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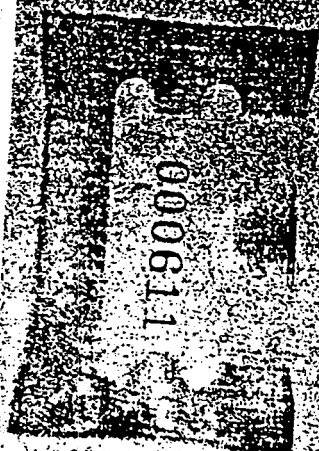
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VOLUME 1 OF THE TRANSACTIONS
55th NATIONAL SAFETY CONGRESS

(October 23-26, 1967, Chicago)

Papers Delivered in the

GENERAL SESSIONS

(With List of Exhibitors and General Index)

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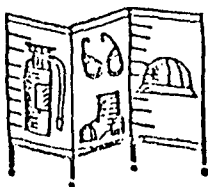
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1969	October 27-30
1970	October 26-29
1971	October 25-28
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National Safety Council

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ANNUAL COUNCIL MEETING

INVOCATION

By RABBI MORDECAI SIMON

Executive Director of the Chicago Board of Rabbis

Almighty and Eternal God:

Inspired by your ethical and moral teachings, we have come together to reflect upon our progress to this time and to consider the tasks still before us.

As citizens of a nation dedicated to the Fatherhood of God and the brotherhood of man, we are charged to do justly, love mercy and to walk humbly with You; to extend compassion, understanding and aid to the perplexed and sorely-tried; to love our neighbor as ourselves.

To these humanitarian heights has the National Safety Council dedicated itself through its noble aims and purposes of constantly working, studying and planning for means that will result in the extended health, welfare and education for all.

To these noble ideals, we pray, may we ever remain faithful, as we develop a continuing sense of dedicated commitment to this organization, our respective professions and those we serve, a commitment which both elevates and ennobles.

We beseech Your blessings upon all who have affiliated themselves in the attainment of these common objectives. Endow them with the knowledge, wisdom and guidance necessary for fruitful leadership and success in the attainment of these goals . . . Inspire us to labor zealously and unflinchingly for the perpetuation of the American way of life.

Guard our country from iniquitous designs, intolerance and blind prejudice. Keep our borders free from every enemy, both from within and without . . . Grant us clear minds so that we may approach the problems of our day with forthrightness and unselfishness . . . Spread Your tabernacle of peace over all the nations of the earth.

May the work of peace be righteousness, and its effect, freedom from fear and want for all men. *Amen.*

Penalties.

Penalties of both a civil and criminal nature are provided for in the Act.

A civil action for preventive relief, including an application for a permanent or temporary injunction, restraining order, or other order, may be instituted by the Secretary in the district court of the United States for the district in which the mine in question is located or in which the mine operator has its principal office, whenever an operator (1) violates or fails or refuses to comply with any order of withdrawal and debarment, or (2) interferes with, hinders, or delays the Secretary or his duly authorized representative, in carrying out his duties under the Act, or (3) refuses to admit an authorized representative to a mine, or (4) refuses to permit the inspection or investigation of any mine, or of an accident, injury, or occupational disease occurring in or connected with a mine, or (5) refuses to furnish any information or report requested by the Secretary.

Upon conviction, persons may be punished by a fine of not less than \$100, or more than \$3,000, or by imprisonment not to exceed sixty days, or both, where (1) there is a violation or failure or refusal to comply with an "Imminent Danger Withdrawal Order," or (2) there is a violation of a mandatory standard and failure or refusal to comply with an order of abatement if the failure to comply with the order of abatement has created an "imminent danger", that is, a danger that could cause death or serious physical harm in such mine immediately or before the imminence of such danger can be eliminated.

These criminal penalties have a peculiar twist to them. In Senate Report No. 1296 the Committee stated—

"Section 14(b) . . . makes mine operators liable to criminal penalties (fines of \$100 to \$3,000 and imprisonment for up to 60 days) upon conviction in Federal court of one specified offense. This offense is: violation

of, or refusal or failure to comply with, an order of withdrawal and debarment, if, at the time the order is made, a danger exists 'that could cause death or serious physical harm in such mine immediately or before the imminence of such danger can be eliminated.'

"These criminal penalties do not apply, therefore, to a mine operator who has been given a notice fixing a time limit for abatement of a violation of a mandatory health or safety standard, who has failed to abate the violation within the time allowed, who has then been given an order of withdrawal and debarment, and who has then violated, failed, or refused to comply with this order—unless his failure to abate the violation has created an imminent or immediate danger of death or serious physical harm by the time the order of withdrawal and debarment was issued."

Thus, it would seem that an offense has been committed if between the time of issuance of a notice of abatement fixing a time limit within which to abate, and upon the expiration of the time, the failure to abate the violation of a mandatory standard has resulted in a condition of imminent or immediate danger.

The Act was effective on September 16, 1966; however the provisions with respect to issuance of "Imminent Danger Withdrawal Orders" and "Elapsed-time Withdrawal Orders and some of the penalty provisions do not become effective until one year after the date of publication of notice in the *Federal Register* of the designation of mandatory standards.

The meanings and interpretations of the Act in many respects will have to await the time when we are faced with actual situations and circumstances which undoubtedly will arise after the Act becomes fully operational. Some questions and disputes may not be entirely clarified or decided until cases are heard and decided by the Board of Review and by the courts.

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1967 National Safety Congress

problems. Invite them, seek them, get them to come to you. Be approachable.

9. Have a trial period, followed by a careful re examination by all people concerned.

Helpful Hints for the Successful Supervisor.

The five most important words of a supervisor are, "I am proud of you."

The four most important words of a supervisor are, "What is your opinion?"

The three most important words of a supervisor are, "If you please."

The two most successful words are, "Thank you."

The one most important word is, "You."

The least important word is, "I."

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55th NATIONAL SAFETY CONGRESS

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IMPORTANCE OF DUST CONTROL

By HENRY N. DOYLE

Assistant Chief, Division of Federal Employee Health,
U.S. Public Health Service

One could dispose of the assigned topic in a very short order by stating that dust control serves two primary functions—disease prevention and explosion control. I would assume, however, since you have asked me to discuss this subject that you are anticipating a much more philosophic treatment and, because of my background, your interest is in the health aspect.

If we are to view this problem from the philosophic viewpoint, three factors must be considered: The biology of man, our present state of knowledge, and our social concepts.

First, let us look somewhat superficially at the anatomy of the respiratory system. Man's respiratory system evolved to handle a relatively pure mixture of oxygen, nitrogen, and the noble gases. However, to protect the lungs from the natural contamination of the atmosphere, such as wind-blown dust and pollens, several protective mechanisms developed. The nose became prominent and was filled with many small hairs to serve as a filter device for particles as small as 5 microns. The respiratory tract between the nose and the major branches of the lungs developed fine hairlike structures which served to trap the dust particles and, by means of a continuous upward motion, to reject through the nose or mouth. Finally, if a dust particle penetrates these defenses, the lung tissues were equipped with phagocyte cells which engulfed the dust particle and removed it from the sensitive area.

Thus, man is equipped to live in an environment which nature planned many eons ago. When the natural defenses of the respiratory tract are broken down, the lung finally becomes a physiological dust trap. The miracle is that man can survive in today's environment which is vastly different from the environment which nature planned.

Each of us who live and work in an urban area suffer a constant insult and an overload on the respiratory system due to man's contamination of the atmosphere. Superimposed on the technologic contamination of the atmosphere with particulate matter, man further insults his respiratory system by smoking which is known to destroy the cil-

iary and phagocyte systems, thus increasing the risk resulting from exposure to industrial dust and atmospheric pollution.

Those of us entering the 5th and 6th decades of life represent the first generation to be exposed to a continuous complex technologic contamination of the general atmosphere, coupled with the almost universal practice of smoking. Thus, it should be a shock to realize that respiratory diseases assuming a more prominent place in the nation's morbidity and mortality pattern. Chronic bronchitis, emphysema, most forms of lung cancer, and certain forms of correlative heart disease all result from the deposition of particulate matter in the lungs. In those exposed to industrial dust, the hazard is intensified and extended to other diseases such as pneumoconiosis and heavy metal poisoning.

Although epidemiologic evidence is lacking, observations tend to support the conclusion that respiratory diseases other than classical occupational ones are more frequent among workers exposed to industrial dust. That massive dust concentrations over a prolonged period destroy the natural defenses of the respiratory system thus leaving the lungs susceptible to infections and non-infectious diseases is no longer a debatable question.

From this point on, we shall have to confine our discussion to the classical occupational dust diseases since this is the area where our epidemiologic techniques are sufficiently sophisticated to demonstrate a causal relationship. Historically, this relationship has been known by observation for over 3,000 years. However, it has only been within recent years that we have been able to place this relationship into biologic perspective. It took the work of many investigators to ultimately arrive at the five cardinal factors involved in the production of dust-induced diseases, although in retrospect it appears to be simple relationships. These factors are:

1. The size of the dust particle must be such that it will penetrate the respiratory system—generally less than 5 microns.

2. The dust must contain a toxic component; for example, silica or one of the heavy metals.
3. The concentration must be sufficiently great to overcome the body's natural defenses.
4. The exposure must extend over a long period of time.
5. All individuals do not react alike. Some have greater resistance to the disease processes than others or, conversely, less resistance.

Only within recent years has this relationship been taken one step further and developed into a mathematical one which says that given a toxic dust of less than 5 microns, disease is then the product of time and concentration, or D (disease) $= T$ (time) $\times C$ (concentration). The formula, of course, has several disadvantages, the foremost being that disease has no definable starting point and, because of the factor of individual susceptibility, would apply to large groups rather than to individuals.

Given a large population and using an arbitrary diagnostic sign as a reference, it should be possible to develop a definable biologic relationship between time of exposure and the concentration of toxic materials. If such a body of knowledge existed, it would be possible to inform a miner after x particle years of exposure that further work in the mines may endanger his health; that after $x + y$ particle years, he has a certain risk of developing pneumoconiosis; and, after $x + z$ particle years, his chance of developing pneumoconiosis is almost 100%.

I trust that the above will always remain in the realm of fantasy for the record-keeping job would be stupendous. Nonetheless, we have come perilously close to such a system on several occasions especially in those areas where environmental controls were neglected.

The formula $D = T \times C$ is generally used by the industrial hygienists in setting maximum allowable concentrations. Ideally, the product of $T \times C$ should be zero. However, under practical operating conditions, this is not possible. Therefore, time is fixed in accordance with man's normal working span and the concentration is adjusted in accordance with the relative toxicity of the dust under consideration. Thus, prevention of the dust diseases becomes a function of controlling either the time of exposure or the concentration of the dust or reducing the

production of the two to an acceptable level.

The traditional method of control in the mining industry has been to limit the concentration of the dust by certain accepted procedures, such as ventilation and the use of dust suppressants such as water.

A recent study of the Public Health Service has demonstrated that a significant number of bituminous coal miners have a disabling respiratory disease commonly referred to as "coal workers' pneumoconiosis." Many questions remain to be answered especially regarding the etiology of the disease. That dust has a significant role in its etiology is unchallenged. Although a similar disease has been known in the anthracite industry for many years, a review of the literature would indicate that the prevalence of pneumoconiosis in the bituminous industry was not very great until about 1950.

The signs and symptoms of the disease are so obvious that it is difficult to accept the concept that the apparent increased prevalence is related to improved diagnostic techniques. However, the apparent increase and prevalence may be related to the increasing use of mechanical equipment underground. Unfortunately, very little data is available which would permit a comparison of dust conditions before and after mechanization.

It is possible that many coal mines may have reached the ultimate in dust control with existing ventilating systems and mine layout. To change either of these factors requires a large outlay of capital which possibly cannot be equated with production gains. Thus we have reached the point where other methods of dust control will be necessary. Certainly the industry has not fully explored what can be done through alterations in machine design. Coal cutting and removing machines were designed to obtain the maximum tonnage in the shortest time period. Another design criteria needs to be added—with the minimum dust production.

All efforts to date have been directed at reducing to a minimum the value of C in the equation $D = T \times C$. The cost of accomplishing this reduction to an acceptable level may prove to be inconsistent with economic returns. Should this prove to be true, then efforts will have to be made to reduce the T factor in the equation. This can be accomplished in one of three ways:

1. By complete automation.

2. Limiting the work time of underground employees.
3. By providing the underground worker with an artificial environment.

Complete automation does not appear to be feasible at this time although great strides are being made to reduce the number of men underground. For obvious reasons, the principle of job rotation to reduce exposure time has never been acceptable to labor or management.

The provision of an artificial environment has the ring of an exotic method applicable to the exploration of space. In actuality attempts have been made to create such an environment by the use of air filtering devices which fit over the nose and mouth. Such devices, generally referred to as respirators, have certain inherent disadvantages such as discomfort, breathing resistance, and communications interference. For these reasons, labor and management as well as the health profession have developed an inanity regarding the potential use of protective equipment.

It is difficult to accept the concept that a total life support system can be provided for a man in space but that we are unable to design a life support system for a man in a hazardous underground environment. It is possible that a major obstacle may be our image of a coal miner. It is difficult to visualize a coal miner looking like anything other than a coal miner. To accept him with the appearance of a scientist or a technician is almost an impossibility.

So far this presentation has avoided a discussion of a hygienic standard for bituminous coal dust. Such a value does not exist in the United States for exposure to bituminous coal dust and until such a standard is developed, the C value in our equation has no significance.

Bituminous coal until recently was considered a nuisance dust and, as such, the ACCIII value of 50 million particles per cubic foot (MPCF) was applicable. Epidemiologic studies have not been conducted in the United States which would permit the establishment of hygienic standards for bituminous coal dust. Research in the European countries tend to support a respirable mass standard rather than one based on particles per unit volume of air. The mass standard which expresses dust concentrations in milligrams of dust of less than 5 microns per unit

volume of air has a number of advantages over the particle number standard.

Limited observations show a correlation between the weight of dust deposited in the lungs and disease conditions whereas such correlation has been possible with particle number. In using the mass sampling method, dust evaluation is much simpler and instrumentation permits the determination of individual exposures. Most of the European countries are moving toward a mass standard which will likely be in the magnitude of 1 milligram per cubic meter of air.

Only since about 1935 has society in this country recognized that it has a responsibility to those who have developed dust diseases through their occupation. Medical compensation was a shocking concept many when it was first adopted. To others the inadequacies of our first compensation laws for the dust diseases was appalling. Another three decades our present concept of compensation may be viewed as archaic. European legislation which has established the precedence for workmen's compensation in the United States is tending toward more liberal benefits for workers with pneumoconiosis.

The principle of partial disability is well established in most Western European countries. In the United States the worker affected by a dust disease is often in a less favorable position than a person disabled by an accident or other occupational disease. In many of the laws the time limits that apply to the length of exposure, to manifestation of the disease, and the filing of claims are too short to take into account the slow maturing nature of dust diseases.

Principles for compensation of the dust diseases have tended to remain in a fix and rigid pattern based on knowledge that at least a quarter of a century out of date. Such procedures have resulted in practices that are frequently unfair to both parties. Rigid administrative requirements and the concept of compensation for only the totally disabled has doubtlessly been unfair to the workers with bona fide cases of occupational pneumoconiosis. On the other hand, so courts in an attempt to overcome certain administrative limitations have probably been too liberal in their interpretations.

It is my personal opinion that unless occupational pneumoconiosis compensation laws are modernized, we may face many new problems

administering a just and fair system of compensation for the dust diseases. Some of the factors which need to be considered are:

1. A better definition of those disease conditions which are caused by the inhalation of dust.
2. Full recognition of the delayed development of the disease process.
3. Compensation payments based on the degree of disability rather than radiological appearance.
4. Removal of the last employer responsibility concept.

In the last two decades our fundamental knowledge of the dust diseases has pro-

gressed further than in all of the preceding centuries. Despite this, the dust diseases continue to be our most costly occupational diseases in terms of morbidity and compensation costs. The greatest reservoir of pneumoconiosis is in the bituminous coal industry.

Despite these advances in knowledge, our preventive techniques have not materially changed in the last quarter of a century. The total elimination of this disease for which we have both the engineering and medical tools represents a great challenge to this profession. However, if the job is to be done, new concepts of prevention and control must be investigated.

WHAT THE COAL INDUSTRY IS DOING TO CONTROL DUST

By GEORGE L. JUDY,
Executive Vice President
Bituminous Coal Operators' Association

The emerging of mechanical mining of coal in the United States, coupled with all the publicity today on air pollution, has brought the problem of dust control to the focus of the mining industry's attention. This problem has been accentuated by the application of the more modern methods of coal recovery by continuous and longwall machinery and by the increase of rock drilling for roof bolt installation.

The industry has recognized this situation with appropriate gravity and has taken steps to apply and advance the technology of dust control. In light of our present limited knowledge of the effects of inhalation of various concentrations of dust over long periods of exposure, current control measures appear to be successful. Should further studies prove that lower dust concentrations are necessary for a healthful atmosphere, the industry will meet those standards by improving current control measures or by developing new technology.

Such studies are now being undertaken jointly by the United States Bureau of Mines and the Public Health Service of the Department of Health, Education, and Welfare with the cooperation of the mining industry. Representatives of the member companies and staff of the Bituminous Coal Operators' Association serve officially as advisors to the

government agencies involved in this project. Member companies are making available their facilities for dust surveys under actual mining conditions.

The industry has, if for no other reasons than increased comfort and safety through better visibility, applied a wide-range of dust control methods and devices. Stronger measures are being employed or tested where silica dust is involved or where bituminous dust is created in undesirable concentrations.

Silica dust is being controlled effectively by wet drilling or vacuum collectors used with rock drills. Improved cutting bits have simplified these methods of control and the acceptance by workmen of the use of respirators generally has been realized by the publicity given to the recognizable problem of breathing silica dust.

Rock dust standards have been strengthened by the lowering of the allowable limit of free and combined silica content from 25 percent to 5 percent. Reduction of exposure to silica dust has been helped by the employment of conveyor belts and rubber-tired vehicles for coal haulage and for man trips. All told, the industry has found and is applying the means to control the silica dust encountered in coal mining.

The problem of controlling coal dust is, on

the other hand, more complex, preparation, and is confused by the fact that the breathing of coal dust has not been positively recognized with respect to its contribution to respiratory or circulatory ailments. Constant effort is being made to find means of producing less dust in the mining operation and to abate, divert or collect the dust that is produced.

In conventional mining, the use of properly situated high pressure water sprays, in which the use of additives is sometimes beneficial, has brought about a considerable reduction of dust at its primary sources in drilling and cutting. Water-filled PVC bags for stemming blast holes, improved coal shooting techniques, and direct application of fine mist or fog sprays have proven effective in abating dust at its primary source in blasting. Secondary dust sources such as loading and transferring coal also can be controlled by sprays, and roadway dust where a problem by wetting or application of calcium chloride.

One large mining company which began an intensive study of dust resulting from conventional mining upon its introduction in the middle 1930's conducted dust surveys which showed concentrations ranging from 96 to 227 million particles per cubic foot without the use of water sprays during the loading cycle. With the combined use of wet drilling, compressed air blasting, "bug dusting" units and sprays on cutting machines, sprays on loading machines and at transfer points, roadway sprinkling and salting, and with normal ventilation, typical concentrations in million particle per cubic foot were reduced to 14.29 for undercutting and shearing, 9.25 for drilling, 9.49 for blasting, and an average of 7.89 for shuttle car loading, tramping and dumping. This compares with concentrations of up to 268 mp/cf for hand-loading operations in the same seam.

Continuous mining normally results in the production of more dust and longer periods of operator exposure. Here, the methane liberation rate frequently dictates the use of auxiliary face ventilation with its attendant benefits of dilution and prompt removal of dust. Exhausting auxiliary ventilation systems are more inefficient and are less effective for gas removal, but are advantageous for dust removal in that the air current is away from the operator. This has been remedied in various ways, either by use of both exhaust and force tubing situated on oppo-

site ribs with the exhaust inlet in by the blower discharge or by the use of a force fan mounted on the machine but operating exhausting with respect to the direction of air flow.

The most sophisticated innovation for environmental dust control is the cryogenic breathing apparatus which is being tested by a major coal producer for use by continuous miner operators. The prototype device consists basically of a portable cryogenic storage vessel bracketed on the machine together with a heat exchanger and a quick-disconnect-coupled delivery hose to a breathing mask fitted with a demand type regulator. The quick disconnect and 5-foot length of hose give the operator freedom of movement and exit.

The portable storage vessels are filled on the surface from a blending tank into which liquid oxygen and nitrogen are fed in proper proportions. When charged fully to 35 psi, the vessels weigh 28 pounds. They measure 7 inches in diameter and 23 inches in length and are equipped with a pressure gauge and control valve.

Other methods of providing dust-free air at comfortable temperatures to continuous miner operators such as by low-pressure compressors or scrubbers are being explored. None of these devices has had sufficient tests to merit complete evaluation especially in light of the unknown degree of the physiological affect of breathing bituminous coal dust.

Longwall mining sometimes introduces significant concentrations of coal dust into the air stream in which certain crew members are exposed. Encouraging results in suppressing such dust by high-pressure infusion of water in advance of the longwall face have been experienced at the No. 20 Mine of The Carbon Fuel Company.

Water infusion and other means of wetting and of collecting dust do have the additional benefit of reducing the possibility of dust being raised in the atmosphere in explosive amounts. Auxiliary ventilation, except where dust can be effectively collected or diluted at the end of the tubing, does not have this feature, and where it is necessary to maintain high velocities, float dust will be carried for considerable distances in return airways.

Suspended float dust and precipitated accumulations can be rendered in explosive by the use of trickle dusters which introduce

enough rock dust into the return air stream to dilute the coal dust to an inert mixture. This has the advantage of continuous protection and obviates the need to reapply rock dust in back entries.

Some coal dusts are particularly difficult to wet without the use of additives or increased temperature to lower the surface tension of the water. The principle of increasing the water temperature to improve "wettability" has been used with outstanding results by at least one major company for special applications such as transfer points in tipples and in a long inclined surface conveyor tunnel. They have found that steam jets at critical transfer points will suppress the dust effectively through all subsequent transfer points including final rail loading. There is, however, little encouragement that steam could be used practically in underground coal mines.

Increased ventilation in the last open breakthrough and at the face is still the most common means of combating air-borne dust. This is largely because of the close relationship of methane and dust with respect to their rates of liberation (generation) and the necessity to dilute and remove them. Many mines circulate quantities of fresh air several times the legal minimum through the last open breakthrough. Superior quality material for line curtains is now available and is gaining wider use in the industry for conducting air into the working place more effectively. Further, the industry has endorsed the United States Bureau of Mines proposal to revise the permissibility schedule to require that boring-type miners be designed with a 200-square inch cross sectional area for accommodating auxiliary ventilation ductwork.

As described in a paper presented at the 51st Annual Meeting of the Mine Inspectors Institute of America by M. C. W. Connor, Jr. of United States Steel Corporation's Gary Division, a two-split ventilation system developed in that division is being used to control methane and dust and to direct the dust generated at the face away from personnel. This involved development of a mining sequence in which a separate fresh-air split is coursed over the continuous miner and directed to the return permitting the mining of two or three places on cycle. The system

made more effective use of the ventilating current at the face by minimizing the use of line brattice and eliminating the need for shuttle cars to travel through cheek curtains. Maintaining the line curtain ahead of the operator is essential in order to minimize dust in his vicinity and promptly dilute and remove gas.

Little has been done effectively in the medical fields toward the prevention or treatment of silicosis and other respiratory ailments. The "Aluminum Therapy" process involving inhalation of aluminum and alumina dust as a counteractant which was developed by the industry-sponsored McIntyre Research Foundation in Canada has largely fallen into disuse. This is partly because the Foundation required those companies to which it licensed the process to employ extensive engineering controls to abate dust underground, and that these controls, in themselves, were found to be sufficient.

There is some amount of controversy regarding the methods and procedures for collecting and precisely evaluating dust samples. The standard instrument used for years by the coal industry is the midjet impinger. The midjet impinger has a sampling efficiency of 80-100 percent. Threshold limits for mineral dusts are based on impinger sampling, making the dust counts of such samples directly comparable. The United States Bureau of Mines--Public Health Service dust study proposes to use other types of sample collection devices for both area sampling and for "personnel" sampling. Concurrent impinger samples will be taken in order to establish a basis for conversion of the data collected during the many years of industry study of dust concentrations. The personnel samplers will be used to determine the actual concentration of dust to which various occupations are exposed, at the breathing zone, over a full shift period. The experiment is expected to span a period of several years before meaningful data can be obtained for comparison with clinical studies of respiratory ailments of miners.

In summation, it is apparent that coal dust can and in most instances is being controlled to tolerable levels; and that the industry is willing to meet the challenge posed by studies designed to determine whether coal dust standards should be improved.

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DUST CONTROL AND OTHER SAFETY MEASURES ON A LONGWALL FACE

By H. C. MORTON

Division Supt., The Carbon Fuel Company, Carbon, West Virginia

During the summer of 1963, along with other officials of The Carbon Fuel Company, I visited the longwall faces operating in Eastern Associated Corporation's mines at Kopperston and Keystone. Our purpose was to evaluate the system as a possible solution to roof control and recovery problems in our No. 20 Mine at Carbon, W. Va. No. 20 Mine is in the Eagle Seam and at that time had been operating for a little over two years. The roof in the mine is composed of a strata of very soft and unconsolidated shale which varies in thickness from twelve inches to ten feet. This roof strata can be held very well in entries with wooden headers bolted to the top and timbered, however, when over 60 percent of the seam is mined by conventional room and pillar methods the shale roof becomes hazardous and difficult to handle. Consequently seam recovery was low, not over 55 percent, and the cost of production was about equal to the sale price. No. 20 Mine was about to fail and we were looking for a saviour.

I was greatly impressed with the longwall system I observed at Eastern Associated Mines—it was love at first sight. I felt at that time that the retreat longwall method had the potential of the most economical, conservative and safest method of mining coal. Now, after having been directly associated with longwall mining for over three and a half years, my feelings have not changed.

Of course, the method has not reached the potential—it has probably now only reached a level of evaluation equal to the model "A" Ford in that line of excellent automobiles. As we sang then, "Henry made a Lady out of Lizzy"—we now have something more like a lady in the line of mining equipment.

No. 20 Mine is now operating three sectional units of equipment. In addition to the longwall unit, one conventional shuttle car unit is used for developing longwall panel entries and one for mining areas of the seam adjacent to old mine workings or crop and property lines that cannot be fitted into the longwall pattern. Although the development section is driving only two entries which is

very inefficient, since the longwall went into service, the mine has remained in an economically sound position.

Our longwall face started operating March 2, 1961. On July 1, 1967, the section had operated 1,575 shifts and had produced 1,103,262 tons of clean coal or 700.49 tons of clean coal per shift. Add about 20% for seam rejects and the total material handled was 1,379,077 tons or 876 tons per shift. Operating time for these calculations includes all the time the mine operated minus the time the longwall equipment was moving and being set up. Considering the fact that we have experienced several rather serious roof falls on the head and tail entries and on the longwall face and suffered from other problems which slowed production, we are at least not ashamed of these figures.

Seam recovery as we are presently operating is good. The first panel entries were driven in sets of three entries on 70-ft. centers. The two rows of 54 ft. x 80 ft. chain pillars were left in the gob. While working with these projections we were recovering 83 percent of the seam area between the butt-off and barrier pillar. Now, we are driving only two entries for development. The chain pillar between the entries which is left in the gob is only 17 ft. thick and 78 ft. long, so we are now recovering 96.47 percent of the seam area. Reducing the number of chain pillars left in the gob to one row of very thin pillars not only increased seam recovery but it also contributed to our success with the system by eliminating squeezing in the tail entry and on the tail side of the face.

In my opinion, large non-yielding pillars left in the gob behind the face and between the caved area and solid coal to be mined on the adjacent panel has been the principal cause of the failures in the retreat longwall method of mining in most cases. They will also cause squeezing and bumping in other seams, over and under, when they are mined in later years.

There have been numerous growing pains connected with the retreat longwall system. A lot of learning has been necessary and a lot more is needed before the system reaches

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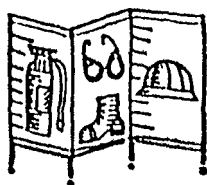
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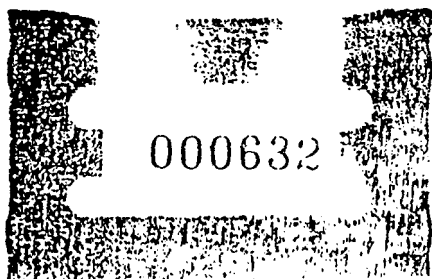
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minimum injury to employees; to promote maximum efficiency; and to effect savings by preventing injury and by reducing interruptions caused by occupational accidents."

The objective was followed by an outline of methods of obtaining the objective: "The effectiveness of the Accident Prevention Plan will depend upon the participation and cooperation of supervisors and employees of all contractors and sub-contractors engaged on this project, and the coordination of their efforts in carrying out the following basic procedures:

1. Planning all work to protect against personal injury, property damage, and loss of productive time.

2. Maintaining a system of prompt detection and correction of unsafe practices and conditions.

3. Making available and enforcing the use of personal protective equipment and mechanical guards.

4. Establishing an effective system of tool and equipment inspection and maintenance.

5. Establishing an educational program to insure the interest and cooperation of all employees through:

- A. Personal example and safety contacts.

- B. Instruction in safety requirements and insistence on compliance with such requirements.

- C. Safety meetings.

- D. Effective use of bulletins, posters, or other safety literature.

- E. Investigation of all accidents to determine their cause and promptly taking the corrective action to prevent their recurrence.

6. Each contractor's and sub-contractor's principal supervisors shall obtain a copy of and shall comply with the Indiana Safety Code for the Construction Industry, and rules and regulations applicable to the work performed by each employer on this project."

Following the outline of six methods to gain the objectives, the responsibilities of the chief project engineer; the safety coordinator; the contractors and sub-contractors; and the job foremen are outlined.

The chief project engineer is responsible for the entire plan as I have outlined it to this point and, in addition, must appoint a safety coordinator, authorizing him to enforce safety measures and to recommend corrective action when sub-standard practices and conditions are observed.

The responsibility of the safety coordinator is to follow all phases of the plan as they have been outlined and in addition maintain adequate records.

The responsibilities of the contractor and sub-contractor are:

1. Comply with all provisions of the Accident Prevention Plan, including attendance at and participation in safety meetings.

2. Appoint a qualified representative with full authority to act on all matters relating to the Accident Prevention Plan.

3. Plan work to protect against personal injury, property damage, and loss of productive time.

4. Cooperate with the project safety coordinator.

5. Comply with the requirements of the Indiana State Code and all other codes relating to his operations.

6. Provide to employees and visitors all personal protective equipment required by the exposure and enforce the use of such equipment.

7. Insure that prompt first aid is administered to an injured employee and transport him to the project clinic or as otherwise directed by the clinic.

8. Comply with all required accident reporting procedures.

The outline of the job foreman's responsibilities include:

1. Setting a good example for the men.

2. Instructing in safe work practices and work methods.

3. Use of proper protective equipment and proper tools.

4. Checking for unsafe conditions and practices.

5. Completely investigating accidents to determine causes and taking all necessary corrective action.

6. Promptly completing required Accident Reports.

7. Holding meetings with men.

The Burns Harbor construction supervision and safety personnel are continually in the construction areas and insist on strict compliance with the Accident Prevention Plan and the "General Safety Rules for Contractors". The fact that the Bethlehem Steel Corporation provides workmen's compensation and general liability insurance to cover approved contractors on the project greatly enhances enforcement of the safety program by Bethlehem and compliance with the program by the contractors.

Weekly safety meetings are held by the craft union stewards, and assigned committees from these meetings meet with plant protection and safety department personnel of the Burns Harbort plant to further assist in the compliance by all contractors toward the desired goal of maximum safe working conditions.

Periodically, the business agents for the crafts make safety tours of the construction areas with members of the construction and safety departments pointing out various constructive improvements to further improve the program.

Considerable time is spent working with the A.F.L. craft union safety representative to insure a mutual understanding that, for a safety program to be effective, requires the cooperation of both management and labor. Without the complete sincere support of the

unions toward a sound safety program, the only "lip service" for safety exists with no meaningful action resulting.

Compliance and cooperation on this project has been excellent. Only infrequently have actions, other than firm reminders, been required to bring the safety program back into line. The aid of the purchasing department is enlisted when the most severe corrective actions have been necessary and the procedure has been most effective.

Our program is not unlike other programs in the construction industry, having the common denominator of planning, motivation, communication, and follow through accompanied with dedicated hard work on the part of each individual on the site. We attempt to implement our program with enthusiasm in a directness of purpose eliminating "lip service" and the attitude "we will look at it problem later".

OCCUPATIONAL HEALTH IN THE CONSTRUCTION INDUSTRY

By FRED OTTOBONI

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Occupational health in the construction industry is a subject that has not yet received any real interest or attention in the United States. Articles appear from time to time in the American literature on a specific health hazard, such as lung cancer in asbestos insulators, or lead poisoning in painters. Other than a few papers originating in California, where a start has been made on the heat, noise, and dust problems of heavy equipment operators, almost nothing seems to have been written on the present health status of the individual crafts or on the overall health problems or needs of the industry.

This lack of interest and work is significant. Either there are no problems in the industry worthy of mention, or there is an appalling lack of some vital ingredient which is necessary for stimulating the growth of a systematic interest in the health of more than four million American workers.

First, let's define "occupational health". The term has been so loosely used over the

last few years that intelligent discussion of the subject has been difficult. Some people interpret it to mean everything from a finger to the social well-being of the craftman's family. For our purposes here, however, occupational health means the prevention of work-caused disease and disability; control of the work environment, an area where both labor and management have clear responsibility for observation, discussion, and hazard control. This definition requires particular meaning when one realizes that the majority of occupational diseases are not curable; they are only preventable.

Five conclusions have emerged from studies of occupational health problems in the construction industry. We feel they are fundamental, if progress is to be made. They are the result of nearly five years of observations in California. They dramatically reflect the lack of interest, the lack of programs, the lack of action that beset the industry. It is recognized that the immediate demand

pressing safety problems in the industry may, in part, be responsible for submerging any concerted interest in health problems. While no attempt is made here to detract from the important responsibility for accident prevention in the industry, it is time that programs in work-induced disease prevention begin to receive the attention they deserve. High accident frequencies cannot, by any stretch of the imagination, justify a lack of interest in healthy working conditions.

Our first conclusion—there is a basic need to recognize that construction workers are now suffering job-induced diseases and that new diseases will emerge with advancing technology.

To the casual observer or even a member of the industry itself, it is reasonable to believe that occupationally-induced diseases in construction work are not a problem. The crafts have long histories of working outdoors in the fresh air with hammers, shovels, and other tools which have in the past traditionally presented safety problems, but not health problems.

A look at the Federal or State health statistics appear to support this concept; not because there is a lack of problems, but because neither the Federal government nor the states—with the possible exception of California—keep any statistics on the subject. When no disease is reported, it is natural to conclude that none exists. However, what appears as no problem is, in reality, no information on the problem.

Experience in California supports this conclusion. In recent years, physician's reports of occupational diseases among construction workers have been coming into the State Health Department at approximately twice the average rate for all California workers. Since 1949, when recording began in California, this rate has been continuously among the three highest of all the major industries. The diseases involve the skin, the lungs, systemic poisonings, hearing loss—essentially the whole range of illnesses normally believed to lie in the exclusive province of factory workers.

Field investigations suggest that more is to come. For example, an estimate based on hearing tests conducted at construction sites by fully-qualified audiologists indicates that some 20,000 heavy equipment operators now working in the state have permanent noise-induced hearing loss. The trend toward

larger, faster, and more powerful equipment designed without consideration for the long-term health of the operator, is expected to intensify this hearing loss problem. It also is expected to introduce silicosis for the first time as a disease of the operators of dozers, power shovels, and front-end loaders.

The equipment operator is not alone in facing these health hazards. The recent replacement of the plasterer's conventional trowel with a spray nozzle has introduced serious hearing loss problems insofar as the plaster guns that we have measured are concerned. Further, the gun application of asbestos-containing fireproof coatings continues without control and without concern. Yet, data coming in regularly from studies of men working around asbestos dust leave very little doubt that the gun operator and other craftsmen in the area are being subjected to the risk of asbestosis and lung cancer.

There are many more examples. Plastic adhesive and surfacing materials have made life an itchy nightmare for the tile setter and the cement mason. It is important to realize that much of this skin disease is accompanied by a permanent allergy to the epoxy resin hardener used in the process. The slightest further exposure to the hardener brings on a repeat case of the itch and the man is permanently disabled for any further work with the plastic.

Another example involves today's welder. There was a time when very little except ordinary steel was found on a construction job. An unprotected welder could work with very little hazard from fumes. Alloys are changing this. For instance, inhalation of the fumes from manganese steel will produce an illness which closely resembles Parkinson's disease. Consider also that nickel, cadmium, vanadium, and some other metals are toxic by inhalation.

It is clear that the pick and shovel are gone, and along with them went the fresh air and the iron man. The construction industry has entered the era of machines and chemicals, and it should recognize this.

A second conclusion—it must be recognized that the methods which have been developed for the protection of the factory worker may not be feasible on a construction job.

Most of the occupational health literature and practically all of the preventive methods in use were developed with the factory

worker in mind. The factories, and the critical industrial health problems of the 19th and early 20th centuries, are gone where the interest, the research, and the money has been invested. The emphasis today, although comparatively small, is still on the factory. As a result, the standard control methods available in all the textbooks, ventilation, isolation, enclosure, substitution, and personal protection, are organized to make practical and economical sense in a factory setting.

The factory hand works for the most part in a fixed location. Exposure is repetitive and predictable over a long period of time. Utilities are available and control methods can be designed, tested, and finally built-in as part of the company's long-term capital investment. It is not unusual to see a \$20,000 ventilation system built into a plant to protect 10 or 15 welders.

But look at the welders on the construction job. In a lifetime, each will have done about as much work and generated as many fumes as a factory welder. However, the control system here is non-existent, because the control methods in the textbooks do not make practical or economic sense on a construction job.

Factory spray painting is done in a ventilated booth, according to the books. Since a booth would cost too much on a construction job, we scratch our heads and spray paint anyway.

Dust, noise, heat, and almost any health problem is controlled by cookbook methods in the factory. The cook book doesn't work for construction, so we live with the problems and hope they will go away.

It is now critically necessary that we accept the fact that a construction job is not the same as a factory job, and that the factory hazard-control cookbook—although free—is not applicable.

A third conclusion—we must begin to develop our own occupational health standards.

The golden era of occupational health in the United States ended in the mid-1950's. The movement which began in the 1930's and provided wide knowledge of industrial diseases and excellent textbooks is slowly dying. The Federal program is small and without legal authority. State programs not only have been declining in manpower, but show little interest in the construction industry. The traditional standard-setting agency

for occupational health in the country, the American Conference of Governmental Industrial Hygienists, is dependent upon its dues-paying members for support. Its \$13,000 yearly total budget will not cover more than a fraction of the country's problems, and that fraction will be factory-oriented.

On this basis, it is unlikely that the widely subsidized work that went into helping the industrialist to understand his problems and to custom-tailor his environmental control will be available to the construction industry. The facts are that the responsibility for providing a reasonably healthy place to work lies directly with construction labor, and construction management.

The need for environmental standards is growing with each day. Noise offers a fine example: Heavy equipment, trucks, compressors, chain saws, jackhammers, and a wide variety of power hand tools are producing hearing loss that is reaching scandalous proportions. There are choices. The individual contractor can hire an acoustics expert and modify these tools at his own expense. As another choice, he can attempt to stuff earplugs in his men, a method that will be of no practical value on a construction job, and one that will probably reduce productivity. A popular alternative is to do nothing and let the insurance companies worry about it.

The sensible solution is to collectively write a set of performance standards for power equipment. These can be written right now, from knowledge at hand, and would specify maximum allowable noise intensities at an appropriate given distance from the equipment. The tool manufacturers may have difficulties at first. But their engineering and research departments are available and in the best position to control hearing loss at the lowest possible cost.

Adequate labelling also must be considered. Very few of the materials capable of causing eye, skin, or lung problems such as plastics, paints, welding rods, fluxes, solvents, lubricants, etc., have useful warning labels when they reach the construction site. This has two negative effects, in addition to the potential for injury. First, even the interested men cannot find out how to protect themselves. And second, if the material does cause a problem, the men have no clear information that might be useful in selecting less harmful product for the next job.

This is particularly dramatized by the experience of the cement masons, where labels are often so vague as to make it impossible for them to determine whether the surfacing material they are expected to apply on a particular job is a dermatitis-causing epoxy, a bronchospasm-causing urethane, or a relatively safe polyester.

The noise and label problems are straightforward. They follow the textbook closely. Others may not be so simple because of the mobile nature of construction work. Solutions to these will require imagination and money. Ideas from the space program are sure to be useful and we expect to see exploitation of the controlled individual environment in the form of air-supplied suits for plasterers, cement masons, and welders; and air-conditioned, noise-and dust-tight capsules for heavy equipment operators. Standards, once set, can make these easily accessible at mass-produced costs.

The logical approach is to accept the responsibility and begin to develop some standards that can be put into contracts and equipment purchase orders; otherwise the industry faces attrition of skilled manpower, higher compensation costs, hazard pay, and if the problem gets bad enough, the inevitable application of the ill-fitting industrial cookbook to these construction jobs.

A fourth conclusion—records and statistics must be kept.

I repeat, health information on working men is scarce. This is particularly so in the construction industry because even the information that is obvious in a factory is clouded by the nature of construction work.

A factory is a relatively permanent environment. Jobs acquire reputations: they *smell*; *old timers* get lung disease; this or that chemical will make you sick if you inhale it. This is epidemiology in its most primitive form, done without the help of the professionals or the government. Nevertheless, it is very effective in discovering diseases and developing control methods.

Contrast this with a construction job. The office is often a house trailer and a single craft is not likely to be on a given job for more than a year. Who now is going to do the epidemiology? Work-induced health damage, suffered by a craft during the course of a single project very easily passes without notice. It is not until a series of such projects—and years—have passed that disability is

marked enough to prevent further employment. At this point, cause-effect relationships are obscure. No single event can be held responsible, and the work force has a few less craftsmen. If by some chance the illness is recognized as work-induced, the last employer may be held responsible for the entire cost of compensation. This is no solution.

For example, earth mover operators have long suspected that somehow spinal problems are connected with their jobs. This may or may not be so; there are no statistics. It is hardly possible that all equipment operators are born with bad backs. It is most likely, however, that the vibration and bouncing on some types of seats on some types of equipment are causing spinal damage. Unless it is known, first, whether or not operators are truly suffering spinal problems and second, exactly which machines and what conditions are responsible for the problems, prevention of "back trouble" will be impossible.

With computers now available, it is feasible to record the pertinent details of every job, every illness, and every death for every man working in the construction industry. This should be done by every craft union, with the cost shared by the employer. Routine computer output will then tell us whether painters die young, or equipment operators get silicosis, or plasterers get emphysema, and whether the lung cancer that has been found in asbestos insulators is being controlled or not controlled.

A fifth conclusion—uniform, reasonable regulation must be insisted on.

Competition is very real in construction. In fact, it appears to be so fierce that it often is cited as the justification for poor health and bad safety practices. For instance, the question as to why water is not being used to control dust on a given haul road very often will bring the reply that this is highly commendable; however, "it was not included in the job estimate because the competition never includes such things, and in order to bid the job successfully it was necessary to dispense with the water wagons".

This is a standard answer for many problems. Its effect is to penalize the legitimate contractors and to make the natural growth of healthy working conditions next to impossible. This fanatic interest in cost-reduction seems to be eroding the few existing health standards accepted by the industry.

For example, everyone knows that a sandblaster should wear an airsupplied helmet.

This has been accepted without question for decades. Yet during the last year the writer has seen five construction jobs where sand-blasters were working. They all religiously wore the proper helmets—but not one had an air-supply hose connected to the helmet! Apparently the air supply isn't being figured into the bids anymore, even though it is still in the law.

Diesel engines in underground construction are an example of long-term, legal erosion. Diesels were allowed underground only after long study and, finally, the setting of rigorous standards by the Bureau of Mines. These included specially designed engines, matching exhaust scrubbers, and ventilation rates based on numbers which accompanied the vehicle from the manufacturer. Competitive progress over the last 20 years has led to the erosion of standards and the acceptance of any diesel vehicle with a home-made scrubber, and ventilation rates based on air sampling methods that have not been proved reliable. The engineered and tested standards and safety factors prepared by the Bureau of Mines are being forgotten. Although a few contractors still use Bureau of Mines equipment, continuous pressure from the industry has eroded the minimum standard. One thing is certain: eroded standards, no

matter how legal, neither increase profits nor make diesel exhaust better to smell nor safer to inhale.

The competitive inducement to save money by shaving health and safety costs need not continue. Good applicable standards, as they are developed under our third conclusion noted above, can be made a part of all construction contracts and all labor management contracts. In this way, healthy working conditions will be officially recognized as a legitimate cost of doing business and the toll will be paid in dollars by the buyer of services rather than in the health and longevity of the craftsmen who provide them.

The construction industry has a host of hidden and pressing occupational health problems, with more to come. For the short term future, government rescue does not seem possible and a serious and planned effort by management and labor is badly needed.

The construction industry has enjoyed and become addicted to the privileges of hard work and fresh air. Change is always difficult. But one way or another, like it or not the technology that we are using to change the face of the earth will, in the long run change us also.

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names are different. Following the directions of the manufacturers in mixing and applying these chemicals is the safest policy and will give the most effective results. The person in charge of the program should be well acquainted with the terms used in the recom-

mended instructions and familiar with the equipment provided to do the job. His knowledge must be thorough and accurate, for according to the old saying, "It's better to know nothing than to know something that's not so".

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be brought into the picture here. It looks like the Department Superintendent, or Production Manager, or maybe even the Factory Manager, has not spelled out in clear and concise terms just what the Foreman's safety responsibility really is. You will recall that when John finally decided to shut the machine down he stated, "I'll probably get fired for this."

QUESTION: What about Foreman John's language? Is it just "shop talk?"

ANSWER: It may be, but it sure could convey the wrong impression to anyone working for him. I think he would command much more respect as a leader if he talked of and thought of his fellow workers with more respect.

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Electric we find the following three steps particularly fruitful:

1. Acquaint private physicians with nature of work, requirements of Benefit Plan, and function of company medical staff. This has been accomplished by various means, ranging from simple phone calls to plant visits to open houses for community doctors. We find a direct correlation between the amount of familiarity a patient's doctor has with the company and the length of illness absences.

2. Visitation of sick employees to discuss convalescent progress. This visitation may be done by supervision or nurses. In the past we have utilized visiting nurses, but we are having our nurses primarily visit by telephone now. It is still company policy to have supervision visit the employee to show continued interest in the employee while he is disabled.

3. Once a patient is ambulatory, he is asked to visit the company dispensary. The ability of the employee to return to his regular job or to "light duty" can then be discussed between company and private physicians.

Obviously, this kind of close attention to employee's health, and to the work and home environments that contribute to it, can best be accomplished by an on-premise medical force. A company as large as Western Electric finds the effort not only a humanitarian necessity, but one which pays off in on-the-job performance.

The scale of Western's commitment to employee health can be seen in these figures

—37 full-time and 99 part-time physicians; health and safety programs at 57 company locations; programs ranging from biomechanics to computerized epidemiological studies, and fundamental research in such varied fields as heart disease and laser hazards.

I appreciate that smaller companies cannot spread these costs across a large employee body. Many companies have found that private clinics can take on this vital medical-management partnership. Others depend on insurance benefit plans—a sure way to prolong absences. Many reports have indicated there is a tendency for length of absences to increase as benefits increase.

Sound management plan is essential to control absenteeism. It creates the psychological and physical environment conducive to good attendance. The cooperation of family and occupational physicians can do much to improve this attendance. This cooperation can restore the ill and injured to work as soon as possible and practice on a broad scale all that we mean by "preventive medicine." Management and medicine can make a contribution to the operating efficiency of the organization. But most important of all, a vigorous medical-management plan is a foundation upon which to build a healthy society on and off the job. As the pressures of our technological age increase, as our urban environment becomes more complex, it is imperative that we bring business and medicine together to seek mutual solutions to health and safety hazards.

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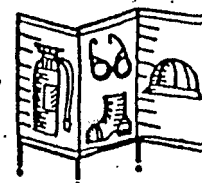
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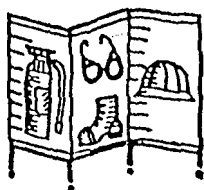
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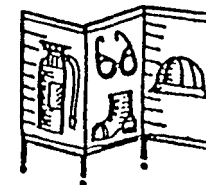
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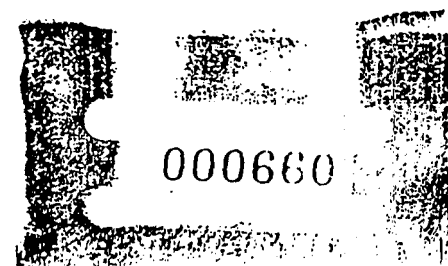
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