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sensitization. They are inclined to ignore the warnings because in many cases the skin reactions do not appear until several months after a person has started working with the resin. Once a reaction has developed, they must exercise even greater care than required initially in order to prevent a recurrence.

High Energy Fuels

The race for missile supremacy and the conquering of space has confronted us with increased problems of exposure to high energy fuels and their decomposition products. Among these are hydrazine and the boranes — diborane, pentaborane and decaborane.

Hydrazine finds its use as a propellant fuel, either alone or with other compounds such as nitric acid, hydrogen peroxide or oxygen. It has a maximum allowable concentration of one (1) part per million, and in addition to the inhalation hazard, the material is absorbed through the skin. It is primarily a central nervous system stimulant causing excitement, convulsions and cyanosis.

Diborane is a gas at room temperature and has a maximum allowable concentration of 0.1 part per million. Inhalation produces congestion, edema and hemorrhage in the lungs. Its toxicity is comparable to that of phosgene.

Pentaborane is a volatile liquid with a tentative maximum allowable concentration of 0.005 part per million; however, it is recommended that the exposure be kept as near to zero as is possible since no medical preventive or therapeutic agent has yet been developed for this compound.

Decaborane is a solid having a tentative maximum allowable concentration of 0.05 part per million. Both decaborane and pentaborane attack the central nervous system. Protection is best afforded by the use of air-supplied respirators or cartridge-type respirators that are specifically designed and designated for protection against these compounds.

In concluding this brief discussion, may I point out to you that the services of your local, state, and federal health agencies are always available to you. Should you desire information on the potential health hazard associated with any material or process to which you or your associates are exposed in your particular place of work, feel free to contact any one of them for assistance in evaluating the problem.

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OCCUPATIONAL HEALTH HAZARDS — MEDICAL ASPECTS

By HERBERT K. ABRAMS, M.D.
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I would like to quote from a famous writer his description of a "modern" community:

> It was a town of red brick, or of brick that would have been red if the smoke and ashes had allowed it; but as matters stood it was a town of unnatural red and black like the painted face of a savage. It was a town of machinery and tall chimneys, out of which interminable serpents of smoke trailed themselves for ever and ever, and never got uncoiled. It had a black canal in it, and a river that ran purple with ill-smelling dye, and vast piles of buildings full of windows where there was a rattling and a trembling all day long, and where the piston of the steam engine worked monotonously up and down, like the head of an elephant in a state of melancholy madness. It contained several large streets all very like one another, and many small streets still more like one another, inhabited by people equally like one another, who all went in and out at the same hours, with the same sound upon the same pavements, to do the same work, and to whom every day was the same as yesterday and tomorrow, and every year the counterpart of the last and the next. . . .

On every side, and as far as the eye could see into the heavy distance, tall chimneys, crowding on each other, and presenting that endless repetition of the same dull, ugly form, which is the horror of oppressive dreams, poured out their plague of smoke, obscured the light, and made foul the melancholy air. Strange engines spun and writhed like tortured creatures; clanking their iron chains, shrieking in their rapid whirl from time to time as though in torment unendurable, and making the ground tremble with their agonies. . . .

Before you try to guess which city this is, let me tell you. Charles Dickens wrote this in his book *Hard Times*, published in 1854, describing a typical city in England during the years of the industrial revolution (1760-1830). The description sounds too familiar for comfort to us in America in 1961, at a time when we are going through another industrial revolution: automation, atomic energy, space travel, and many powerful new chemicals. They are exciting developments. They offer a promise of a wonderful world of tomorrow. However, they also pose serious threats to our health and well-being, unless they are properly controlled.

We must ask ourselves whether we are better prepared to meet these threats than the English were 150 years ago. Certainly, we are better prepared technically. In 1800, except in a few instances, little was known about the health aspects of exposure to chemicals, to ionizing radiation, or the effects of long hours of work, poor lighting and ventilation. Today, however, our technical knowledge is sufficient, so that we can say with assurance that we know how to use any chemical with safety. We know how to set up proper protective measures to make every job safe.

The big question is, "Are we utilizing this knowledge?"

Perhaps you who represent workers in industry know the answer better than I do. Let me give you only two examples that will help provide the answer. In Illinois, in 1958, there was found "a drug packaging plant where 103 employees were subjected to a full body fluoroscopic examination each day as they left the plant as a check against pilferage. During the examination, the entire body from the top of the head to the bottom of the shoes was exposed to ionizing radiation. The firm had practiced this procedure on all employees for some 12 years, but discontinued it when advised of the hazards involved." I am quoting from the Report of the Atomic Power Investigating Commission to the 71st General Assembly, State of Illinois, March, 1959.[1]

In the same report, the study found that:

Gross contamination and excessive levels of radiation typify nearly all radium processing installations in Illinois included in the survey. These conditions result from a lack of adequate shielding of proper routing of materials, as well as poor housekeeping within the plant, as noted by the contaminated paper and rags littering the floors, the lack of local exhaust ventilation and presence of contamination in eating areas. In addition, it was noted that labels on containers of radium-luminous compounds do not contain information as to the quantity of radioactivity included. In all radium plants surveyed, little or no use was made of personnel monitoring devices, such as film badges and, therefore, there is no adequate record of radiation exposures received by working personnel.[1]

This was Illinois, 1958—thirty years after the tragedy of the girls who painted watch dials: they pointed the brushes containing radium paint with their lips, and later died of bone cancer.

The role of environment on health grows in importance as we gradually control the infectious disease agents that caused the plagues of old, and as the chemical and physical hazards of our industrial environment become ever more important determinants of our health and our diseases. A recent report of the Public Health Service made for the House committee on appropriations states: "After hearing the evidence, the members of the subcommittee concluded that the health hazards resulting from changes in the environment are far greater than is generally realized and that all levels of government, industries, and research and educational institutions need to step up their efforts to deal with the problem."[2]

The number of chemical materials man is being exposed to is increasing constantly. Over 600 chemicals are currently being added to food; over 600 million pounds of pesticides are used annually, in the United States. Approximately 500 new chemicals are introduced on the United States market each year.

The occupational environment is the basic element in our total environment. Our occupations largely determine how and where we as individuals will live, and, indirectly or directly, may actually influence our life expectancy and our mode of death. Our

industries, in addition to affecting the immediate eight-hour working environment, also largely account for the chemical and physical contaminants in the air we breathe, the water we drink, and in the food we eat.

One example will illustrate: recent studies show that people living in manufacturing areas experienced higher death rates than residents of non-manufacturing areas. The difference was greatest for cancer, and tuberculosis of the respiratory tract (mainly of the lungs), and for various forms of heart disease.[4]

Air pollution was a major factor in causing this greater mortality, but socio-economic conditions also played an important role.

Occupational Diseases

Occupational disease hazards may be classified in various ways. For example, by the type of agent which causes the disease: chemicals, in the form of liquids, dusts, gases, fumes and vapors; physical agents, such as noise, ionizing radiation, abnormal temperatures and pressures, vibration, and physical strain; infectious disease agents, such as the germ that causes brucellosis in meat-packing house workers and farmers.

Or occupational diseases can be studied according to the part of the body affected or the kind of disease. For example, many toxic chemicals may attack the skin, causing an inflammation which we call dermatitis. These or other chemicals may affect the lungs, the liver, the kidneys, the bones, or various combinations of organs of the body, and, in many cases, the entire system.

Occupational diseases may be acute and temporary, or may be chronic and long-lasting. Brief exposures to certain chemicals may produce symptoms that are of short duration, and the individual recovers quickly. A good example of this is metal fume fever, arising from inhalation of the fumes produced when certain metals are heated to temperatures above the melting point. Among the metals which can cause this are zinc, copper, magnesium, cadmium, iron, manganese, and other.

More important, however, are the chronic diseases of industry. These are the diseases of relatively long duration arising usually from long-continued exposure to relatively small amounts of toxic chemicals. Sometimes these diseases do not show symptoms until long after, in many cases years after, the exposure has stopped. A good example of this is beryllium, a metal which may result in serious and fatal lung disease up to 15 or more years after breathing the contaminated dust or fumes.

We must remember that diseases, like everything else affecting living things, cannot be put into rigid categories. Not all chronic occupational diseases need to result from long-continued exposure. Only a brief exposure to a large dose of ionizing radiation (X-ray or radioactive chemicals) may result in cancer. Similarly, a brief exposure to a sufficient dose of carbon tetrachloride may result in chronic kidney disease or liver disease. In other words, there are many variations and combinations of these conditions.

To attempt a detailed listing of all of the chemicals and metals which can cause disease would only be disturbing and confusing, and we would be in danger of not seeing the forest for the trees. Every industrial chemical is dangerous. It is merely a matter of determining how dangerous it is and establishing procedures for protecting against it. The time is past when "experts" can stand before a group of workers, or, for that matter, a group of physicians and scientists, and say without evidence that this or that chemical when absorbed into the body is harmless. I recall only a few years ago attending meetings of industrial physicians and being shown X-ray pictures of lungs of coal miners, black with inhaled coal dust, and being told that this dust was harmless. Yet, long before that time, British scientists had demonstrated that coal dust can cause disabling lung disease in miners. We in the United States were merely slow to accept the evidence.

Diseases of the Lung

The respiratory system (lungs, bronchi, and larynx) is the most frequent site of chronic diseases caused by industrial poisons. For a long time, we have recognized that silica dust as it is inhaled by the metal miner, the foundry worker, the pottery worker, the tunnel digger and others, causes a disabling and often fatal disease called 'silicosis.' Similarly, we know that asbestos dust causes a serious lung disease called

'asbestosis.' And, there is a lung disease found in workers in the manfacture of alumina abrasives, called 'Shaver's disease' (after Dr. Shaver who described it). The dust has high concentrations of alumina and silica. Diatomaceous earth, a form of free silica, similarly causes serious lung disease. And there is byssinosis, resulting from the inhalation of cotton dust. Until a handful of years ago, some of the experts insisted that many dusts when inhaled into the lungs were inert; that is, they produced no effect on the body. However, as we learn more, we find that these so-called "nuisance" dusts are also capable of causing disease. For example, talc, corundum, feldspar, graphite, porcelain, barita, cement, mica, slate, kaolin, and many others.

Even farmers, as well as grain handlers in the holds of ships, suffer from a respiratory disability when inhaling large amounts of grain dust. They develop chronic bronchitis with shortness of breath, cough, etc. Chronic bronchitis can result from inhalation of irritating dusts, fumes and gases: for example; phosphorus chloride and other volatile chloride compounds, acid fumes, phosgene, nitrous gases, aldehydes, solvents and other chemicals.

One of the leading toxicologists in the country, Dr. Herbert Stokinger, of the Public Health Service, points out that:

> . . . our experience with occupational lung diseases makes it difficult to escape the conclusion that *all dusts*, irrespective of their nature, if breathed in sufficient quantity and for sufficient time, may cause profound damage to the lung, and emphasizes the desirability of the physician's obtaining an accurate and thorough history on individuals suspected of pulmonary disease.[4]

Other Chronic Diseases

Let me discuss a few more of the chronic disease hazards, since these are the chief occupational health problems of the present day. The chlorinated hydrocarbons, such as carbon tetrachloride, represent a large group of chemicals used in industry. These can damage the liver and the kidneys. The chemicals known as aromatic amines, represented by beta napthylamine, used in the manufacture of dye and other commodities, have been proven to cause cancer of the urinary bladder. The central nervous system—that is, the brain and spinal cord—can be affected by many chemicals. Tetraethyl lead causes severe brain disease called encephalopathy. Manganese, one of the important industrial metals, causes a disease that is remarkably similar to multiple sclerosis. Carbon disulphide may cause severe nervous system effects, affecting the nerves, muscles, and brain.

Serious and sometimes fatal blood diseases may be caused by exposure to benzol. Of course, we know that ionizing radiation in any form—whether through exposure to X-rays or radioactive chemicals—may cause fatal blood diseases as well as various types of cancer. The bones can be affected by exposure to radioactive chemicals, fluorides, phosphorous, and other chemicals. Cadmium affects the lungs and kidneys.

The heart may be affected by the metal known as antimony, and possibly by nitroglycerin, and there have been a number of reports that the heart may also be affected by brucellosis infection, which occurs among slaughter house workers and farmers.

Nitroglycerin and related chemicals used in the manufacture of dynamite and other explosives make an interesting story and illustrate some of the problems in occupational medicine. Workers have been exposed to this group of chemicals for many years. They have known for many years the severe headaches this chemical causes. For years, also, we have heard reports of sudden deaths among workers exposed to nitroglycerin. We do know that this chemical has a powerful effect on the body. It causes profound reduction in blood pressure, severe headaches, palpitation of the heart, nausea and vomiting, fainting, dizziness, and other symptoms. It can also cause skin inflammation. Whether it can cause heart disease is disputed. Even though we have known this chemical for many years, there has been insufficient investigation of the health hazards, and inadequate preventive measures.

Cancer

Occupational cancer is one of our most serious problems. It also provides us with a remarkable opportunity to study cancer in general. The first breakthrough in the mystery of cancer came with the discovery of an occupational cancer. In 1775, in England, Dr. Percival Pott called attention to soot as a cause of cancer of the scrotum in chimney sweeps. These were little boys who climbed into the chimneys to clean them out. Years after working in this

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occupation, they died of cancer of the scrotum, which was traced to the soot which penetrated their clothing. Similarly, for years we have known that an excessive number of uranium miners in Europe have died of lung cancer. (Recent studies in our own uranium mines reveal dangerously high exposures.')

Since then numerous other chemicals, in addition to ionizing radiation, have been demonstrated to be capable of causing, or contributing to the development of, cancer in various parts of the body. Some examples are beta naphthalamine, which I mentioned earlier, causing cancer of the urinary bladder, coal tars which can cause cancer of the skin, chromates which cause cancer of the lung, and many others. Recent studies have focused suspicion of lung cancer hazards in the work of welders, sheet metal workers and other metal workers.

Skin Diseases

Skin diseases are, as you know, the most frequent type of occupational disease which we see. Most of them result from direct irritation by chemical or physical agents. A smaller number result from an allergic reaction to a chemical. Almost any chemical contact can result in dermatitis. Many of the new chemicals are causing skin troubles. For example, the epoxy resins: These materials are being widely used in electronics, automotives, pattern-making, die-casting, aircraft, and other trades—for surface coatings and paints, molding compounds, various plastics, and electrical insulation. Another group of chemicals which causes skin disease are the chromates. Chrome ulcerations of the skin are well known. The chlorinated hydrocarbons also may cause skin diseases. One of them is called 'chloracne' because it resembles acne. Machinists and metal workers often get a dermatitis from cutting oils. Coal tars produce skin changes, some of which may turn into cancer. There are a host of others, too numerous to mention.

Protection

These are only a few examples of the occupational disease hazards arising from contact with chemicals. The alert worker will become acquainted with the materials he is handling and the process he is using, so that he can help to protect himself and his fellows. If he should suffer excessive exposure to some harmful material, he will know what to tell the doctor who examines him. The alert doctor will be able to correlate the occupational history with the physical findings and symptoms and decide whether the patient is suffering from an occupational disease.

Very few occupational diseases produce such characteristic symptoms that they can be readily identified as an occupational disease. After all, the body can react to harmful stimuli only in a limited number of ways. For example, a worker may have severe pains in his abdomen. These might be caused by appendicitis or by lead poisoning. Leukemia may result from unknown causes or from exposure to X-rays. A person suffering a certain type of paralysis may have multiple sclerosis, a disease of as yet unknown cause, or it could be manganese poisoning. The person who has a cough, shortness of breath, and is losing weight, may have tuberculosis, silicosis, berylliosis or cancer of the lungs. A history including occupational history and a thorough examination is the only way of telling those conditions apart.

Prevention

All occupational diseases are preventable. If we were doing our job right, we would have nothing to talk about today. The fact is that unknown numbers of people are suffering from a great variety of occupational diseases because we are not adequately protecting against them. What are the protective measures which we should follow?

(1) *Education:* Employees should be given adequate training for their jobs, so that they understand the process, know the materials they are handling, and, therefore, can protect themselves and other workers from injury.

Key employees should be instructed in first aid. Management and labor both have responsibilities here. Shop health and safety committees can help in the health education of workers. *There is no substitute for knowledge.*

(2) *Protection of the environment.* This means from the air of harmful dusts, fumes, gases, vapors. This is accomplished by means of engineering measures, such as exhaust ventilation, enclosure of hazardous processes, wetting down methods for suppression of

dusts, and substitution of less harmful for dangerous materials. Good lighting and reduction of noise, etc. are other environmental problems that the engineer can help to solve.

Only when engineering measures are not possible should respirators or other personal protective devices be depended on for protection against inhaling of harmful materials.

(3) *Good housekeeping and sanitary place of work:* This means a clean place of work, free of dirt and dust, and accident hazards. There should be adequate toilet, washing, shower, locker and eating facilities. Hand washing alone can often prevent dermatitis and other diseases. All containers of chemicals should be properly labeled.

(4) *Personal protective devices:* Wherever necessary, management should supply workers with respirators for protection against noxious dusts, fumes and gases in the air; suitable gloves and work clothing for protection from harmful chemicals; hard-topped shoes and hats for protection from falling objects; safety goggles, etc.

(5) *Medical protection:* This includes first aid facilities and a medical department. Every worker should have a periodic physical examination, not for the purpose of disqualifying him for work, but for the purpose of detecting disease early so that prompt measures can be taken to protect his health. The physician has an ethical obligation to inform the worker or his family of any finding important to his health.

In addition to first aid and medical care for work injuries, all workers and their families should have access to modern medical care. Unions throughout the nation are obtaining such care through collective bargaining. Union health centers and other plans, such as Health Insurance Plan of Greater New York and the cooperative health plans, are attempting to bring good care, including preventive medicine, to working people.

(6) *Plant health and safety committees:* Every place of work should have a committee of representatives of the workers concerned with the health protection of the men and women in the plant. This committee should have authority to make periodic inspections of the plant and make recommendations to management. The committee should meet regularly with the plant physician, the nursing staff, the plant safety and industrial hygiene engineers, and with other representatives of management to discuss health and safety problems and to plan programs of education of the workers in these problems.

(7) *Government safety and industrial hygiene agencies:* These agencies should be called upon for help, whenever the union believes that management is not adequately providing health and safety measures in any particular problem.

How We Are Doing Our Job

How well are we doing in protecting our workers? Let me cite a few facts. The prevalence and incidence of occupational diseases in the United States is unknown, because in many states there is no reporting of occupational diseases. And, in those states where there is reporting, it is incomplete and not uniform. Moreover, we know that numerous occupational diseases are not recognized because of medical ignorance, deficiency in medical education, deficiencies in workmen's compensation laws and health and safety laws.

Health services in many private industrial plants are inadequate, and most workers are employed in small plants where such services are not provided. According to the Public Health Service, 70 per cent of the labor force is not receiving proper industrial hygiene and health services.

The governmental agencies, federal, state and local, which are charged with responsibility for protecting the health of workers are for the most part grossly inadequate in their resources and services. They suffer from lack of funds, personnel and even from lack of authority. At least seven of our states have no occupational health units in their health or labor departments, and of all of the state occupational health agencies in the entire country, there are less than 60 physicians employed. There is no uniformity of industrial health codes and standards, and the states differ in the hazards regulated and in their regulations for the same hazards.

There is a serious and growing shortage of physicians and other health personnel both in and out of industry. Dr. Harold J. Magnuson, Chief of the Division of Occupational Health of the U. S. Public Health

Service, estimates that by 1970, industry will need 4800 physicians, but is expected to have only 2900; while 35,000 industrial nurses will be needed, but only 26,000 are expected; and 3400 industrial hygienists will be needed, but only 1600 are expected.

Workmen's Compensation

Good workmen's compensation laws are basic to the health of industrial workers. Without strong workmen's compensation laws, it is difficult to see how we can ever have really effective implementation of our industrial health measures. The fact is that although the workmen's compensation laws are the earliest form of social legislation in the United States, they are in almost all cases hopelessly behind the time. They are inadequate in their provisions for compensation, for medical care and rehabilitation, and most of them have not been brought up to date to permit equitable recognition and compensation for the injuries inflicted by radiation and chemical hazards which cause chronic diseases, usually after long latent periods between exposure and the first symptoms of disease.

Two states still have no occupational disease coverage. Nineteen state laws cover only specified diseases. Most of the laws exclude farm work, domestic work and casual employment. In over half the states, employees in small establishments which have less than a specified number of employees are excluded, and in 12 states the laws apply mainly to a list of "hazardous" employments. Many white collar workers are today excluded from the workmen's compensation laws.

Research

The level of our research in occupational health is correspondingly low. Research is largely in the hands of private industry, and it is guided substantially by the economic needs of the particular industry. Even where research is done in universities, much of this is subsidized for special needs by private industry. Governmental agencies sporadically have made excellent contributions, but their resources are chronically inadequate. There is an urgent need for a system of research and consultation facilities in various parts of the country where workers and employers alike can go for scientific solutions to their problems.

Hope for the Future

Last year, a subcommittee of the House committee on appropriations under Congressman Fogarty conducted hearings on these problems. These are published in a "Report on Environmental Health Problems," available through the Government Printing Office. It is interesting reading. These hearings raised hope that better appropriations would be made to the Public Health Service and other agencies for an expansion of services in the environmental health field.

In the meantime, there is a dangerous vacuum in the supervision of hazards from ionizing radiation as differences prevail among the interested agencies, AEC, U. S. Public Health Service and the states, over jurisdiction in this field. At the moment, controls in this field are a patchwork with good programs in a few states like New York and California, but poor or almost non-existent programs in most others.

The implications of all this should be obvious. Occupational health and workmen's compensation vitally and directly affect the health and life of working people. Yet the unions so far, for the most part, seem to be apathetic about this. Now that unions are deeply involved in health insurance, for the care of non-occupational diseases, perhaps there will be a resurgence of interest in the environmental factors which affect our health.

A few unions have begun to help themselves. Some have negotiated clauses in their collective bargaining agreements embodying a number of the preventive measures I outlined earlier, and have also asserted the union's right to bring expert consultants into the plant.

The United Auto Workers has a department of occupational health, staffed by two experts in safety and industrial hygiene. The International Association of Machinists has a medical consultant. The International Chemical Workers' Union also has a medical consultant and recently appointed a staff safety man. These people can be of great help to workers in providing them with expert knowledge and honest information. Obviously, however, every union cannot and should not hire its own corps of experts and set up its own research laboratories. We are dealing with big social problems, and they must be met socially.

Professor of Sociology of Columbia University, C. Wright Mills, defines the issue in this way:

> No moral endeavor, no political orientation, no human study that does not pay close attention to man at work, can possibly be adequate for our time. For work is affected by and in turn affects all that man is and all that he might become. The question we must ask of any society or of any social program is what kinds of men and women does it select, encourage, create? And, in terms of this human evaluation, the most important question we can ask is whether work is a void in which men sacrifice themselves or whether work is a central feature of a style of life in which man may realize himself. . . .[6]

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SOME OBSERVATIONS ON OCCUPATIONAL DERMATOSES

By PAUL P. BOSWELL, M.D.
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Incidence of Industrial Skin Diseases

While there are at present no reliable statistics on the incidence of occupational dermatoses, their frequency is undisputed. Indeed, in World War II evidence indicates that there were more skin casualties than all other battle casualties in this very specialized occupation of soldiering.

In England, a three year study done between 1930 and 1932 inclusively, more than 72 per cent of all occupational diseases were found to be industrial or occupational dermatoses.

Reports from the compensation boards in seven states in this country indicated that 65 per cent of all compensible cases were occupational dermatoses. In a fashion more understandable to those of us accustomed to cost and taxes, this means an estimated loss of more than ten weeks per year with an annual cost of approximately one million dollars. This in itself, a staggering figure.

Anatomy and Function of the Skin

With these brief statistics, it is well to ask something of their body area, so easily disposed to such great measure of damage. And *again* it is felt that a most superficial look at the anatomy and function of the skin as it is related to this question, is indicated especially for those not related to the medical sciences.

It is not always realized that the skin is one of the most important organs of the body. In its embryonic development, it represents the first of the three primary or basis tissues formed, the ectoderm. And from this ectoderm the largest sensory organ is developed, the brain. So the skin is not only a prologue to the brain, but remains the next largest sensory organ.

The skin is an organ, a very complex organ, constituting about one sixteenth of the total body weight. It contains, within its comparatively thin structure, muscles, blood vessels, nerves, glands, specialized cells such as those that produce pigment and appendages such as nails and hair.

With over-simplification, we can divide the skin in two major layers—an inner layer, called the corium and an outer layer called epithelium. The inner layer is tough, elastic and resilient, and its chief function

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*Past General Chairman

1961 National Safety Congress

DUST STUDY PROGRAM, PENNSYLVANIA DEPARTMENT OF MINES AND MINERAL INDUSTRIES

By W. ROY CUNNINGHAM
Deputy Secretary

At the time of this presentation, our active participation in this program is one year old. While we are too new at this work to offer definite conclusions, we are hopeful that through this discussion we will be able to give you some helpful information.

We in Pennsylvania, as well as you from other coal-producing states, have long been concerned with the explosion hazard of bituminous coal dust. Through intelligent research we have learned how to guard against coal dust explosions. The same consideration has not been given health hazards from coal dust in all areas. This could be due to the fact that medical authorities are not in unanimous agreement that the breathing of bituminous coal dust is harmful. Be that as it may, the growing lists of those suffering from silicosis among our bituminous coal mining people are reason enough for those of us having to do with the health and safety of persons employed in our mines to study the problem and attempt to offer corrective solutions.

There have been limited studies made in the bituminous area of Pennsylvania by various agencies and some by individual companies, but it has not been done on a large enough scale to be sufficiently valuable to health authorities in enabling them to evaluate the harmful effects of breathing such dust. In the anthracite area, more concentrated studies of coal dust conditions have been made. It is recognized that the breathing of quantities of anthracite coal dust is harmful, but even in this area, these studies were not comprehensive enough to offer any definite conclusions.

In the bituminous area, we do know that various processes of mining aggravate and increase the silica content of the suspended dust. Medical authorities are in unanimous agreement that silica dust is harmful when breathed over an extended period.

In 1938 the Governor of Pennsylvania requested the United States Public Health Service to make a study of certain phases of the people associated with occupational disease possibilities in the anthracite region of Pennsylvania. It was hoped that such a study would offer some criterion that would enable the establishment of safe limits of dust concentration. This study was made and a report submitted to the Governor of the Commonwealth. Among other conclusions, the report contained the following:

"Analysis of the data for the purpose of determining safe limits of dust exposure indicated that employment in an atmosphere containing less than 50 million dust particles per cubic foot would produce a negligible sum of cases of anthraco-silicosis when the quartz contents of the dust was less than 5 per cent. In the gangways where the silica content of the dust was about 13 per cent, a safe limit appeared to be 10 to 15 million particles per cubic foot. The limit of toleration for rock workers was set tentatively at 5 to 10 million dust particles per cubic foot of air."

The above listed allowable limits apparently were the basis for threshold limit values adopted by the American Conference of Governmental Industrial Hygienists. These threshold limit values were first adopted about 25 years ago and were reaffirmed at the meeting of this organization in New York, April 23 to 26, 1960. They are as follows:

1. Below 5 per cent free silica, 50 MPPCF*.
2. From 5 to 50 per cent free silica, 20 MPPCF*.
3. Above 50 per cent free silica, 5 MPPCF*.

*Million particles per cubic foot.

I have not had the opportunity to become fully acquainted with occupational disease laws of the various coal mining areas. The part of Pennsylvania's occupational disease law pertaining to lung disorders is contained in Pamphlet Law 520, Act of June 21, 1939 as amended in 1957:

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Law 520, Act of June 21, 1939,
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"The employer liable for the compensation provided by this article shall be the employer in whose employment the employee was last exposed to the hazard of the occupational disease claimed regardless of the length of time of such last exposure, provided that when a claimant alleges that disability or death was due to silicosis, anthraco-silicosis, asbestosis, or any other occupational disease which developed to the point of disablement only after an exposure of 5 or more years, the only employer liable shall be the last employer in whose employment the employee was last exposed to the hazard of such occupational disease during a period of six months or more and providing further that in those cases where disability or death is not conclusively proven to be the result of such last exposure, all compensation shall be paid by the Commonwealth."

A greater part of the bill for occupational disease falls on the taxpayers of Pennsylvania. This is due to the fact that because of the very economic conditions of the coal industry, miners are forced to change employment from one mine to the other frequently. During the last biennium ending June 1, 1961, the total occupational disease bill to the taxpayers of Pennsylvania was upwards of $27 million. Approximately 90 per cent of this was paid to miners for lung disorders. In my opinion, the authors of our present legislation are to be commended for their humane effort in alleviating suffering and financial distress among our mining people because of health disorders that originated during their work in various mines. My purpose in describing a part of our law is to point this out to further explain why the Pennsylvania Department of Health and the Department of Mines and Mineral Industries started and will continue this study. You can readily understand that a compensation bill to the state of this magnitude excited public opinion to the point that the reasons therefor were demanded.

Some years ago the Pennsylvania Department of Health started a study wherein chest X-rays were taken of individuals working in our mines both in the anthracite and bituminous regions. This X-ray study is continuing and will continue throughout both areas of Pennsylvania. Because of the Department of Health's findings through their study of the various X-rays, they felt that they would be in a better position to offer intelligent solutions to this problem if they could likewise study the dust conditions in our mines. An Attorney General's decision gave the Department of Health personnel the right of entry into the mines for the purpose of making this dust study.

The Department of Health personnel were most proficient in dust sampling techniques. However, they were not familiar with the various mining practices in the anthracite and bituminous divisions. The Secretary of the Department of Health at that time realized that his people would need assistance from trained mining personnel, and requested the Secretary of Mines and Mineral Industries to have a mine inspector accompany the survey team and be responsible for their safe conduct during the study. In Pennsylvania as in other states, mine inspectors are charged with certain mandated duties. One provision of our mine law requires mine inspections at regular intervals. Time taken from legally required duties for the purpose of conducting dust study survey teams into the mines necessarily interrupted regular mine inspections.

Our department felt that the mine inspectors could not continue this additional work and still comply with the mine inspection laws. A meeting was arranged and attended by representatives from mine management, United Mine Workers of America, the Secretary of the Department of Health, and the Secretary of the Department of Mines and Mineral Industries. At this meeting coal operators justly objected to having personnel unfamiliar with coal mines unaccompanied by representatives of some state agency who would be responsible for their safety. They felt that the Department of Mines and Mineral Industries should be charged with taking dust samples underground in the coal mines.

The Secretary of the Department of Health and the Secretary of the Department of Mines and Mineral Industries were both cognizant of the fact that to be of any value, a dust study would have to be a continuing function of one of the departments. Spot checks had been made in the past, and they were of little value. We are fully aware that the data being collected by our people during this continuing study must be made on a division-wide basis. Anything less than this would be of no more value

than those spot studies taken previously at infrequent intervals.

Secretary Lewis E. Evans of the Department of Mines stated at a later meeting, comprised of the same representatives who attended the original meeting, that it was his intention to employ first-grade mine foremen as dust study personnel both in the anthracite and bituminous divisions. Following this meeting, four first-grade mine foremen were employed—two assigned to the anthracite division and two to the bituminous division.

A comprehensive six-weeks training period was arranged to familiarize our dust study personnel with various techniques of sampling and analyzing coal dust. Following this training period, we equipped two complete laboratories—one in each division. Presently, dust counts are made with a microprojector. Some work has been done on direct counting, and our personnel are familiar with both methods. Qualitative samples are collected by our people and the determinations are made by the Department of Health. The laboratories are not presently equipped to make qualitative analyses.

At the end of the training period, Secretary Evans met with the dust study personnel from both the anthracite and bituminous divisions. He outlined a tentative procedure and described his expectations. Briefly, his instructions were:

1. He emphasized that dust study personnel must be concerned only with the work for which they were employed. This department had reports that on some occasions, personnel making similar studies had exceeded their authority and reported situations about which they had no knowledge or jurisdiction.

2. He insisted that before entering the mine, our personnel should have a thorough understanding of the property, thus enabling them to conduct a study that would be representative of the dust in suspension throughout the mine.

3. He suggested that periodically, procedures were to be discussed with representatives of the Department of Health and with mine management.

4. Our people were advised that the purpose of this study was to enable the Department of Health to evaluate the effects of dust on the lungs of our mining people, and that any piece-meal publication of the report could have undesired effect. Therefore, it had been agreed by all parties to this study that one copy of the report would be furnished to the Washington office of the United Mine Workers of America, the operator of the sampled mine, the Secretary of the Department of Health, and one copy was to be retained in the Department of Mines and Mineral Industries.

Before our entry into the first mine, three of the major companies operating in the bituminous area expressed the desire to conduct studies simultaneously with our personnel in their mines. We welcomed this idea and felt that in time other coal companies in Pennsylvania will express the same interest and conduct studies of their own.

At the time this was written, we had completed surveys in at least one mine of each of the companies who were making simultaneous studies. We then met with the coal company industrial hygienists from these companies and outlined our procedure. We invited their criticism, and I am happy to report that in the main, they were most complimentary. It was felt by all concerned that periodic meetings of this type would prove most beneficial in arriving at a standard procedure that would be indicative of the intended purpose.

Insofar as is possible, we have adopted similar procedures both for the anthracite and bituminous divisions. It might prove interesting and helpful to this group to outline this procedure:

1. The Deputy Secretary of Mines and Mineral Industries of the pertinent division makes arrangements with mine management to conduct a dust study in a specific mine.

2. The dust study personnel meet the state mine inspector at the mine for the purpose of becoming acquainted with local mine management. At this meeting, the mine inspector goes over the mine map and gives a description of the methods of mining being practiced. It is only for this one-day meeting that our state mine inspectors are delayed in their regular duties. They can, of course, as time permits, accompany our dust study personnel on at least a part of the survey.

3. No attempt is made to study every working place in the mine. During the orientation discussion, our dust study per-

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sonnel ascertain the number of ventilation splits, the percentage of retreat mining compared to first mining, and a general description of the haulages over which men are transported. This orientation period has proven most helpful in making plans for the actual survey.

4. Determinations are made of each of the various classifications and in proportion to the number of such classifications in each mine. For example, if there are twenty continuous mining machines operating in a mine, we make an effort to take dust counts and samples at at least half of them. Likewise, the same procedure is followed for each of the various job classifications.

5. Daily samples are correlated into average time weighted exposures. For example, if a continuous mining operator is to be sampled on a certain day, the operator is met at the lamphouse by at least one of our dust study people. The sampling period starts on the ingoing mantrip. Originally, we took 10-minute samples, but we learned that sampled periods of such short duration were not necessarily representative of each individual operation. Now, samples are extended over a one-hour period and at least 30 minutes of that hour represents the sampling time. This is done by sampling for 10 minutes and delaying for 10 minutes throughout the hour. By doing this, we feel that the entire day during high dust and low dust concentrations, periods can best be described.

6. With each time weighted exposure, a dry dust sample is taken. We have tried various devices for collecting dust from the atmosphere without success. Presently, we are collecting adhering dust from ribs and/or timbers. Along haulages, dust traps are installed so that this dust can be collected over an entire shift period.

The quantitative samples are collected in alcohol using a midget impinger. The Department of Health feels that counts should be taken within 24 hours. Some of the coal company-employed hygienists do not agree that this is necessary. However, since this information is sent to the Department of Health, we comply with their directions. The qualitative samples are collected and sent to the Department of Health for analysis. With each time weighted exposure, there is also listed a silica determination of the dust collected during the operation.

In our years of operation, we have sampled five mines. To be of any value, there are not shortcuts to be taken in making a dust survey. Our dust study people are fully familiar with mining and mining operations. It is not necessary for mine management to assign personnel to accompany them into the mine. They stay with the individual classification being sampled on each particular shift and need not be taken into or brought from the mine during the shift. At the completion of a dust survey, reports are prepared and sent only to the interested representatives of each agency and mine management of the sampled mine. Since it was originally agreed that these reports would contain all information pertinent to the survey, they are quite voluminous and are composed of the following:

1. Letters of transmission.

2. A synoptic description of the mine. This description includes the number of persons employed, methods of ventilation, methods of allaying dust, transportation, and conclusions. If, during our dust study, we find that dust concentrations are beyond the allowable threshold limits for an entire average time weighted exposure, this information is given to our district mine inspector for his action. I am happy to report that in the mine study thus far, there has been little necessity for this procedure.

3. Location of qualitative dust sampling points.

4. Qualitative analysis results.

5. A description of the impinger samples taken and the determination of the dust count.

6. Dust size determination from 0 to 10.1 microns.

7. Copies of the various forms used in making this study are attached for your information.

The Department of Health is only interested in dust sizes from 0 to 5 microns. However, some of the coal companies continue these size determinations to 10 microns, and we for the present are doing likewise.

We are too new at this work to offer any definite conclusions. We have learned that ventilation alone is not sufficient for allaying micron-size dust. Likewise, spray systems alone will not sufficiently allay dust particles of this size. We do feel that we have learned conclusively that a healthful atmosphere at working faces, particularly

where mechanical mining is being practiced, is dependent upon an efficient combination of both ventilation and water sprays.

In roof bolting operations, we have been able to determine the efficiency of certain dust collectors. I would like to say at this point that some of these collectors are most efficient. It is this dust containing from 35 per cent to 65 per cent silica, depending upon the nature of the material drilled, that is most harmful.

As this program continues, I am certain that we will be able to offer more conclusive and valuable information to groups of this kind. I feel that I have had an invaluable experience in being permitted to initiate this program in the bituminous division of Pennsylvania. Secretary Evans has emphasized on many occasions that health is a function of our department, and if through this program we can prevent one case of silicosis, anthraco-silicosis, or pneumoconiosis, the program will be well worthwhile.

I am certain that this is not only Pennsylvania's problem, but a problem in all mining states throughout this nation. It is well deserving of our best efforts and consideration.

SAFE PRACTICES IN STRIP MINING

By EUGENE E. QUENON
Director of Safety, Peabody Coal Co., St. Louis, Mo.

Injury records at strip mines, compiled on a tonnage basis, have always been enviable when compared with deep mines, and one is likely to take for granted that serious hazards seldom exist in strip mines.

Shortly after being employed by Peabody Coal Co., I had a very rude awakening to the fact that hazards in the strip mines were numerous—and that many of these hazards were serious and decidedly dangerous.

While many hazards exist in strip mines under normal mining conditions, some of these same dangers become much more serious under adverse weather conditions, and cannot be entirely eliminated without the assistance of improved weather. Peabody Coal Company's injury records definitely indicate that adverse weather has a direct bearing on the increase in frequency and severity rates of accidents at our strip mine operations.

The following example will serve to point out the effect of severe weather changes in the operation and maintenance of our strip mines. Late last Fall, a round of inspections was made at our strip operations. The weather was ideal, and conditions of the pits, haulage roads, equipment, shops and cleaning plants, as well as newly painted buildings and well-kept lawns and yards, all seemed to coincide with the wonderful weather.

Working conditions such as were observed during this inspection, along with the attitude of employees toward adhering to safety practices, gave me a confident feeling that real progress was being made toward an over-all improvement in safe working conditions which would ultimately result in a much lower frequency and severity rate.

A prolonged cold spell of several weeks duration followed these inspections. During this time, the surface had frozen to a depth of 15 inches; and when thawing started, the pleasant surroundings observed a few weeks earlier at many of our mines had, indeed, changed to such an extent that conditions throughout the operation seemed to invite accidents. The hardships caused by muddy terrain not only created new hazards, but were indirectly responsible for several equipment breakdowns. The over-all adverse weather conditions actually appeared to discourage boss, workers and supervisors from following adopted safety practices that were normally in effect.

Other than the main haulage roads and uncovered coal at these mines, the surroundings were a mass of mud that definitely retarded the entire mining operation and created new hazards. Highwalls and spoil banks now presented a definite danger from falling or rolling material; handling power cables in the mud was much more