safety footwear.

Jackson Products, Air Reduction Sales Co., Div. of Air Reduction Co., Inc., Warren, Mich.
Insulated electrode holders, cable connectors, face shields and goggles.

Jom, Philadelphia, Pa.
Industrial work gloves, safety sleeves, hand guards, North P.V.C. gloves, North or ve clothing.

Jones & Co., Rumford, R. I.
Full vision visor goggles.

Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Wire rope slings, wire rope.

Junkin Safety Appliance Co., Inc., Louisville, Ky.
Power press guards, grinding wheel shields, stretcher equipment.

Justite Mfg. Co., Chicago, Ill.
Safety cans, oily waste cans, safety electric lantern, flashlights and fire extinguishers.

Karel First Aid Supply Co., Chicago, Ill.
Industrial hospital equipment and medical supplies.

Kelley Paint Co., Louisville, Ky.
Convoy skid-proof safety enamel, Halt-fire barrier paint.

Keystone View Co., Meadville, Pa.
Occupational and driver vision tests, lantern slide projectors.

Kidde, Walter & Co., Inc., Belleville, N. J.
Fire detecting and extinguishing equipment, ultrasonic burglar alarm.

Kimball Safety Products Co., Cleveland, Ohio
Personal protective devices for industrial workers.

Mathias Klein & Sons, Chicago, Ill.
Linemen's safety equipment and tools.

Knapp Bros. Shoe Mfg. Corp., Brockton, Mass.
Safety shoes.

Kunz, J., Glove Co., Chicago, Ill.
Linemen's, bridgemen's and welders' quality gloves.

Leeder Mfg. Co., Inc., Briarcliff, N. Y.
Pressurized dry chemical extinguishers.

Legge, Walter G., Co., Inc., New York, N. Y.
Safety floor maintenance materials, conductive coatings, static eliminators.

Lehigh Safety Shoe Co., Emmaus, Pa.
Leather and rubber safety footwear.

Lighfoot Co., Inc., The, New York, N. Y.
Shin cleansers—powdered, liquid, bar and waterless.

Logan Emergency Showers, Glendale, Calif.
Industrial emergency showers, eye-wash fountains.

Lowery Brothers, Inc., Chicago, Ill.
Wire rope splicing service.

Maico Co., Inc., Minneapolis, Minn.
Maico audiometers for industrial hearing testing.

Marsh & McLennan, Inc., Chicago, Ill.
Insurance broker and agencies.

Martindale Electric Co., Cleveland, Ohio
Protective dust masks, eye protectors, face shields, s

Masury-Young Co., Boston, Mass.
Floor maintenance materials.

McAn, Thom, Safety Shoe Div., New York, N. Y.
Safety shoes.

Electric test instruments.

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ermott, Julian A., Corp., Ridgewood, L. I., N. Y.
 urning and safety lighting for municipal, industrial, utility and aviation use.

onald, B. F., Co., Los Angeles, Calif.
 ustrial safety equipment.

cal Supply Co., Rockford, Ill.
 xible unit aid, snake bite first aid, burn first aid.

opolitan Life Insurance Co., New York, N. Y.
 eful materials for use in community health and safety programs.

o Switch, Div. of Minneapolis-Honeywell Regulator Co., Freeport, Ill.
 ety interlock switches and electric controls for power machines.

urn Co., Detroit, Mich.
 y skin protective creams, ply garb safety and protective clothing, plygloves plastic
 coated work gloves, ply waterless hand cleaner.

er Equipment Co., Inc., Franklin, Pa.
 nemen's safety belts, straps accessories and industrial safety belts.

e Safety Appliance Co., Pittsburgh, Pa.
 ety equipment for every industry.

onal Medical Supply Co., Chicago, Ill.
 ustrial first aid supplies equipment and instruments.

-Flasher Mfg. Co., Burbank, Calif.
 ustrial, traffic emergency flashing signals.

rco Mfg. Co., Inc., Kansas City, Mo.
 ire rope fittings, safety hooks, load protectors.

r Castle Battery Mfg. Co., New Castle, Pa.
 chool crossing signals.

hols Engineering Co., Chicago, Ill.
 eel, unloading and tank car work platforms.

ifier Mfg. Co., Lincoln, Neb.
 ire detection, sprinkler supervisory, watchman tour, municipal alarm systems.

upational Hazards, Cleveland, Ohio
 ublishers.

ox, Inc., San Francisco, Calif.
 onox Skin Toughener and Footmats for Athlete's Foot.

born Mfg. Corp., Warsaw, Ind.
 afety Pliers and tongs for feeding punch presses.

y-Catalyst, Inc., Wayne, Pa.
 atalytic purifiers for controlling CO and other automotive exhaust fumes.

c-Kit Co., Greenwich, Conn.
 Jnit type first aid equipment.

ckwood, G. H., Mfg. Co., St. Louis, Mo.
 afety industrial skin cleaners and dispensers.

tent Scaffolding Co., Inc., Chicago, Ill.
 Wood, aluminum magnesium safety ladders, suspended sectional steel tubular
 steel and aluminum scaffolding sidewalk protection canopies, steel grandstands
 and fold-a-way scaffold.

Petersen Engineering Co., Santa Clara, Calif.

Pengo tension wire stringer, Pengo earth augers and other construction equipment
 for the utility industry.

Pioneer Rubber Co., Willard, Ohio
 Gloves; all kinds, liquid proof.

Porto-Clinic Instruments, Inc., New York, N. Y.
 Driver testing and training equipment and visual aids for driver and traffic safety.

Positive Safety Mfg. Co., Cleveland, Ohio
 Power press guards.

Prarie State Products Co., Chicago, Ill.
 Metal and electrical safety and directional signs.

Progress Industries, Inc., Norwood, R. I.
 Safety goggles.

Protectoseal Co., Chicago, Ill.
 Fire prevention equipment for flammable solvents.

Prutman, Ted Defrosto Mirrors, Inc., Lynwood, Calif.
 De-Icer truck mirrors.

Palmosan Safety Equipment Corp., Brooklyn, N. Y.
 Respirators, eye protection, helmets, protective clothing, asbestos and leather gloves.

Putnam Rolling Ladder Co., Inc., New York, N. Y.
 Reinforced plastic and extension and single ladders, and oak rolling ladders.

Pyrene-C-O-Two Div., The Fyr-Fyter Co., Newark, N. J.
 Carbon dioxide and dry chemical extinguishers and systems. Smoke detectors.

Racine Glove Co., Inc., Rio, Wis.
 Gloves, apparel, protective equipment—leather, asbestos, and steel reinforced.

Radiator Specialty Co., Charlotte, N. C.
 Safe-T-Cone rubber traffic guides.

Randolph Laboratories, Inc., Chicago, Ill.
 Carbon dioxide fire extinguishers, dry chemicals on automatic systems.

Reece Wooden Sole Shoe Co., Columbus, Neb.
 Wooden sole safety boots, shoes and sandals.

Riegel Textile Corp., Industrial Gloves Div., New York, N. Y.
 Industrial work gloves.

Rockwood Sprinkler Co., Worcester, Mass.
 Automatic fire protection systems; sprinklers, waterfog, fogfoam and foam.

Rose Mfg. Co., Denver, Colo.
 Industrial safety equipment.

Safeguard Mfg. Co., Woodbury, Conn.
 Modern press guards.

Safety Box Toe Co., Boston, Mass.
 Safety steel toes.

Safety Clothing & Equipment Co., Cleveland, Ohio
 Safety clothing and equipment for every type of industrial work.

Safety First Products Corp., Elmsford, N. Y.
 Fire extinguishers.

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Safety First Shoe Co., Inc., Holliston, Mass.
Safety steel toe shoes for men.

Safety First Supply Co., Pittsburgh, Pa.
Industrial safety equipment.

Safety Tower Ladder Co., Burbank, Calif.
Safety equipment for fixed ladders and scaffolds.

Salisbury, W. H., & Co., Chicago, Ill.
Linemen's rubber protective equipment.

Sarole, Inc., Linden, N. J.
Non-traumatic carrier.

Sawyer-Tower, Inc., Boston, Mass.
All types of protective and safety clothing.

Schrader's A., Son Div., Brooklyn, N. Y.
Pneumatic press controls, valves, cylinders and associated products.

Scientific Industrial Supply Co., Chicago, Ill.
Gloves, clothing and general safety equipment.

Scott Aviation Corp., Lancaster, N. Y.
Scott air-pak demand inhalator, demand respirator, hydro-pak.

Searjeant Metal Products, Inc., Mendon, N. Y.
Punch press safety guards, controls, and accessories.

Sellstrom Mfg. Co., Palatine, Ill.
Face and eye protection equipment.

Speakman Co., Wilmington, Del.
Industrial emergency showers, eye-wash fountains.

Standard Safety Equipment Co., Chicago, Ill.
Industrial safety equipment.

Stephenson Corp., Red Bank, N. J.
Automatic resuscitation equipment and chemical breath test for intoxication.

Stonehouse Signs, Inc., Denver, Colo.
Industrial accident prevention signs.

Stop-Fire, Inc., New Brunswick, N. J.
Fire extinguishers.

The Surety Rubber Co., Carrollton, Ohio
Personal protective equipment for industrial and electrical workers.

The Surty Mfg. Co., Inc., Chicago, Ill.
Linemen's safety equipment and industrial workers protective equipment.

Taylor, S. G. Chain Co., Inc., Hammond, Ind.
"Taylor-Made" alloy steel sling chains and allied products including Tayco patents alloy steel drop forged hooks.

Tect, Inc., Dumont, N. J.
Vythene and other Tecsolve safety solvents.

Titmus Optical Co., Inc., Petersburg, Va.
Safety eyewear, ophthalmic instruments, lenses, frames and sun wear.

Tool Co., Inc., Coverdale, Pa.
Non-spalling hand tools and hand protectors for same.

Union Wire Rope Corp., Kansas City, Mo.
Wire rope "Tuffy" slings, "Tuffy" towlines.

United States Safety Service Co., Kansas City, Mo.
Industrial eyewear.

Universal Match Corp., St. Louis, Mo.
Safety programs for employees, match book safety programs, employee health, sanitation programs, fire prevention programs.

Wagner Sign Service, Inc., Chicago, Ill.
Wagner changeable copy displays.

Watchmocket Optical Co., Inc., Providence, R. I.
"Eye-Savers" plastic eye protection and Plasi-Glow safety signs.

Welsh Mfg. Co., Providence, R. I.
Safety goggles, lens, face shields and helmets.

Western Industrial Pharmaceuticals Co., San Francisco, Calif.
Poison ivy, oak and sumac ointment.

Westline Products Div. of Western Lithograph Co., Los Angeles, Calif.
Industrial signs, markers, safety signs, pipe markers, labels, letters-numbers-signs.

Wheeler Protective Apparel, Inc., Chicago, Ill.
Industrial safety clothing for heat and abrasive hazards.

Whitney, L. A., Associates, Inc., New York, N. Y.
Visual aids—flannel boards, programs—complete art and production service.

Williams Jewelry & Mfg. Co., Chicago, Ill.
Safety awards, badges and trophies.

Willson Products Div., Ray-O-Vac Co., Reading, Pa.
Industrial goggles, gas masks, helmets and respirators, and allied safety devices.

The Wilson Rubber Co., A Div. of Becton, Dickinson & Co., Canton, Ohio
Rubber and synthetic industrial gloves for every use.

Wolverine Shoe & Tanning Corp., Rockford, Mich.
Industrial safety shoes.

EDUCATIONAL EXHIBITORS

American Optometric Assn., St. Louis, Mo.
"Vision For Safety"—On The Highway, In Industry.

Argonne National Laboratory, Lamont, Ill.
"Equipment and Guides Used in the Performance of Radiation Safety Work."

Boy Scouts of America, New Brunswick, N. J.
Exhibit of 1958 Good Turn Campaign.

Inter-American Safety Council, Inc., New York, N. Y.
The Safety Council serving all Latin America.

National Bureau of Standards, Washington, D. C.
"Loading Effects of Wind on Towers."

National Society for The Prevention of Blindness, New York, N. Y.
Educational material on conservation and utilization of eyesight in industry.

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Advisory Representative—W. L. TUBBS, Colonel, USAF (Ret.), assistant for ground safety, DCS/Personnel, Department of the Air Force, Washington, D. C.

Advisory Committee—E. P. MARCONI (Chairman), manager, Safety Branch, AERO, Inc., Tullahoma, Tenn.; A. F. PAGNOTTA, chief safety engineer, Autonetics—A Division of North American Aviation, Inc., Bellflower, Calif.; F. R. TEMPLE, chief safety engineer, CONVAIR—A Division of General Dynamics Corp., Fort Worth, Texas; H. I. HEMPHILL, safety director, Air Research Manufacturing Co., A Division of Garrett Corp., Los Angeles, Calif.; R. S. MOORE, safety director, Grumman Aircraft Engineering Corp., Bethpage, Long Island, N. Y.; M. L. ANDREWS, El Segundo Div., Douglas Aircraft Co., Inc., El Segundo, Calif.; R. WILKINS, safety administrator, North American Aviation, Inc., Los Angeles, Calif.

Advisory Representative—HOWARD H. WARZYN, National Safety Council, Chicago, Ill.

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Newsletter Editor—N. L. CHRISTOFFEL, staff superintendent, Safety, United Air Lines, Stapleton Airfield, Denver, Colo.

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Staff Representative—HOWARD H. WARZYN, National Safety Council, Chicago, Ill.

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job. Our objectives should include efforts to promote the safety of employees and their families by: maintaining a comprehensive safety program for employees driving company owned vehicles; providing material on highway safety to aid employees driving their own cars; encourage employees to develop safe practices in their homes, on the farm, or in recreational activities; participating in community safety activities.

EXTEND EFFORTS OFF-JOB

The fruits of plant safety discipline should be shown in the off-the-job activities of the employee. If we have really sold him on the rules of conduct not only for machinery operation, but all phases of personal safety, then the employee will practice these rules not only in his own home, but also in driving his car or while using recreational facilities.

This does not answer the question of how many days' suspension an employee should receive for an infraction of safety rules. I have purposely refrained from attempting to answer that question because in my opinion that is not a safety problem. The punishment for the infraction of rules is

actually the responsibility of the supervisor in conjunction with the Labor Relations Department.

Where there are many infractions of rules, it is probably due to the fact that the top echelon of the organization are not whole-heartedly in agreement with them, that the supervisor in immediate charge has used the rules as a matter of convenience rather than as a matter of protection for the employee.

Good safety discipline cannot be measured by the number of people suspended for violation of safety rules but rather can be measured by the spirit, the push, and the sincerity with which top management operates the safety program. Safety discipline is the direct result of sound, reasonable logical rules of conduct as recommended by the safety department, and enforced at all levels of management.

Safety discipline depends on the attitude and the manner in which the supervisor carries out his day to day assignments and contacts with the employee. Safety discipline is the day to day activities of the employee carrying on his routine duties not only on the job, but also off the job.▲

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Spurring Chairman—ARVID TIENSON, safety director, Material Service Corp., Lyons, Ill.

Representative—CLINTON H. HOCH, National Safety Council, Chicago, Ill.

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highly hardened component in high pressure equipment is the cap of the common, flat-gasket type high pressure reactor or "bomb." This is required for practical, structural reasons, but we attempt to avoid it by using other types of closures in all but small, medium-pressure vessels.

With this one exception, a minimum of 10 per cent elongation should be specified for materials used in the construction of high pressure equipment. When purchasing metal stock for this use it is wise to specify metal that is free of flaws or inclusions, and is warranted by x-ray or other suitable tests.

Before a vessel is placed in service it must be pressure tested, preferably to one and one-half times its maximum working pressure. A log sheet should thereafter be kept for each vessel so that a history of its service is available. Frequent inspection of each vessel and regular periodic pressure tests are required to avoid failure resulting from corrosion, small stress cracks, embrittlement, etc.

CONED CONNECTION

The common coned high pressure connection has frequently been a source of difficulty, most of which is easily avoidable with a little care and attention. The sealing surface is on the tapered end of the tubing, and the force is applied from the threaded gland via the collar on the tubing. First, the seating surfaces and threads should always be smooth, clean, and in good order. If not, they should be remachined or replaced as may be the case.

A common error in assembly of one of these connections is in not placing the collar the proper distance back on the tubing. If it is too far back a good seal can be made but all of the force is taken by only a portion of the threads of the gland, resulting in failure under pressure.

High pressure gauges present some problems, but a little thought when locating them will easily remedy this. Always use the solid front or "blow-out" back type of high pressure gauge and remove the glass face cover. A piece of plastic film may be placed over the face of the gauge to keep out dirt. The gauge should never be placed in such a position as to be directly in line with operating personnel, but are best lo-

cated behind a barricade and observed with mirrors. They should not be used to more than 70 per cent of rating, and will last a lot longer and maintain accuracy better if used at only 50 per cent of rated pressure.

Gas storage or supply cylinders are rather "thin-skinned" and should not be located in an operating cubicle. In event of trouble, their presence can only add to the problem. The use of check valves in lines between vessels, reactors, supply cylinders, etc. adds greatly to the safety of the operation. These one-way valves prevent the possible backing up of a reactant or catalyst, which can have disastrous consequences.

However, a word of caution concerning the use of check valves! They are usually a spring-loaded ball valve and are easily fouled and rendered inoperative by small amounts of foreign material or dirt. Frequent inspection and testing of these devices is imperative, otherwise one may be led into a false sense of security.

In essence, the human side of safety reduces itself to one point—education. The problem becomes one of teaching men to understand their equipment and to think carefully before they act. For instance, one must somehow get across the idea that high pressure equipment, just because it looks rugged, does not require a strong arm and a long-handled wrench for assembly. Care, cleanliness, and a sawed-off open-end wrench will usually do a much more effective job on research scale equipment.

OPERATING PRACTICES

Points such as this must be emphasized, demonstrated, and then continually re-emphasized. We had a technician with whom we had to go so far as absolutely to forbid him to operate a high pressure valve with any more force than he could exert by holding the valve handle between his little finger and thumb. This may have been an extreme measure, but the man finally understood.

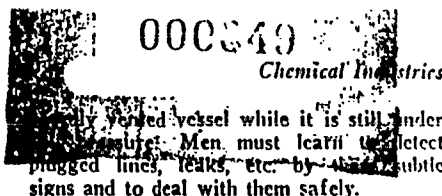
We use job description sheets, our accident prevention Key Point Cards and other means of discussion to review important points and hazards with the men. One must cultivate the idea that the safety practices are ground rules which are just not to be broken. In a large plant such as ours the men who come into the area from the shops and services department present

difficult problem. These people may be in the area only occasionally and for short periods of time.

They may have little knowledge of the equipment or work, and must be carefully instructed regarding safety practices which may be peculiar to high pressure work. This type of situation will vary with the particular installation and circumstances, but we should always keep in mind the uninformed "stranger" who has occasion to be in the area.

Clear thinking and attention to detail are essential in this type of work. Always be on guard for signs of trouble. For instance, when releasing the pressure from a system it is possible to detect an obstruction in the entry to a pressure vessel by observing such things as the rate of fall of pressure in the lines. Abnormal behavior in this respect is a sign of danger.

Observation of such signs may avert the disastrous consequences of opening a sup-



posedly closed vessel while it is still under pressure. Men must learn to detect plugged lines, leaks, etc., by the subtle signs and to deal with them safely.

The same philosophy applies to disassembly and maintenance work on such equipment. Each line and vessel must be treated as though it is a loaded gun until you are absolutely certain about it.

High pressure work may be done safely if we use clear, critical thinking and careful planning. We cannot afford to be hasty, to disregard safety practices "just this one time" or to let our guard down in any other way. This applies to all types of high pressure work, be it large or small, simple or elaborate.

Even if the installation is small and funds are limited, it is still possible to keep this basic philosophy and conduct the work in a safe manner. In that respect, safety is like happiness—it is the man that counts and money just cannot buy it. ▲

CONTROLLING HEALTH HAZARDS IN A CHEMICAL PLANT

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Hazards that are likely to be present in a chemical plant are:

1. Ordinary mechanical hazards
 - accidental injuries (falls, dislocations, sprains, fractures, contusions, lacerations, thermal and chemical burns, foreign bodies in eye or skin)
 - in association with mechanical equipment, noise, vibration, fires, explosion, flying particles or missiles, slippery floors, rigging, stairs, ladders, elevators, vehicles
2. Modern physical hazards
 - ultraviolet and infra red radiation; ultrasound, high frequency waves; X-ray, radium, other alpha, beta or gamma radiation

3. Chemical hazards
 - old and well known (but not fully controlled) chemicals
 - new products of research and development (often unexplored)
 - exposure in course of research on new products
 - pilot plant development of new products or processes
 - new manufacturing processes involving new ways of handling well-known chemicals or new chemicals.
- (1) locus of hazards—aspect of portal of entry—local effects, such as contact with skin, dermatitis—sensitization, gross injury to skin, skin cancer, or inhalation of gases, vapors,

mists, fumes, dusts. Also asphyxiation, irritation of lungs—acute (edema, pneumonitis), irritation of lungs—chronic, pneumoconiosis, fibrosis, emphysema, and granuloma (Bc). In addition cancer of lung, deposition—radition within lung and hilar lymph nodes; specific carcinogenic agents are hazards. Ingestion of chemicals, following upper-respiratory trapping of dusts, following contamination of hands and handling things that go into mouth and following contamination of food stored in work rooms—eaten in dirty lunch rooms are potential dangers.

- (2) nature of hazard—aspect of absorption—systemic effects such as: acute intoxication, percutaneous, respiratory, alimentary absorption (often two or all three combined); chronic intoxication—remote enzymatic or metabolic effects and organic damage; or remote radiation effects following absorption and distribution of radioactive materials in body—example—bone and marrow, following absorption, distribution and metabolism of specific carcinogens—example—bladder tumor.

RECOGNITION AND IDENTIFICATION OF HAZARDS

1. Toxicologic investigation (in laboratory) (stepwise with progress of research and development in industry)
 - (a) screening—preliminary choice or elimination of materials under consideration—
 - immediate toxicity—indicative of type of control measures based on portal of entry (type and point of application of preventive procedure) (degree of precision required in protection, i. e. extent of apparent danger) (medical criteria—type of anticipated-injury or disease)
 - (b) Comprehensive—(adapted to the problems to be met)
 - manufacturing hazards
 - hazards of transportation and use as raw materials by others
 - hazards of final product
 - cumulative effects if any

- metabolic fate in body—remote effects—long-term—chronic—injurious effects
 - diagnostic and prognostic procedures based on results of investigation
2. Toxicologic investigation—(in plant) clinical investigation of personnel
 - basis of all specifications for safe environment
 - sometimes the only basis for recognition of hazard, e. g. beryllium, occupational cancer

CONTROL OF HAZARDS

1. Medical measures of control—environmental—(operations, plant conditions and (how men work)
 - clinical examination—all types.
 - policing the plant—(clinical findings and tests on personnel)
 - identification and quantitation of responses to observed exposure—within physiological (tolerable) limits—beyond physiological limits
 - warning of need for further protection
 - disposition of personnel with respect to exposure restriction of time (duration) of exposure—removal from exposure—temporary or permanent
 - personal protective equipment (choice and supervision, physiological criteria) adequacy of equipment employed—adequacy of its maintenance—adequacy of its use
 - education, group meetings, written instructions, hygienic manual, combined with operating manual
 - reports to engineering personnel (in both operations and industrial hygiene) and to management
2. Engineering measures of control
 - designing and applying measures of control—physical devices for protection against chemicals—plant design—operations design—ventilating design
 - policing the plant (environmental monitoring) inspection—critique of maintenance operations—analysis of materials—air analyses.
 - personal protective equipment (choice and supervision—engineering criteria)
 - reports to medical personnel, and management (directly or through physician)

3. Administrative measures of control
 - appropriate organization of hygienic facility in relation to operations
 - appropriate budgetary provision for hygienic effort
- Adequate control depends upon the complete understanding of the hazard through physiologic and toxicologic research.
- In addition, satisfactory team work includes:

LIVING IN THE AIR WE BREATHE

by H. H. FAWCETT

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Living in the air we breathe has been a problem since God created man from dust and then breathed into him the breath of life. But even today, the vital role of breathing in our daily life has not been completely appreciated. This paper reviews briefly (1) air contaminants, and (2) commercially available respiratory protective devices, with emphasis on their limitations, and on the training and maintenance necessary for safe and effective use.

Each of us is a creature of habits, but none of our habits is more vital to life than is breathing. So automatic and effortless is this habit that we give almost no thought to our respiration, although most of us cannot live without air for more than five minutes. From the second of our birth when we descend from in utero (where the oxygen partial pressure corresponds to 33,000 feet altitude) into a world with a mixture of gases called air, we must breathe several quarts of air each minute so our body cells can exist, grow, and perform their functions.

For an average lifetime of 70 years, we may breathe in excess of a half billion times. By contrast, we consume "three square meals" and "six glasses of water" daily. Our air requirements which we obtain virtually without effort are of greater significance by any standards than water, food, clothing, and shelter, which demand much

"day-by-day" thought and deliberate action to obtain.

We live at the bottom of an ocean of air called the atmosphere, a narrow band of mixture of several gases which is composed mainly of four-fifths nitrogen and one-fifth oxygen. Virtually limitless in volume and mass as we view it from the ground, it thins out into space. Half of its density is under 18,000 feet. In a multitude of ways the air assists all living things to exist.

FUNCTIONS OF AIR

Besides providing oxygen for breathing—oxygen which lungs transfer to the blood—air conveys both sound and light, absorbs heat, enables fires to burn, propels boats, turns windmills, makes possible air brakes, vacuum cleaners, and other useful machines. Air in motion forms winds which modify climate, equalize heat and cold, and distribute rainfall. Rivers high in the air, such as the jet stream, greatly influence weather and are an increasingly important factor as airplanes travel at higher altitudes. The ancient Greeks ranked air with earth, fire and water as one of the four fundamental elements.

Since each of us has been breathing several times each minute from our birth, respiratory protection and devices to aid or supplement breathing might seem unnecessary. If pure air were truly ubiquitous, and no harmful gases, vapors or dusts existed,

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1. Physiological and nursing measures applied to personnel—measures to be applied to environment (hygienic specifications)
2. Engineer (including chemist, physicist and technicians) measures to be applied to environment (hygienic technologic applications)
3. Management
 - proper organization
 - proper financial implementation

breathing problems would be confined to underwater or to travel in high altitudes. Unfortunately, pure air is a relatively rare commodity, and is much harder to obtain pure than many chemical elements and compounds.

Some variations of the air are caused by natural forces (such as moisture from rain or dust from winds on dry earth), while some are due to man (such as combustion products, unburned or incompletely burned fuels, solvents, vapors, dusts, fumes, inert and toxic gases). When these variations are small, we say that the air is "pure," but when the variations, either alone or in combination, exceed our ability to adapt to them, or our ability to tolerate them, we say the air is "bad."

AIR POLLUTION

No simple yardstick has yet been devised to tell us when air ceases to be "pure," although numerous air pollution studies are underway, and threshold limit values (maximum allowable concentrations for industrial exposures) are available as a guide. We have just begun to realize that air pollution control may be even more important than stream pollution control. When extreme conditions exist, as in London, Meuse, Donora or Los Angeles, we know that human life is more difficult than other times when smog is not present.

On a minor scale, every year a serious problem exists from dust or pollen (such as rose fever, hay fever, or ragweed fever) for allergic persons, and we have found that respirators are frequently considered a welcome supplement to medication for the relief of such conditions.

Most breathing air supply problems can be controlled with adequate ventilation. If air could be properly treated to remove particulate matter, noxious vapors, and toxic gases, heated or cooled, and then distributed as required, breathing can be reduced to a minor problem insofar as purity of air is concerned. Unfortunately, adequate ventilation and air treatment is sometimes impossible or impractical where emergency action must be taken to preserve life and property.

They must provide man with respiratory protection if we expect him to survive. The case histories of accidents acted at random from many

sources and appended to this paper, shows that respiratory problems have occurred in many diverse activities. Specialized knowledge and action in advance is essential if such injuries are to be prevented.

It is sometimes glamorous or unusual incidents which produce serious results; failure of a pressure system in an airplane at high altitudes will cause blackouts in seconds; above 43,000 feet, even breathing pure oxygen is not adequate—a pressure suit or a pressurized cabin is essential. On the other hand, no less serious are the problems when commonplace materials, such as a few sausages overheating and burning on a frying pan on a kitchen range produced sufficient smoke and toxic gases to overcome the occupants; firemen required respiratory protective apparatus to effect a rescue of the unconscious victims.

Gases and smokes resulting from fires have been studied for years, and excellent reports are available, but it is impossible to predict what gases may be encountered or in what concentrations in a given fire. A large number of different flammable chemical compositions or chemical combinations that change with heat, such as plastics, fabrics, insulation, refrigerants, solvents, paints, insecticides and building materials, play important roles in our daily lives.

VARIETY OF GASES IN FIRES

In addition to carbon monoxide, carbon dioxide, and water (present in nearly all fires), one may expect ammonia from burning wool, cyanogen from burning silk, acrolein from burning fats, sulfur-containing gases from burning rubber and leather, and chlorine-containing gases from burning or smoldering chlorinated plastics. From piled newspapers smoldering in limited oxygen, 41 per cent of the total gases given off was found to be carbon monoxide, and 43 per cent was carbon dioxide.

A pile of newspapers in a large open hallway would give an entirely different concentration of carbon monoxide and carbon dioxide within the breathing zone than the same pile burning in a small enclosed basement. Determinations ranging from two per cent to four per cent carbon monoxide have been made using recognized CO detectors in the smoke of building fires in the same room in which firemen were engaged in extinguishment, by a medical doctor

wearing self-contained breathing apparatus. A vigorous movement is now underway to encourage fire and other rescue services to use adequate respiratory protection more effectively.

AIR CONTAMINANTS

The conventional classification of air contaminants follows:

- A. Aerosols (dispersoids) (particulate contaminants)—dusts, fumes and mists.
- A better classification of aerosols is based on physiological effects:
 - A. Nuisance and Inert: produce no known injuries: calcium carbonate, magnesium carbonate, gypsum
 - B. Inert pulmonary reactions: produce non-specific pulmonary reactions: silicates, carbon, aluminum
 - C. Minimal pulmonary fibrosis-producing barium compounds, tin, iron oxides
 - D. Extensive pulmonary fibrous-producing silica, asbestos
 - E. Chemical Irritants: produce inflammation or ulceration alkaline reactions: acids, fluorides, chromates
 - F. Toxic systemic poisons: produce pathological reactions: lead, manganese, antimony, arsenic (not more toxic than Pb), arsenates, organic-phosphates, cadmium, radioactive, beryllium (more toxic than lead)
 - G. Allergic manifestations: produce allergic reactions: pollens.
 - H. Fever-producing reaction: action unknown or allergen: metal fumes, certain textile dust, (hemp, cotton, jute, bagasse)

A. AEROSOLS

Formerly called dispersoids or particulate contaminants, these are substances present in the air as minute particles (such as dusts), as fumes (such as metal fumes), or as mists (such as chromic-acid mists). In grouping these together, it is recognized that they may be physically filtered, screened, or adsorbed from the air with properly designed filters. Aerosols may range in size from 150 microns to a thousandth of a micron in size (1 micron equals 39.37 millionths of an inch or 1×10^{-4} centimeter). Many dusts are also fire and explosion hazards.

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Pneumoconioses (Greek for lung dust) or **silicosis** are a group of lung conditions which result from the inhalation of dust. Silicosis is one of the most common types of pneumoconiosis, and is caused by the inhalation of "free" or "uncombined" silica, such as quartz, opal flint and crystalite. Many other dusts may produce lung involvement such as asbestos, talc, the silicates, carbon, iron and barium.

Other dusts cause chemical irritation, such as the acids, alkali substances, fluorides and chromates. Allergic reactions may be caused by common dusts such as pollens, synthetic resins, plastics, felt, fur, gums, spices, tobacco, paper, rubber, wood, starch, flour, and wool. The Bureau of Mines groups all the above dusts as "Pneumoconiosis-Producing and Nuisance Dusts."

TOXIC DUSTS

Another classification of dusts refers to "Toxic Dusts." Some have a lower threshold limit or maximum allowable concentration than does lead, although the Bureau of Mines classification uses lead as a reference. Among aerosols more toxic than lead are: cadmium oxide fume, chromic acid and chromates, mercury, mercury (organic), yellow phosphorus, picric acid, selenium, tellurium, calcium arsenate.

Respirators approved for all the above dusts (both toxic and pneumoconiosis-producing and nuisance dusts) are called "dust" respirators. A few substances, such as beryllium and radioactive substances, are not currently covered by Bureau of Mines schedules.

"Fumes" include aerosols formed by the condensation of vapors from heated metals. Melting, cutting, and welding of zinc, lead, cadmium and other metals produce such fumes.

"Mists" and "Sprays" include liquid droplets formed when liquids are carried into the air or are formed by a reaction with the moisture in the air. An interesting example is 0.3 parts per million sulfur dioxide, with sunlight, forms 20,000 particles per c.c. of sulfuric acid mist.

The availability of filters with pore sizes from 10 millimicrons (approximately the size of the polio virus) to five microns (the size of common contaminants in liquids) has greatly improved and speeded up analyses

of aerosols such as acid mists, metal fumes, smokes, and radioactivity.

In recent years, study and measurements of even smaller particles in air than previously observed, known as condensation nuclei, have contributed greatly to our understanding of the nature and number of particles in air. The particles in the air on which water will condense are called condensation nuclei; under natural conditions only the larger particles are so effective. When the air is sufficiently super-saturated apparently any particle will serve as a condensation center.

Particles from such diverse substances as platinum, silver, stearic acid, glycerin and lubricating oil will all form droplets at a sufficiently high supersaturation of water vapor. Practical methods are now available to measure the number of particles in an aerosol in free air. A wider use of the technique already available for size and numbers of an aerosol would not only throw light on some of the problems of air pollution but would certainly lead to further improvements in our knowledge of aerosols.

Respirators for insecticides are tested and listed by the U. S. Department of Agriculture.

B. GASES AND VAPORS

In this major group may be included most of the air contaminants which are not classified as aerosols.

1. *Irritant gases* are those which produce inflammation of tissue, such as the skin, the eyes, and the respiratory tract membranes. They are divided into two general groups:

- action is limited to irritation (such as hydrogen chloride)
- action extends to systemic effect (such as oxides of nitrogen)

Some of these gases and vapors have pronounced odors, but the nose cannot be depended upon as a reliable method of estimating concentrations.

2. *Asphyxiants* are substances which deprive the body tissues of oxygen, causing hypoxia (oxygen starvation). Two general methods of action are known: simple asphyxiants (such as nitrogen, hydrogen, helium, and methane), which dilute or replace the oxygen partial pressure in air; and chemical (such as carbon mon-

oxide, hydrogen cyanide, hydrogen sulfide, acetonitrile, aromatic nitro and amino compounds like aniline, nitrobenzene and derivatives), which combine with the hemoglobin of the blood to prevent oxygen-carbon dioxide exchange.

The insidious nature of the action of the simple asphyxiants, and the speed with which they can act, is still not widely appreciated; whereas most people have a healthy respect for the chemical asphyxiants. Under proper medical supervision, pure nitrogen may be breathed for several seconds and this technique has been used clinically by Himwich and others. However, nitrogen and the other simple asphyxiants give almost no warning between the time breathing air is replaced with the asphyxiant and unconsciousness overtakes the subject.

PHYSICAL REACTIONS

A loss of mental facilities begins within a few seconds, and unconsciousness may occur shortly after with no warning. The brain is the first organ of the body to be affected seriously by oxygen want, and the subject "blacks out" quickly. Mention is made of this little-appreciated phenomenon not only because asphyxiants can be released in a room or tank with inadequate warning from the action of a fixed carbon dioxide fire extinguishing system, from a large spill of liquid nitrogen, from a leaking gas system, from an inert-gas producer, or from a leaking cylinder, but also because airline-supplied respirators, hoods and suits are frequently attached to a plant air supply with little appreciation of the hazard.

For example, at the Acids and Heavy Chemicals sub-section meeting, Chemical section, National Safety Council, October 25, 1956, no company present reported use of a special air system for respiratory equipment. If a cross-connection should occur anywhere in the air system which would permit an asphyxiant, toxic, or flammable gas to enter the air used for breathing, the results can easily and rapidly be fatal.

Oxygen, used indiscriminately, may also be a hazard, since serious fires have been reported where oxygen, either from a cylinder or an airline, or a leaking hose or pipe, was used for breathing purposes in an airline respirator or hood where welding or other flames were involved. Only a com-

pletely separate air supply, supplied by a compressor which cannot evolve carbon monoxide, carbon dioxide, oil mist or other unwanted impurities or from cylinders of tested known purity should be used for airline respirators, hoods or suits. In any event, regardless of supply, the system should include pressure relief valves, filters and absorbents as recommended.

2. *Anaesthetics* are gases and vapors whose action is primarily by inducing the symptoms of anaesthesia when inhaled in sufficient quantities. These include the substances which come to mind when the word "anaesthetics" is mentioned, such as the ethers, chloroform, methyl chloroform (1,1,1-trichloroethane), trichloroethylene, ethylene oxide and nitrous oxide (laughing gas), as well as hydrocarbons, aldehydes, ketones, other halogenated hydrocarbons, the aromatic hydrocarbons, alcohols, esters, and carbon disulfide.

DECOMPOSITION OCCURS

In addition to the physiological action of these materials alone and in combination, decomposition products are produced in a fire or when they are otherwise subjected to heat. Even relatively harmless substances such as the Freons and the Genetrons, (widely used as non-flammable refrigerants of low toxicity, as replacements for ammonia, sulfur and ethane), will evolve toxic decomposition products if they are heated above their decomposition temperatures. This has occurred where Freons and Genetrons were used as cleaning solvents.

Metal parts, after cleaning, were heated above the safe limits in order to dry and flash off the remaining solvent. Several persons were hospitalized with pulmonary congestion. Trichloroethylene degreasers, properly installed, maintained and operated, are safe, yet the failure or misuse of these vapor degreasers has created serious hazards including both fires and toxicity.

Mass hysteria and unconsciousness due to the little-appreciated anaesthetic action of the trichloroethylene has occurred in seconds; in one incident 72 persons were overcome, and in another, 26. Fortunately, all recovered after removal to fresh air and oxygen inhalation. The hazards of carbon tetrachloride mixtures in fire fighting and in other applications are well documented.

3. *Substances producing other effects*—This classification includes several substances whose action differs from previously mentioned substances. Included in this group are mercury, white phosphorus, tetraethyllead, nickel carbonyl, arsine, the boron hydrides, phosphine, hydrogen sulfide, and the widely-publicized military "nerve gases." The initial action of these gases and vapors is primarily on the nervous system, with respiratory arrest following.

CONTAMINANTS COMBINE

If the above classifications appear complicated, it must be remembered that these air contaminants seldom occur alone, and that even less is known about the combined action of two or more substances, especially if they are in different groups, than of the individual substances. Even if particles in the air are non-toxic in themselves, they are known to act as carriers of condensable toxic vapors—formaldehyde can have its toxicity increased five times by the presence of an aerosol.

It is little wonder, then, that respiratory protection can become a highly complicated subject, and that the practical application of respirators, gas masks, and self-contained breathing apparatus (all with their limitations), even by persons thoroughly trained in their use, is not cut-and-dried or fool-proof.

Relatively untrained persons in an emergency situation, are in especially vulnerable positions. Many of the case histories attached to this paper clearly point to the need for more widespread appreciation of the nature of the hazard, as well as of the limits of the various respiratory protective equipment used.

RESPIRATORY PROTECTIVE DEVICES

A. AIR-PURIFYING RESPIRATORS

The fundamental limitations of any air purifying device are that the air must be within the limits for which the respirator was designed (for example, the oxygen content must be more than 16 per cent); the particular unit will only protect against the specific substance or combinations for which it was designed, (for example, aerosol [dispersoid] [filter type] respirators will give no protection against gases and vapors); and the canister or filter must be

maintained in proper working condition (on a properly maintained facepiece that fits snugly enough to exclude leakage):

Aerosol (filter type) respirators require frequent changes in filters when breathing resistance becomes uncomfortable when used where excessive dust or fumes are involved. Chemical cartridge respirators will safely protect only against the specific vapors and gases in non-emergency situations where no more than 0.1 per cent is encountered.

Extremely toxic materials, such as acrolein, acrylonitrile, aniline, dimethylaniline, arsine, bromine, carbon disulfide, carbon monoxide, dimethylsulfate, hydrogen cyanide, hydrogen fluoride, hydrogen selenide, hydrogen sulfide, iodine, methyl bromide, methyl chloride, nickel and iron carbonyl, nitrobenzene, nitroglycerine, nitromethane, oxides of nitrogen, ozone, phosgene, phosphine, phosphorus, trichloride, stibine, sulfur chloride, the boron hydrides and others are too toxic even in low concentrations for reliance to be placed on simple cartridge type respirators.

NOT FOR ODORLESS GASES

Chemical cartridge respirators should not be used against gases which are odorless or whose odor threshold is high, since the only warning of failure of the respirator or of concentrations which are above the ability of the respirator is odor. Methyl chloride is an example of such a gas whose warning properties are too slight for practical purposes. Substances which are highly irritating to the eyes, such as sulfur dioxide, require eye protection (such as a goggle, an air-supplied hood, or a full-facepiece).

Several lacrimatory (tear-producing) substances, such as benzyl chloride, are in the same classification, and a respirator alone is clearly inadequate. Some substances, such as carbon monoxide, cannot be stopped by a chemical cartridge (except by the Hopcalite in the Type N universal gas mask and in the miner's pocket self-rescuer). Ammonia cartridge respirators will protect against ammonia up to 1,000 p.p.m., while eye irritation from ammonia begins at about 700 p.p.m.

Mercury cartridge respirators are effective against concentrations of mercury vapor not encountered at ambient temperatures, but service life is proportionately

reduced where higher concentrations of mercury from elevated temperatures and pressures are present. (There is no Bureau of Mines approval schedule for mercury respirators). Combination cartridges have the limitation of a shorter service life when used with one particular type of hazard than the equivalent specific single-purpose canister would have for the same hazard.

FACEPIECE TYPES

Normally, respirators use a "half-mask" facepiece, covering the nose and mouth, while gas masks use both full-masks and full facepieces. (Only full facepieces on gas masks are approved by the Bureau of Mines). Recently, the "self-rescue" or "pocket" respirator, normally used with a cartridge containing Hopcalite with a dryer and designed for escape from mines, has been extended into other cartridges.

The mouthpiece of this style respirator is held tightly by the front teeth of the wearer, and the breathing is accomplished through the mouth. A nose clamp blocks off the openings of the nostrils, and prevents irritation of the membranes of the nose. A neckband permits the respirator to be worn ready for instant use. Twelve different filter cartridges will fit the basic holder and mouthpiece.

Industrial canister-type gas masks, with canisters designed for specific substances or combinations, have the same limitations in general as chemical cartridge respirators, except they are effective in concentrations of any specific gas or members of the same group of gases for which they are designed of not more than two per cent in air or a two per cent total for a mixture of gases for which the canister is designed.

The ammonia canister is approved for three per cent ammonia. For shorter periods of time, industrial canister-type gas masks can be used in higher concentrations, but the time of service life will be reduced. Depending on the size of the canister, and the service for which it was designed, the service time varies.

Protection for a combination of various gases, such as acid gases, organic vapors, and ammonia can all be obtained in one canister, but the service life of such a combination is shorter in the combined canister when used with one specific substance than is the life of an equivalent canister

designed for specific substance alone. The only warning that a canister or cartridge is "exhausted" is the detection of odor of vapor or gas passing through the canister or cartridge.

Persons who need corrective lenses in order to work properly when wearing the respiratory protection, especially full facepieces, may find of interest two methods of incorporating lenses inside a facepiece. One method consists of wire frames which fit around the circumference of the sight lenses, and hold a 50-mm round prescription lens.

PRESCRIPTIONS IN FACEPIECES

A second method consists of a center post built inside the mask, onto which can be attached 40mm rimless glasses. Such arrangements seldom allow perfect alignment of the prescription lenses to the viewer's eyes, but, with adjustment, a sufficiently accurate fitting can be achieved for most purposes for reasonably long periods of time.

The type N universal gas mask canister is constructed of several layers including activated carbon (to remove organic vapors), soda lime (to remove acid gases and carbon dioxide), copper sulfate (to protect against ammonia gas), silica gel and other dryers (to remove moisture both before and after the Hopcalite), and Hopcalite itself (a mixture of metallic oxides which catalyzes the conversion of carbon monoxide to carbon dioxide), plus a filter for smokes.

This canister can be used as protection against smoke and gases which do not exceed two per cent by volume total, where adequate amounts of oxygen are present. Sixteen per cent oxygen is cited as the practical minimum, but life is not actually in danger until about 14 per cent or less oxygen is present. A timer is used to count the number of inhalations, and indicates about two hours total use.

DISPOSE OF CANISTERS

A canister should be discarded at least as soon as the timer indicates the pointer has completed one revolution, if not sooner. One authority recommends that universal canisters be weighed immediately on receipt from the manufacturer, and that they be discarded as soon as they have gained 45 grams. This 45 grams limit was imposed since it represents the limit of the dryers

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to keep the Hopcalite dry, and also to prevent excessive breathing resistance from developing as the dryers become moist.

The shelf-life of the universal canister, once the canister has been attached to the facepiece is one year, if stored with the bottom seal in place, even though the mask has not been used. If stored with both top and bottom seals unopened, as received from the manufacturer, the shelf-life is considered by some to be four, and by others, five years.

With an respirator or gas mask, the problem of proper fitting of the facepiece is critical. In addition to the time honored technique of holding the hand over the opening in the bottom of the canister while inhaling gently to see that the facepiece will collapse on the face, another technique recently suggested by the A.E.C. is to use isoamyl acetate.

Since isoamyl acetate (which smells similar to bananas) can be detected in a concentration of as low as one part per million, a small leak will be detected if the acetate is placed on cotton and the cotton passed slowly around the edges of the mask without touching either the wearer's face or the mask. If the wearer can detect the odor, a leak is indicated and the mask should be further adjusted until the odor can no longer be detected.

CIVIL DEFENSE MASKS

As part of its chemical warfare defense program, the Federal Civil Defense Administration is stockpiling a mask designated as CD V-800 organizational mask for use by civil defense personnel. The canister on this chin-style mask is the same as used in the U. S. Army Assault Mask. This mask is reported to give "excellent protection against CW (Chemical Warfare) and BW (Biological Warfare) agents, as well as against the inhalation of radiological particles, or CBR (chemical, biological and radiological)".

Designed to be used in conjunction with a detection kit, CD V-810, which will detect and distinguish between the nerve gases and the mustard gases, the V-800 mask is a specific mask for war gases (including nerve gases) and will not protect against carbon monoxide, ammonia and other gases. The Army Chemical Corps recently an-

nounced a new E-13 mask for troops. It is designed to give the soldier complete protection against the inhalation of war gases, germ warfare agents and airborne radioactive fallout particles, but does not protect against direct radiation.

The new mask does not have the protruding canister used in current masks. This was made possible through development by the Chemical Corps of a new light-weight, pliable gas-aerosol filter material. Pads of this material are enclosed within cavities molded into the rubber facepiece of the mask. Lower breathing resistance, superior vision, better speech transmission, and greater comfort are claimed.

It should be noted that the CD V-800, the existing and the new Army gas masks should be used for purposes for which they were designed only. After both World War I and II, several instances were reported where "surplus" Army masks were used for protection against gases for which they were not designed, with serious consequences. It is important that gas masks are not misused.

B. AIR-SUPPLIED RESPIRATORS

Since the simplest solution to all respiratory problems is to supply pure air to the breather, the use of an air supply from some remote source where the air is not contaminated is both simple and logical. For many applications, air-supplied equipment has real advantages, but this equipment is subject to definite limitations. The simplest type is the Bureau of Mines Type B hose mask, which is a facepiece to which is attached a hose without a blower which must extend to a respirable source of air. This mask depends on the breathing action of the wearer to move the air. For this reason, a maximum hose length of 75 feet has been established for the hose mask without blower.

Low pressure blowers, operated either by hand or by power (power blowers do not carry Bureau of Mines approval) are used to supply Bureau of Mines Type A hose masks up to 150 feet. All hoses should originate at the blower.

A respirable source of air must be assured, and there must be present at the breathing source. Fouling of the hose may cut off the air supply, and the route must be the same as the entrance

route. These hose masks can be used safely only if the above precautions are observed.

Airline-supplied Bureau of Mines Type C respirators are divided into two classes: (a) the continuous flow type and (b) the demand or intermittent demand flow type; (a) is usually used with a powered compressor or blower, while (b) is usually used with breathing air supplied from cylinders. The use of such equipment in atmospheres immediately hazardous to life is not recommended since failure of the air supply or fouling of the hose would be serious, and further, it is absolutely necessary to have respirable air of unquestioned quality.

We have previously noted the hazard of using a plant air supply for air-supplied breathing equipment. It is recommended that a separate air system be used exclusively for breathing air. Depending on the pressure available and the diameter of the hose, there is a limit to the length of hose which is practical.

Wherever possible, such systems should be piped as close to the outlet as possible, so possibility of fouling of the hose and cutting off the air supply will be minimized. Exit from areas where air-line respirators are used must, of course, be the same as the route in. If a compressor or tank supply is used, sufficient pressure relief control must be available to protect the wearer against pressure in excess of that prescribed for the equipment.

AIR-INFLATED SUITS

Air helmets, air hoods, and air-supplied suits have the same general limitations as for air-line respirators. An interesting development in this field is the use of air-inflated suits for protection of the whole body against hazardous materials.

In one form, the large impervious plastic tunnel or pipe allows a man to work in one room while using air from another—the slight air pressure supplied giving both breathing air and inflation (or body) to the suit. The front of the suit is tailored into a facepiece, and arms with gloves are attached. Mobility is reported good within the obvious limits imposed by the length of the tunnel attached.

In another form, a complete suit with built-in arms and legs is supplied with air for inflation and a hood, also air supplied

is used for head, face and respiratory protection. Depending on the particular fabric, plastic, or composition used in its construction, this suit allows work inside tank reaction vessels and other confined space which still contain a hazardous atmosphere.

Properly used, together with safeguards to insure that the wearer's air supply and life-line are always in proper position and working order, this suit has increased safety and decreased operating costs in maintenance work inside tanks containing materials which are corrosive or are easily absorbed through the skin such as aromatic amino and nitro compounds. The same limitations noted above for air-line respirators should be noted.

Regardless of the type "respirator" used, a definite program of control is necessary to insure the device is used properly, is properly maintained, and that it is doing what is expected of it. After the Canadian Chalk River atomic reactor incident, respirators were used to prevent inhalation of radioactive contaminants. This program was successful only after a respirator official was appointed to control the use and maintenance of respirators, regular urine-samples were analyzed to show definitely the degree of absorption, and an improved respirator was made available.

C. SELF-CONTAINED BREATHING APPARATUS

Self-contained breathing apparatus supply complete respiratory protection in any concentration of toxic gases and under any oxygen deficient atmosphere. However, certain gases and vapor will cause systemic poisoning by skin absorption. Although a small group, these exceptions are highly important, including hydrogen cyanide, nitro and amino aromatic compounds, ethyleneimine, phenols and a few others. These gases and vapors require complete skin protection of an impervious type in addition to respiratory protection.

EARLY REBREATHING APPARATUS

The early self-contained rebreathing apparatus, which was imported from Europe, had serious deficiencies. Loss of life was reported by users in this country; 19 accidents are reported involving 26 fatalities between 1911 and 1940, due partly to equipment failure and partly to improper use.

Where life-lines and standby rescue squads were employed, the apparatus was generally satisfactory in the hands of well-trained users.

The first self-contained breathing apparatus to be approved by the U. S. Bureau of Mines was of the two-hour rebreathing type.

The oxygen rebreathing type apparatus is relatively heavy (39# for the two-hour type) and is bulky. Most self-contained (closed circuit) oxygen breathing apparatus in use today require mouth breathing with a nose clip, but a full facepiece has recently been approved. Careful training is required in use and in maintenance of this apparatus. A minimum of 20 hours initial training is recommended by the Bureau of Mines.

RESTRICTS MOVEMENT

Demand-type air and demand-type oxygen breathing apparatus is available in half-hour, quarter-hour and 7½ minute ratings. Only the half-hour demand apparatus is Bureau of Mines approved; the Bureau has no approval schedule at present for any self-contained apparatus of less than a half-hour. Although the schedule of work on which the Bureau's half-hour rating is exhausting, large men under extreme stress have exhausted a half-hour (40 cu. ft.) cylinder in significantly less than a half-hour.

Differing only in whether it is supplied with compressed oxygen or compressed air, the apparatus weighs nearly 30 pounds for the half-hour type, with the large cylinder (40 cubic feet) on the back. It is relatively awkward to put on and it restricts action in confined spaces. With practice, it may be put on and into operation from a mounted backboard in less than 20 seconds.

The back position of the cylinder makes it difficult to crawl under equipment. Climbing in and out of small openings, such as manholes, requires care when wearing this type apparatus. Operation of a motor vehicle is awkward when wearing a cylinder on the back. (15-minute and 7½-minute demand apparatus use smaller cylinders slung on the side of the wearer, which overcomes this objection to some extent.)

The purity of the air or oxygen with which the cylinder has been charged should always be questioned since other gases such

as nitrogen, acetylene and carbon dioxide and gas mixtures other than air have actually been found in "breathing air" cylinders. Errors in compressed air used for breathing may be rapidly fatal, and every newly-filled cylinder should be checked to insure it actually contains "breathing air," regardless of the source of supply.

Unless the user has his own compressor producing air of an unquestioned purity, no cylinder should be put on a demand breathing apparatus or air-supplied respirator, hood or suit until the contents have been checked for purity. The Orsat gas analyzer or the Beckman paramagnetic oxygen analyzer are often used in analyzing oxygen percentage while carbon monoxide may be checked with the National Bureau of Standards colormetric tester available from two manufacturers.

High pressure cylinders may leak, and frequent inspection is necessary to insure that the air or oxygen is actually available for use in an emergency. High pressure valve, gauge, and demand regulator must be maintained in top operating condition by inspection and a regular preventative maintenance schedule as recommended by the manufacturer.

ATMOSPHERE CUTS SERVICE

If demand-type apparatus is worn in environments where pressure above one atmosphere is present (as in caissons or tunnels under higher than atmospheric pressure), the service time is reduced as the pressure increases. This is also true of underwater use of the regular demand-type apparatus; a special adaption is available for underwater swimming. Other peculiar effects have been reported when demand and closed circuit oxygen breathing apparatus was worn under pressure.

The use of oxygen in atmospheres above two atmospheres absolute pressure should be avoided since oxygen produces a toxic effect under such conditions. For periods up to 12 hours at normal atmosphere pressures, however, oxygen may be used without apparent ill effects by healthy persons—persons in questionable physical condition should not wear any emergency breathing equipment, but should remain away from contaminated water.

When of air or oxygen has been depleted, the supply in the demand type

apparatus cuts off abruptly, and the facepiece must be removed immediately or asphyxia can occur. One British half-hour breathing apparatus has available as optional equipment an automatic warning whistle (Pat. No. 644105) which will start to blow when the cylinder pressure falls to 300 pound/square inch, to aid in warning the wearer to return to fresh air at once.

The seal around the facepiece must be absolutely gas-tight in a toxic atmosphere since in the demand-type apparatus the facepiece is under slight negative pressure momentarily during the beginning of the inspiration phase of the cycle. A recent revision by one manufacturer eliminates this negative pressure part of the cycle. Another novel feature of another demand mask (54 cubic feet of air or oxygen divided between two 26 cubic foot cylinders for balance) is a plug-in attachment carried with the mask for administering resuscitation to an overcome person on-the-spot while still in a toxic atmosphere.

In the above discussions, no mention has been made of the fire and explosion hazard of air which is richer than 21 per cent in oxygen, or of pure oxygen itself. Certainly air should not be replaced with oxygen, either in a breathing apparatus, in a ventilation technique, or for any other purpose, without full consideration of the increased potential hazards from fire, as the oxygen concentration increases above the 21 per cent oxygen content of air. A flammable vapor-oxygen mixture requires only about one thousandth the energy to ignite it as does a corresponding flammable vapor-air mixture.

The resulting fire or explosion is many times more violent. Failure to appreciate these facts (which have been published and well documented for years) has cost many lives. For this reason, it is as important to analyze a suspected atmosphere for oxygen concentration as for flammable vapors and gases, and for toxic gases. By using either the time-honored mine safety lamp as an oxygen indicator, or the more recently available Beckman paramagnetic oxygen analyzer, it is possible to obtain fast and sufficiently accurate oxygen analyses for practical purposes.

Combine such oxygen analysis (which will reflect inert gases or oxygen deficient atmospheres as well as excessively high oxy-

gen concentrations) with a check for flammable vapors and gases (using one of many instruments commercially available) and a check for whatever toxic gas is suspected (for CO, for example, the National Bureau of Standards glass tubes containing palladium chloride which changes color with CO). To ignore any one of these fundamentals is to run risk of trouble.

SAFE 45 MINUTES

The self-contained oxygen-generating breathing apparatus is approved by the Bureau of Mines, and is rated for 45 minutes. Some of the models produced for the military are not Bureau of Mines approved, however. The weight of 14#, carried on the chest and stomach, gives it a decided advantage both in weight and convenience over the demand-type apparatus, although the chest position creates limitations in use under some conditions.

The highly exothermic reaction which generates oxygen from the potassium superoxide (K_2O_2) evolves significant heat, which might serve as an auto-ignition source to carbon-disulfide or nickel carbonyl vapors under extreme conditions. This temperature of the canister surface may reach 250°F, and is equivalent to the hazard presented by unshielded incandescent lamps, hot plates and steam pipes in such an atmosphere.

When worn in hot areas, or while working hard in the heat, the oxygen generated may occupy a volume which requires "dumping" of surplus oxygen to maintain comfort. The apparatus requires care in starting, especially in sub-freezing temperatures—for this reason it is considered good practice that both the apparatus and the canisters be stored inside or in a heated truck cab or automobile, and that the apparatus be thoroughly started above freezing temperatures, if possible.

Unless the sub-freezing starting is thorough, the wearer may be aware of insufficient oxygen during the first few minutes, by a feeling of "light headedness" and difficulty in coordination. If such a condition is noted, he should return to fresh air, deflate the bags and re-start the apparatus, until the breathing rate and the generating rate balance before re-entry.

In inserting the canister in the canister holder (canister is stored separately), care

must be exercised to avoid cuff from the torn top seal when removing it, and the canister brought securely into place after it has been punctured by the sharp point designed into the apparatus for that purpose. The facepiece should not be donned until the canister is completely sealed. A fresh canister should always be used in any emergency.

Once opened, a canister will continue to evolve oxygen even when removed from the apparatus and re-capped. To enter a hazardous atmosphere with a used canister is a highly dangerous practice—a fresh canister must be employed to insure safety. In view of the relatively high cost of these canisters, the temptation to re-use canisters is great, but should be avoided, and canisters promptly disposed of to insure the safety of the next user.

DON'T RE-USE CANISTERS

The disposal of the self-contained oxygen-generating canisters must be performed according to the instructions. Oil, grease, gasoline, or other flammable or combustible liquids must be kept from the canisters, or an explosion will result. Water in large quantities should be used to destroy a canister. The canisters should be promptly disposed of, and not be left sitting around where they could contact combustibles.

For reasons noted under discussion of demand-type breathing apparatus, the self-contained oxygen-generating apparatus should not be worn under pressures greater than two atmospheres absolute.

Smaller Self-Contained Breathing and Oxygen Inhalation Devices

U. S. Bureau of Mines approval for self-contained breathing apparatus currently makes no provision for apparatus rated for less than 30 minutes. In emergencies where a smaller, less cumbersome device with a shorter life would give adequate protection, the only available devices until recently were regular demand masks with smaller cylinders for 20, 15, and 7½ minutes service, using the same facepiece, reducers and regulators as on the larger approved devices.

Recognizing that many (perhaps most) breathing emergencies can be brought under control in 10 minutes, and that the first 130cc of expired air contains actively lit-

tle CO₂, there is now available a light-weight device in which oxygen from small cylinders, supplemented by the first 100cc of the previous exhaled breath, is used for breathing at a rate of seven liters per minute. The device is still too new for extensive field experience, but represents a novel and new approach to the weight, bulk and cost of presently approved equipment.

Another recent development is a small portable anaesthesia and oxygen breathing device which is designed for use by medical personnel primarily, but which has obvious application as a "self-rescuer" for escaping toxic atmospheres. The device consists of a face piece with pressure limiting valve, an aluminum central body, a soda lime canister in volumes of 100cc to 500cc, two aluminum cylinders, each containing three liters of oxygen, and a six liter rubber rebreathing bag.

Using the device for escape, it is claimed a young male adult walking three mph can travel safely for 1100 yards using a 200cc soda lime canister, and 1800 yards using a 500cc canister. Since the complete unit weighs less than two pounds, and the oxygen cylinders are pocket-size, the device may rightly be called pocket-size, and, in the hands of trained personnel, should be useful for self-rescue oxygen inhalation or resuscitation.

Maintenance, Training and Medical Precautions

In discussing respiratory protection, we have shown the importance of breathing "good" air, briefly reviewed the major air contaminants, and discussed briefly apparatus available. We have stressed the limitations of each type, rather than the advantages, since we believe that limitations were not as widely appreciated as advantages. The ideal breathing apparatus has yet to be developed. We have tried to create the impression that a thorough knowledge of the particular apparatus used is essential for its safe use under various conditions.

Maintenance of the apparatus in first-class condition so it is immediately ready for use at any time is likewise important. Metal parts of apparatus will wear, tarnish or corrode. Face pieces will slowly "age." Face pieces will take a "set" and must be discarded. Cylinders, regulators and valves

on demand-type apparatus must be checked frequently for leaks; canisters on industrial or universal service masks or chemical cartridge respirators must be replaced.

Washing the facepiece with an antiseptic solution or soap, rinsing in clear water, and drying will assure that sanitation and cleanliness is not neglected. This also prolongs the useful life of the facepieces. Proper storage conditions and frequent checking for deterioration are as important with respiratory protective equipment as with fire extinguishers, parachutes and life-lines.

TRAINING DEFICIENT

Training is the third, and perhaps most important leg of the triangle of respiratory safety. There is serious deficiency in this phase of the respiratory program. Putting on a device for a few minutes once a year is not adequate training. The U. S. Bureau of Mines Health and Safety Activities, through its district and sub-district offices, conducts training courses in first-aid, and also in the use of various emergency breathing apparatus.

The course can be modified to meet special needs on request. Addresses of offices which offer these courses may be obtained by contacting the Health and Safety Division of the Bureau of Mines, 4800 Forbes St., Pittsburgh 13, Pa. This service of the Bureau is available to the mineral and allied industries, as well as to governmental agencies. The Bureau has at each of its Health and Safety field offices throughout the country mine-rescue equipment, and will make it available to trained personnel in any emergency.

During training, breathing apparatus should be worn for relatively long periods, in dark and confined spaces, climbing hills or stairs, duplicating all manual labor expected, and in smoke-filled atmospheres by hand-carried lights while performing work. Smoke generators are available, which will quickly fill a room, a basement, a tunnel or a small building with a smoke that is realistic, but which is relatively harmless and can be ventilated out without any damage.

The "buddy" system and team drill should be practiced, as in a real emergency. The use of life lines should be a part of this training, and should be a standard part of any underground, tank or smoky operation.

Signals as used by mine rescue team on OATH (O=OK=1 pull; vance=2 pulls; T=take-up=3 pulls; help=4 pulls) should be employed and stand-by men, ready to enter the area for rescue, should always be on hand.

Hand-carried short-wave two-way radios may also prove useful for communication between base and field party. When used in atmospheres which may contain flammable vapors or gases, any electrical devices should have a "permissible" rating by the Bureau of Mines for the gases or vapors involved.

PHYSICAL EXAMS LACKING

The need for proper physical examinations for persons wearing emergency equipment has not always been appreciated in the past. A regular program of physical check-ups with particular attention to the respiratory and circulatory system as well as general physical condition probably would have prevented some cases where inhalation of a smoke combined with physical exertion with or without respiratory protection, has produced serious illness.

Pulse rates before, during and after exercise, general physical condition, moderate weight, good eyesight and proper teeth alignment (where mouthpiece breathing is involved) are considered vital to pre-training by the Bureau of Mines instructors. A practice of not permitting persons to return unprotected to smoke or fumes after they have been overcome and revived, would help prevent more serious inhalation effects.

Such restraining action may require physical force to implement it in practice, since a patient who is partially recovered from fume or smoke inhalation may display highly irregular behavior. One recommendation is that persons sufficiently exposed to smoke and carbon monoxide to require treatment should not return to active duty in less than four to six hours, while those who have been rendered semiconscious or unconscious should rest 24 to 48 hours.

Properly maintained breathing apparatus, used with full appreciation of its limitations, by healthy persons, properly and adequately trained, will eliminate most "fume" disabilities in the future. However, the ideal breathing apparatus for all applications has not been developed, and may not be developed until there is sufficient demand for it.

000356

Chemical Industries

CASE HISTORIES

AMMONIA

The incident in question took place in Singapore, Malaya, during the early days of the war 1942, just prior to the fall of the city to the Japanese.

Our ship was tied alongside the docks, having just completed a mission. The city was under air attack continually, so that we maintained a full scale Battle Watch, ready for any emergency. It was after one of these raids that a strong odor of ammonia was observed on our ship; our blower ventilating system was picking it up. Investigation by our shore patrol informed us that a large cold storage plant had been hit and that the local fire department was attempting to rescue several members who were trapped inside the buildings.

Our fire and rescue section was dispatched to the scene at once; we were equipped for such work with demand-type breathing apparatus, with proper protective equipment and safety lines. Upon arrival we were briefed as to the plant layout and the possible location of 10 men inside the building with a British type canister mask for protection. We entered the area working in pairs, and during the next 20 minutes removed 10 firemen, who had been well trained by the best of British methods, but unfortunately ill equipped for such violent conditions.

When found, all men were unconscious and upon removal from the building were rushed to the hospital, oxygen being administered enroute by a fine Australian medical team. Of the 10 men rescued, six died from the effects of ammonia inhalation, four men recovered completely.

During the entire operation none of our team experienced any breathing difficulty; the teaching of damage control, fire and rescue work by Naval standards are very good. Their careful selection of reliable equipment has been the result of careful research and experience.

NITROGEN IN AIR-LINE RESPIRATOR

Employees in an area were required to use air-line respirators as a precaution against inhalation of radioactive particles. The air line was also used to provide instrument air.

FILMS

1. *Mechanisms of Breathing* (EBF) 612.2-1, Pennsylvania State University, Audio-Visual Aids Library, State College, Pa. or Encyc. Brit. Films, Inc. 1150 Wilmette Ave., Wilmette, Ill., (16mm sound, 11 min).
2. *Oxygen*, 16mm sound, 10 min., B&W and color, Coronet Films, Coronet Bldg. Chicago 1, Ill.
3. *The Air We Breathe*, 16mm sound, 26 min., B&W; Mine Safety Appliance Co., 5-45 49th Ave., Long Island City, N. Y. or local sales office.
4. *The City That Disappears* (Los Angeles), 16mm sound, color, 30 min., (Stanford Research Institute, Menlo Park, Calif.
5. *A Report on Smog*, 16mm sound, color, 20 min. (same source as 4).
6. *You Bet Your Life*, 25 min., 16mm sound B&W, available same source as 3.
7. *Use of Oxygen in Aviation*, TF1-4595, 22 min., 16mm sound, color, same source as 8.
8. *Oxygen, In-Flight Requirements*, TF-1-5038A, 25 min., 16mm sound, color, Air Force Training Films, Eastern Film Exchange, 1356 Film Library Flight (APCS) (MATS), Marietta Air Force Station, Marietta, Pa.
9. *Oxygen-In-Flight Equipment*, TF 1-5038B, 30 min., 16mm sound color, same source as 8.
10. *The Physiology of Anoxia*, 30 min., 16mm sound, B&W, same source as 11.
11. *The Breath of Life*, 10 min., 16mm sound color, H. J. Polk, Oxygen Therapy Dept., Linde Air Prod. Div., U.C.&C., 30 E. 42nd St., New York 17, N. Y.
12. *Safe and Efficient Oxygen Therapy*, 20 min., 16mm sound color, avail. same source as 11.
13. *Nitrogen Inhalation Therapy*, 10 min., 16mm silent color, Dr. H. E. Himwich, Galesburg State Research Hospital, Galesburg, Ill.
14. *Solvey Chlorine Emergency Devices*, 16mm silent color, 40 min., Research Dept., Solvey Process Div., Allied Chem. & Dye Corp., Solvey, N. Y. or local Solvey sales branch off.
15. *Use of the Air-Chem Suit*, 16mm sound, 30 min. color, Cost Reduction Section, Chamber Works, Organic Chemicals Dept., E. I. DuPont de Nemours & Co., Inc. (Penns Grove, N. J.) avail. both with magnetic sound tract & regular optical sound tract.
16. *Breathing Apparatus*, Fire Dept. Training Film, 16mm sound B&W, 30 min., Public Relations sect. Los Angeles Fire Dept., Los Angeles, Calif., also avail. as Navy Train. Film
17. *Breath of Life*, 16mm sound, color, 10 min., Scott Avia. Corp., Lancaster, N. Y.
18. *No. 2 Training Film*, 16 sound B&W, 20 min., Scott distributors.
19. *Damage Control, Oxygen Breathing Apparatus*, MN-6931A, 16mm sound, B&W, 22 min., Navy Train. Film, U. S. Naval Train. Aids Center, E. Coast, 207 W. 24th St., N. Y. 11, N. Y.
20. *Rescue Companies*, 16mm sound 30 min., by Warwick & Tompkin, Public Relations section, Los Angeles Fire Dept., Los Angeles, Calif.
21. *Nerve Gas Casualties & Their Treatment*, 16mm sound color, 30 min., State CD Offices, or thru the Federal CD Admin., Battle Creek, Mich. on Fed. contributions prog. or thru W. B. Jacques, E. R. Squibb & Co., 745-5th Ave., New York, N. Y.
22. *Gas Obstacle Course*, TF-14440, 16mm sound, B&W, 19 min., 1943 (Air Force) 8.
23. *Effects of Weather on the Travel of Smoke & Gas Clouds*, TF-1-4666, 16 sound, B&W, 21 min., 1949, avail. same as 8.

000357

Chemical Industries

A regular compressor and a standby pressor were provided on the air line. At a week-end, both compressors were out of service, so bottled nitrogen was manifolded into the line by a temporary jumper connection to maintain instrument air pressure. An employee, aware of the circumstances, was told to wear a filter-type mask. By habit, however, he entered the area and was found dead several minutes later due to nitrogen inhalation in the air-line respirator he had worn instead of the filter-type mask.

Breathing air systems, using an approved compressor or tank system, should be closely supervised and used only for breathing. Employees whose work takes them out of contact (visual or audible) with others should be closely supervised. Human error caused this fatality.

CARBON TETRACHLORIDE AGAIN

Bunker C oil leaks had sprayed oil over the walls and ceiling of a small boiler room. Fearing the fire hazard which might result from using kerosene on the electrical equipment, the plant engineer had four men use a bucket of carbon tetrachloride with a long-handled brush.

Respirators of the proper type were provided and worn, but due to a missing part and poor fitting on one mask, one of the men became ill and was hospitalized three weeks with typical carbon tetrachloride poisoning symptoms.

A properly adjusted respirator, a less toxic solvent (such as 1,1,1-trichloroethane), and ventilation—any combination of these measures would have prevented this injury. It was also noted that the injured man occasionally consumed alcoholic beverages—a contra-indicated action in solvent areas.

PHOSGENE

A chemist suffered a major injury when phosgene gas containing dissolved HCl escaped from a cylinder too fast for the capacity of the hood. The chemist was wearing a Type N universal canister mask, but he noticed that his eyes were irritated when he took the mask off moments later in the fresh air.

Two men who worked alongside him were wearing air-line respirators and did not smell phosgene nor notice any eye or throat irritation. The chemist was hospitalized

for 10 days from a toxic exposure to phosgene fumes, and was absent from work for about one month. The two other men suffered no ill effects whatsoever.

NO RESPIRATORY PROTECTION

A chemist was decomposing a reaction mixture containing phosphorous oxychloride in a hood by pouring it over ice onto a four-liter beaker. While his back was turned, the reaction became violent and the mixture overflowed onto the hood floor. A small amount also spilled onto the laboratory floor, since he did not have a catchpan under the beaker.

He directed his laboratory assistant to leave the room promptly, but stayed behind to throw some ice on the spill on the floor and open windows. He re-entered the laboratory after 10 minutes, when the fumes had subsided considerably, and cleaned the spilled material off the floor. This required 10 minutes, during which period he inhaled some of the fumes, chiefly HCl . He did not use any respiratory protection, although it was available.

He did not notice any ill effects that day, other than eye and throat irritation, but he was hospitalized on the following day for bronchial and pulmonary congestion. He was in the hospital for four days.

* * *

A vertical catalyst bed was being rodged out to remove solids. Dust and fumes from the solids being discharged at the bottom of the reactor were sufficient to cause coughing and discomfort to the operator, although spot ventilation was being used at the top of the column.

The operator continued to work on his shift, but that night he had an attack of nausea and vomiting, accompanied by persistent coughing. Following a recurrence of the original attack, he was admitted to a hospital for four days.

An air line respirator was readily available, although the magnitude of the dust hazard was not fully appreciated at the time.

* * *

During the operation of a small scale reactor housed in a barricade, it was necessary to enter the barricaded area and withdraw condensate every half-hour. This removal consisted of opening a valve at the

bottom of a condenser to check for and remove any unconverted by-products. In performing this operation it was necessary to discharge some vapors to insure complete withdrawal of the condensate.

The injured had been doing this during his shift without using the air-line respirator which was prescribed protection equipment for this operation. In addition to this exposure, he had entered the barricade during the early part of the shift to make minor repairs to a leaky blower.

The injured worked for several days with no apparent ill effects. While at home he developed a fever and shortness of breath which was subsequently diagnosed as acute bronchial asthma. He was home for three days.

In this case, the injured failed to obey written and verbal instructions to wear an air-line respirator, and the injured's shift leader failed to enforce this rule. Since then, all operators in this group have been re-instructed in the necessity for observing regulations regarding barricade entry, and have been informed that repeated violation of safety regulations may constitute grounds for dismissal.

WRONG TYPE MASK

An employee washing out a chlorine tank car passed out due to insufficient oxygen. A fellow employee put on a Type N universal canister gas mask and entered the car for rescue purposes. He, too, passed out and it was necessary to use self-contained breathing apparatus to rescue both. Fortunately, both men recovered.

* * *

Fire was located in a drying-storage room of steel construction, measuring 8 feet x 50 feet x 30 feet closed by an asbestos curtain at one end. There was no possibility of ventilating. The room was located on the sixth floor of a factory and contained a large quantity of "wood flour" (pulverized saw dust), used in casting ornaments, contained in 100# bags. Fire was started by an electric motor in the rear-most portion of the room.

The room was smoldered for some time and it was heavily loaded with smoke, and of course a high CO and CO₂ content. Alarm was sounded when the heat finally

built up enough to activate a sprinkler head, which transmitted an A. D. T. alarm. Since very little smoke was visible external to the drying room (which was held at approx. 150°F) the first firemen went in without any protection. They were quickly overcome.

Members of the rescue company followed closely behind using Type N universal canister masks. These functioned well on the sixth floor outside the drying room, but inside, one of these five men was overcome. The other four heeded the warning sign of "overbreathing" and retreated to fresh air before being overcome. These same men returned to the room after donning self-contained breathing apparatus. In all, 30 men were overcome in this multiple alarm fire—multiple only because all men from the first companies were overcome. All the firemen recovered.

NO RESPIRATORY PROTECTION

A chemist was preparing to use hydrogen sulfide for a determination and when the valve was opened, a leak developed because a washer did not seat properly.

Before the employee could close the valve, the hydrogen sulfide was ignited by the flame from a bunsen burner located in the same hood. In an attempt to close valve, the employee re-entered the room, without wearing protective equipment, was overcome, and struck his head on the edge of a bench as he fell to the floor. He was rescued by another employee who was wearing a demand self-contained breathing apparatus. He was hospitalized for three months and as a result of this incident lost his sense of smell.

ANOTHER SOLVENT INCIDENT

Two electricians, journeyman and apprentice, were working in a concrete pit—four by six foot top opening and standing on the bottom, the ground level was in the proximity of their eyes, nose and mouth. Repair of the small motor involved using a solvent an inhibited grade of 1,1,1-trichloroethane. Approximately 10 minutes after entering the pit, the one electrician appeared to be swaying, somewhat in a stupor and somewhat incoherent. A combination of lifting and pushing forced the man out of the pit. The other electrician used the ladder in leaving the pit.

A few minutes exposure to fresh air and the "overcome" electrician stood up and walked to the dispensary. Examination revealed him to be coherent and no signs of narcosis. He rested for about half an hour and returned to his job—by this time the job in the pit was completed.

A few pertinent facts are in order: solvent was not spilled on the floor of the pit, the "overcome" electrician had returned to work that morning after being off for several days due to a bronchial inflammation, and the other electrician never demonstrated or mentioned any ill effects.

INERT GAS IN TANK CAR

A tank cleaner entered a tank car (which had previously contained caustic soda) and started to wash it down with a hose with the bottom outlet open. After failing to reappear in a normal time, investigation revealed the man lying in the bottom of the car. Upon removal and attempts at resuscitation, it was determined that he had died as a result of weak alkali solution having been taken into the respiratory tract.

This is strong evidence that the inert gas used to unload the car was a byproduct of chemical operations, low in oxygen and could have contained carbon dioxide, carbon monoxide, nitrogen and other constituents. Upon checking the air (oxygen and 2000 ppm of reducing gases which would commonly be reported as carbon monoxide).

Inasmuch as the official coroner's report stated that the man fell to the bottom of the car apparently due to heat exhaustion, there was no significant publicity concerning this incident. Corrective measures have been taken to avoid any recurrence.

TANK JOB CLAIMS LIFE

A maintenance mechanic lost his life, and his assistant narrowly escaped in tank incident.

Repair work had been scheduled inside the tank to begin after lunch, and two men assigned to the job. The mechanic decided to look over the job about 11:30 a.m. and went into the tank after sending his helper for certain supplies. The inert gas (which contained essentially nitrogen with small percentages of CO and CO₂) supply to the tank had not been shut off, since the mechanic had not informed anyone of his entry. The mechanic was quickly overcome.

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His helper returned a few minutes later, shouted for help, then went into the tank to aid the first man who was unconscious. Before help arrived, the helper was also overcome, but both men were promptly removed to fresh air. The helper was successfully revived, but the mechanic could not be brought back to life.

Failure to follow established tank-entry procedures was the reason given for this fatality.

INERT GAS

Two men entered a kettle to repair an agitator, which is normally a two day job. On the first day nothing unusual happened. On the second day the men went into the kettle, worked for an hour, and came up for a coffee break. When they re-entered kettle, they began to feel weak. They were actually too weak to climb out of the manhole after 15 minutes, but finally crawled out. They came to as they stepped out into the air.

After investigation, it was discovered that one of the men had opened an inert gas line instead of an air line. Close to the top of the kettle was a section for a hose line to be piped to outside the building. The hose was only half-way down into the kettle. The inert gas was heavier than air, when they bent over to pick up tools, they would get inert gas until they eventually were made ill.

* * *

An engineer went down to inspect a kettle. He began to feel sick and came out. Upon investigation later they found the kettle had been "blown-out" with inert gas and did not follow through by removing the gas with proper air ventilation. (The engineer recovered immediately upon leaving the kettle)

* * *

A man went into a non-enameled kettle. The complete kettle was blanked off with exception of entrance. The kettle had been "blown-out" with inert gas. He was overcome. It was necessary to resuscitate the man quite a while before he recovered.

ILLUMINATING GAS IN TRENCH

Two men were working in a series of three by seven by seven foot trenches dug along a 75-foot length of a street. While tapping a high pressure illuminating gas main to install a jumper line into a low

pressure main, a drill slipped and opened a valve in the tapping machine. Gas was released into the trench.

One man immediately left the trench, but the other was overcome. A laborer standing on the bank observed this, and immediately descended into the trench. He tied a rope around the waist of the unconscious man before he, too, was overcome. Meanwhile the foreman of the job put on an air-line respirator and went into the trench to close the valve. By the time the two unconscious men were brought to the surface by the foreman, one was sufficiently ill that inhalators could not revive the laborer even after a half-hour of resuscitation. The other unconscious man was revived.

The final score: three men treated at hospital for gas inhalation while one man was dead on arrival.

MASK IMPROPERLY ADJUSTED

A near fatality occurred when an operator went to tighten a chlorine line in the Waste Treatment Plant and the line disintegrated, thus exposing him to a full blast of chlorine. He had his face mask on, but due to maladjustment, he was hospitalized for twenty-four hours.

NARROW ESCAPE

A plant protection officer entered manhole to inspect water valves, collapsed after about three minutes, was unconscious for three and one-half hours, revived by artificial respiration. If there had not been another officer watching and a truck with a rope on it nearby, this would likely have been a fatality. A six inch artificial gas main 30 feet away had broken and the gas had seeped into the hold. No respirator was worn.

METHYL CHLORIDE

A leak developed in the methyl chloride compressor which was being used to transfer methyl chloride from the drier through a tank to storage. The leak was first discovered by a foreman who had heard the compressor pounding and who entered the area to investigate.

He detected excessive quantities of gas. An operator entered the area with a filter type respirator, but left when he detected methyl chloride through the respirator. Shortly afterward he was

observed staggering and shouting outside. He was wearing a dust respirator. Both men were given oxygen and sent to the dispensary. Each of the men had a pale white complexion with a bright red overtone.

An examination of the compressor after the incident showed a crack along the base of the compressor housing. This was caused by liquid methyl chloride in the compressor.

The tank had been full for three days and had been frosted over, indicating the presence of liquid.

The incident was caused by attempting to transfer through the full tank.

OXYGEN WASN'T THERE!

During degreasing operations involving the use of Freon-113 (Trifluorotrichloroethane), it appears that one operator fell into the tank while attempting to disengage the basket. The other operator, without calling for help, immediately entered the tank to go to his assistance. Both men lost their lives due to suffocation in the oxygen-deficient atmosphere.

In fire safety, we have long hammered at the point of calling assistance before tackling any fire alone. The same point should be reiterated again and again in training personnel where the hazards of suffocation or entrapment exist. In many large chemical plants, personnel are often widely spaced and telephones are not always readily available at all locations. In practically all plants, however, a fire alarm box is located quite conveniently to all operating stations. Pulling the fire alarm box summons trained assistance and supervision in a matter of seconds. Where feasible, employees should be trained to use the fire alarm box instinctively to summon assistance before attempting on their own.

In any case where hazard evaluation discloses the possibility of suffocation or entrapment, personnel should be thoroughly trained to overcome the instinctive reaction to go immediately to the victim's assistance and to summon help first by the fastest available means.

HYDROGEN SULFIDE!

One man suffocated and two escaped death when exposed to H_2S .

This accident was caused when a precipitation tank overflowed and spilled

bearing liquor on the floor. The liquor drained into a sump near the leach tank and was then pumped into a reserve holding tank. Later, pipes from a reserve sulfide holding tank were disconnected, allowing the contents to drain on the floor.

The sulfide, during clean-up was washed into the sump and then pumped into the same reserved holding tank. An immediate reaction generated large quantities of H_2S , filling the area surrounding the tank. Unaware of this, three employees entered the area.

The first employee collapsed just as he passed the tank. The remaining two men walked a few feet further; one collapsed and the other reached a window and called for help. Other members arrived and gave artificial respiration while the ambulance was summoned. On arrival at the hospital, the first employee was pronounced dead.

Processing plants and laboratories in the program contain the elements to produce not only gases like H_2S but disastrous fires and explosions as well. These can occur from an uncontrolled chemical process reaction or, as in this case, from improper mixture of two chemicals. Infrequently, storage of incompatible chemicals can be separated physically for safety, which was done here afterward. More reliably, however, the employees should be instructed fully in the adverse effects of chemical combinations possible in the operation.

ALIPHATIC HYDROCARBONS

A pipe-fitter, aged 26, was gassed by aliphatic hydrocarbon fumes in a pit 20 feet by 10 feet by 6 feet deep in an oil refinery while he and another man were inserting a blank in a pipeline which had been shut off. Both men were wearing breathing apparatus supplies with air from a hand-pump, a Y piece being used to supply the two sets of apparatus from a single pump.

While working in the pit, the pipe fitter, who was apprehensive and difficult to reassure, was seen to remove his mask. The safety attendant, who, with the foreman, was watching from ground level, replaced the mask and assured him that it was working properly. When the joint was opened, some liquid escaped owing to residual pressure, and the pipefitter endeavored to come away, but was persuaded to return.

Later, when he again attempted to leave

the pit, his airline caught on the bottom of the handrail and impeded his exit. This caused him to panic and he took off his mask. The foreman and the safety attendant running to his assistance, pulled him to safety as he collapsed. His workmate continued to work in the pit without any trouble.

After being given artificial respiration and an injection of coramine, the pipe-fitter was removed to hospital where he recovered. The apparatus which he had been wearing was subsequently found to be in good order, but it was unwise to compel him to work under circumstances of which he was obviously afraid.

AMMONIA

One afternoon, while the engine-room foreman of an ice-cream factory was standing near an oil separating unit, there was a report and ammonia liquid and gas issued from the sump. It was later found that the rubber seal between the sighting glass housing and the sump had "blown." The engine room was immediately evacuated, the foreman taking with him a canister respirator from a rack.

The fire brigade was called and warning given to all employees in the factory. As the concentration of gas was too high for the canister respirator, the foreman was unable to re-enter the engine room to reach the ammonia isolating valve. The gas spread rapidly through the factory area and many of the 100 employees, most of them women, were affected.

There was some degree of panic and some women were rescued from the canteen by firemen. Sixteen women employees and two firemen were admitted to hospital but only three persons were detained overnight. Seven of the women were sufficiently affected to require notification. Occupants of houses within a radius of 50 yards of the factory were also affected. The firm had already been advised to provide self-contained breathing apparatus and they were again advised to keep apparatus of this kind outside the engine room as well as the canister respirators.

TWO FATAL ACCIDENTS WITH BENZENE VAPOR

In one accident a laborer, aged 23, was fatally gassed and an ambulance room attendant and a fireman were also gassed while

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attempting to rescue him. The foreman had given instructions for four of a series of 6 benzol tanks to be cleaned after they had been steamed out, tested and declared free from gas. While the laborer with his workmate was preparing to start work on a tank which had been steamed out, he enquired about another tank which had not been steamed and was told they were not instructed to clean that tank.

When the workmate returned after fetching a respirator and a lifeline he saw that a ladder and hose pipe had been lowered into the unsteamed tank and that the laborer had unaccountably entered without a lifeline or respirator. After shouting for help he attempted to enter the tank, at the bottom of which there was about 12 inches of liquid, but was forced to come out because of the fumes.

During the rescue operations a fireman, who in his hurry entered the tank without a mask, was gassed, as was the ambulance room attendant who had donned a fresh-air mask and a lifeline but dislodged his face mask while in the tanks and lost consciousness. The laborer was given artificial respiration and oxygen but failed to recover.

The other fatal case was a benzol house attendant aged 47, who was found lying prone and unconscious on the floor, which was saturated with benzol. He was immediately dragged into the open air and artificial respiration was started at once, this being continued with the aid of a rocking stretcher, oxygen also being given. Despite this treatment, he was found to be dead on arrival in hospital.

When the distillation temperature had been reached it was the attendant's duty to reduce the steam sufficiently to allow distillation to proceed in the normal manner. If this was not done, the crude motor spirit would boil rapidly and would eventually overflow on to the floor. After the accident, the plant was found to be in order, and it was assumed that the accident was due to the use of too much steam.

CARBON DISULPHIDE

Following the discovery of a leak at a rotary sulfuric acid furnace used for the preparation of carbon bisulphide, the manager decided that breathing apparatus was necessary while repairs were being

effected and he issued a permit-to-work certificate accordingly. Without being instructed to do so, a laborer climbed up a ladder to the top of the furnace.

He was not wearing breathing apparatus and, being overcome by escaping gas, he fell to the ground about 10 feet below. After recovering consciousness he was able to walk to the ambulance room.

FOUR CASES OF CHLORINE POISONING

In four cases in which only slight exposure to chlorine gas occurred, the effects were stated to have been aggravated by the existence of a previous chest condition. One of these cases was a plant operator who inhaled a whiff of chlorine when adding hydrochloric acid to a reaction vessel under negative pressure, after having put in a slurry of sodium chlorite. The doctor who treated him in hospital considered that the inhalation of a small amount of chlorine had "triggered off" an acute attack in a man subject to asthma.

A process operator, aged 32, whose exposure to chlorine from a leak in a plant for the chlorination of dimethylacetol was slight, suffered from cough, breathlessness and pain in the chest. The chest physician, who found a lesion in the left upper zone and kept him under observation at rest at home to assess the activity of the tuberculosis lesion, thought the infection was a factor greater than chlorine exposure in this case. A night watchman, aged 58, said to have had a previous chest condition, suffered from a sensation of choking, cough and respiratory tightness following a slight leak of chlorine from a control valve.

The fourth case in this group was a fitter, aged 57, who, with other men was cleaning an air-cooler plant from which some water containing four p.p.m. of chlorine was leaking. The other men were unaffected by the small amount of chlorine, but the fitter, who was stated to be a heavy smoker, which caused him to cough continuously, became unconscious and suffered from lachrymation and cough.

IMPROPER VENTILATION

A laboratory technician was cleaning a vessel with a mixture of hydrochloric and nitric acids. The work was being done in a sink in front of an open window. How-

ever, there was not sufficient ventilation to prevent the worker from inhaling fumes to make him sick to his stomach. The proper type Canister Respirator was available on the lower floor but the person was not familiar with its use.

NO RESPIRATORY PROTECTION

Several specific instances are known where personnel should have worn protective equipment and did not although it was available and the specific personnel were familiar with use. For the most part these instances involved professional grade personnel of the "difficult personality" category engaged in Research and Development. Injuries were in all of these cases from volatile vesicants, and though injuries were serious enough to have resulted in lost time, there was, in fact, no lost time.

In one instance the employee was convinced to use recommended safety procedures by a combination of greatly increased supervisory pressure and alarmist industrial hygiene propaganda. In another instance such stresses produced no apparent effect.

RESPIRATORY PROBLEMS

We have had people injured while they were wearing respiratory equipment and also we have them injured by not wearing them even though they were available. Some of the latter are the "Smoke Eater" type who think they can get along without the stand-by equipment.

A basic problem with any respiratory protective equipment is knowing the limitations of a particular device. Actually, the popularity of the self-contained breathing apparatus can be attributed to the fact that its limitations are far less than any of those that depend on chemicals for air purification. In addition, the operator does not have to be concerned in knowing whether there is sufficient oxygen in the air.

In one particular process we were confronted with a number of stages in which reactants were more or less open to the atmosphere. In spite of a number of spot ventilators there was a prevalence of noxious odors, most free chlorine.

Chlorine is considered here for its nuisance and noxious characteristics rather than for its toxicity. Even small amounts have a definite odor and they usually cause

an operator to get out of the contaminated area. This latter incidently provided cause for an additional problem and usually ended in a lost time injury. Many times the individual would go outside for fresh air where it was too cold for his condition. He would catch cold and would come near to developing into pneumonia.

During the time this particular process was being developed, operators got used to the chlorine type odor. At this same time the self-contained breathing apparatus was not the popular item it is today. A chemical cartridge respirator was what they generally carried draped about their neck. Probably many times the trouble was located and the mask removed after the contaminated area was under control without the operators' having an exposure.

A number of times though, the capacity of the cartridge was unknowingly depleted by prior uses. Then again, the general contamination would instill in the operator the idea that his mask was O.K. when it really wasn't. The operator would then prolong his trip beyond limits and have a very bad trip. To sum up then an operator

- would not know the condition of his mask because he was generally conditioned to the contaminant.
- would not know the remaining capacity of the mask.
- would realize that the mask was not working but would remain in the area thinking he could get by or hold his breath a moment longer in order to complete the job.

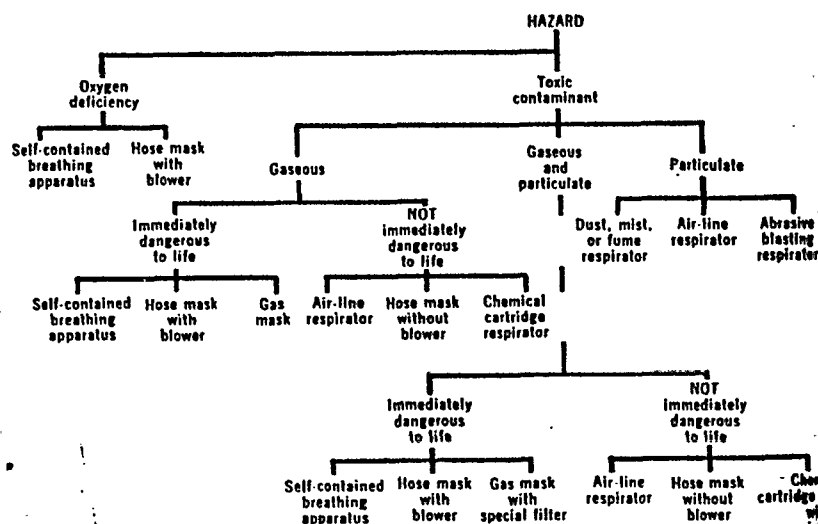
The second part of the problem refers to the people that do not use the equipment that is available. These are the "Smoke Eaters" or the ones that think they can chance it. Even today with the self-contained breathing apparatus available, this practice continues. I witnessed an entry to a contaminated area (FII fog).

This particular entry was made for no good reason at all. Two men were putting their self-contained breathing apparatus on and this fellow decided to go in with a handkerchief over his nose. It turned out that the men wearing self-contained breathing apparatus made the necessary emergency shutdown, ventilators soon decontaminated the area, and normal entry could be made.

SOAP DUST

Our operation is essentially a soap manufacturing plant and the air in our factory is frequently contaminated with soap dust from detergents and dust arising from fine woodflour and cornmeal. We issue our employees a dust mask (not Bureau of Mines approved). The filter element consists of a honeycomb construction of whipped foam latex.

This device does a modest job of filtering, however, we have never been completely satisfied. Despite the fact that we have issued masks to all personnel about half of our personnel prefer to use an ordinary handkerchief wrapped about their face which appears to do a satisfactory job without the unpleasantness of the dust mask.▲

OUTLINE FOR SELECTING RESPIRATORY PROTECTIVE DEVICES

"Reprinted from Bureau of Mines Information Circular 777"

LABORATORY AND PILOT PLANT SAFETY

(A Symposium)

LABORATORY BARRICADING OF HIGH PRESSURE AND EXTRA HAZARDOUS REACTIONS

by **GODFREY J. MOLL**

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Safety engineers are often called on to formulate or approve plans for laboratories in which high pressure or extra hazardous reactions will be safely operated. In these designs the protective shield or barricade is the only fixed piece of safety equipment which will remain operable 100 per cent of the time. Equipment, instrumentation, and safety devices are all apt to fail at any time regardless of maintenance and inspection. The judgement of the best-trained operating personnel need only be wrong once. The barricade may be considered as the primary safety device.

High pressure and extra hazardous research projects are being carried out in unbarricaded laboratories in many universities and at some industrial research centers in the United States. Workers at these installations will point with pride at their perfect safety record, but tomorrow might yield their first and last accident. The management of CIBA Pharmaceutical Products Inc., Summit, N. J., has recognized the risk involved in not barricading high pressure reactions.

Our high pressure laboratory was constructed in a built-up area presenting the problem of not only protecting the operating personnel but also the personnel of adjacent buildings from the effects of missiles and shock waves. A suitable barricade was constructed of 16-inch reinforced concrete with a reflector wall of similar construction eight feet from the frangible wall. Further protection was provided by hanging one-half inch wire rope blast mats between the building and the reflector wall, which would operate on the ballistic pendulum theory in stopping missiles and dissipating shock waves. This is but one approach to the problem of barricading.

The question often arises as to what should be considered hazardous enough to warrant the expense of barricading. Some authors feel that when equipment is installed to handle inflammable materials at pressures greater than 500 psi the use of some form of barricade should be considered. When research at high gas pressures or work on known explosives is conducted the protection of personnel and other facilities with an adequate barricade must be considered.

In small-scale flow experiments where the amount of material in process is small, it is common to use pressures as high as several thousand pounds without special barricades. Once it has been decided to build a barricade there are still many questions to be answered. The two most important as far as the barricade is concerned are the materials of construction and their thickness.

MUST KNOW MISSILE

If we knew the velocity, weight and shape of the missile and the maximum force expected from an explosion, we could design a barricade using a minimum wall thickness. Barricades must be designed to prevent penetration by large missiles at low velocity, such as reactor heads, and also small missiles at high velocity, such as tubing, nuts or other small fittings. Penetration is dependent upon the velocity of the missile at impact, the physical properties of the missile, and the characteristic of the material used to construct the barrier.

The speed of sound has been suggested as a velocity, as most objects when propelled through air decrease in velocity to the speed of sound. If missiles of higher velocity are expected, the modified Petry equation for penetration can still be used to calculate a

PUBLISH CASE HISTORIES

Still another letter recommended publishing actual case histories of the misuse of toxic chemicals and their results. Since the same toxic chemicals are used in many laboratories or pilot plants, it would no doubt be worthwhile to make available information of this kind.

Setting up a toxicology chart was another idea received. This chart could contain columns giving the name of the toxic material, maximum allowable concentration, appearance, the type of operation where this material would be used, how it is absorbed

by the body, the symptoms, first aid and the safe way to use the chemical.

These are all good ideas but your committee on Toxic Chemicals needs more information both on an expansion of the preceding ideas listed as well as new ones.

It is the responsibility and moral obligation of each of us to do what we can to further the cause of safe practices which will prevent suffering and the loss of human life. Please send your ideas on the use of toxic chemicals to R. V. Montello, Research Division, National Cash Register Company, Dayton 9, Ohio. ▲

A BIBLIOGRAPHY OF TOXIC CHEMICALS

Prepared by: Toxic Chemicals Committee,
Laboratory and Pilot Plant Group,
Chemical Section of the National Safety Council

This compilation of references on toxic chemicals is made possible through the cooperation of the following committee members: John E. Fox, safety director of the Monsanto Chemical Co., Texas City, Tex.; Robert A. Quisno, president, Hill Top Research Institute, Inc., Miami, Ohio and Ralph V. Montello, head, materials dept., Research Div., National Cash Register Co., Dayton, Ohio. Assistance was also given by J. B. Black, department of health, education, and welfare; A. H. Christian, American Viscose Corp.; H. H. Fawcett, General Electric Co.; and J. N. Romine, Phillips Petroleum Co.

The scope of this work is aimed at presenting a list of references on the toxic chemicals useful to members of the chemical industry. It covers books and periodicals.

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out that liquid oxygen is commonly referred to as LOX in the Missile and Rocket Industry. The oxygen manufacturers were not aware of this practice but felt that it should be discouraged because for many years the term LOX has stood for liquid oxygen explosives in which liquid oxygen is only a part. Also, tanks, sold under such trade names as LOX and LOXETTE, may be used for the storage and handling of many liquefied gases such as oxygen, nitrogen, argon, hydrogen, etc.

At that meeting the group suggested that the secretary of the International Acetylene Assn. take steps to discourage this usage. The secretary of the IAA wrote several letters to principals of the Rocket and Missile Industry. A safety engineer in the Air Force read the minutes of last year's meeting in the Chemical Section Safety Newsletter and contacted the IAA. Through his efforts, the Air Force has taken steps to discontinue the use of the

term LOX. This was reported in the October 1957 issue of Missiles and Rockets in an article entitled "Liquid Oxygen Replaces LOX Abbreviation in USAF".

The Air Force is undertaking this action to prevent dangerous and possible disastrous results of the use of the term LOX for liquid oxygen. The term LOX will be deleted from all USAF technical orders and contracts including reclassification to the Department of Defense that it also take steps to abolish the use of the term LOX.

A member of the group reported that he had received a full tank car of benzene compressed in long tubes manifolded together. In attempting to open the main outlet valve, they twisted the stem. He wanted to know how to release the pressure. It was the group's recommendation that the gas supplier be contacted in any case where the valve is found to be inoperative, whether it be on a tank car or individual cylinder.▲

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NATIONAL SAFETY COUNCIL 1957-58

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namely, area safety efforts. However this gap is easily closed in an effective manner by the individual safety activities of committee members in their own areas of jurisdiction. They can hold brief scheduled periodic employee safety meetings, provide for limited area safety inspections and conduct other safety activities as the nature of their accident prevention problems dictate.

AREA SAFETY ACTIVITIES

Now let's see if this Organization and Program satisfies the five requirements mentioned in the beginning of my talk.

- Management motivation to support safety: The Accident Review committee keeps him informed of the costs of accidents and of its effect upon his merchandising activities; the Methods Correction Committee sees to it that he knows about the serious hazards that exist, and, finally, he too is subjected to the constant safety propaganda prepared by the Educational Group.

- Authoritative direction is implied in the selection of a junior executive to serve as head of the safety committee where in cooperation with the plant director and the store engineer or service manager he can wield considerable safety influence, on a planned basis.
- A definite program is assured by the creation of the three sub-committees each charged with an important function which lies well within their competence and the scope of their store activities.
- Specific responsibilities assigned to each characterizes each of the sub-committees outlined for us completely.
- Effective safety communication: Each can readily see that effective communication is fully provided by the operation of a sub-committee whose whole function is one of communication with employees at all levels, at all times and through a great variety of methods.

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Off-the-Job Safety Chairman—WALTER A. DUDEK, safety and security director, The Conrad Hilton Hotel, Chicago, Ill.

Trades and Services Newsletter—Restaurants, Hotels: Co-Editors—MARK DUNLOP, editorial director, National Restaurant Assn., Chicago, Ill.; JOHN J. RUFFLEY, JR., director of research, National Restaurant Assn., Chicago, Ill.

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Staff Representative—RAYMOND C. ELLIS, JR., National Safety Council, Chicago, Ill.

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rule says *not to use air hoses to blow off our clothes*, so we put the words *air hose* on a card.

We distributed these 16 cards to the conferees, and in discussion asked "Who has the card that says *'air hose'*?" when somebody raised his hand, we asked what the safety rule was about air hoses. Normally they came pretty close to the rule, and we discussed each rule and its importance. The conferees brought out many examples of accidents that happened because the rules were broken.

LOCKING-OUT RULE

Session three was devoted to one of the safety rules: "The zone engineer or engineering supervisor is responsible for properly safeguarding against dangerous conditions developing during the progress of a repair job." The area of safeguarding machines from being started when being repaired is potentially very dangerous.

In our company some machines are quite large, extending three to five stories high. It would be easy for a worker to start such a machine when someone was working on it, if proper precautions weren't taken.

To drive home the necessity for "locking out" a machine every time it is worked on, we showed a film, "It's in the Cards," produced by the Abitibi Paper co. of Canada. In our conferences we asked the conferees to note the behavior of the people to see if they could pick any of the seven types we discussed in session one.

We concluded the session agreeing that it is important to observe the behavior of our people to prevent accidents.

PERSONAL TRAITS EMPHASIZED

In our last session, we discussed how people are both different and alike. Sometimes we overlook that people are so different, one from the other. To demonstrate this the conferees participated in a little experiment. We gave them a number and asked them to double the number and then re-double as far as they could go in 60 seconds.

After the minute was up, we read correct answers and asked them to mark on their paper how many times they had doubled the number correctly. In every class there was a terrific range from a low of two or three times up to 20 or 21 times. It was pointed

out that this large range of differences was true in any group of people for any abnormal trait or characteristic.

We discussed the people who would most likely cause problems, and concluded that most problems would come from those at either extreme of the range. Then we said that although every one is different, there are distinct and similar types of personalities.

Five of the common types of personalities that can cause difficulties are:

1. The fellow who is sloppy
2. The tough guy
3. The show off
4. The loud mouth
5. The practical joker

The *sloppy man* is frequently lazy, leaving things lying around. The *tough guy* thinks safety is for sissies. He's the fellow who runs the machine with the guard off. He's much too tough to get hurt! The *show off* is interested in calling attention to himself. He will take chances to get people to notice him. The *loud mouth* attracts attention to himself by telling others how to do their job. He's the authority on everything. The *practical joker* can give us a pretty rough time.

The problem is not how to recognize these but how to handle them. The session ended with a summary of the four sessions and the four foundations for good relations. Any house of safety would have to be built on these four foundations:

1. To let each person know how he is getting along, supervisors must know his accident, hospital, attendance, production and quality reports with an understanding through observation of the behavior of our people.
2. To give credit when due, supervisors should have an attitude of fairness and sincerity.
3. To tell people in advance about things that will affect them "safety wise" they must know the safety rules.
4. To make the best use of each person's ability they need skill in leadership remembering that everybody's different and recognizing that people must be treated as individuals.

These are the foundations upon which any house of safety must be built.▲

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*Past General Chairman

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OFFICERS OF THE AMERICAN SOCIETY OF SAFETY ENGINEERS NATIONAL SAFETY COUNCIL 1957-58

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Term Ending 1960—GEORGE M. KINTZ, chief accident prevention & health & U. S. Bureau of Mines, Region VI, Dallas, Tex.; CLYDE F. SCHLUETER, accident prevention manager, Employers Mutuals of Wausau, Wis.; VIRGIL WOMELDORFF, safety director, Illinois Power co., Decatur, Ill.

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Central Region—JOHN F. JONES, safety supervisor, Commonwealth Edison Co., Chicago, Ill.

East Central Region—MYRON L. MILLER, supervisor of safety, Westinghouse Electric corp., East Pittsburgh, Pa.

*ROBERT CLAIR resigned due to illness. He was replaced by DONALD G. VAUGHAN on Jan. 14, 1958. JOHN F. JONES, safety supervisor, Commonwealth Edison Co., Chicago, Ill., was made second vice president.

West Central Region—HOLLEY P. BRADLEY, supervisor of safety, Service Pipe Line co., Tulsa, Okla.

Southwest Region—EDWIN B. LOCKE, manager engineering department, Texas Employers Insurance Assn., Dallas, Tex.

Western Region—S. KIRKLEN COLLINS, superintendent, accident Loss & Prev. Dept. Fireman's Fund Group, San Francisco, Calif.

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Special Committee on Motor Vehicle Operation—AMOS E. NEYHART, head, Institute of Public Safety, The Pennsylvania State Univ., General Annex University Park, Pa.

Special Committee on NSC-Society Relationship—DR. WILLIAM P. YANT, of research & development, Mine Safety Appliances co., John T. Ryan Laboratory, Pittsburgh, Pa.

Special Committee on Review of the Constitution and By-Laws—WILLIAM JR., Professor of safety & Industrial Engineering, School of Industrial Engineering, Georgia Institute of Technology, Atlanta, Ga.

Special Committee on Society Exhibit at Museum of Science and Industry—R. GRAHAM, Safety Engineer, Bituminous Casualty Co. Insurance Exchange, Rm. A-917 Chicago, Illinois

Historian—EDWARD B. LANDRY, Benjamin Franklin Station, Washington

National Safety Council Representative—DAVID L. ARM, manager, Industrial Division, National Safety Council, Chicago, Ill.

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SOUGHT FRINGE BENEFITS

After this the regaining and the betterment of working conditions became a focal point for activity. Upon being partially or totally successful the demands of labor turned to the so-called fringe items. Recently, the fight to stay ahead of the rising cost-of-living has demanded the attention of the worker and his trade union.

We have passed over rather hurriedly the general bargaining history of the labor movement since its rebirth in the early 30's and of course a number of items which have been important have not been mentioned.

During this time most unions had little time or energy to devote to protecting the safety of the members. In all fairness, however, there have been some outstanding jobs done by the unions in some industries and in some segments of industry.

The best job by the unions has been done, as far as safety was concerned, in those industries deplorable with safety records. This was accomplished principally because safety was foremost in the mind of the worker. He saw his fellow worker injured and killed and as far as he was concerned protection of life and limb took precedence over other demands.

UNIONS WROTE SAFETY CODES

A number of unions have devoted a great deal of time and effort in formulating and promoting safety codes to reduce fatalities and lost-time injuries. Safety codes are extremely important and worthwhile, however, without proper policing the expedient employer and employee can enjoy a field day. Each effort, put forth by the union, regardless of size, is important in the overall effect of preventing injuries to the wage-earner.

Each International Union has an obligation to make known to its affiliated local union that the union has an obligation to represent its membership in the field of safety whenever it can effectively do so. The International Union has a responsibility of encouraging local unions to affiliate with the National Safety Council to promote a united front for labor in the field of safety, irrespective of International affiliation.

International Unions should encourage local unions to participate in plant, com-

munity and state sponsored safety programs. Each International Union should establish a department headed by a competent director to assist in promoting safety within its local unions. International Unions with training departments or educational departments should add to their curriculum a course to prepare the plant union safety committeeman to do his job.

USE PUBLICATION MEDIA

Publications such as newspapers, journals, magazines and bulletins can most effectively be used in promoting safety in the mind of the membership. Usually these organs find their way into the home of the member, where not only he, but others can read them. The International Unions should enthrone their local unions with a desire to promote adequate industrial compensation laws so that the injured member will receive adequate care and compensation.

Many employers had little time for accident prevention as long as the community and charitable organizations took care of his injured and maimed worker and the dependents of his fatalities. When industrial compensation laws were enacted and the employers had to assume an additional cost burden, the employer usually became interested in his accident frequency. It is true there have been and there are employers who have been genuinely interested in the safety and the welfare of their employees. However, it is regrettable that in the past there have not been more, because there would be fewer people working at a reduced income because of an injury and there would be fewer widows working to support their families because of a fatality.

EMPLOYERS' ATTITUDES CHANGED

Generally speaking the attitude of employers regarding safety has been changed. This change has come slowly in some instances and rather fast in others. Some employers have the attitude that safety is the problem of management and the carrying out of safety programs is a sole function of management. Others have taken a realistic approach and have felt that a program of accident prevention within a plant must have the support of both labor and management and have created joint labor and management safety programs.

giving labor the opportunity to assist in determining what an effective program should contain.

Some of the top management people in the Pulp and Paper Industry of the West Coast have in recent years stated that the most valuable asset this industry has is the people who work in it. Another industrialist stated that safety was on the same level of

giving labor the opportunity to assist in determining what an effective program should contain. They must have said that because those management men and their unions have developed a joint safety program and in a period of the past 10 years have reduced the frequency figure for mills in Washington, Oregon and California, a total of 45 mills with approximately 20,000 workers, from an average in 1945 of 38.99 to 6.04 in 1956.▲

OCCUPATIONAL HEALTH CONTROL THROUGH ENGINEERING

by FLOYD A. VAN ATTA

industrial hygienist, United Auto Workers, Detroit, Mich.

The engineering part of the occupational health program is concerned with the control of those aspects of the work environment which may have an adverse effect upon the health of the workers in the area. The most obvious conditions are those concerned with the temperature, humidity, lighting and ventilation of the place of work.

One tends to think of these items as concerned with comfort rather than with health but it should be quite obvious that if the temperature is excessively high, or excessively low it can be rapidly fatal and this is indubitably an effect on health, although not a chronic one.

Somewhere between the normal room temperature and humidity at which we are comfortable and efficient, and the temperature and humidity at which we die rather abruptly, there is a limiting value at which men can work, probably not in comfort but without permanent harm. It is part of the business of the industrial hygienist to determine this point and to arrange the working conditions so that the limit is not exceeded.

Sometimes the control of heat and humidity problems is through ventilation and it is always the first idea, when a man is working on a hot job to turn a fan on him. It always helps some but on most hot jobs it is only a part, and often only a small part, of the total control which is needed. To control properly the man's thermal en-

vironment it is necessary to consider, and often to control both the humidity and the temperature of the air which surrounds him and the sources of radiation which are within sight of his working position.

INDUSTRIAL POISONINGS

The major interest of the industrial hygienist in ventilation comes in the control of industrial poisonings. There are a few cases in which industrial diseases are contracted as the result of swallowing some material or as the result of contact of some materials with the intact skin. But they most commonly arise from the inhalation of dusts, vapors, mists, gases or some other form of material in the air. The reason for this is clear after a moment's thought.

Such materials as the phenolic compounds (carbolic acid, cresols, resorcinols and so forth) and the aromatic amines (aniline, toluidines and so on) are easily and rapidly absorbed through the skin but the undamaged skin is designed to protect the body from attack and is a complete barrier against the vast majority of materials.

Because people do not make it a custom to eat the things which they handle in industry, industrial diseases caused by ingestion are also uncommon. They can and do occur, people do eat occasionally with their hands contaminated with toxic materials and eat as much as is required reduce industrial

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disease. I recall one plant where the employees of a heat-treating department had discovered that they could have nicely toasted sandwiches by floating them on a piece of steel on the lead pot. This is one of the better methods for developing chronic lead poisoning by ingestion of lead.

Since this sort of thing is rather unusual, the major problems in the engineering control of occupational disease have to do with preventing various kinds of dusts, vapors, gases, or mists from getting into the air in a place where men can breathe them. There are a variety of methods available.

SUBSTITUTE MATERIALS

It is sometimes possible to substitute a less toxic material for the one which is being used and avoid the problem. A rather common example would be the substitution of a water emulsion paint for a lacquer made up with solvents. This solves the problem of control of solvent vapors with no further effort. It does not necessarily solve the whole control problem since the pigment may also be toxic.

Occasionally, it may be possible to avoid the hazard by putting it somewhere where people do not go in the normal course of work. It should not be overlooked that isolated operations almost always require supervision and maintenance and the people who do this work must be protected. An isolated operation which is a serious source of air contamination is very apt to become a neighborhood nuisance.

SAFETY—A MORAL RESPONSIBILITY

by DR. CAMERON P. HALL

executive director, National Council of the Churches of Christ in the U. S. A.,
New York city

Like the two bit coin in your pocket, safety has two sides. One side deals with what we do when safety fails; the other side concerns what we do to promote safety. Specifically, we are to dig beneath the program and method, beneath the device and technique to the moral basis for why we should do even more than we are in push-

A more generally applicable device is the enclosure of the process. This is most readily seen in the chemical industry where many processes are carried out in a completely closed system from the raw material tanks at one end of the packaged product at the other. When thoroughly carried out, enclosure of the process unquestionably provides the most complete and most fool-proof protection for the workmen.

The type of control which is most common is removal of the contaminant, either from the general atmosphere by ventilation or at the source by local exhaust ventilation or by other means, such as wet operation, which will prevent contamination from being dispersed into the atmosphere.

The industrial hygienist will generally consider protective equipment to be pretty far down the line as a primary method for controlling a hazard. It is useful as a primary means when the hazard is of short duration or occurs infrequently. The main use of personal protective equipment is as a second line of defense after the hazard is pretty well controlled by engineering means.

The main problem, in a great many instances is to recognize the exact nature and extent of the hazard. When this has been done, the appropriate means of control are apt to be fairly obvious. The fact that the particular condition has never been controlled by a particular procedure which looks correct is not an adequate reason for deciding that it never can be.▲

ing our safety record higher and higher. At this safeguard-end of the safety problem religion has a place as significant as at the breakdown-end. A concern for safety measures is fed by a lively sensitivity to the welfare of the individual that is at the heart of the religious life of this nation. Judaism and Christianity are together in affirming

this living truth: the individual is of worth because he is of worth to God. What we as a people do to express in practical terms the worth and dignity of the individual is a moral responsibility upon each of us as an individual and together in groups.

You are intimately involved in all the problems and interests of organized labor. Safety is one of these, but it is not isolated from your other issues which are also moral issues. So before I plunge into the moral responsibility, I want to stress that safety is part and parcel of other labor programs which are also shot through with moral responsibility.

For instance, safeguards against unemployment are an accepted moral responsibility. We have the Full Employment Act of 1946, which makes the avoidance of unemployment a public policy. That a man not lose an opportunity to work is a moral issue; that industry, labor and the public join in putting a floor beneath the chance to be employed is a moral responsibility. When technological advances, such as automation, are introduced which threaten the availability of jobs, counter measures are promoted by labor, and receive a good hearing among us. Why? Because dealing with threats to unemployment is accepted as a moral responsibility in our American way of life.

UNEMPLOYMENT—A MORAL ISSUE

But whence come major threats to a man willing to work being unable to work? Cyclical, technological, and other causes, to be sure, stand out. But men are often—all too often—out of a job because they have been hurt or maimed or disabled as well as fired because of some overall economic or technical squeeze. Loss of job and income is due in large part to failure in safeguards against accidents. Safety is a moral responsibility because assuring the opportunity for employment is a moral responsibility.

Again, ethical practices by both labor and management are recognized as a moral responsibility of both. This phrase—"ethical practices"—has taken on specific reference to the right of the individual union member to protection against the misuse of union and welfare funds. But certainly he is equally entitled to protection from unnecessary accidents—through education and training, on the one hand, and through

personal safeguards on the other hand. The failure by a union toward, or by an employer of, any carelessness in safety measures is an unethical practice toward union members and other workers—it is a failure in moral responsibility.

SAFETY PROMOTES FREEDOM

And thirdly, American labor is out in front in helping bring the strength of the United States into the free world. A sense of moral responsibility for safety is at the heart of what the free world stands for—the worth and dignity of the individual. Many tests that we Americans have to meet before world opinion have to do with safety—tests that we are far from passing with the grade that we can always be proud of. Last fall, we had to expose to the world the hazard to their safety of nine Negro children in going to an Arkansas school. That kind of hazard to safety is a failure in our moral responsibility toward the worth of a child.

But turn to another aspect of our national life. Our march to ever greater abundance, ever greater productivity, ever greater technological prowess is impressive, even breathtaking. But we should be equally concerned with the pace we are setting in on-the-job, occupational safety. And beyond this we now stand on the threshold of the nuclear energy industry, with its reactors and isotopes, its fissionable fuels and their radioactive wastes. The hazards of radiation in this new industry give to moral responsibility for safety a new dimension and urgency.

Let me just mention three characteristics of the potential harm there is in radiation: 1. when you are hurt by over-exposure, you do not know it at the time and so start caring for it; you learn of it—later; 2. the harmful effects are not transitory; instead, they add up—accumulatively; 3. radiation can reach into the human reproductive system and hence blight later generations. While these dangers are near the surface in the use of radio-active materials, they can be kept under control by vigilance. Certainly safeguards against these risks should have top priority in a safety program.

When a stranger, say from the relatively underdeveloped countries in Asia and Africa, or from behind the Iron Curtain, should ask of us, "In your impressive rush toward mounting economic prosperity, and now into

This is sheer gain, but these laws still focus on doing something for the man who has met with an accident, rather than on driving full steam into eliminating causes for accidents. When a ship is sinking, then the whole weight of responsibility rests on manning the life boats and getting the passengers and crew off the vessel. When an auto has gone hurtling off a thruway then the weight of moral responsibility is to rush medical care.

But neither life boats nor ambulances are the full measure of moral responsibility that rests upon us today when ships still sail the high seas and cars ride the highways. Our moral sense has grown up beyond that level of moral satisfaction. In its modern concept moral responsibility stresses preventing the worst from happening on the oceans and

on our roads rather than being content with picking up the pieces after the worst has happened.

Total security is a goal that is beyond our reach, but great progress can be made when men of competence and good will and devotion join together to help each other in every way possible to promote safety measures against accident hazards. The symbol of this step is, I suppose, the National Safety Congress itself. It stands for moral responsibility toward these hazards at its best, for our deepest responsibility toward the victim of accidents is to see to it that all is done to keep him from becoming a victim. And that is a worthy cause for all of us, wherever we are—in labor and management, in education and in government. ▲

LABOR'S STAKE IN SAFETY

by A. J. HAYES

international president, International Association of Machinists; vice president, AFL-CIO, Washington, D. C.

I don't intend to stay within the limits of this title because I am certain little new information could be said about "Labor's Stake in Safety." It is obvious that no one could have a greater stake in industrial safety than the men and women who are the direct victims of industrial accidents.

To an employer — matters of industrial safety, occupational disease, accident prevention and workmen's compensation—are all tied up with economic considerations. They are important insofar as they affect—and can be made to reduce—insurance costs, training costs, and material costs. But these are all money costs—cash costs—costs that are measured in dollars and cents.

To a worker, on the other hand, an industrial accident is a matter of something that is even more tangible than money. It is a matter of a man's blood, bones and sinew—of tragedy, suffering and sorrow. And sometimes, in fact, more than 50 times a day—on every working day—it is a matter of life itself to someone, somewhere, in this country.

That is why I say that labor's stake in safety is pretty obvious. Therefore I don't touch upon aspects of the subject that are not often discussed—aspects that are somewhat controversial. Perhaps they are not discussed because they are controversial.

ETHICS IN SAFETY

Since my views and public statements on the "corruption in unions" issue have been as frank and honest as I can make them, I see no reason to be any less candid in stating my views about matters of industrial safety. I assure you, however, that I am not injecting controversy for its own sake, but because these are matters that concern the men and women who run the risk of being injured, diseased or killed in their jobs.

Safety—and accident prevention—have an ethical as well as an economic side. I think none of us—whether we represent labor or management—would disagree with certain basic ethical principles in the field of industrial safety. We would all agree, for example,

that the objective of industrial safety should be the preservation of human life and the protection of human health. We would further agree that an employer has a moral responsibility to protect his workers against disease, accidents, mental stress and infections from the conditions of employment.

We all profess to agree that human life is not cheap; that man is not something to be sacrificed to a machine. And yet, these ethical principles are not always applied in day to day life nor are they self-enforcing. In practical application they come into conflict with individual economic interests, and thus must be enforced either through group action, or by society as a whole through political action.

As a rule, society does not move as fast as the need would indicate. We all know, for example, that the first industrial revolution had run its course for more than 100 years before society got around to adopting and enforcing rules and regulations of industrial safety. For more than 100 years industrial workers were given no legal protection against the risks and hazards of industrial employment.

Here and there, a lone individual employer might attempt to provide decent and healthful working conditions for his workers. But on the whole, the story of factory employment in the 19th century—and through the early 20th century—was a pretty ghastly one.

I don't need to go into the details that are indicative of the cold indifference with which human life was held in American mines and factories. Suffice to say, it did not seem to matter how many men, women and children were killed or crippled in the course of a day. There were always more waiting at the gates the next morning—driven by raw poverty to plead for a chance to jeopardize their lives and limbs.

SOCIETY BROUGHT CHANGES

The point I am getting at, of course, is that change—when it came—was not the result of any regeneration of moral and ethical conviction on the part of employers. It came rather because society as a whole was thoroughly revolted. It came because American people were finally shocked enough to correct a condition that had prevailed—and grown worse—for 100 years.

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So we finally got factory laws—and workmen's compensation—and an organized effort to make mines, factories and mills safer places to work. But of all the legislation aimed at this objective, workmen's compensation was the key. For until employers were made directly and financially responsible for the results of workers' accidents, they had no economic reason to prevent accidents. The whole pattern and fabric of our industrial safety program throughout the nation rests entirely on how good and how effective our workmen's compensation and our occupational disease laws are.

ECONOMIC REASONS

Oh, of course, you can point to many other good economic rationalizations for industrial safety. You can say industrial accidents add all kinds of direct and indirect costs to production. You can point to the cost of hiring and training a new employee, of equipment damaged in a work accident, of the time lost by other employees when an accident occurs.

But I will throw them all right back to you and say that these considerations were present long before we had industrial accident programs—and that it wasn't until accident prevention was reinforced with workmen's compensation and occupational disease legislation that employers really became safety conscious.

So it seems that the thing that counts here is how good our workmen's compensation and occupational disease legislation really are.

And that's a good question! I've spent my whole adult life in the labor movement. As a matter of fact, I was projected into it by the very thing we are talking about here today—an industrial accident. I went to work at 17 years of age because my father was totally disabled by a work injury—an injury that eventually killed him.

In the course of many years of studying and dealing with the problems of my union—which are, of course, the problems of the members of my union, I realized that our present system of workmen's compensation and occupational disease legislation is completely and wholly inadequate to meet the needs of our complex industrial society.

I am not alone in that conclusion. There are, in fact, many men in the labor movement today who feel even more strongly

than I do—men who are firmly convinced that workmen's compensation has been a gigantic swindle on the American worker.

This nation has tried to deal with a national problem by having 48 separate, conflicting—and in a sense—competing state statutes. And there is no doubt but that workmen's compensation is one kind of labor legislation that states use to compete with one another to attract industry.

In fact, whenever we go into the state legislatures to get improvement or expansion of existing laws, we invariably meet employer counter-arguments to the effect that any further improvement in coverage or benefit structure will shove industry into the waiting and sympathetic arms of states which are more concerned with payrolls—than with the people on those payrolls.

SAFETY INTEREST LACKING

Certainly the health and safety of the nation's work force should not be a pawn in any state's bid for new industry. But that is just what it is under a system that allows Mississippi or Arkansas or Georgia to compete for industry by offering low workmen's compensation benefits and a minimum of safety regulation at the plant level. Why should an employer pay \$40 a week for a temporary total disability in Illinois—when he can go to Arkansas and pay \$25 a week for the same injury?

The situation in workmen's compensation legislation is so bad, in fact, that the Secretary of Labor, Mr. Mitchell, although speaking for an administration that normally follows a hands-off policy in state legislation, has been constrained to speak out and to plead with the states to bring their laws into line with modern conditions.

But because employers can play off one state against another in this matter, the results have been somewhat negligible. There is no indication that the remedy will ever catch up with the need, until there is broader recognition that industrial accidents are a national problem—one that is truly solvable only on the national level.

The lack of a strong and equitable workmen's compensation system leads to a corresponding lack of interest in enforcement of safety codes and regulations. In many states the Bureau of Factory Inspection—by whatever name it goes under—is little more than a son to the conscience of the

state legislature. In fact, the inspection service in such states is not only understaffed, but the staff is underpaid, untrained and technically unqualified to do a competent job in a field that needs a high degree of competency.

But as bad as the situation in workmen's compensation and factory inspection may be, the situation in occupational disease coverage verges on the criminal. And this is a matter of more than just poor legislation. It is incredible to think that in the second half of the 20th century 20 states still either have no coverage or limited coverage of occupational disease.

But the greater problem is that there is too little understanding of the nature and complexity of occupational disease. The range and source of occupational disease in modern industry is practically limitless. None of the ways by which man makes a living is completely free of some hazard to physical or mental health. The risk of occupational disease grows greater every day as industrial processes become more and more dependent upon and saturated with toxic dusts, fumes, vapors, gases, acids and alkalis.

Every day thousands of workers are exposed to everything from arsenic to mercury poisoning, from benzene compounds to magnesium poisoning, from sulphuric acid to chromium poisoning. Thousands have no physical or legal protection whatsoever against the chemicals and poisons that are slowly killing them.

UNAWARE OF RISKS

In fact, many are not even aware of the risk. They will find out when it is too late. In many states they will also find out that they have no right to compensation under the occupational disease law. I wonder how you tell a man who has contracted carbon tetrachloride poisoning, for example, that he isn't entitled to benefits under the occupational disease law because the legislature of his state hasn't seen fit to recognize that carbon tetrachloride poisoning is an occupational disease?

I recently read a statement to the effect that "the scope of occupational disease is vast almost beyond calculation" and "it comes, in fact, unpleasantly close to being the major public health problem of our time."

If that is so—and I for one am inclined to believe it—it is tragic commentary on our time—on the ethics of a business community that has done so little about it. It is even more tragic in view of the fact that we are now entering a new phase in our industrial development—a phase of such sweeping change that some commentators have referred to it as a new industrial revolution. Think of that—we are entering a new industrial revolution without ever having fully solved the problems that attended the old one.

I wonder if it will again take us 100 years to make even a decent start on the health and safety problems that will arise out of automation and atomic energy. These problems are not a part of a distant tomorrow but are already a part of the world today. Now more than 1,500 industrial plants are using atomic materials in one form or another—in 1,500 establishments American workers are already exposed to the hazards of atomic radiation.

Can we say the state laws in existence today—indeed can we say that any system of state inspection and compensation—are adequate to care for the workers who will get leukemia or bone cancer because of exposure to atomic radiation?

DON'T KNOW PROTECTIONS

Personally, I feel somewhat discouraged about the prospects. How can the states protect and care for victims of industrial radiation when they haven't yet learned to protect and care for victims of occupational diseases that have been prevalent for generations? We need only look at silicosis and pneumoconiosis to see the failure. And failure to provide adequate treatment and compensation for these dreadful dust diseases is paralleled by the failure of industry to finance programs of research that would lead to their prevention at the source of exposure.

Related to the problems of occupational disease and radiation is another matter that has received almost no attention in industry, or in government. That is the matter of mental disease. We already know enough about automation to know that it will throw workers into a lonely and eerie world inhabited by monster mechanical devices.

We also know that our mental hospitals are already crowded with people who have

broken down under the stress of life in a complicated, impersonal and highly industrialized society. But we don't know how much more stress people can take, or what effect automation will have on a worker's nervous system. At what point does the human mind crack up from sheer loneliness, lack of contact with fellow workers, from uninterrupted repetition and brainwashing boredom?

I am not just tossing questions out at random here. All of the things I am talking about—from workmen's compensation and occupational disease to radiation and mental distress—have a valid relation to industrial health and safety—and are proper subjects of labor interest.

LOOK FOR DANGERS

For safety is a broad term. It is defined as: (1) the state or condition of being safe; (2) freedom from danger or risk; and (3) freedom from injury.

Safety means freedom from any kind of danger, risk or injury. When we apply that definition to industrial conditions we must think in terms of hidden dangers. We must change our attitude toward occupational diseases—go out looking for them instead of trying to pretend they don't exist, or implying if they do exist, that they have no relation to industrial causes.

I am not exaggerating when I say that industry has taken a "head-in-the-sand" attitude up to now. It has tried to cover up occupational diseases rather than to isolate, prevent and care for them.

There has been little research—either governmental or private—in the field. The Public Health Service spends less than one cent for each worker each year on the prevention of occupational diseases. The National Institute of Health, which has made hundreds of research grants during the past three or four years, has made less than half a dozen in the field of occupational health. There is an iron curtain of secrecy around this whole subject.

Not only does industry fail to support and subsidize research in occupational diseases, itself, but men who have tried to do independent research find that it is virtually impossible to get facts, information, or cooperation from the people in industry who are in a position to help. Worse still, if a

research project does tend to show a correlation between employment and disease, the authors find it is almost impossible to get their work published or distributed.

The result is a deplorable lack of information about occupational disease. We are years behind other countries in this respect. One expert in this field said that research in pneumoconiosis in this country is 25 years behind that of Great Britain.

SECRETS PREVAIL IN INDUSTRY

Industry actively opposes objective research and free interchange of information on occupational diseases because it is more afraid of the possibility of paying compensation benefits than it is that workers will die from lack of proper information and adequate precaution.

Here are specific examples that will illustrate this point. There is some medical evidence that the chemicals used in the dye industry and in the manufacture of synthetic rubber cause or contribute to cancer of the bladder. In fact, one of these—amine—is so dangerous that it has been outlawed for all industrial uses in Britain since 1951. But efforts to prove, publicize and restrict the dangers of this deadly acid have hit stubborn resistance in this country. The large chemical companies have refused to find out if amine does contribute to cancer of the bladder and have strongly resisted independent research into this problem.

Much the same situation holds true in the asbestos industry. There appears to be decided after-effects on workers who produce asbestos in that there is a marked correlation between asbestos employment and lung cancer. Here again, the industry has been traditionally reluctant to cooperate in a full scale scientific study of this curious correlation. This reluctance to do research in health hazards recurs in industry after industry.

DOCTORS OFTEN BIASED

But even worse when workers do succumb to cancer of the bladder or the lung, or to some other equally horrible diseases, we are treated to the spectacle of company doctors who testify that the disease couldn't possibly have been caused by their employment. Doctors are supposed to be above reproach in our society. But as a labor official I have known of too many cases in which company

doctors have testified against workers and for management in occupational disease cases even though they knew their testimony was biased.

It should not surprise us that doctors can be unobjective in these cases where their testimony is bought and paid for. We have only to look at the wide-spread difference of opinion among doctors as to the effect of cigarette smoking to see that their testimony can sometimes be something less than truthful. Most doctors who are not in the pay of cigarette companies are convinced by all the scientific evidence on record that cigarettes undoubtedly contribute to lung cancer. But the doctors on the payrolls of the tobacco companies either deny that cigarettes contribute to lung cancer, or at best maintain that there is not yet enough proof.

As we contemplate these conflicting views among professional men—and as we thoughtfully study the reluctance of industry to be honest about this matter of occupational disease—we cannot help but wonder whether the lust for profits has made many men forget the real purpose of life. What is the real purpose of life? Is it production and profit—or the well-being of the individual? If there is conflict between the two, do we sacrifice production and profit or the well-being of the individual?

The ethical answer is obvious. But the practical methods of reaching the logical ethical conclusion are more difficult.

FEDERAL ACTS NEEDED

We could make a start by enacting comprehensive federal workmen's compensation and occupational disease legislation to take the place of the chaos that results from having 48 different state systems. But I have no hopes for such a constructive approach in the foreseeable future. I am afraid the insurance lobby, and the employer groups that profit from weak administration are too strong for us at this time. So we'll just have to make that one of our long range objectives.

But there are some things we can do right now. We can try to have programs set up in the National Institute of Health and in the Public Health Service which would recognize the importance of occupational disease—and which would put the research effort in this nation on a par with that of other civilized industrial nations.

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If we cannot get decent factory inspection from the state government, then we the labor movement must resort to self-help. Many unions are thinking in terms of collective bargaining clauses which would require the employer to adopt the safety standards set by the American Standards Association as the minimum acceptable in the shop.

LABOR FIGHTS FOR SELF

We are also prepared to bargain for more supplemental injury benefits when the compensation provided by state laws is not adequate to sustain a worker and his family. Although our efforts will directly benefit only the 17 million organized workers, perhaps they will release new pressures that will eventually result in improved legislation benefiting all workers.

The American labor movement has but one purpose—one reason for existence in American life—to serve and protect American workers. There are times when we

make ourselves pretty unpopular because we keep looking for the things that are wrong with American industry and society.

I may have offended industry men with this indictment of the ethics and morals of our business community. But I would be derelict in my duty and false to my trust as an elected officer of one of America's greatest unions if I did not say frankly and candidly that we in the labor movement are not satisfied with present legislation relating to industrial health and safety, workmen's compensation and occupational diseases.

In a sense this is a great challenge to the National Safety Council—a challenge that can be met only if all facts are squarely faced. If we in the labor movement could count on your assistance in the fight for better legislation and more research on both the state and federal levels we might, together, make this a far happier, healthier and safer nation in which to live and work. ▲

GOOD COMMUNICATIONS HELP SAFETY

by GEORGE SCRIVEN

public relations director, United Rubber, Cork, Linoleum & Plastic Workers of America, AFL-CIO, Akron, Ohio

Our organization has been safety minded for many years. The record on that score speaks for itself in a loud and clear manner. The results of our efforts, in cooperation with enlightened managements, tell the story of how we have seen the number of accidents reduced in the plants in which our members work. I shall not go into specific figures on frequency rates and such.

I don't suppose any of you would dispute the flat statement that good communications help safety. But I'd like to try and give you some of the techniques, the how and the why of that statement.

First, let's do a little word analyzing. I certainly don't want to sound like the pontifical professor lecturing his class on semantics. But when we say *good* in our topic, "Good Communications Help Safety," we immediately infer that there is another kind

besides good. And there certainly is. I think there is a lot of bad and fuzzy communications going on in all fields.

Within the subject matter at hand, I would say the word *good* means that type which gets some concrete reaction and results. In the United Rubber Workers, we think our communications have been *good* because we have the results to show for it.

MUST HAVE RECEIVER

Now for the word *communications* in the phrase. You can't have communications—the *good* type that is—unless someone is sending the message and someone is receiving it. I was in the Air Force in World War II, and I served as a radio operator in the Pacific aboard a B-29 Superfortress. When I sent a message and no one received it, I didn't have communications. I was

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valve, operating from the press shaft, is used to interlock this circuit.

There are many different ways to air valve a press clutch or brake. Depending on the specific application, certain ways may

be less hazardous than others. For the in safety, other items, such as adequate guarding and interlocking, are very important and must also be given careful consideration.▲

OFF-THE-JOB ACCIDENTS

Statistics are such boresome things
And figures rather dull.
It's hundreds, millions, billions, trillions,
Over which we mull.

But facts are facts where ere we go
Regardless of amounts,
So here's some facts on accidents,
And that's what really counts.

It isn't always big machines
With blades of sharpened steel
That rob a man of arm or leg
And make his senses reel.

Nor is it always "on the job"
Most accidents take place,
But just the opposite is true
And figures prove our case.

It's carelessness in little things
At home and on the street
Neglect in moving objects small
Away from running feet.

A makeshift ladder, sliding rugs,
Electric cords that spark
A disregard for cellar stairs
And stumbling in the dark.

Crossing where no crossings are
While looking at the sky,
Driving on a slippery road
With milestones whizzing by.

These are the things that take a toll
We all should frown upon
So watch for them when off the job,
As well as when you're on.

—Humble Pipe Line Company, Houston, Tex.

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*Former General Chairman

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INCENTIVE AWARDS FOR GOOD SAFETY RECORDS IN THE MINING INDUSTRY

by JOHN McKENNA SMITH

safety engineer, Asbestos Corporation Limited, Thetford Mines, Quebec, Canada

This paper deals with the application of safety incentives at Asbestos Corporation Limited in Thetford Mines, Quebec. Awards for safety achievements have been used by this company for the past six years. This period compared to an equivalent period before the award program shows the accident experience has improved appreciably.

To attribute the improved experience solely to safety incentives would be incorrect because supervisory training and revised and improved methods have helped our accident prevention program. Nevertheless, no single feature has been more instrumental in making our workers safety conscious than safety incentives.

Asbestos Corporation Limited is engaged in the mining and milling of asbestos ores in the Thetford Mines—Black Lake district of Quebec. Some 2,000 men are employed, operating three plants with a large expansion program in progress at one of them. Each plant consists of a mine, a mill, maintenance shops and facilities for the storage and shipping of bagged asbestos.

INCENTIVE PLAN

Six years ago the safety department of Asbestos Corporation Limited examined several plans to improve the safety record of the company. If accident prevention could be constantly before the worker, the accident frequency and severity would decrease. This would lower the compensation rate, since this company operates on a merit rating basis within the rate structure set by the Quebec Workmen's Compensation Commission for the Quebec Asbestos Mining Association.

A safety incentive plan was proposed to management based on the following principles:

1. The goals for safety awards should be realistic and possible to attain by any group which would pay particular attention to accident prevention.

2. The employees should know their standing during the time the plan is in operation.
3. The awards or incentives should be distributed to as many employees as possible.
4. One group of employees should not be penalized for the poor performance of another group.
5. Tangible prizes are better than monetary awards.
6. The safety incentive plan must be understood by all employees.

Management accepted a safety incentive plan based on these principles, and it began on November 1st, 1951. It is still in operation.

I will elaborate on each principle and show how these principles were applied by our company. The success of the plan is due to strict adherence to the basic principles.

GOALS EASY TO ATTAIN

Before proposing any safety incentive plan, it is advisable to review the past experience of the company and of other organizations in the same industry. This review or survey will guide in setting objectives for safety awards.

It would indeed be unrealistic to base objectives on a yearly frequency of five lost time accidents per million man hours of exposure when your best previous frequency has been 20 and that of the industry 12. In other words examine your records and set your objectives so they may be reached by extra effort in the field of accident prevention. Do not expect miracles and do not set the objectives so high the employees will feel they cannot attain these objectives.

At Asbestos Corporation Limited, our survey of past experience and local conditions indicated that consecutive man-shifts worked without a lost time accident would

be the best basis on which to make awards. This basis had several advantages, and selection of awards will be explained later in this paper.

- a. Within our reporting or labor accounting set-up, this figure could be easily reported by the timekeeping departments daily.
- b. If a lost time accident occurs on any day during the month, it is not necessary to wait until a new period before another no-accident record can start.

The objectives were set so that once the first was reached, the group continued to amass consecutive shifts since the last lost time accident. When the second or third objectives are reached, awards of greater value are distributed.

To be more specific, groups or plant divisions are awarded safety incentives after 10,000, 25,000 and 50,000 shifts without a lost time accident. The value of the award at 25,000 shifts is approximately two and one-half times the value at 10,000 although only 15,000 consecutive shifts have been added to the total.

EMPLOYEES KNOW WHERE THEY STAND

The employees should know their relation to the objective when the plan is in operation.

This principle is extremely important in any work where an objective is being attained. Everyone is familiar with the thermometer chart used in charitable campaigns and war bond drives. For the safety incentive plan at Asbestos Corporation Limited, bulletin boards at the plant entrances or in the punch clock rooms, showed the number of consecutive man-shifts worked since the last lost time accident for each group operating as a unit. These boards are kept up-to-date daily by the timekeeping department at the plant.

MANY AWARD WINNERS

The awards or incentives should be distributed to as many employees as possible.

Several plans operate with the supervisory employees rewarded for safety records established by their workers. Other plans allow so many awards per department or per 100 employees. We distribute awards to each employee of the department or plant division eligible under the plan. The cost

By every employee receiving an award we are eliminating two employee oppositions to an incentive plan:

- a. They feel they work to establish the safety record and then the supervisor receives the reward.
- b. Many feel if their names were placed in a box and one name drawn for a safety award, their name would certainly not be drawn. In other words, they are just not lucky in lotteries.

All production and maintenance employees, the plant supervisory and clerical staff, and watchmen are eligible for safety awards. Head office staff, laboratory employees and a group at our non-operating properties are not included in the plan.

One group of employees should not be penalized for the poor performance of another group.

When setting up a safety incentive plan based on group incentives, have groups or units of employees who do the same work. The groups should not be too large. Too many employees might be penalized for the poor safety performance of a small proportion of the group. Since this is a group effort, it requires good teamwork and it is amazing to see how older employees advise new men on unsafe manner.

The breakdown of each plant for the safety incentive plan followed the main working divisions: i.e., mine, mill, shops or maintenance, and general or yard labor. Each group is a unit which operates independently in the plan. If a lost time accident occurs in the mill, it does not affect the records of other groups.

The groups are not equal in size but by setting the objectives on the basis of consecutive man-shifts worked since the last lost time accident, the exposure to injury is equal for all groups.

The objectives are the same for all groups. There were several objections to this; many employees maintained their work was more hazardous and should therefore receive a handicap. Our experience however, has shown that the equal objectives for all groups were justified. This is a point to study carefully before an incentive plan is put into operation.

It is preferable to distribute useful items as safety awards than to give the equivalent in cash. Many companies distribute individual pins, or departmental trophies. This certainly advertises the accident prevention program but a pocket knife, wallet or some small tool is a constant reminder of accident prevention. The distribution of useful items has been quite popular among our employees.

The safety incentive plan must be understood by all employees. This basic principle applies to any incentive plan initiated and operated by a business organization. When the safety incentive plan began, notices were posted on all company bulletin boards explaining its operation. Meetings with supervisors illustrated in more detail just how the plan would work. When new employees are hired, the plan is explained in the pre-employment interview.

To recapitulate briefly the safety incentive plan of Asbestos Corporation Limited: Each operating plant is subdivided into four sections which operate independently in establishing safety records of consecutive man-shifts worked without a lost time accident. When one of the following objectives is reached, 10,000, 25,000, or 50,000 and so on in 25,000-shift increments, each employee is entitled to a safety award if he has worked at least 75 per cent of the time in that section during the period the record or objective was being established. If a lost time accident occurs in a section, the cumulated man-shifts drop to zero and a fresh start is made.

SELECTING AWARDS FOR SAFETY

The selection of suitable awards is important. When employees are eligible for awards, they are entitled to the choice of one of five or six items.

The system used by Asbestos Corporation Limited entails more work and possibly has some disadvantages but it is more acceptable to our employees. If we decided everyone was to receive a flashlight or a pen knife there would be many complaints about how many our men already had; therefore, it is wise to allow a choice of awards.

The decision of the five or six items is made along the following principle: two personal items, i.e., pocket knife, flashlight, lighter; two items for the home, i.e.,

Pyrex ware, table lighters, mixing bowls; two tools, i.e., hand axe, pliers; tapes.

To illustrate the range of awards distributed over the past five and a half years, the following list for each series of awards has been compiled:

First Award (10,000 shifts)

Mixing bowls, flashlights, table lighters, playing cards, ash trays, pipes, thermos bottles, wrenches, combination squares, hammers, tinners' snips, hand axes, wrench sets, ball point pens and razors.

Second Award (25,000 shifts)

Steak knives, Silex coffee makers, bill folds, vises, can openers, casting rods, pipe wrenches, pocket watches, a cash allowance on a pair of safety shoes and First Aid kits.

Third Award (50,000 shifts)

This is reached on an average of once a year by one of the sections within the company. The awards consist of: safety footwear, flash camera, carving set, socket wrench set, aluminum chairs and in some cases, combinations of two 25,000 shift awards.

Fourth Award (75,000 shifts)

This mark has been reached once by one section. At the request of the majority of the employees in this section and with the approval of management, instead of increasing the value of the individual awards as we do for the first three objectives, each employee received an award in the 25,000 shift range and a drawing was made for two television sets, installed in the employees' homes complete with outdoor antenna.

Needless to say this created considerable interest in accident prevention throughout the company. The president, the general manager and other top company officials, were present for the drawing. The event was covered by the local press and some local correspondents for the Metropolitan dailies. When another group reaches the 75,000 shift mark a drawing for an expensive award will be made only if it is the expressed wish of the majority of employees of the section.

Anyone in accident prevention knows it is difficult to attribute improvement in safety experience to any one item. Asbestos Corporation Limited has been constantly changing and improving working methods, and

has had an active supervisory training program during the past five years. I shall indicate the improvement in the safety experience since the inception of the safety incentive plan and point out some features which might be directly attributable to accident prevention awards.

Table I is a breakdown of our accident experience from 1947 through 1956. This period was chosen because it illustrates a period of five years, 1947 through 1951, prior to the introduction of the safety incentive plan and a five year period, 1952-56, that the plan has been in operation.

Tables II and III are a compilation and average of these two five-year periods.

These records indicate an improvement since the inception of the safety incentive plan. When the compensation cost plus the incentive cost for the 1952-56 period is compared to the compensation cost alone for the 1947-51 period, we find a yearly average saving of over \$30,000, and this in a period when the compensation benefits as well as the wages were increasing.

A downward trend has started in the accident frequency, severity and costs when the incentive plan was introduced. However, it is quite definite that the introduction of safety awards accelerated the improvement in accident prevention.

TABLE I
ANALYSIS OF ACCIDENT EXPERIENCE, COMPENSATION AND
SAFETY INCENTIVE COSTS, 1947-1956

Year	Lost Time Acc.	No Lost Time Accidents	Days Lost	Hours of Exposure	Frequency	Severity	Compensation Cost	Incentive Cost
1947	232	198	5,824	4,461,293	52.0	1306	\$121,017	
1948	158	268	10,127	4,629,167	54.1	2190	32,616	
1949	102	155	16,231	3,141,106	32.5	4850	60,061	
1950	132	209	15,036	4,482,187	29.5	3350	102,688	
1951	91	215	1,602	4,361,799	20.8	367	22,914	
1952	54	199	8,492	4,148,237	18.1	2055	22,178	\$ 9,355
1953	63	203	7,742	4,062,835	15.6	1905	33,319	6,613
1954	29	232	7,781	4,177,222	6.9	1850	25,886	9,795
1955	62	267	1,542	4,387,010	11.9	353	31,262	7,575
1956	38	252	1,163	4,299,542	8.8	272	29,173	7,394

TABLE II
COMPARISON OF ACCIDENT EXPERIENCE, COMPENSATION AND
SAFETY INCENTIVE COSTS, 1947-1951, 1952-1956

Period	Lost Time Acc.	No Lost Time Accidents	Days Lost	Hours of Exposure	Frequency	Severity	Compensation Cost	Incentive Cost
1947-51	715	1,044	47,820	21,075,472	83.9	2270	\$339,296	
1952-56	236	1,163	26,725	21,069,846	11.2	1268	146,818	\$40,732

TABLE III
COMPARISON OF AVERAGE YEARLY ACCIDENT EXPERIENCE, COMPENSATION
AND SAFETY INCENTIVE COSTS, 1947-1951, 1952-1956

Period	Lost Time Acc.	No Lost Time Accidents	Days Lost	Hours of Exposure	Frequency	Severity	Compensation Cost	Incentive Cost
1947-51	143	209	9,564	4,215,094	33.0	2270	\$ 67,859	
1952-56	47	231	5,345	4,213,969	11.2	1268	29,364	\$ 8,147

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was given to this. In maintaining a safe plant, however, all three must be given equal importance.

Since asphyxia has become an increasing threat in our more complex industrial world, it behooves us all to do our utmost to com-

bat it. As industrial nurses you can do your part by learning more about the hazards in your own plant, and then by being ever ready to act immediately. By applying your knowledge and skills you may be able to restore breathing and save human life.▲

NEW TRENDS IN OCCUPATIONAL HEALTH PROGRAMS

by DR. H. GLENN GARDINER

medical director, Indiana Harbor Works, Inland Steel co., East Chicago, Ind.

The inclusion of the words "trends" and "new" necessitate establishing a base from which to launch.

To identify the subject matter, I avoid the highly technical changes in the complex field of chemistry generally and the atomic energy area particularly. The more technical phases of these special fields seldom concern the nurse and few physicians. Yet, the impact of these developments is felt throughout the industry.

Going back to the beginning trends in occupational health in 1937 we will first discuss the field of patient care. Few important medications used then are still in use today. Of course, the principles of good, clean, basic surgical care have not changed. Some antiseptics today were then new and still to prove themselves. Tetanus antitoxin was widely used, but their problem of serum sickness and various other potential allergic phenomena attendant to its use are still with us today. Immunization of large groups with booster shot follow-ups was not yet practiced.

None of our present battery of chemotherapeutic and antibiotics were then available. There were such things as antitoxins, specific antisera, vaccines of general and specific types, the mysterious bacteriophages and immunogens being used with hope, but the effectiveness never approached the success we now routinely anticipate with our medicines.

Many adjuncts of yesteryear are little used or unknown today. Similarly, the diseases they were calculated to control are

little known or rarely seen today: functional knowledge of fluid and electrolyte balance, early postoperative ambulation, internal fixation materials (metal alloys) used in bone surgery such as intramedullary pins and plates better tolerated by the tissues. Plastic and metal suture materials producing little or no tissue reaction are further examples of technical progress in traumatic surgery. Amphetamines and antihistamines have come into their own.

WORKMEN'S COMPENSATION LAWS

Secondly, 1937 was the year of legal awareness of occupational disease. For the first time industry and the business firms concerned with Workmen's Compensation were forced to take cognizance of liability for certain occupational diseases.

The big bad monster was silicosis. How well I remember the fear and consternation in Industry and Casualty Insurance Carriers of Workmen's Compensation when legislation enforced these responsibilities. So little was known about the disease at that time. The widespread industrial exposure to free silica was fantastic. Some people predicted total bankruptcy for industry and the allied insurance people. Time and reason have taken the place of fear.

Silicosis is known, but completely controllable in our modern industry by better housekeeping, improved handling techniques, substitution of safer, yet suitable materials and where necessary, the use of personal protective equipment. Management has been compelled to change its attitude or be pe-

nalized by legal action. Desirable working conditions as contrasted to minimal legally allowable conditions have many favorable aspects which pay off in the long run, both directly and indirectly.

Now occupational disease must embrace many things: the pneumoconioses, the dermatoses and the many toxic exposures. The hazard of uncontrolled exposure of lead fumes, benzol, carbon tetrachloride, beryllium, cadmium, trichlorethylene, insecticides, and now more recently radioactive materials have opened a new field for exploration.

INDUSTRY FOLLOWED LEGISLATION

With the coming of O.D. acts, people realized the need for promoting occupational health programs in industry. The existing units in city, county and state health departments were expanded—new departments were established where none existed before. Large industry found it economic to seek their help. Where the problems were great and the demand exceeded the existing facilities, some of the more foresighted industries developed their own programs.

Large casualty insurance carriers responsible for the smaller industries pursued the course of enlightened preventive medicine beyond the field of simple mechanical principles of safety. Other allied groups, dedicated to saving life and limb created or expanded such programs, notably, the National Safety Council, the American Medical Association and the Industrial Hygiene Foundation. Pre-employment physical examinations, including chest x-rays, were desirable in most industries and a must in others. Selective placement became a reality to employ certain people without liability risks to employers.

Occupational health was influenced by the effects of World War II. Even before the United States became an active participant, industry moved into high gear production-wise. The resultant attendant hazards were apparent and often resulted from constant demands for increasing quality, as well as quantity. With active war declared, governmental agencies were concerned both directly and indirectly in all plants handling war or defense contracts.

Their concern was not limited to sabotage alone, but included development of new

products and processes. Industry produced large quantities of high quality products both old and new, and as expeditiously as possible with due regard to health and safety of the people producing. With the wartime economy, programs previously considered too expensive suddenly began. The cost plus war contracts allowed the introduction of things long wanted and considered worthwhile. In the health field particularly these programs were favored.

WAR EXPANDED INDUSTRY SAFETY

With the O.D. acts and World War II, occupational health came of age and gathered momentum. The unprecedented post war prosperity has been a potent factor. The creation of new groups and expansion of old groups represented physicians, nurses, hygienists, dentists and physicians. A board of occupational health as a subspecialty of preventive medicine with public health and aviation medicine has come into being. Special training at postgraduate level is now available in a number of medical schools for special degrees certifying training and proficiency in this field.

Competition exists between the various organizations representing the interests of the professional people but it is a healthy, co-operative competition, adding to the accomplishments of each other and the ultimate goals of all.

In the field of occupational health, safety and health are inseparable. Industry has learned that it is economic to give formal attention to matters pertaining to health and safety. Large industries provide their own, small industries buy from or through insurance carriers or groups providing medical, dental, nursing, hygiene, engineering or other applicable services. More professional people are devoting part or all their time to problems related to occupational health than ever before.

Permanent impairment, time lost from work and the mortality and morbidity of occupational origin is at an all time low per unit produced. Our old problems are largely controlled, and new problems anticipated and minimized. Those escaping temporarily are soon identified, classified and dealt with. More and more the expert is called during the planning stage. By this means the recognizable hazard in the new product or process

is considered and often with great economic advantage. The delay in marketing a product after discovering an unsafe process can be disastrous. Materials or procedures can be altered when anticipating a toxic hazard of intolerable scope will occur.

CONTROL ENVIRONMENT FOR HEALTH

Environmental controls by the engineering and occupational hygiene approach in the better organized plants give attention to minute details. Not only hazards, but nuisance problems receive attention. Dust, gas, smoke, fumes and vapors which may be a community, as well as a plant problem, are seen. The very presence of these things in some manufacturing processes may indicate an inefficient or uneconomic operation, and correction would serve a multiple benefit. Also, under this general program are food available to workers, its preparation, handling and disposition in a safe, clean, appetizing manner, a place to eat, and garbage and sewage disposal in a safe and acceptable fashion.

Water pollution is often a greater problem than air pollution. The sportsman and the nature conservationist, backed up by laws, keep us alert to the dangers and damages of polluting lakes and streams. Sanitary facilities, bath water, drinking water, salinized as a convenience if general plant area is hot and pest control, should not be overlooked in the area of environmental control.

The rapid developments in chemistry and physics are almost beyond comprehension. Competition brings almost a daily announcement of an improved product, something that will do more for less and easier. With this comes the problems of employees' danger in toxicity of products, its basic components, its by-products, its production techniques, and also the hazard to the community, the ultimate consumer, the consumer's neighbor and customers. Here we are talking about the present day insecticides, the solvents, i.e., hydrocarbon derivatives such as in the rubber and synthetic rubber industry, and the radioactive materials. Geiger counters are now as commonplace to the hygienists as was the impinger a few years ago.

More pre-employment physical examinations are being carried out. Fewer injuries per unit produced are encountered. Earlier

treatment and new techniques with present medications hastens healing with less production time loss and less permanent impairment residual. Union Health Centers are daily assuming a more important role in the health matters of the worker, his family and the community.

Far more nurses are employed in industry and their presence and proper functions are better understood and supported by management. The need for their collaboration with the physician responsible for the plant health program is soundly established, but not practiced as closely as desired in many instances.

EDUCATION AIDS O.D.—

With the advent of visual aids in training and safety programs, we have the most advanced media for health education purposes, for on-the-job and off-the-job activities. These messages relate not only to the employee, but the various members of his family. Perhaps more familiar are the health messages presented through payroll envelope inserts, bulletin board and various magazines, newspaper and other media. The trend is increasing utilization of services through effective application of expert knowledge in a broadening and growing field of specialization.

TWENTY YEARS INCREASED PROBLEMS

Are all of our problems solved? Not by a long way. Automation and industrial research and progress generally will see that this does not occur. The effects and effects upon emotions and morale may create problems not easily solved. This has increased the need for nurses, psychologists, physician and other specially trained personnel. The newer drugs termed "tranquilizers" have proven helpful when used judiciously.

Now 20 years after the O.D. furor of 1937 are we facing a problem of similar size and similar concern? Strangely and coincidentally we are. Noise and occupational deafness right now is a very major concern of many industries, businesses and casualty insurance companies, similar to the near-panic from the early version of silicosis.

Recently we learned a great deal about noise and its harmful effects on human hearing. There is still a great deal to be learned. Some of the early hysteria is abating. Rep-

representatives of joint committees of medical specialists and others are releasing conclusions on the basis of present knowledge for guidance. We can not yet say with reasonable certainty some of the things that must be said and sustained before legislation amends the Workmen's Compensation Laws.

Workmen's Compensation is a means of providing a cost of living during periods of disability due to occupational illness or injury and to offset the loss of future earning capacity (based on past experience of the individual) of a person permanently impaired by occupational illness or injury. Some states still provide little or no remedy under the law for the employee, and there is a great disparity between benefits provided in the states. Due to the lag in our legislative system, no state provides adequately and probably never will unless a more practical, flexible, realistic, applicable formula is legislated to follow the constantly changing cost of living.

Amendments to Workmen's Compensation acts in recent years have done little to improve the situation. In addition, the interpretation of the existing acts by politically qualified, but otherwise unqualified representatives, have led to widespread abuses which embrace the creeping socialism

so despised in principle by many of us. There is no doubt that there are many people deserving of help from public funds, yet this scarcely constitutes reason for calling upon Workmen's Compensation benefits at the immediate expense of industry to pay compensation for conditions not even remotely related to the man's job, simply because there is presently no other place wherein money can be made available to him. Industry has been and continues to be the whipping boy of our inadequate social system as it exists today in the legal sense.

We must say something to discourage complacency, carelessness and the indiscriminate use of wonder drugs, including tetanus antitoxin, the sulfas, penicillin and its derivatives and all the other chemical and antibiotic preparations. They are two-edged swords. There are definite indications for their use and definite contra-indications, and also a broad area of uncertainty where good judgment and experience must be relied on. To date we have no reasonable substitute for experience. The indiscriminate use of these drugs is reprehensible and at times approaches criminal. The potential of mishap, sensitivity, etc., is great and must not be taken lightly. As a rule when in doubt, don't. Make your mistakes on the safe side.▲

SOME CURRENT ASPECTS OF MEDICAL QUACKERY

by OLIVER FIELD

director, Bureau of Investigation, American Medical Assn., Chicago

In discussing the subject of "Some Current Aspects of Medical Quackery," it is perhaps advisable to consider the present status of pretension to medical skill in the light of what has gone before, particularly during the past half-century.

The Bureau of Investigation has been functioning for more than 50 years as a clearing-house of information on matters in this category. The Bureau was started as a department of the *Journal of the American Medical Association*, partly because of the zeal of the young physician

who, soon after graduation from medical school, came to work as an editorial assistant. But his own personal experience caused him to begin a crusade of exposure of the evils of quackery and the venality of a large segment of the "patent medicine" industry.

At about the time this physician arrived as an employee of the American Medical Association, the Congress passed the first Pure Food and Drugs Act. The examples that we have of "cures" and products and their labeling in those days illustrate the

changes that have come about, particularly by the passage of the 1938 Federal Food, Drug and Cosmetic Act.

NO INFORMATION SOURCE

Before the passage of that Act, which, among other things, requires the revelation of the active ingredients on the retail label, there was no source except perhaps the Bureau of Investigation to furnish the medical profession and the public the information. Books, pamphlets, and reports in the *Journal* itself constituted the media whereby Dr. Arthur Cramp did his very effective work.

Before the discovery of insulin by Banting and Best of Toronto, there were a good many diabetic quacks. Their principal products were diuretics. Their claims were broad, their performance woefully inadequate.

Today, however, it is in the field of cancer that the particular interest of both the public and the medical profession lies. In a period of 10 months we counted, in a little more than 4,000 inquiries, more than 1,000 on the subject of cancer "cures" and treatments.

The example that we have here, particularly the Hoxsey cancer treatment, and examples of the methods of promotion, make it evident that over the years the quack has learned by experience that he is ever so much more effective when he hides behind religion and when he sells the public on the claim that he is a martyr to medical persecution.

FEDERAL GOVERNMENT HELPS

The federal government, in the agency of the Food and Drug Administration, has sought for several years to stop not only Mr. Hoxsey, but others, one of whom is particularly known in Vancouver, namely Dr. William F. Koch, who began his promotion from Detroit in 1919.

Although Dr. Koch has been ordered by the Federal Trade Commission to cease advertising that any of his preparations has

any value in any disease category, his successors, the Christian Medical Research League of Detroit, continue to sell "Glyoxylide" for \$25.00 for a 2 cc. ampule. Glyoxylide is labeled to be a one in trillion aqueous dilution of several alleged ingredients. It is not at all surprising that no chemist has been able to find anything in the ampule but water.

In other fields the quack capitalizes the advancements of science. We have, for example, the products alleged to be radioactive, which originated in the United States at least, in the mid 1920's. These were sold as rejuvenators and "cure-alls." Some had no radioactivity whatsoever, others were dangerously radioactive. The modern application is the uranium-mine promotion. This has had the benefit of publicity and large patronage in Montana, California, and several other states.

The same is true of the radio. When the radio became popular in the 1920's, a California physician, Dr. Albert Abrams, announced his "E.R.A."—Electronic Reaction of Abrams—claiming that he could diagnose from a drop of the blood, and that a disease had "vibratory" rates. Abrams had many imitators, among whom was a chiropractor in Los Angeles named Ruth Drown. Dr. Drown claimed, also, that she could diagnose from a drop of the blood, but failed miserably when put to a test before a committee of scientists at the University of Chicago.

There are many other categories in which the quack flourishes—in the field of reducing preparations, arthritis and rheumatism cures, rejuvenators, the special dietary food and the cure-all gadgets. It was Voltaire who said that the quack was born when the first knave met the first fool. The Bureau of Investigation has never accepted that as an adequate definition, feeling that if the person had some knowledge, it would be more difficult for the quack to fool him. That is the premise upon which the Bureau has operated, and hopes to operate in the future.▲

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Assistant General Chairman

ization of the necessity to analyze more completely?

Does this mean that employees don't take specific action because they don't analyze properly or because their evaluation of the hazard leads them to believe that nothing much serious can happen to them or because they think they might be censured for being too cautious or taking too long to do a job?

These are some of the questions for which we are now seeking some answers. We don't have them yet, but we are working on them.

OFF-THE-JOB ACCIDENTS

Statistics are such bore some things
And figures rather dull.
It's hundreds, millions, billions, trillions,
Over which we mull.

But facts are facts where 'er we go
Regardless of amounts,
So here's some facts on accidents,
And that's what really counts.

It isn't always big machines
With blades of sharpened steel
That rob a man of arm or leg
And make his senses reel.

Nor is it always "on the job"
Most accidents take place,
But just the opposite is true
And figures prove our case.

In conclusion, we feel that our serious injury index is a step forward in accident prevention activities. It has helped us refocus our sights on the goal of preventing injury rather than solely on the prevention of loss of time from work. It may not be the ultimate solution to the injury prevention problem, but it is a step in the right direction. In addition, the use of the Operation Research group adding its time, efforts and talents to the safety problem has been productive and will be more so in the future.

It's carelessness in little things
At home and on the street
Neglect in moving objects small
Away from running feet.

A makeshift ladder, sliding rugs,
Electric cords that spark
A disregard for cellar stairs
And stumbling in the dark.

Crossing where no crossings are
While looking at the sky,
Driving on a slippery road
With milestones whizzing by.

These are the things that take a toll
We all should frown upon
So watch for them when off the job,
As well as when you're on.

—Humble Pipe Line Company, Houston, Tex.

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are to work, in company with their foreman, who would point out the safe and efficient way to do the job.

The foregoing orientation and safety education program is obviously not suggested for boomers or drifters who will hit the road with their first paycheck. Rather it is intended for the "home guards" who can be expected to stay on the job long enough to justify the time and money expended on them. It would be followed up at intervals with evening safety education sessions, using audio-visual aids.

Since the average 20 to 24 minute film teaches more lessons than can be absorbed, combining the running and re-running of short sections of a training film with the discussion-conference technique, is advocated. As an example, the

Rarig Motion Picture Company of Seattle reproduces the sound-color film "Hill Loggers" which they made for the Columbia, Pacific Northwest and the Wood Loggers Associations, in six 15 minute sections. They publish a film of questions and answers for each section and a "Conference Leaders' Manual" to accompany the films.

The small operation, or the one in which new men come singly, presents more of a problem. However the same objectives of orientation and safety education, accomplished by individual instruction, rather than group sessions, can improve labor relations and promote woods safety. This is only a preliminary to the most important on-the-job training under a safety-minded supervisor. ▲

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This terminal is at Meadville, Pa., where I am chairman of the division superintendent's safety committee. (All such activity on the railroad comes within the jurisdiction of our superintendent of safety). There are 400 employees in 16 sub-departments that are contacted each month at 12 locations where they can be readily assembled. The committee is made up of the top departmental heads of the local operations.

PROGRAM SET-UP

The chairman sets dates for meetings and notifies the members, as well as sends notices to all departments for bulletin board posting. The notices carry the time for the meetings and the subject matter to be considered. Diversified material is used; however, only one subject is taken up each month, e.g.—

Review of preceding year's safety posters.
Checking on safety rule books and their usage.

Proper clothing and health protection.

Thanksgiving, Christmas, New Years, or any special holiday can provide suitable topics for safety talks, as well as the seasons of the year, vacation, school opening, etc.

Once a year a motion picture on safety is shown and the following month a discussion on the film creates interest.

Every possible angle that can be used to keep a fast-moving, 20-minute, safety meeting on the chosen subject is employed to create human interest.

Near the close of each sub-departmental meeting, a short discussion period is held for a status report on items brought forward from preceding month's meetings. Additional items requiring attention are elicited and only safety items that cannot get immediate correction are considered for

the summary report given to the division superintendent. Handling in this manner, the list of items is kept to a minimum and include those requiring further study and in a few instances require appropriations which must be approved before corrections can be made.

DIVIDED INTO GROUPS

The functioning of the committee is simple. Ordinarily there are 12 members who make the rounds and this number is divided into three groups of four members each, referred to as Groups A, B, and C. All members present themselves at the first location. Immediately with the start of this meeting, or the subsequent meetings, Group A moves forward to the next location to assemble employees and introduce any preliminary feature or arrangement in anticipation of Group B.

The talk or message is handled by Group B as are the discussion periods. Instances where more time is required than the scheduled 20 minutes, Group C stays on to clear up safety items that become involved during the discussion period. The success of the meetings depends greatly on a functional and well-balanced schedule, and the dividing-up of the Committee into the three groups has been very effective.

The primary objective of the work of this committee is to encourage employees to actively participate in the safety program to correct the causes of accidents, and help correct unsafe practices and conditions regardless of department which becomes involved. In this safety promotional work, maintenance of equipment and stores operations are so involved with the safety of every department that it is felt greater benefits are obtained through a committee representing all operations. Possibly this procedure would be of value at other railroad terminals.▲

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trol. Once a year on the last Sunday before July 4, a "Safety Sunday" is held in the state. In cooperation with the Oklahoma City Ministerial Alliance, the Highway Patrol prepares a kit of sermons, talks, messages and other material which is distributed to clergymen and others who take part in "Safety Sunday." This effort is non-sectarian and highway patrol officers give sermons on traffic safety on this day.

Clayton Hess of the California Highway Patrol described the California program to combat drinking and driving. A special program each December is aimed at curbing the dangers resulting from Christmas office parties. A variety of material is prepared including posters, leaflets, and special attention-getters such as a reaction timer.

Warren Taylor, health and safety dept. manager for the U. S. Junior Chamber of Commerce, discussed a project conducted by a Jaycee chapter in which a newspaper offered a prize to any driver who could stop his car within 50 feet traveling at 35 m.p.h. The challenge was printed in the paper under a picture of burned tire marks on a pavement. Taylor reported that no one claimed the prize.

Thomas C. Hempfield of the Mansfield (Ohio) Police Department described a police-sponsored, city-financed "Safety Town" for pre-school children. Children are taught traffic safety both in classrooms and in a miniature "town" with streets, sidewalks, traffic signals and markings.

P. W. Graves, safety inspector for Continental Motors Corp., Muskegon, Mich., described his company's traffic safety program which includes bulletin board or carton cards, outdoor posters for parking lots, place mats in the company restaurant and full-page ads in the local newspaper.

Dan Hollingsworth, director of the Oklahoma City Safety Council, told of the publishing and distributing of a traffic manual in Oklahoma City.

Linda Shuler described a television program called "Aftermath" which has a great deal of interest in Dallas. The program takes an actual traffic case and dramatizes it using real people, real judges, police, rather than actors.

W. J. Sturm of Hardware Mutual, Stevens Point, Wis., described a traffic safety project held in Stevens Point with the cooperation of the local taxi cab company. The cabs carry white flags with Green Cross for Safety. If an accident occurs anywhere in the city, all the cabs carry a red flag for 48 hours. If a second accident occurs, the cabs fly a black flag for one week as a constant reminder to the community.

Mark Markson, Minnesota Highway Dept., told of a summer camp maintained by the American Legion for the training of patrol guards. Both boys and girls can attend a one week course at the camp which is fully equipped with camping facilities.

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