The Pneumoconioses

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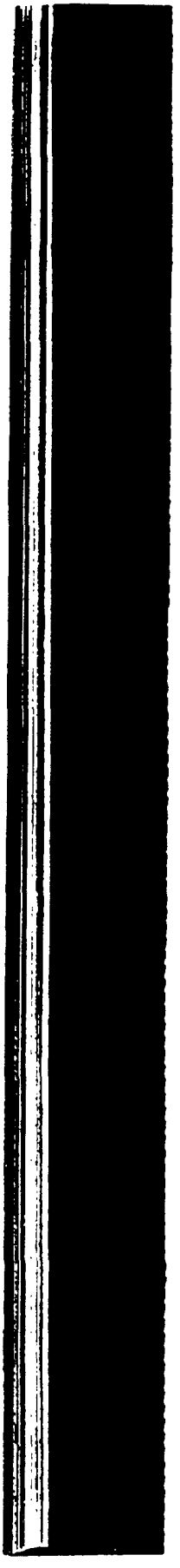

To the Memory of

LEROY UPSON GARDNER

who, as the director of the Saranac Laboratory,

achieved a world-wide reputation in pneumoconiosis research

Preface

Twenty-two years have elapsed since the publication of "Silicosis and Asbestosis" (Oxford Press).

During this interval there has been a continuing and increasing interest in pulmonary disease due to the inhalation of dust and other impurities. There has been widespread activity in combating atmospheric polution on a community wide basis, but the diseases due to inhaling dust in mine and factory are still with us.

On the credit side, research in these diseases has been carried on in many countries. Our concepts of pulmonary pathology and physiology have broadened. There has been marked progress in therapy and prevention, and in the technique of evaluating pulmonary function. Our knowledge is far from complete but with respect to prevention we know more than we are willing to put into action, an all too familiar pattern in preventive medicine. We can hope that this attitude of complacency may be overcome.

The Editor is especially grateful to Dr. Kenneth W. Smith, vice-chairman, Industrial Hygiene Foundation, for his assistance in the preparation of material; to Dr. Andrew Riddell, Provincial Department of Health, Toronto, Canada, for making available X-ray films of silicosis; and to Mr. Paul Herring, New York University Hospital, for preparing films for publication.

THE EDITOR

Introduction

The subject matter of this book concerns several well-known and recognized pulmonary diseases of the lungs resulting from the inhalation of inorganic dust. They are characterized by the formation of fibrous tissue in the lungs, slow onset and by a general resemblance in symptoms. They are grouped under the term "Pneumoconiosis" and are occupational. The following definition of pneumoconiosis was adopted by the International Conference, held in Sydney, Australia in 1950.

"While in a sense the term pneumoconiosis connotes any condition of the lungs resulting from the inhalation of dust that may or may not be of any clinical significance, for the purposes of the International Labor Organization, pneumoconiosis is a diagnosable disease of the lungs produced by the inhalation of dust, dust being understood to be particulate matter in the solid phase, excluding living organisms." To this definition the Editor would add "Also excluding allergic reactions."

There are occupational pulmonary diseases, due to the inhalation of organic dust, such as Byssinosis and Baggasosis and possibly others, which are not included herein.

The inclusion of beryllium disease in this volume may be questioned, but with due consideration of the pros and cons it seemed advisable to include it, though some prefer to term it toxic pneumonitis.

The pneumoconioses have a characteristic in common in that the structural changes they cause in the lungs are irreversible, but further progress in therapy may change this.

CLASSIFICATION OF DUSTS

There are numerous classifications of dust, depending upon the intent of the classifier. The following is offered as being useful and practical for the industrial physician.

1. Organic dust: Fur, feathers and textile dusts with which we are not here concerned.
2. Inorganic dusts:
   a. Inert (non-proliferative) dusts which do not cause pulmonary changes leading to disability or death; *viz.* carbon, graphite iron, calcium and magnesium compounds, lime-

stone marble chalk, gypsum cement and silicates (except asbestos and talc).

b. Poisonous dusts such as lead, manganese and radioactive dusts. This group is not included herein.

c. Dusts producing pulmonary fibrosis or inflammatory lung changes: silica, asbestos, diatomite, beryllium, coal.

It is with group c. that we are here concerned as these are recognized as important causes of disability and death in many occupations the world over.

It is quite possible that as we continue to explore occupational dust diseases there will be additions to group c. and that our opinion of dusts not now included in group c. may be changed.

CHAPTER 4 — Part Three

Pathology of Asbestosis

Our present concept of the pathogenesis and histogenesis of asbestosis is based mainly upon the experimental work of the Saranac group of workers under the guidance of Gardner[1] and more particularly upon the relatively recent summarization of previous findings and extended results by Vorwald et al.[2] There is a dearth of basic information on this subject from other laboratories.

According to Vorwald et al[2] the early asbestotic lesion in the human lung consists of peribronchiolar fibrosis and on the basis of this premise these investigators have become convinced that they have reproduced the experimental counterpart of the human asbestotic lesion in animals. By the same reasoning, they have also arrived at definitive conclusions regarding the pathogenesis of this disease.

The hallmark of asbestosis in the human lung is diffuse fibrosis of the walls of air spaces associated with asbestos bodies. This fibrosis has been loosely designated as "alveolar" fibrosis. There is, in addition, a concomitant pronounced perivascular and peribronchial fibrosis as well as fibrosis of the interlobular septa and of the pleura. Emphysema is usually present in the involved parenchyma. It is characteristic of the advanced stage of asbestosis to demonstrate roentgenologically the greatest involvement at the bases of the lungs. The asbestos bodies consist of symmetrical, club-shaped, golden-brown structures, usually segmented averaging 3 to 5 μ thick and 20 to 50 μ long. It is worthy of emphasis that the mere presence of asbestos bodies is *not* pathognomonic of asbestosis even though the earlier literature has devoted much space to their appearance, genesis, and significance. The presence of these "curious bodies" as they were once called, simply indicates exposure to and inhalation of asbestos fibers.

The asbestos bodies are believed to be formed by the adsorption of proteins upon asbestos fibers in conjunction with endogenous iron, the latter giving the structures their characteristic, golden-brown color. They may be found free in the air spaces or embedded within interstitial tissue but rarely in lymph nodes. Naked asbestos fibers are also frequently seen in the interstitial tissue near asbestos bodies. Vorwald et al.[2] believe that an asbestos fiber which has been

converted into an asbestos body is no longer capable of producing tissue injury.[2] The term *asbestos* body is preferred to "asbestosis" body because the former does not imply the existence of asbestosis. The term, asbestos body in contradistinction to asbestosis body was first used by Schuster.[3]

There is no question but that the experimental work at the Saranac Laboratory, first under the guidance of Gardner and later under Vorwald's direction, represents the most laborious and comprehensive investigation of asbestosis to date. Unfortunately, in spite of the claim that the peribronchiolar fibrosis produced in the animals is equivalent to the early human asbestotic lesion, there is little resemblance of this experimental lesion to that which is found in the symptomatic asbestos worker.* Nevertheless, the diffuse pulmonary fibrosis as it may be found in human asbestosis has been described in a dog by Schuster.[3] This dog had lived in an asbestos factory for 10 years. It is also unfortunate that opportunities to examine early human asbestotic lesions have been rare indeed. There is therefore a need to confirm Gardner's and Vorwald's observation and to document more fully the early asbestotic lesion in the human lung as well as the subsequent developments leading to the fully developed diffuse pathologic entity.

Asbestosis, like silicosis, may occur as a component, either major or minor, in pneumoconioses due to mixed dusts. These dusts, in addition to asbestos, frequently consist of one or more of the following: various silicates, cement, carbon, and silica. In the mixed pneumoconioses, depending upon the nature of the other dusts, it may be very difficult to decide how much of the observed fibrosis is caused by asbestos dust and how much by one or more of the other dusts present.

The relatively pure asbestotic lesion may occur in two forms, as an actively proliferating, interstitial pneumonitis or florid type, and as an inactive, "burned-out," relatively acellular interstitial pneumonitis in which the septal walls are heavily collagenized. The latter is much more frequently encountered (in my experience).

In the florid type of asbestosis there is a very active proliferation of alveolar cells many of which remain attached to the septal wall

*Dr. Ian Webster of the South African Institute for Medical Research informed me that his laboratory has recently successfully reproduced the human type of asbestotic lesions in animals. However, this work has not as yet appeared in print.

and are associated with a supporting reticulin stroma. This stroma is integral with the axial reticulin of the septal wall. Many of the proliferated cells have become detached and give the air spaces the appearance of what has been termed a desquamative pneumonia or alveolar catarrh. The thickening of alveolar walls by the cohesive, proliferated alveolar cells with their supporting reticulin stroma constitutes an accretive type of interstitial pneumonitis.[4] Depending upon the degree to which the cells become multilayered, the air spaces may become reduced and some, even obliterated.

There is also an expansive type of interstitial pneumonitis[4] in florid asbestosis. This is characterized by an edematous widening of the space between the basement membrane of the alveolar capillary and that of the alveolar surface epithelium. Low[5] as well as Policard and Collet[6] and Schulz[7] have demonstrated this space beautifully with electron photomicrographs. Concomitant with the edematous widening of the intermembranous space there is an increase in reticulin fibers within the space. Because the expansive widening of the alveolar wall is limited, there is no significant narrowing of air spaces by this type of pneumonitis.

In the inactive, "burned-out," type of asbestosis, the type most often seen at autopsy, the walls of the air spaces are thickened by collagen and are essentially acellular. The air spaces are generally greatly enlarged. What the anatomical designation of the large air spaces might be is difficult to determine. Their large size precludes their consideration as alveoli. What happened to the alveoli and by what process these structures had disappeared is not known.

A very important and, at the same time, interesting feature of asbestosis is the status of the pulmonary capillary bed. The teaching has been that the main defect in pulmonary function in asbestosis is an alveolo-capillary block and this has been explained on the basis that there is an interposition of collagen or cells between the capillary wall and the free surface of the respiratory membrane. Theoretically, it should be relatively simple to demonstrate such a basic lesion. However, in practice this demonstration is difficult. When a septal wall has undergone collagenous change, the capillary is often difficult to demonstrate. In other situations a plethora of capillaries may suggest an angioma-like appearance upon one or both surfaces of collagenized septal walls similar to the condition described by Pratt.[8] Such capillaries may be very distended, and often expose more than one-half of their cylindrical surface to the alveolar lumen on *one side of the septal wall only*. Usually, the apparently free surfaces of the capillaries show no suggestion of mural thickening. With

such vastly different and divergent pictures represented in histopathological preparations it may be difficult to maintain that there is morphologic support for the functional concept of alveolo-capillary block.

Progression

The literature contains diametrically opposed statements in regard to the progressiveness or non-progressiveness of asbestosis. The only systematic and factual study of this problem was made by Lynch and Cannon.[9] In this paper, 40 autopsied cases of asbestosis were classified and correlated with regard to the presence or absence of fresh fibrosis (florid asbestosis) or old fibrosis (burned-out asbestosis) and the duration as well as the recency of the exposure. These investigators write, "In this series occurs evidence that the disease does not progress beyond a limited time after exposure to asbestos dust ceases. . . ." This conclusion received additional support in the incineration studies of Gross and Smith[10] who found that the amount of acid-insoluble ash in asbestotic lung tissue was, at best, exceedingly scanty and that by virtue of the fibrous character of the dust, it was not readily mobilized during intercurrent episodes of edema and therefore progression (in the sense of the development of new inflammatory dust foci) did not occur.

Opinions to the contrary are either *ex cathedra* statements without supportive evidence, or the evidence rests solely upon clinical or X-ray interpretations without histopathologic substantiation.

There is little doubt but that some asbestotic patients may develop increasingly severe dyspnea even after removal from further dust exposure. It would, however, be improper to assume from such deterioration of the clinical status that the pulmonary fibrosis due to asbestos dust has progressed. Quite commonly it is an associated emphysema and cor pulmonale which account for the increasingly severe dyspnea.

Complications

It is not an uncommon fault of medical writers to use sporadic concomitant findings as the sole basis for claiming an etiologic relationship. Such claims have been made or implied without evidence for many conditions found associated with asbestosis. It is interesting to note for instance, the stress placed by several earlier writers on the presence of bronchitis, bronchiectasis, abscesses, bronchopneumonia, and even tuberculosis in association with asbestosis. Although a relationship between tuberculosis and silicosis has been proven

clinically as well as experimentally, no such relationship has been established for asbestosis and tuberculosis. As a matter of fact, such clinical relationship has been denied[11] and the experimental evidence is also not supportive of this view.[2]

In recent years, the association of pulmonary carcinoma with asbestosis has been the topic of many publications.[12] It seems only proper to expect the same rigorous criteria for the establishment of etiologic relationship between pulmonary cancer and asbestos as have been demanded for the proof that pulmonary cancer is caused by excessive cigarette smoking.

In a careful study which involved such a rigorous application of recommended criteria, it was found that an etiologic relationship between pulmonary cancer and asbestosis did not exist among asbestos miners in the Canadian province of Quebec.[12]

However, Doll's study (in collaboration with J. F. Knox)[13] showed that in a large plant of the textile asbestos industry in England there had been a hazard of pulmonary cancer in 113 male asbestos workers employed for 20 years or more. The risk of lung cancer was about 10 times that expected in the general population. The study also included details of 105 consecutive coroner's necropsies on asbestos workers performed between 1935 and 1953. It included all cases in which asbestosis might have been considered a contributory cause of death. Among these were 15 primary lung cancers associated with asbestosis and 3 primary lung cancers without associated asbestosis. The latter 3 cases occurred in men whose asbestos dust exposure was 12 years or less and after dust control laws became effective. Since the adoption of these laws, there appears to be no evidence that a hazard continues to exist under the working conditions now prevailing in England.[14]

In the United States, sporadic reports of primary lung cancer associated with asbestosis have appeared,[15, 16] most of these cases occurring in people engaged in asbestos textile fabrication or in the installation of pipe insulation.

The development of chronic fibrous and often obliterative pleuritis as well as of lobular septal thickening is very common in asbestosis. Nevertheless, the absence of such pleuritic changes has been noted in cases of manifest asbestosis.[9] The cause of this chronic fibrotic inflammation is difficult to fathom since asbestos fibers, as a rule, are not demonstrable in this fibrous tissue.[9]

Because of the inconstancy of occurrence, Lynch and Cannon[9] suggested that the pleuritic process in asbestosis may be a secondary phenomenon. Another possibility which may be considered is based

on the apparently metastatic character of the fibrosis which suggests that the fibrous reaction is due to a generalized hyperactivity of pulmonary connective tissue cells induced by asbestos fibers. This excessive fibroplasia could be a part of a response to a hypersensitivity to these fibers.

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CHAPTER 9

Prevention

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Basically, prevention is a responsibility of management which by law is obliged to provide and maintain healthful working conditions. On the face of it, prevention is a simple matter—eliminate silica dust and there is no silicosis. Actually this often involves complicated and expensive procedures, calling for the utmost in engineering skill and ingenuity. Immense progress has been made in recent years, and millions of dollars spent in designing dust exhaust systems and adapting them to many types of factory equipment, including textile machinery (where asbestos is used). Standards of air dustiness have been elaborated by Governmental authorities, and consultation service by both Governmental and private authorities is available almost everywhere to industrial firms.

In operation at the plant level, both the industrial hygiene Engineer and the Industrial physician carry the burden of responsibility. The former supervises working conditions, the latter supervises the individual worker. The physicians' function commences with the selection of the applicant for work. Obviously the selection of industrial applicants cannot be made on the same basis as is done in the military services. Men with physical defects can work and must be given the opportunity to work. But in this area of pulmonary dust diseases the examiner can recognize certain conditions which, if present, should bar an applicant from work in the dusty trades.

The following comments on selection, are contributed by Dr. Reginald Smart.

"Prospective employees in all dusty industries should have adequate pre-employment examinations. In addition, follow-up examinations should be repeated at regular intervals varying from six months to one year depending upon the particular dust hazards involved.

"It should be emphasized that auscultation of the lungs and heart is more reliable in the detection of early diagnosis of emphysema, bronchitis, bronchial asthma and heart disease than are many laboratory procedures including chest films.

Clinicians and radiologists often do not realize that the x-ray is an inefficient method of detecting the early stages of pulmonary emphysema, pulmonary fibrosis and even of incipient pneumoconiosis.

"Properly taken chest films consisting of postero-antero and left lateral views (the lateral preferably taken with a Potter-Bucky diaphragm) are an extremely important part of the examination. Care should be exercised that these films are taken with modern equipment using a sufficiently short exposure time so as to obviate both cardiac and respiratory motion. The X-ray tube should have a small focal spot which gives a film of sharp and fine detail. Proper development of the films under controlled conditions of time and temperature, and the use of fresh film stock, fresh solutions and intensifying screens of good quality and detail are essential, if films of diagnostic quality adequate for industrial purposes are to be obtained. In our experience, P-A flat and lateral chest films are more useful than stereoscopic views particularly in evaluating such conditions as pulmonary emphysema or fibrosis, hilar adenopathy, pleuritis, tumors, atelectasis, engorgement of the pulmonary vessels, abnormalities of the thoracic cage and diaphragms, and even of pneumoconiosis.

"The annual re-check chest film should always be compared with the earlier X-rays in each worker's file. Only in this way can the physician detect the earliest X-ray evidence of pneumoconiosis or of other chest disease. Furthermore, comparative review of each worker's film series enables the physician to discover at an early date those individuals who are showing unusual susceptibility to dust exposure. Whenever employees develop X-ray findings suggestive of pneumoconiosis after a comparatively short period of dust exposure (two to four years), it has been our policy to advise the worker to leave the industry before he develops serious disease or significant disability."

A further responsibility devolves upon the plant physician. All toxic materials used in plant processes should be identified, as well as the areas where exposure occurs.

All materials which *may become toxic* by treatment or by combination with other materials, nontoxic in themselves, and the areas where such changes may take place, should be identified.

All employees coming into contact with toxic materials should be trained to know these materials, and how to handle them safely, as well as how to maintain cleanliness and good housekeeping.

All this implies a planned educational program which is a responsibility of both the engineer and the physician. Each has his contribution to make. Unless employees and also the *foreman* understand *why*, for their own good, it is essential for them to cooperate in such a program, efforts at prevention will fall short.

Where practicable, nontoxic materials should be substituted for toxic ones. Engineering design, or redesign may be necessary to overcome toxic exposures.

Face masks, respirators, helmets or other protective devices have a limited value, and their use should be mainly restricted to emer-

gencies (except where equipment such as positive pressure helmets are obligatory as in sand blasting). It is important that all individual protective devices be kept clean and in good working order. It is a responsibility of management to see that this is done.

In summary, prevention requires the cooperation of engineer and physician. The engineer installs ventilation and dust exhaust equipment, but it remains for the physician and the industrial hygienist to determine whether these installations are accomplishing the desired result. If check examinations of the working force reveal cases of early or beginning pneumoconiosis, obviously the installations are faulty in design or are not being properly maintained. As in the practice of all preventive medicine, constant vigilance is essential and nothing should be taken for granted. (On more than one occasion, the writer has observed a dust exhaust system removing dust from one portion of the plant and allowing the dust to flow back into another portion of the same plant.)

CHAPTER 10

Medicolegal Aspects of the Pneumoconioses

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In our approach to the subject matter of this chapter it is advisable to have a clear concept of the definition of "Pneumoconiosis." The term has been the subject of various definitions, but the following seems to express a modern concept:

> "Pneumoconiosis is a broad generic term used to describe all forms of pulmonary reaction to dust lodging within the lungs, with no implication as to the character, severity or the effect on function."[1]

Similar interpretations have been made by Sander, Wright and Vorwald.[1] Attention is called to the following statement appended to a resolution passed at the International Conference on the Pneumoconioses at Sydney, Australia in 1950.

> "The Conference deprecates further extension of terms beyond those already in common use and suggests that for the future the terminology of 'Pneumoconiosis' should take the form of naming the dust to which the worker is exposed or alternatively the industry or process concerned."[2]

The concept of this term indicating deposition of dust within the lungs, occasions various legal problems incident to the injury resulting to the individual who has sustained the condition. It raises the question as to the right of the subject to maintain a cause of action for damages or file claim for compensation against the employer in

AUTHOR'S NOTE: The writer assumes full responsibility for all statements contained in this chapter. He has consulted with Dr. Anna M. Baetjer, Associate Professor, School of Hygiene and Public Health, Department of Environmental Medicine, Johns Hopkins University, Baltimore, Maryland; Dr. Arthur J. Vorwald, Professor and Chairman, Department of Industrial Medicine and Hygiene, Wayne State University, Detroit, Michigan; Mr. Andrew Kalmykow, Manager of Casualty Department, Association of Casualty and Surety Companies, New York City; and Dr. Milton Helpern, Chief Medical Examiner of New York City, from whom he has received helpful suggestions.

All legislative references are as of November 1, 1961.

his employment where dust prevailed causing injury to the individual so exposed. These problems are varied and have led to special provisions contained in legislative acts in the various States of the United States. The pneumoconioses attained national prominence at the time of the National Silicosis Conference, when consideration was given by the Secretary of Labor and various committees to the medical, engineering, economic, legal and insurance phases of the disease of silicosis.[3]

The sequelae to this conference were the enactment of various amendments to State compensation laws to provide compensation for the pneumoconioses with particular reference to the diseases of silicosis (resulting from the inhalation of Silicon Dioxide—SiO_2) and asbestosis (resulting from the inhalation of Asbestos). There is no uniformity in this legislation, although many of the laws enacted have similar features, and consideration will be given to the legal aspects of the disease.

Legal Remedies for Employees Sustaining Pneumoconioses

Prior to the enactment of the workmen's compensation laws of the various States making provision for the compensation of pneumoconiosis, certain jurisdictions recognized the common law liability of an employer for occupational disease injuries sustained by his employees, while other jurisdictions had declined to recognize any common law right of action for injuries so sustained. The primary purpose of the workmen's compensation acts of the several States was to make the employer an insurer for accidental injuries sustained by his employees. By judicial interpretation of these statutes, the courts of some States have held that occupational disease injuries were within the definition of "personal injuries," while the courts of other States have expressly denied the inclusion of occupational disease injuries as within the purpose or contemplation of such acts.

The English common law has always recognized and enforced the liability of an employer for injuries to his employees caused by the employer's negligence. Therefore, in those jurisdictions that upheld the right of an employee to maintain common law actions it was encumbent upon the employee to prove the employer's negligence in the conduct of the manufacturing operation where hazards of the disease existed. In common law actions, the employer retained his common law defenses of[1] employee's assumption of risk,[2] employee's contributory negligence, and[3] negligence of employee's fellow servants. Upon the enactment of compensation statutes, the employer became an insurer of his employees for all injuries made compensable

by the statute. This resulted in the abolishment of the employer's common law defenses. Benefits to the employee became limited to the schedules set forth in the statute. This effected the prompt payment of compensation benefits at the time when it was most needed by the injured employee. Common law trials were eliminated, resulting in the removal of this type of claim from our courts of common law. Technical legal procedures was dispensed with, trials were eliminated, and administrative agencies were established to award financial compensation to the injured employee during the term of his disability, or the payment of benefits to his dependents in the event of his death. All of the States of the United States have enacted workmen's compensation laws and only the States of Mississippi and Wyoming have failed to extend these laws to compensation for occupational diseases. Sixteen States[4] provide so-called scheduled coverage for occupational diseases naming the specific diseases which are compensable under the statutes. The employer may elect general coverage under the laws of four States: Montana, Nevada, Tennessee and Virginia. Twenty-eight States[5] and the Federal jurisdictions under the Longshoremen's and Harbor Workers' Compensation Act[6] provide so-called general coverage which makes compensable any and all occupational diseases. Therefore, the disease of pneumoconiosis is compensable in these States and in Federal jurisdictions. Specifically, the disease of pneumoconiosis is compensable in Alabama, Louisiana and New Hampshire. The diseases of silicosis and asbestosis are compensable in Arizona, Colorado, Georgia, North Carolina, Tennessee, Texas, Vermont and Virginia; silicosis, asbestosis, and berylliosis are specifically compensable in New Mexico; and silicosis, asbestosis and anthracosis are compensable in Oklahoma. The disease of silicosis is specifically compensable in Idaho, Iowa, Kansas, Maine, Montana and New Hampshire; silicosis and brucellosis are compensable in South Dakota.

Concepts of Injury

In order to determine the exact definition of the term "injury" in any given jurisdiction, reference should be made to the statute of the particular State in question or to judicial decisions defining that term. However, the following definitions of the term "injury" are available:

> "Damage or hurt done or suffered; detriment to, or violation of, person, character, feelings, rights, property, or interests, or the value of a thing." (Webster's New Collegiate Dictionary).

"Any wrong or damage done to another, either in his person, rights, reputation, or property. An act which damages, harms, or hurts." (Black's Law Dictionary).

The following citation from Black's Law Dictionary (Fourth Edition) relates to the term "Personal injury" as used in compensation acts:

"In Workmen's Compensation Acts, 'personal injury' means any harm or damage to the health of an employee, however caused, whether by accident, disease, or otherwise, which arises in the course of and out of his employment, and incapacitates him in whole or in part.[7] A disease of mind or body which arises in the course of employment with nothing more is not within the Massachusetts act, but it must come from or by an injury, although that injury need not be a single definite act, but may extend over a continuous period of time.[8] A 'personal injury' as that term is used in the Workmen's Compensation Act, refers not to some break in some part of the body, or some wound thereon, or the like, but rather to the consequence or disability that results therefrom."[9]

Concepts of Disability

The objective of the enactment of the workmen's compensation statutes of the various States was to award monetary benefits for disability resulting from injuries arising out of and in the course of employment. It will be noted that the benefits so payable are for *disabilities* resulting from injuries and *not* from the diagnosis of a disease or condition. There is a distinction between the diagnosis of the disease of pneumoconiosis and disability arising therefrom.[10] One common feature of all compensation statutes is to provide for the payment of compensation based upon a percentage of the claimant's average weekly wage determined at the time the injury occurs. Generally, there is some monetary limitation of liability expressed in dollars payable per week; provision being made so that compensation is paid at the rate of 66–2/3 per cent of the average weekly wage of the claimant, not to exceed a certain monetary figure. Therefore, the principle was established that compensation was to provide payment of monetary benefits in lieu of wages that the claimant was losing due to disability resulting from the given injury.

It is interesting to consider the various concepts of the term "disability." The common law theory was that the term represented "injury to the body." Reference is here made to the following definitions of the term "disability" that have assumed general popular usage:

"State of being disabled; absence of competent physical, intellectual or moral power, fitness or the like; also the instance of such lack." (Webster's New Collegiate Dictionary).

Without making reference to the concept of the term used in compensation statutes, Black's Law Dictionary (Fourth Edition) defines the term "disability" as follows:

> "Absence of competent physical, intellectual or moral power; impairment of earning capacity; loss of physical functioning that reduces efficiency; inability to work."[11]

Since we are dealing with the concept of the term as used in the occupational disease provisions of workmen's compensation statutes of the various States, examination of these statutes shows a variety of definitions. Where the term is not defined in the language of the statute itself, such definition is left to administrative or judicial interpretation, and to that end a review of the important decisions is necessary to define the term in any given State where it is not defined by statute. Occupational disease compensation statutes have adopted three distinct concepts of the term, as follows:

The first concept is found under the law of the State of New York:[12]

> "Whenever used in this Article: . . . 'Disability' means the state of being disabled from earning full wages at the work at which the employee was last employed."

This definition is followed in the laws of the States of Iowa, Michigan, Minnesota, North Carolina, and Rhode Island.[13] It is to be noted that this definition presupposes wage loss in order for the claimant to receive disability benefits. Assuming that an employee has the disease of pneumoconiosis but has sustained no wage loss under this theory the claimant would not have a basis for compensation. Definitions of this type apparently give effect to the purpose and objective of the enactment of compensation statutes, namely to substitute monetary benefits during the period when the injured employee has sustained a wage loss.

The second concept of the term "disability" is found in the law of the State of Arizona:[14]

> " 'Disablement' means physical incapacity by reason of an occupational disease as defined in this chapter to perform any work for remuneration or profit."

This concept is followed substantially in the laws of the States of Georgia, Montana, Nevada, New Mexico, South Carolina, and Utah.[15]

The third concept of the term is found in the law of the State of Idaho:[16]

"Except as hereinafter otherwise provided in this chapter, 'disablement' means the event of an employee's becoming actually and totally incapacitated, because of an occupational disease, from performing his work in the last occupation in which injuriously exposed to the hazards of such disease."

This definition is substantially followed in the laws of the States of Kansas, Maryland and South Dakota.[17]

Examination of the language set forth in the statutory references above indicates that the New York statute presents the fairest concept of this term to both the employer and the employee, providing that disability is dependent upon loss of wage. The second concept set forth in the Arizona statute seems to be too extreme and unfair to injured employees. Compensation would be dependent upon the fact that the employee was permanently and totally disabled and unable to do any work for profit in any other trade or occupation. The third concept, referred to in the statute of Idaho, will present problems for the administrative agencies. It is possible for an employee to be adjudged as permanently and totally disabled from pneumoconiosis on the theory that he should not be returned to work in a dusty trade. He may be able to procure some employment in other trades or occupations where he has not sustained any wage loss and where, as a matter of fact, he may procure wages in excess of those received in the employment where his injury occurred. In the event the claimant's pneumoconiosis is complicated by an active tuberculosis infection it would seem proper to provide that he should receive an award of permanent total disability. In such cases, it would be desirable to remove the employee from the continuing exposure to dust and also to eliminate the possibility of the exposure of fellow employees to tubercle bacilli.

The writer wishes to call attention to the fact that for the actual determination of the technical definition of the term reference should be made to compensation statutes or judicial decisions within the State that is the subject of inquiry. As indicated, there is lack of uniformity in this concept which will inevitably give rise to differentials in administration of the various State laws.

Special Legislative Provisions Applicable to the Pneumoconioses

With respect to compensation for the pneumoconioses, there are many different provisions in legislation that have been enacted and a summary review thereof will be of interest. Consideration will be given to the following subjects:

(1) Designation of State legislation to provide medical boards or medical examiners to assist the administrative agencies in their determination of the claims.
(2) Time limitations for the filing of claims.
(3) Time limitations relating to death benefits.
(4) Provisions for medical and hospital care.
(5) Compensation for partial and total disability.
(6) Monetary limitations for liability.
(7) Statutory requirements for exposure within the State where compensation is sought.
(8) Legislation applicable to Second Injury Funds.
(9) Waivers of compensation.

(1) *Designation of State legislation to provide medical boards or medical examiners to assist the administrative agencies in their determination of the claims.*

Assuming that a given claim for pneumoconiosis is contested, the principal questions presented for decision by the administrative agency are medical questions, namely, the determination of the following issues:

Whether or not the claimant has sustained an occupational disease compensable under the statute, and the nature and extent of disability.

The following States make provision for the appointment of medical boards, panels or consultants to resolve these questions or to serve in an advisory capacity to the industrial commission: Arizona, Colorado, Georgia, Idaho, Iowa, Maine, Maryland, Montana, New York, North Carolina, Ohio, Oregon, Rhode Island, South Carolina, South Dakota, Texas, Utah and West Virginia. The use of medical boards or special medical examiners has been the subject of criticism on the theory that it is practically impossible to procure totally impartial, unprejudiced medical opinion; furthermore, that the litigants have the right to present their own medical testimony and that the use of medical boards and panels or medical examiners belittles the honest opinion expressed by medical witnesses that may differ from the decisions of such boards or examiners. The purpose of the enactment of compensation statutes was to avoid the express hazard and uncertainty of technical legal trials in the determination of the issues presented during the course of the hearing by the least expensive method that is possible. It may be that any qualified doctor assigned to a panel or as a consultant to the administrative agency for the purpose of resolving the medical issues in a given case may

have a background of professional employment that tends to make him partial either to one side or the other. The fact remains that in a given case, his opinion would be independent of any allied interest in the litigation and would, therefore, serve the ends of justice for the determination of these issues. With respect to the appointment of medical consultants or boards, there is no uniformity as to the legislative provisions involving their appointments and reference should be made to the statute of any given State to ascertain the powers, duties and effect of the opinion of medical boards or consultants. From the standpoint of proper administration of justice, it would seem desirable that the panel or medical board should have available to it all of the germane medical testimony involved in the case, including all medical reports, X-ray examinations, history of the case, nature of exposure to dust, and the extent of such exposure, together with full details of the employment record. Independent of the opinion of the board, or panel, each party should have the privilege of offering such medical testimony as it deems necessary for the proper presentation of its case.

It must be further borne in mind that the use of boards or panels would vary from State to State, depending upon the industrial conditions in any given State and the location of industrial activity within that State. What might be suitable for the State of Utah would not necessarily be suitable for the State of New York. In those States that have employed the use of medical boards or panels their operations have generally been successful. Every effort should be made to avoid political appointments to boards or panels to the end that the best medical opinion with respect to the particular disease that is the subject of complaint could be made available to the administrative agency.

(2) *Time limitations for the filing of claims.*

This subject has presented one of the most troublesome legislative provisions incorporated in any of the State laws, and again there is no uniformity among State laws. All laws include a period of limitation within which claims must be filed. Examples of these provisions are:

A fixed period of time after injury.

A fixed time after disablement.

A fixed time after the employee knew or should have known of the existence of the disease or disability.

A fixed time after the first manifestation of the disease.

A fixed time after last exposure.

A fixed time after the last payment of compensation.

A fixed time after disablement which must occur within a fixed number of years after last exposure.

A fixed time after exposure within which disablement must occur.

With respect to the pneumoconioses, it must be remembered that a given claimant may have demonstrable evidence of the condition over an extended period of time with no attendant disability, discomfort in performing his normal duties, and without his having sustained a wage loss. Query: From what date should the time limitation run in cases of this type? It is known that frequently disability does not occur until many years after the termination of employment or exposure. On their part, the employer or insurance carriers desire to determine liability during the year when the injury occurs or within a limited time thereafter. From the standpoint of the employee who has sustained pneumoconiosis, he may not wish to terminate his employment or make claim for compensation until he is actually disabled or has sustained a loss of wages as the result of the disease. The answer to the question just propounded is among the imponderables of legislation dealing with the pneumoconioses. With enlightened labor leadership and cooperation, the use of physical examinations, including roentgenograms of the chest to demonstrate whether or not the claimant has pneumoconiosis should be extended to pre-employment, during employment, and upon termination of employment. Well-planned medical programs would not only serve to protect the employer but enable the employee to be advised of his condition. After careful study of the time limitations of the various statutes above referred to, the writer recommends a provision with respect to the time limitation of filing claims similar to that contained in the laws of the State of New Jersey, to wit: Two years after last exposure or last payment of compensation, or one year after employee knew or should have known of the existence of the disease, with an overall limitation of five years after last exposure.[18] Assuming that a provision of this type were enacted in the State compensation law, the employer or insurance carrier would be able to terminate liability within a fixed period of time after last exposure which is a determinable fact. On their part, the employees engaged in a dusty trade would have the benefit of a roentgen examination upon the termination of exposure and be advised at that time as to whether or not they had pneumoconiosis, enabling them to file claims therefore within the time fixed by the statute. The existence of pneumoconiosis is medically determinable upon the termination of exposure to dust and it is submitted that no prejudice would arise by the application of this rule.

(3) *Time limitations relating to death benefits.*

With respect to legislative provisions dealing with this subject, there are again numerous differentials among the statutory provisions of the several States, but the basic problem is somewhat simpler because of the certainty of death and the fact that it is proper to require the filing of a claim within a reasonable period of time after death occurs. Examples of the provisions of the various statutes relating to time limitations for the filing of claim after death include the following:

A fixed period of time after death. Death occurring within a fixed period of time after last exposure or following continuous disablement. A fixed period of time after injury.

In all of the States, the requirements exist that pneumoconiosis must be the cause of death in order for death to be compensable.

Upon death, autopsies would disclose the existence of the disease of pneumoconiosis and whether or not it was a causative factor of death. In certain instances, however, an employee with pneumoconiosis may die years after the termination of employment. This frequently happens and in many instances employers and insurers are confronted with the problems of the loss of their records, inadequate records, or the change of insurance carrier. Furthermore, the older the individual becomes the more contributing factors may enter into the cause of death, making it difficult to determine the relationship between the employee's pneumoconiosis and death.

Legislative provisions requiring that death must occur within a fixed period of time after last exposure or following continuous disablement, appear to be the fairest method to employee and employer. The date of last injurious exposure is a determinable date. Proof is available to show the nature of the employment, the evidence of dust in that employment, and whether or not it would be potentially hazardous. Assuming that the employee has suffered continuous, permanent disability as the result of pneumoconiosis, the employer or insurance carrier is apprised of that fact and pays compensation for that disablement. Therefore, it would seem to be proper to extend the time for filing a claim for death benefits until a fixed period after death following continuous disablement.

The provision relating to a fixed period of time after the date of injury opens the case to potential argument and disagreement about the time the injury occurred. Many of the pneumoconioses are benign, while others may progress over an extended period of years with complications of tuberculosis or other pulmonary diseases. A given employee may properly testify that he did not know that he

had the disease because he experienced no disability in performing his normal duties nor did he suffer any wage loss. Our Commissions and Courts have tended to construe provisions of this type to give the employee the benefit of the doubt and to permit him to file a claim when he "knew or should have known he had the disease." This presents an indeterminable time and is highly objectionable to employers or their carriers who wish to terminate their liability in a given case.

(4) *Provisions for medical and hospital care.*

The pneumoconioses assume an aspect separate and distinct from other types of occupational diseases, primarily because no medical cure for these diseases has been found and the basic protection of employees is dependent upon the installation of dust control and other engineering equipment that would prevent the incidence of disease rather than to effect its cure. The most numerous examples of the pneumoconioses are silicosis with its variations and asbestosis, which may produce disability or death.[19] There does not seem to be the need for extended medical care unless the pneumoconiosis progresses to the state where it is complicated by tuberculosis or cor pulmonale. Assuming that the claimant has compensable pneumoconiosis and needs medical care or hospital treatment these should be provided and the claimant should receive adequate medical attention.

Legislative provisions dealing with this subject differ from State to State. Examples of these provisions are the following:

Same provision for accidental injuries.

A monetary maximum.

Time limitation generally expressed in a number of months of treatment.

Twenty-six States[20] and Federal jurisdictions[6] provide full benefits with no limitation to the amount that is payable. Twenty-two States[21] have limited benefits which may be readily ascertained by reference to the State statutes. Two states (Mississippi and Wyoming) make no allowance for medical or hospital benefits. The statutes of each State must be examined to determine the benefits for medical care and hospitalization.

Unfortunately, with respect to the pneumoconioses, we are dealing with what to date has been an insoluble medical problem in so far as hospital care and cure are concerned. It is to be hoped that medical science may ultimately provide a more satisfactory answer to this question.

(5) *Compensation for partial and total disability.*

Upon statutory amendments making the pneumoconioses compensable in our various States, industry and insurance carriers were concerned with the impact of potential liability for compensation from exposure to dust that had been experienced by employees prior to the enactment of the compensating statute. The phrase "accrued liability" entered into discussion of this problem. The liability was not accrued but potential, because upon the enactment of the compensation statute an employer became an insurer of the health of the employee from the diseases made compensable under the statute. An attempted answer was the enactment of legislative provisions denying compensation for partial disability and only awarding compensation for permanent total disability. There was legislative resistance in many States with respect to compensation for the pneumoconioses, with the migration of industries having dust hazards from the States where these diseases were made compensable to some other State. Allied to this phase of the problem was the fact that in most instances the extent of partial disability was not medically determinable until a given employee was unable to continue his employment or had sustained some wage loss as the result of the disease. Assuming that the employee had disabling pneumoconiosis, frequently accompanied by tuberculosis, the medical profession had no difficulty in determining this fact and recommended that such cases should be compensated for on the basis of permanent total disability. The medical profession was reluctant to recommend that a given employee should be removed from the hazards of exposure to dust in the employment where he had worked all his lifetime and seek employment in some other trade. This is certainly understandable. In some cases legislative provisions were enacted enabling a claimant to transfer from his employment where he would be exposed to the inhalation of injurious dust into other trades or occupations where dust hazards did not exist with compensation to be paid for the injury that he had sustained.[22] However, the number of cases in most of the States where this practice was followed has been somewhat limited, primarily because of the reluctance of long-term employees to give up the jobs with which they were familiar and seek employment in other trades. Again, there is no uniformity with respect to this legislation and reference must be made to the statutes of the different States to determine the exact status of the rights of the claimant or the liability of the employer or insurer. It is probable that in the event of an economic recession, claims may be filed for partial disability even though no actual disability exists, where X-ray evidence shows increased hilar

markings as a result of some dust exposure. This factor is an incentive to retain legislative provision denying compensation for partial disability. Twenty-one States[23] deny compensation for partial disability, whereas twenty-seven States[24] and Federal jurisdictions[6] pay some compensation for partial disability.

(6) *Monetary limitations for liability.*

It is practically impossible to be specific with respect to statutory provisions establishing monetary liability for the pneumoconioses and the laws of each State must be examined to determine the benefits that are payable thereunder. As stated above, industry and insurance carriers are concerned about the impact of the passage of laws making the pneumoconioses compensable due to the potential liability for injuries that had been incurred by the inhalation of dust prior to the effective date of the Act. To ease the impact of this burden there was enacted what became known as escalator clauses, whereby a fixed amount becomes payable the first month the Act becomes effective with progressive increases at a fixed rate per month until the whole benefit of the law is reached. Many of these laws have since been amended to eliminate the escalator clauses, although some have been retained. In a number of States maximum benefits are fixed by law while in some States a part of the burden of compensability is shared by special disability funds or by contributions from the State.

Undoubtedly, the escalator clauses above referred to served a useful purpose when first enacted because of the limitation of monetary liability imposed upon the employer. However, the number of claims of silicosis after the enactment of the statutes was not as great as had been anticipated and gradually State legislatures have seen fit to dispense with this method of limitation of liability.

The law now effective in New York State[25] provides compensation for the pneumoconioses only in the event of total disability or death and further makes provision for the payment of compensation in the event that the claimant is totally disabled by dust disease and imposes responsibility for the payment of such compensation upon the employer for the first 260 weeks; the employer continues the payment of compensation thereafter during the claimant's permanent disability, but will have the right to be reimbursed from the Special Disability Fund created under this law. This method may well provide the answer to this most troublesome problem.

(7) *Statutory requirements for exposure within the State where compensation is sought.*

Most of the State statutes contain legislative provisions of a spe-

cific term of residence and exposure to dust in the State wherein application for compensation is made. Again, there is no uniformity in provisions of this type. The purpose of the requirement is to avoid the possibility of a claimant having had exposure in one industrial State going to another State where the benefits under the compensation act were more liberal, or from procuring compensation in the second State unless he meets the statutory requirements with respect to exposure in that State. The term of years for exposure within a given State vary as well and reference must be made to individual State laws to ascertain the answer to the compensability of a claim in any given jurisdiction. The same rules are applicable to death benefits requiring an adequate term of exposure in the given State where compensation is sought before a claim would be compensable.

(8) *Legislation applicable to Second Injury Funds or Special Disability Funds.*

When careful consideration is given to compensation for the pneumoconioses, the natural question arises as to what method could be employed to answer the questions above presented. Potentially, the answer may be found in legislation creating Second Injury Funds or Special Disability Funds in the various States of the Union. These Funds are administered in connection with the Workmen's Compensation Laws of the several States and have as their objective the incentive to employ handicapped workers who sustained a previous injury and who later apply for employment and may sustain a subsequent injury on the job to which they are assigned. The objective of these Funds is to enable the disabled employees to receive full compensation for disability that may result from continuing employment, while the liability of the employer is limited to the benefits due to the second injury; the Second Injury Fund or Special Disability Fund being responsible for permanent total disability representing the differential between the second injury and previous injury. Employees who contract the disease of pneumoconiosis generally find it difficult to obtain employment in those trades where dust hazards exist and where they represent the potential of liability in the event their pneumoconiosis becomes permanently disabling. These laws were given impetus to insure returning war veterans the opportunity for employment if they had suffered some type of permanent injury, such as the loss of a leg, arm or other member of the body, as the result of war casualty. Why cannot this concept be extended to provide compensation for disabling pneumoconiosis pro-

gressing to disability after re-employment in a dusty trade wherein the employee is exposed to the continuing hazard of harmful dust? With respect to legislation dealing with this matter, there is no uniformity in the statutes of the several States. Second injury laws are now effective in all but five States.[26] As of November 1, 1961, only sixteen States[27] and Federal jurisdictions[6] have broad coverage. In the remaining States the coverage is so narrow that the Funds apparently do not serve the purpose for which they were designed and would not provide compensation for disability from the pneumoconioses in the event of permanent disability. Why should not coverage afforded by this legislation be extended to prospective applicants for employment in dusty trades who have had previous exposure to dust with demonstrable evidence of pneumoconiosis? Should these people be relegated to the human scrap heap and be classed as unemployable? Would not the extension of the Second Injury Fund laws to cover this situation be the answer to what is perhaps one of the most troublesome problems in the field of occupational disease legislation?

It is a fact that today applicants for new employment who give a history of previous exposure to dust are generally submitted to X-ray examinations of their chests and if these examinations disclose potential pneumoconioses and a dust hazard exists in the particular plant or operation where they are to be assigned to work they will be denied employment in order to protect the prospective employer from a compensation claim for total disability, which may be exceedingly costly under the statute. By extending the Second Injury Fund legislation to cover the pneumoconioses, the prospective employer would have his liability limited to a fixed amount for the second injury and the Fund would pick up the liability for the difference between the second injury and total disability which had resulted from the accumulation of dust throughout the entire period of the employee's employment. It is probably improper to designate these Funds as "Second Injury Funds" and the name should be changed to "Special Disability Laws." New York State has so designated its Fund.[28] The difficulty presented is the actuarial determination of compensation costs. The question arises as to whether or not the administration of the law will lead to the imposition of excessive burdens upon the Fund after it has been created. With that in mind, it may be desirable to place some monetary limitation of liability upon the Fund in the first instance which may later be increased, dependent upon experience in the administration of the law. Such a

method would be protective of the interests of the employers and insurers and assure the payment of reasonable compensation to the employee or his dependents in the event of death.

Consideration should be given to the legislative provisions of the compensation statutes of Arkansas, Minnesota, North Carolina, Ohio, South Dakota, Texas and Wisconsin[29] which have endeavored to solve the problem of the replacement of employees who have demonstrable nondisabling pneumoconiosis in employment where they would not be subject to the continuing exposure to hazardous dust.

Under the Workmen's Compensation Law of Wisconsin,[30] in the event an employee has a nondisabling silicosis and is discharged from employment in which he is engaged or when he ceases his employment and it is in fact inadvisable for him to continue on account of the disease and he suffers a wage loss by reason of such discharge or cessation of employment, the Commission may allow such compensation on account thereof as it may deem just, not exceeding $7,000. The statute provides for an examination by a physician or physicians to be appointed by the Industrial Commission and the employer and employee may have the opportunity of a hearing before the order is passed. Refusal of the employee to submit to examination would bar his right to compensation and the payment of compensation as ordered by the Commission estops the claimant from any further recovery.

The plans referred to may be beneficial or detrimental to the employee and to the employer. With respect to the employee, he is removed from the continuing hazard of exposure to dust. On the other hand, he may be deprived of continuing in a trade or occupation with which he is familiar and become expert and thereby required to change to some other occupation free from the exposure of dust where he may not be able to command the wage scale that had previously been his. From the standpoint of the employer, there is imposed upon him immediately the financial cost of compensation. On the other hand he is relieved of the potentiality of the claim becoming one of permanent total disability.

Neither of these methods seem to be as equitable as a system providing compensation by way of a Special Disability Fund applicable solely to the pneumoconioses.

Incident to legislation dealing with the Second Injury Funds or Special Disability Funds is the method by which these Funds should be financed. Two States, California and Pennsylvania, wholly finance their Funds with appropriations. Two other States, Kansas and Wyoming, originally financed their Funds in this manner but both

now require payment to the Fund by carriers or self-insurers in death cases where there are no dependents. The State of Massachusetts provided a Second Injury Fund for war veterans, appropriating funds for that purpose and specifying that when the Fund became exhausted the State Treasurer should pay the benefits from a general fund without specific appropriation. As a practical political matter the accomplishment for the financing of these funds by public appropriation poses many difficulties. Legislatures generally would be reluctant to appropriate public funds for injuries that occur in industry. Therefore, it seems proper that the burden of financing these funds should rest upon contributions to be made by employers, self-insurers, or insurance carriers. The methods prescribed for such financing differ under the laws of many of the States, but generally speaking provide for contributions either in death cases where there are no dependents or a percentage of the premium paid to insurance carriers. The underlying difficulty is the lack of actuarial data that would provide a sound basis for determination of the cost. Assuming that the law provided for limitations of monetary liability for totally disabling pneumoconiosis, the impact of the cost upon employers and carriers would be eased; benefits could be increased dependent upon the cost of compensation as revealed by experience over a number of years.

It would seem desirable to have a Special Disability Fund entirely separate and distinct from the Second Injury Funds presently effective in the various States. The reason for this suggestion is that the problems of compensating for the pneumoconioses as above set forth differ from other types of injuries. Assuming that it would be desirable to place some limitation of liability upon the employer until adequate actuarial data could be ascertained it may be desirable from time to time to increase the amount of compensation payable. The basic problem of the evaluation of disability from the pneumoconioses is one which must be resolved by medical research before a satisfactory legislative answer can be found for compensation for partial disability. Much has been accomplished in the medical field with respect to the determination of disability but much remains to be accomplished. The problems presented by the pneumoconioses are unique and undoubtedly distinct from those of other occupational diseases.

(9) *Waivers of compensation.*

Another legislative provision occurring in the laws of a number of States relates to the permitting of waivers for persons who are disabled by the pneumoconioses. In the original enactment of legis-

lation making pneumoconiosis compensable, some of the States permitted handicapped workers, particularly those who had served in dusty trades, to waive their rights to benefits for an injury that had been caused or contributed to by a previous disability. The objective was to assure the continuance in employment of those who had demonstrable evidence of the disease of pneumoconiosis and to avoid their release from employment. Six States[31] permit waivers by affirmative legislative provisions. Sixteen States[32] permit waivers upon the approval of the workmen's compensation agencies. In twenty-six States[33] and Federal jurisdictions[6] waivers are not permitted. Assuming that a given applicant for employment has demonstrable evidence of the disease of pneumoconiosis, he may be unable to obtain employment in some other industry where he would be exposed to the continuing hazard of dust. Representatives of labor, most insurance carriers and most employers have refused to resort to the waiver system, although it is available for legal use as above set forth. While there has not been uniform agreement among employers, employees, administrative agencies and insurance carriers with respect to the use of waivers, they certainly do not solve the problem of the physically handicapped worker who has previously been employed in a dusty trade and seeks further employment with another employer in a trade similar to that in which he has been engaged. Therefore, it may be stated that the use of waivers defeats the basic purpose of the compensation law.[34] Certainly, with respect to the pneumoconioses and the inability to evaluate the percentage of disability that the employee has sustained at the time of his change of employment, waiver provisions appear to be unfair to the employee although a modification of this rule may be found in the statutes of Arkansas, Minnesota, North Carolina, Ohio, South Dakota, Texas[29] and Wisconsin.[30]

The aforegoing discussion indicates some of the major problems that arise in connection with compensability of the pneumoconioses under the compensation statutes of various States. As indicated in the beginning, these diseases were dramatized by the National Silicosis Conference, and have since been the subject of continuing consideration by our various State legislatures. None of the laws presently enacted are letter perfect nor would it be proper to recommend legislative provisions enacted under the laws of a given State for some other State where industrial conditions may be entirely

different. The provisions of the law must be adjusted to the needs of the particular State where it is to apply, although there are certain basic injustices in the present laws, as above pointed out, which can and should be corrected.

The personnel of most State Legislatures includes a major number of attorneys who have approached the enactment of this legislation primarily from the legal point of view. In some instances, medical societies have interested themselves in the enactment of this legislation but legislative committees have not received from the medical profession the basic information that they need to mould the laws into vehicles that may be successfully administered. Claims for the Pneumoconioses in most States represent but a small portion of occupational disease claims although they have been singled out for specific statutory provisions that may not be applicable for the compensation of other occupational diseases. Experience indicates that improvements in the present laws are possible of accomplishment with intelligent, cooperative approach by labor and industry.

Perhaps the ultimate answer to the problem of the pneumoconioses lies in the perfection of our industrial processes to the end that the disease may be prevented. Tremendous advances have been made in this respect in all of the dusty trades during the past thirty years. It has become good business for industry to conduct its operations with full consideration of the health and welfare of its employees to eliminate any potential hazards that exist in industrial processes, but if a disease such as one of the pneumoconioses occurs it should be properly and adequately compensated under the law. The human element will continue to exist; there will be breakdowns in machinery and protective equipment; there will be continuing carelessness on the part of employees exposed to dust hazards. Those responsible for the conduct of our industrial operations must assume programs of continuous and effective engineering and medical controls. By these methods the pneumoconioses *can be prevented* and the entire matter of industrial relations between employers and employees materially improved.

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South Dakota, Chapter 64.08, Title 64, Code 1939, as amended, §64.0804(b).
18. New Jersey, Rev. Statutes, 1937, Title 34, Chapter 15, 1940 Annotated Supplement, with amendments to date, §34:15–34.
19. The Pneumoconiosis Problem, by Eugene P. Pendergrass, M.D., published by Charles C Thomas, 1958, Page 13.
20. Alaska, California, Connecticut, Delaware, Florida, Hawaii, Idaho, Indiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Washington, Wisconsin.
21. Alabama, Arizona, Arkansas, Colorado, Georgia, Iowa, Illinois, Kansas, Kentucky, Louisiana, Maine, Montana, New Mexico, Nevada, North Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, West Virginia.
22. See Ref. 29.
23. Arizona, Colorado, Florida, Georgia, Idaho, Iowa, Kansas, Maine, Maryland, Michigan, Minnesota, Montana, Nevada, New Hampshire, New Mexico (aggregate amount payable for disablement or death $7,500, New Mexico Statutes annotated, 1953, as amended, §59–11–19), New York, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota.
24. Alabama, Alaska, Arkansas (not compensated if less than 33⅓% disability), California, Connecticut, Delaware, Hawaii, Illinois, Indiana, Kentucky, Louisiana, Massachusetts, Missouri, Nebraska, New Jersey, North Carolina, North Dakota, Oregon, Rhode Island, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin.
25. Chapter 816 of the Laws of 1913 as amended and re-enacted by Chapter 41 of the Laws of 1914 constituting Chapter 67 of the Consolidated Laws as amended, Article 2, §15, Sebd. 8, Paragraph ee.
26. Georgia, Louisiana, Nevada, New Mexico (in 1962 the State of New Mexico adopted the Second Injury Fund Law), Virginia.
27. Alaska, California, Connecticut, Delaware, Florida, Hawaii, Kansas, Maine, Missouri, New Jersey, New York, Oregon, Utah, Washington, Wisconsin, West Virginia.
28. Workmen's Compensation Law of New York State, Article 2, §15, Subd. 8(h).
29. See revised statutes, as amended, of the following States: Arkansas, §14–(5); Minnesota, §176.662; North Carolina, Chapter 97, as amended, §97–616; Ohio, §4123.57; South Dakota, Chapter 426, as amended, §64.0818; Texas, §8(e).
30. Wisconsin, Statutes, 1957, as amended, §102.525(1)–(5).

31. Connecticut, Illinois, Iowa, Maine, Maryland, Massachusetts.
32. Arkansas, Colorado, Georgia, Idaho, Indiana, Kansas, Minnesota, Nevada, North Carolina, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia.
33. Alabama, Alaska, Arizona, California, Delaware, Florida, Hawaii, Kentucky, Louisiana, Michigan, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio (a blind employee may waive compensation), Oregon, Pennsylvania, Rhode Island, Utah, Washington, West Virginia, Wisconsin (epileptics and blind persons may elect not to be covered for these injuries).
34. See Bulletin No. 190 published by the U.S. Department of Labor, Bureau of Labor Standards.

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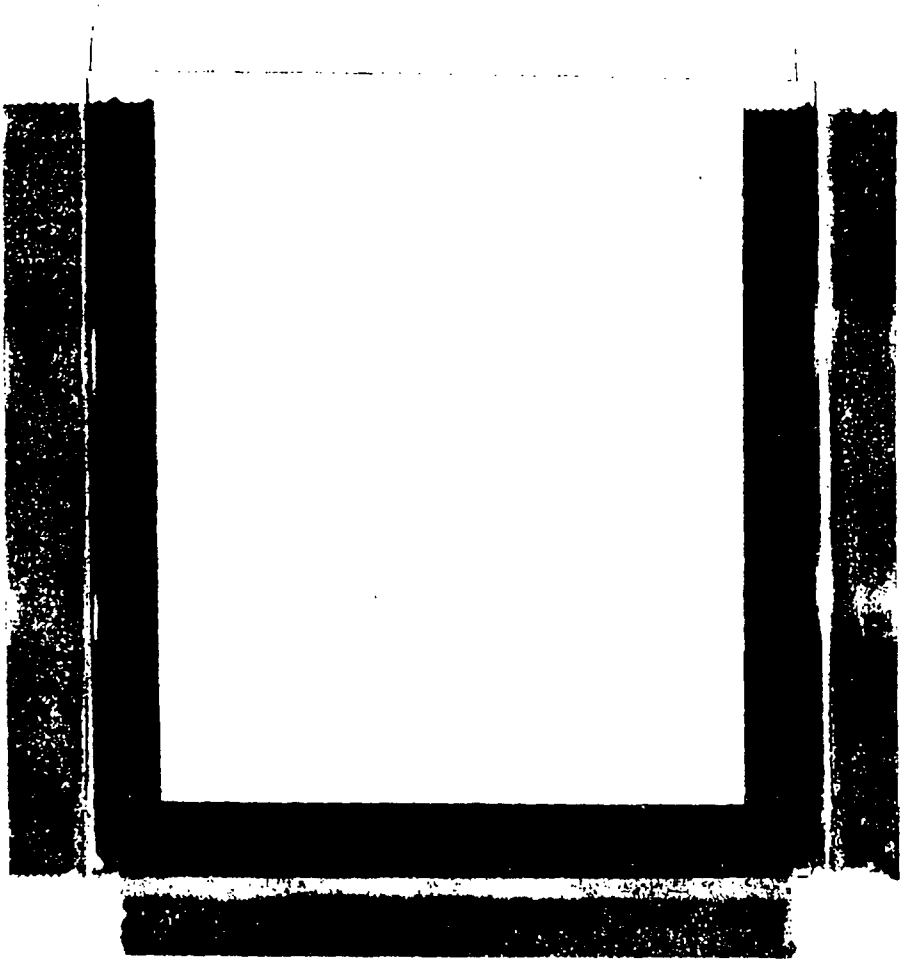

Part One: Four Principles Of Filtration

Air Filtration Basics as Related to Asbestos Abatement

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The purpose of this educational series is to inform the industrial hygienist, consulting engineer and asbestos abatement contractor about the theory and practical uses of air filtration as it relates to asbestos abatement. Generally, most articles written on asbestos abatement discuss the use of various filters and machines to remove asbestos particulates, but do not address the basic theories and principles involved in the process. Violations of these theories will surely cause asbestos contamination.

Air Filtration Basics

Two basic definitions need to be presented which are many times interchanged incorrectly by some industry personnel. The first is *air filtration* which is catching of contaminants in the atmosphere. The second is *air pollution control* which is the collection of contaminants at their source before they get into the atmosphere. These two terms must be understood if one is to discuss asbestos abatement procedures in an intelligent manner.

In the asbestos abatement industry we are using air pollution control theory rather than air filtration theory to abate in the contaminated area.

Principles of Filtration

Viscous Impingement

This principle of filtration uses "inertia" to capture the particles. Heavy particles, when carried in an air stream, tend to move in a straight line even though the air is changing directions when traveling through the bed of filtering media. Eventually the solid particles touch one of the media fibers which is oiled with a sticky adhesive and the dirt particle adheres to the filter fiber.

This method of filtration is used for low or roughing efficiency air filters. The most popular filters under this type are the polyester panel filters and pads used as pre-filters in negative air machines.

Straining

This action occurs when a particle is too large to pass through the media fibers, an action similar to a fly striking an insect screen.

This method of air filtration is used primarily for medium and high efficiency filters, but it also occurs in some types of low efficiency filters.

Examples of this type of filtration are found in most synthetic fiber filters. This principle is used primarily in the secondary stage of filtration in negative air machines, ie., the pleated panel filter and the multi-density internal wire ring filter.

Most air filtration used in respirators, vacuums and negative air machines uses these two principles as their primary or pre-filtration technique in cleaning the contaminated air.

Interception

This principle occurs when air passes slowly through a large amount of extremely fine fibers. Even though the solid particles do not follow the air flow, (due to being lighter than air), the chance for collision is extremely high. This is due to the *diffusional effects*. Very fine particles are bombarded by random motion of air molecules and driven to the filter fibers across the general motion of the airstream. A similar effect takes place as a result of any turbulence present in the gas stream. These effects increase with decreasing particle size. When collision occurs, the dust particles adhere to the fibers due to surface forces, gravity or by the "Brownian Movement," which is the buffeting action of particles in the gas.

The interception principle of air filtration is very important because most atmospheric particles are too small to be removed exclusively by the "Straining" method, or too light to be removed by the "Impingement" method.

(This principle is further discussed in more detail under "Active Forces in Filtration.")

Electrostatic

This method of air filtration uses the electrical theory that attraction between dust particles and collection plates occurs when they are both charged with opposite electrical charges.

Active Forces in Filtration

The necessity to use these principles in *harmony* must be mentioned; and the effects of the principles in ultra-high efficiencies, or H.E.P.A. filters. In H.E.P.A. filtering the operation does not result fundamentally, as is generally thought, from the "Screen" effect, because if this were so how can one explain the fact that a paper with one (1) micron pores retains, with a certain degree of efficiency, particles of 0.3 microns?

In point of fact, the air loaded with dust which arrives on a porous layer is to be divided into a multitude of gaseous micro-currents which travel between the fibers or structure of the material. The particles which are drawn off by the gaseous micro-currents through many changes in direction until the moment at which they are trapped. This practically concerns all types of porous layers, including papers. point of fact, if we consider paper 3/10mm thick, which a standard thickness, a particle of one (1) micron would cross the layer, have to cross distance of at least *300 times* its diameter. During its travel through the porous layer, the particles are retained by the effect of three types of force. These forces are inertia, diffusion and interception.

The forces of *inertia* by which the incident particles come into contact with the fibers or obstacles placed on their route whereas the carrier gas molecules, naturally by-pass the same obstacles; this retention mechanism chiefly concerns large particles, above one micron and increases with the speed of the particle.

The *diffusion* forces which basically exert their action on the sub-micronic particles which behave in the same way as the molecules of gas, and are subject to the Brownian laws of movement; the efficiency of this mechanism is all the greater when the speed of the particle is low.

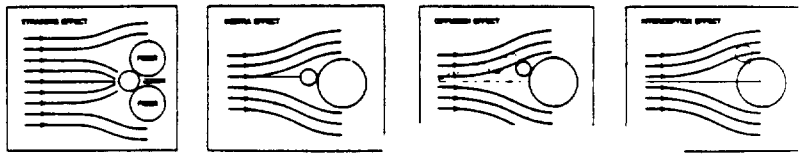
The *interception* forces result from the mass and electric charge of the particles by which some of them are attracted by the fibers of the filtering media.

Penetration

Before leaving the area of air filter efficiencies, it is important to understand that the most important factor in air filtration is the amount of contaminants that get through the air filter (penetration) since this is where the problem occurs. In other words, if a filter is 90% efficient at a given test method and another filter is 80% at the same test method, the 90% filter allows 10% of the test contaminants to pass through where the 80% filter allows 20% of the same contaminants to pass through. In terms of the air cleanliness on the downstream side of both of the filters, the 90% efficient filter is actually twice as efficient as the 80% filter.

A more dramatic comparison is between two filters, one being 99% efficient, and the other 99.97% efficient, at the same test method. In terms of penetration, or relative cleanliness of the air on the downstream side of both of these filters, the 99.97% air filter is actually 30 times more efficient than the 99% efficient one. The 99.99% efficient air filter is 3 times more effective than the 99.97% downstream of the filter.

Part two in the series, March 1987 issue, will discuss test methods in determining the relative efficiency of various types of air filters.



Protective Clothing In Asbestos Removal

By L.B. Zierten
Kimberly-Clark Corp.

Asbestos removal is a hot topic today. As such, discussion on the use and necessity of protective clothing in asbestos abatement is in order.

OSHA Asbestos Standard 1910.1001 (d)(3) requires that respirators and special protective clothing be provided for any employee whose occupational duties expose him or her to airborne concentrations of asbestos fibers greater than the published ceiling levels.

The importance of respirators is (or should be) obvious to those who work in asbestos abatement. Inhaled asbestos fibers can lodge in the lungs, causing asbestosis, a lung disease that has been linked to two different kinds of cancer. Respirators allow workers to breathe without inhaling asbestos fibers.

The Importance of Protective Garments. The use of disposable protective garments is as important as the use of respirators, but for more subtle reasons. Microscopic asbestos fibers and fibrils can lodge in the pores and hair follicles of exposed skin. Normally, workers will shower as they leave the work area. However, this is not enough to remove these small fibers. Outside the work environment, fibers may dislodge from the body and subsequently be inhaled by the worker or by those with whom they come into contact. Disposable garments keep asbestos fibers off the body, preventing subsequent or secondary exposure by the worker and others.[1]

Of course, full-containment disposable garments can compound another health problem associated with asbestos removal: heat stress. In typical abatement operations, the area is sealed off with plastic sheeting, ventilation is turned off and water sprayed on the asbestos to prevent fibers from becoming airborne. These preparations result in a hot, humid environment that can cause physical disorders ranging from relatively harmless heat fatigue to sometimes fatal heat stroke.

The trick is to find garments that prevent dangerous asbestos fibers from getting on the skin, yet, at the same time, allow the passage of air. The latter feature is important because air evaporates sweat on the surface of the skin, which in turn released heat from the body and helps minimize the dangers of heat stress.

Selection a Garment. When choosing garments for asbestos removal, give primary consideration to fabric, construction and comfort. Will it prevent fibers from passing through and lodging on the worker's body?

While a fabric's ability to keep harmful particles away from a worker's skin is certainly important, one should also take into consideration the construction of the garment. The contamination resulting from a garment failure (a rip or tear) is far more serious than any differences there may be between the leading disposable fabrics. OSHA recognizes this fact by incorporating in their regulations procedures relating to ripped or torn garments. Always ask yourself the following: How durable are the seams? Is the garment fitted? Or, does it have excess material that might catch on metal or other objects and rip open? Is it roomy enough to allow workers to move freely without tearing out the seams? Are the garments sized consistently to ensure that workers do not inadvertently rip open a coverall that's too small? These are all questions that one should ask when selecting a garment for asbestos removal.

A Few Words About Heat Stress. As mentioned before, the other common danger associated with asbestos abatement operations is heat stress, which can cause a range of maladies from heat fatigue to heat stroke. Many operations are carried out in hot, humid environments. A garment that does not "breathe," does not allow the passage of air, only exacerbates the problem.

A more in-depth discussion of the effects and dangers of heat stress can be found in the article, "Industrial Gar[illegible] Stress," Industrial Hygiene News, September 1986, p. 58.

Conclusion. In selecting a disposable garment for asbestos removal, one must take into consideration not only the danger posed by the asbestos fibers, but the hazards of heat stress that accompany these operations.

Three crucial factors to keep in mind when choosing a garment are barrier effectiveness, construction and breathability. Of primary importance is the ability of the garment to keep the asbestos fibers off workers' skin. However, one should not underestimate the danger of heat stress, and select their garment accordingly to meet all these needs.

For more information on asbestos removal and protective garments, contact Dan Downey, Kimberly-Clark Corp., 1400 Holcomb Bridge Rd., Roswell, GA 30076.

References
[1]All material in this paragraph from the following: Eric Clay et al. "Protective Clothing: Its Necessity and Use." NAC Journal, Summer 1986, pp. 14-25.

Corrections

Add the following information to the Respirator Supplier Selection Chart:

Scott Aviation, 716-683-5100
Supplies the following types of respirators: Airline Full-Facepiece half mask and has available complete systems and compressors for air-supplied respirators.

National Draeger, 412-787-8383
Supplies the following types of respirators: Full Facepiece SCBA, and emergency escape; and provides filters, panels, compressors and complete air-supply systems.