FILE NAME: Talc (TALC)

DATE: 1960 Nov

DOC#: TALC104

DOCUMENT DESCRIPTION: Medical Journal Article - Problem Areas in Pneumoconiosis

Reprinted from the Archives of Environmental Health
November 1960, Vol. 5, pp. 428-437

Problem Areas in Pneumoconiosis

MORRIS KLEINFELD, M.D., and JACQUELINE MESSITE, M.D., New York

The residual problems relating to the pneumoconioses are numerous. In essence, however, these can be grouped into 3 main areas, namely, (1) the establishment of causal relationship; (2) the evaluation of the degree of disability, and (3) the medicolegal factors. These 3 categories are interdependent and interrelated.

The Establishment of Causal Relationship

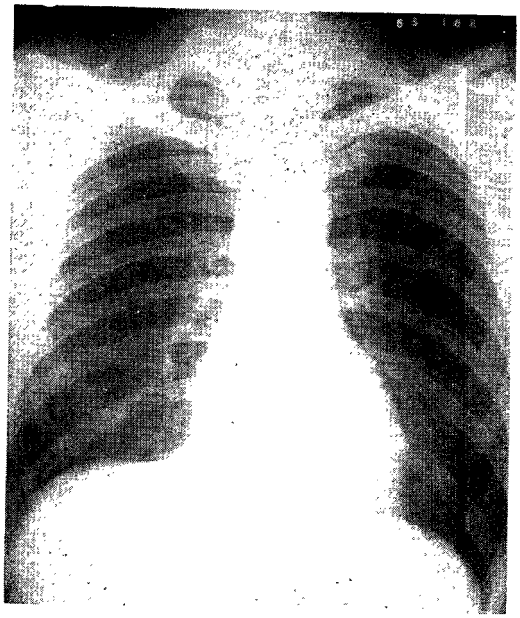
The establishment of causal relationship in any one case requires a knowledge of the occupational chest disease as well as precise information concerning the industrial environment wherein the alleged exposure has occurred. It is in the latter area that the practicing physician is often handicapped, since he does not usually have sufficient information about the industrial environment. This is readily understandable, for rarely does he have the opportunity to visit the work site, acquaint himself with the industrial processes, the materials used, and the degree of protection afforded. Furthermore, evaluation of the work environment often cannot be accomplished by mere inspection but requires detailed chemical and physical analysis of the air-borne dust and parent compounds to which the worker is exposed. Only infrequently does the physician avail himself of a state industrial health agency to obtain assistance in this area.

There are numerous instances which can be utilized to demonstrate how knowledge of both the industrial environment and the occupational chest disease in question is important in determining causality. The following examples will serve to illustrate the importance of knowing some of the factors relating to the industrial environment.

1. *Significance of Particle Size of the Dust.*—A group of workers were exposed to a parting compound which contained 50% free silica. The dust counts taken of the general air and at the breathing zone of the workers at the various operations consistently disclosed air concentrations well above the maximum allowable limit of 5 mppcf. The average duration of exposure of these workers was 12 years. However, in spite of the high exposure, there were only minimal respiratory complaints.

Clinical examination of these workers did not reveal any notable abnormalities referable to the cardiorespiratory system.

Fig. 1.—Posteroanterior view of chest of Patient 1, a silica brick molder who had 18 years of exposure. The roentgenogram shows clear lung fields.



Received for publication Aug. 10, 1960.

Director, Division of Industrial Hygiene, New York State Labor Department (Dr. Kleinfeld). Chief, Medical Section, Division of Industrial Hygiene, New York State Labor Department (Dr. Messite).

No significant incidence of positive x-ray findings for silicosis was obtained.

Figure 1 is a chest roentgenogram which is representative of the group. The principal operation of this worker (Patient 1) was that of a molder for 18 years. He was asymptomatic and no abnormal clinical findings were observed.

The absence of clinical and roentgenographic evidence of silicosis, in the light of a persistent exposure to excessive concentrations of free silica, required further analysis of the dust, particularly for particle size. Of significance, the size of the silica particles was predominantly above 10μ which is beyond respirable range. The lack of consistency between the environmental and medical data is, therefore, explained by the latter observation.

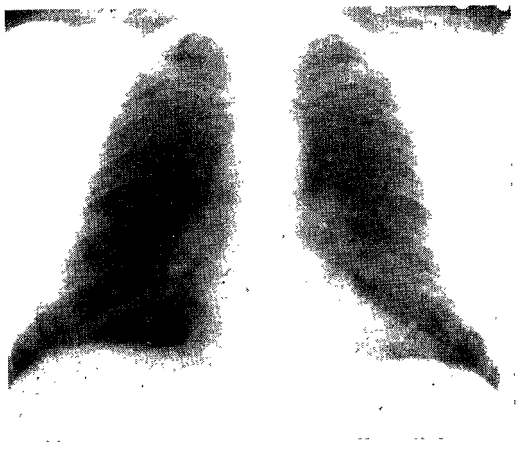
This study emphasizes what is not often appreciated, namely, that exposure to a known toxic dust does not necessarily result in the development of a disabling pneumoconiosis.

2. *Importance of the Physical Characteristic of the Dust.*—Despite similar degrees of exposure to talc dust in two different mills, the workers associated with one plant showed appreciably more respiratory complaints and x-ray evidence of pulmonary talcosis as compared with the other. The only discernible difference was in the physical characteristic of the talc dust. In the plant where the workers' exposure was to the fibrous rather than the granular variety of talc, a significantly higher incidence of dyspnea, productive cough, and chest pain occurred. Similarly, the x-ray findings of the chest were more abnormal in this group. The reason why the fibrous variety is more pathogenic is not readily apparent. Figure 2 is the chest roentgenogram of Patient 2, a talc miller who was exposed to a fibrous variety of dust for 32 years and shows a diffuse fibronodular infiltration bilaterally. This is in contrast to Figure 3, which is the chest roentgenogram of Patient 3, a talc miller who had been exposed to a granular variety of talc for 33 years, and shows only increased bronchovesicular markings. Figure 4 shows a sample of the fibrous variety of talc dust and this is significantly different from the granular type as seen in Figure 5.

3. *The Importance of Knowing the Details of the Worker's Job.*—Not infrequently the physician, while obtaining an occupational history, is misled by his patient's job title. For example, a worker may have a designated title as a "plater," which would imply that he works with plating solutions and is exposed to various

Fig. 2—Posteroanterior view of chest of Patient 2, a miller of tremolite talc for 32 years. Note diffuse fibronodular infiltrations in middle and lower lung fields bilaterally. The left cardiac border is partially obscured by the infiltration.

Fig. 3.—Posteroanterior view of chest of Patient 3, a miller of granular talc for 33 years. Increased bronchovesicular markings are seen.



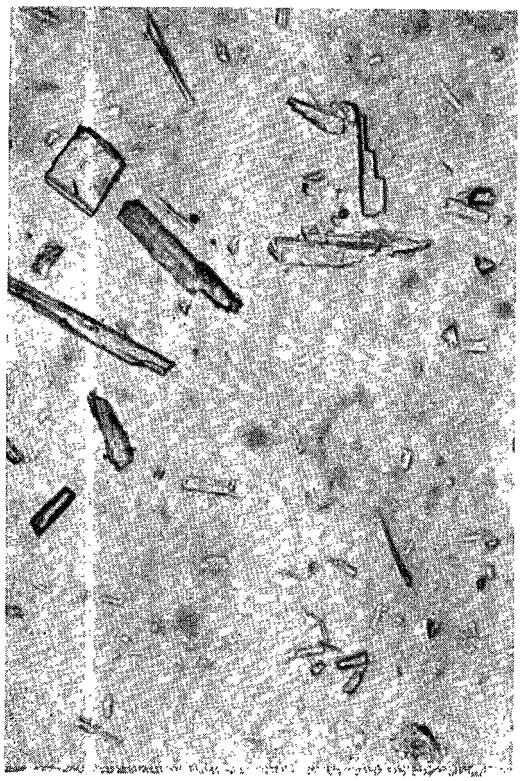


Fig. 4.—Photomicrograph of crushed talc ore showing square and oblong particles and spicules characteristic of tremolite talc; × 725

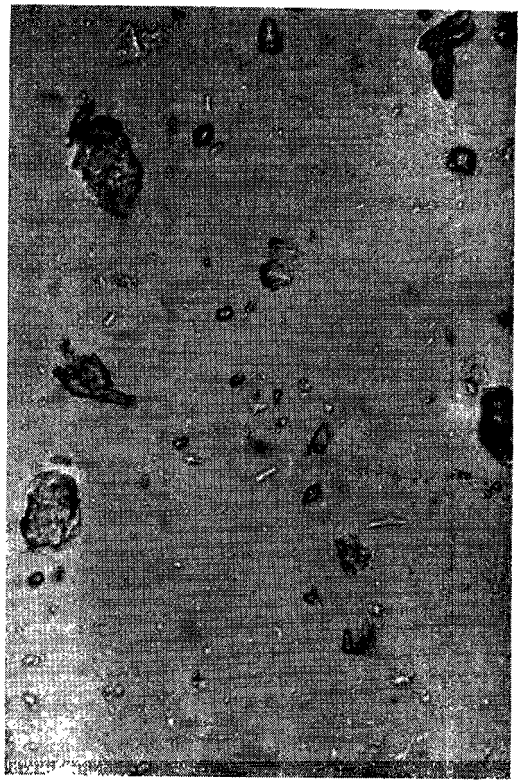


Fig. 5.—Photomicrograph of crushed talc ore showing aggregates of granular or scaly particles; × 725.

solvents and metals required for plating operations. However, he may also do some polishing with a sandstone wheel and thus be exposed to silica dust. To avoid such pitfalls, the physician should make inquiry as to the exact details of his patient's work. At times it is rewarding to know also what other operations are carried on in the vicinity of the patient's area. It is possible that a worker may be exposed to dust from an adjacent operation even though he is not performing it.

The following case illustrates the need for knowing the details of a worker's job.

Patient 4, a 69-year-old white man, was hospitalized because of shortness of breath, wheezing, and pain in the right side of his shoulder of 5 days' duration. His past history revealed that he had been suffering from chronic lung disease for about 15 years and for the past 6 years had been troubled by asthmatic attacks. In addition he had had a weight loss of about 30 lb. during the 3 months prior to admission.

Occupational history disclosed that the patient had been retired for 6 years, but prior to this he was a steam fitter, a job requiring not only his building, maintaining, and repairing furnaces, but also the cleaning of them. He performed this dusty job often without taking any protective measures, such as use of a mouth respirator.

Clinical examination showed a thin elderly white man who was cyanotic, dyspneic, and somewhat disoriented. The eyes reacted to light and accommodation. The chest was emphysematous, and the patient was using his accessory respiratory muscles during breathing. The lungs were hyperresonant. There were dry rales scattered throughout both lung fields. The heart was not enlarged, and the rhythm was regular. There was a systolic murmur Grade 1 at the apex. The blood pressure was 135/75. There were no abnormal abdominal findings. The extremities did not show any atrophy or wasting. The nail beds were cyanotic. The peripheral pulses were felt. The pulse was 108 and regular, the respirations 28, and temperature 99.4 F.

Laboratory data: Urinalysis showed a 1+ proteinuria and occasional white cells in the sediment. The hemoglobin was 12.4 gm. %; white blood count 9,500 cells/cmm, with a normal differential Sedimentation rate was 26 mm, BUN 12 mg/100 cc.; CO_2 22.6 mEq; sodium 139; potassium 4, and chlorides 89 mEq. Sputum culture was negative.

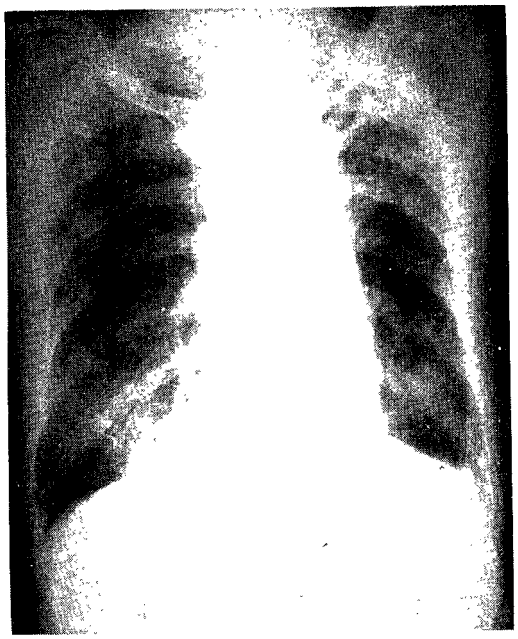


Fig. 6.—Posteroanterior view of chest of Patient 4, a maintainer and cleaner of furnaces for approximately 20 years. A mottled infiltrate is seen in the upper left upper lobe. The lower lung fields are emphysematous and a patchy area of pneumonia.

Chest roentgenograms taken on admission showed a displacement of the mediastinal structures to the right with a considerable amount of hazy mottled infiltrate in the left upper lobe having both a reticular and a miliary pattern. The lower lung fields were emphysematous, and there was a patch of infiltrate in the left base. The appearance suggested a probable pneumoconiosis associated with a patchy area of pneumonia (Fig. 6).

The patient was given oxygen, bronchodilators, and antibiotics, and showed some improvement initially. However, his mental state gradually deteriorated and he became completely disoriented. Three weeks after admission, he suddenly died.

An autopsy was performed and showed primarily an extensive pulmonary anthracosis, bronchopneumonia bilaterally, and pulmonary emphysema predominantly right.

The extensive anthracosis seen in this patient's lung is probably due to his chronic exposure to carbonaceous material while cleaning the fuel burners, which he had done for at least 20 years. Similar cases have been reported by others, particularly among superintendents who did extensive cleaning of coal stoves without using proper protective measures

The following will illustrate the importance of having a broad knowledge of the occupational dust diseases in the determination of causal relationship. This implies not only a knowledge of the clinical and differential diagnostic aspects, but also of the epidemiology of the disease as is indicated by the following case history.

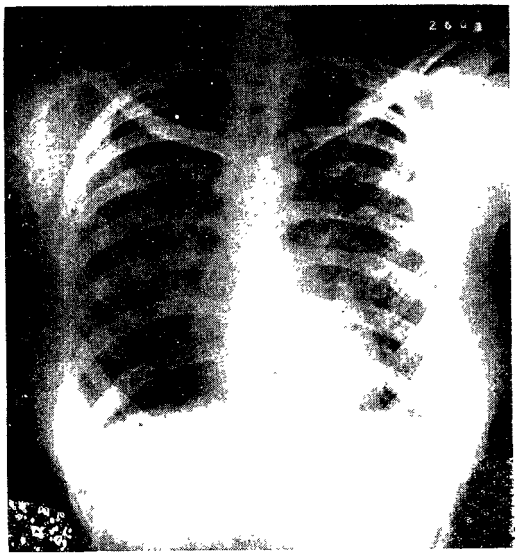
1. *The Importance of Knowing the Epidemiology of the Industrial Dust Diseases.*—The following case demonstrates the importance of knowing the epidemiology of the disease.

Patient 5, a 35-year-old Negro woman, was found to have, on a routine chest roentgenogram taken at the local health clinic, an abnormal chest x-ray characterized by micronodules scattered bilaterally throughout both lungs. She was asymptomatic, and her past medical history as well as systemic review was nonrevealing.

Occupational history disclosed only one episode of dust exposure; this was at the age of 23, when she was employed for 13 months in a steel plant where she used a compressed air hammer to remove hot sand from cast iron. During this operation, she was exposed to heavy concentrations of dust for the first few months, after which time a water spray was instituted to suppress the dust. She disclosed also that she had lived for a period of 2½ years about 6 miles from a beryllium plant where her husband was employed. During this period, her husband brought his contaminated clothes home for frequent washing.

Physical examination showed a healthy-appearing Negro woman, of good color. The physical examination did not show any abnormalities. Lab-

Fig 7.—Posteroanterior view of chest of Patient 5, a Negro housewife, who had a nonoccupational exposure to beryllium from laundering contaminated work clothes. Micronodules are seen diffusely scattered bilaterally, as is compatible with berylliosis.



oratory work-up, including histoplasmin, coccidioidin, tuberculin, and Kveim skin tests, peripheral blood study, total protein determination, and blood cell count, showed no abnormalities. The chest roentgenogram showed micronodules diffusely scattered bilaterally. The heart size and pulmonary artery segments were normal. The costophrenic angles were diminished (Fig. 7).

The history and chest roentgenogram suggest that she most likely has berylliosis, which has been reported to have occurred from such type of exposure.[1] The chest x-ray was compatible with berylliosis, although sarcoidosis cannot be entirely excluded.

2. *Similarity Between Occupational and Nonoccupational Pulmonary Diseases.*—The following cases of pulmonary disease observed in a father and son illustrate the problems of differential diagnosis between occupational and nonoccupational pulmonary diseases.

Patient 6, a 49-year-old white man, complained of a nonproductive cough of several years' duration, which had progressed only slightly. There were no other symptoms. Past history and systemic review were noncontributory. The occupational history revealed that he had been a miner of granular type of talc for 19 years. He had no history of any other occupational dust exposure.

Fig. 8.—Posteroanterior view of chest of Patient 6, a miner of granular talc for 19 years. The roentgenogram shows diffuse micronodular and calcific densities distributed throughout both lung fields. It is compatible with a diagnosis of histoplasmosis, which is endemic in the area where this patient resides.

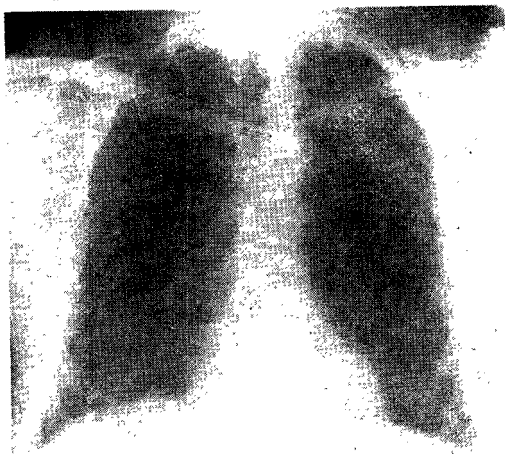


Fig. 9.—Posteroanterior view of the chest of Patient 7, the 18-year-old son of the miner in Figure 8, showing similar findings. He had a minimal talc exposure for two years.

Clinical examination revealed a well-developed, well-nourished man of good color. There were no abnormal physical findings. A chest roentgenogram taken during a plant survey showed diffuse micronodular and calcific densities distributed throughout both lung fields (Fig. 8).

Patient 7, 18 years of age was asymptomatic. His past history and systemic review were nonrevealing. Occupational history showed that he had been employed for 2 years in the same plant where his father worked, but was assigned to the insecticide department where the talc exposure was minimal.

Physical examination showed no abnormal findings. A chest x-ray taken during the same plant survey also showed minute calcifications and a few micronodular densities (Fig. 9).

These two cases illustrate some of the problems in differential diagnosis between occupational and nonoccupational disease. Among the differential diagnoses to be considered are pulmonary talcosis, histoplasmosis, and siderosis. In the father, who has had a potentially hazardous exposure to talc dust for 19 years, the practicing physician may entertain a diagnosis of pulmonary talcosis. However, the presence of a similar chest roentgenogram in the son, whose exposure to talc was only minimal, makes such a diagnosis highly unlikely. Furthermore, the roentgenograms are somewhat atypical for pulmonary talcosis following exposure to the granular variety of talc. In the latter type of exposure one observes more of a hazy mottling and interstitial infiltration

with basilar involvement primarily. Since the area where these people reside is endemic for histoplasmosis, this would seem the more likely diagnosis in both of these workers.

3. *The Significance of Knowing the Incubation Period of the Occupational Chest Diseases.*—In 1938, a chest roentgenographic study of 126 workers in 7 plants engaged in the manufacture of cleansing powders was performed by the Division of Industrial Hygiene in cooperation with the Division of Tuberculosis, New York State Department of Health. The manufactured product contained, for the most part, a finely ground quartz compound, silex, and other siliceous materials of a slighter degree of toxicity as feldspar and volcanic ash. Although this was primarily a chest x-ray survey, all the workers were questioned as to previous occupational exposure to dust.

The results showed that 18, or 14.3%, of the employees had roentgenographic findings compatible with silicosis in all stages. Of these, 4 had x-ray evidence of silicotuberculosis. The mean age of the positive cases and the mean duration of exposure were 40 and 9.8 years respectively. Of particular interest is the fact that 3 of the workers with roentgenographic evidence of silicosis had been employed in this industry for 4 years or less and had had no previous occupational exposure to silica and other dust. The mean age of these 3 cases was 30 years. Figure 10 is the chest roentgenogram of a 30-year-old laborer (Patient 8) who was exposed to this dust for 4 years. The roentgenographic picture shows nodular infiltrations throughout both lung fields.

This study serves to illustrate the fact that excessive exposure to a highly siliceous material of inhalable particle size can produce roentgenographic evidence of silicosis in a shorter period of time than the 10 or more years usually required. This has been corroborated by other investigators. For example, Strutek[2] describes roentgenographic manifestations of silicosis in 3 workers exposed for a period of 1¾ years

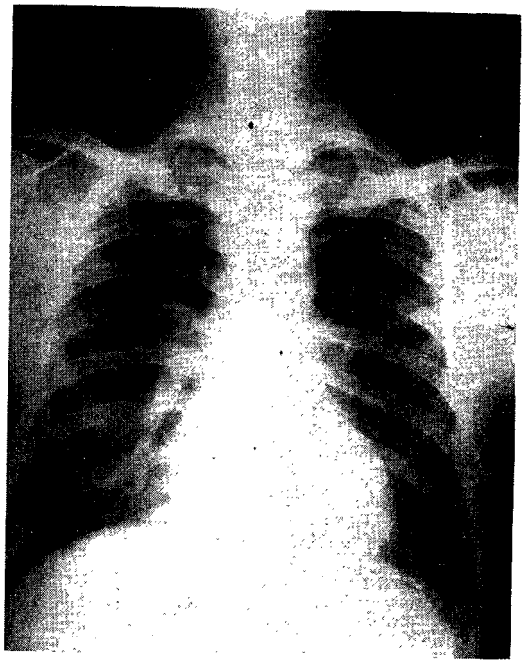


Fig. 10.—Posteroanterior view of chest of a laborer (Patient 8) who had an industrial exposure to a fine cleansing powder for 4 years. Nodular infiltrations are seen widely distributed bilaterally.

to cleansing powders containing 96% silica and 4% oxalic acid. Although the latter author alludes to the role of oxalic acid as responsible for the rapid development of silicosis, it is noteworthy that this acid was not an ingredient of the cleansing powders manufactured by the plants surveyed by this Division. It is worth stressing that a diagnosis of pneumoconiosis should not be excluded from the differential diagnosis simply on the basis of a relatively short exposure to a known fibrogenic dust.

Evaluation of Degree of Disability

Experts in the field recognize that the evaluation of the degree of disability in workers with pneumoconiosis requires a detailed analysis of their environmental exposure, a complete medical and occupational history, clinical evaluation, appropriate roentgenograms, pulmonary function tests, and, in certain instances, a pathological examination of lung tissue. Usually none of these approaches by itself will suffice.

It is generally agreed that there is no substitute for the clinical examination, but

as a single parameter it has its limitations. It must be correlated with the environmental data, chest roentgenogram, and other appropriate tests to be of value both diagnostically and as a basis for evaluating disability. When tuberculosis develops in a silicotic person, one can say with certainty that he is completely disabled, even though this may be at variance with his clinical picture.

The utilization of the chest roentgenogram alone as a basis for disability evaluation is similarly unreliable. It is noteworthy that Greenburg, who studied a group of rock drillers in New York State, reported that approximately one-fourth of the men whose chest x-rays showed advanced silicosis had no complaints. A similar observation was noted in granite cutters.[3] In contrast, a worker may be seriously disabled by persistent breathlessness and yet have little or no roentgenographic evidence of pulmonary disease. This has been particularly emphasized by British investigators.[4] Such cases are often diagnosed as bronchitis and/or emphysema, although either diagnosis may be difficult to prove clinically. This lack of clinical and radiographic correlation has been seen especially in workers who have been employed for many years at a coal face or in iron and steel foundries. Hence, the absence of characteristic roentgenographic abnormalities should not exclude the association of a patient's complaints with his occupational exposure. If a worker manifests respiratory impairment and gives a history of sustained exposure to a dust, one must consider seriously the causal relationship of the industrial exposure to the pulmonary dysfunction, even if the patient's chest x-ray reveals only minimal changes.

When nodular shadows are seen on the chest roentgenogram, it is appreciated that the size of the nodularity may bear no direct relationship to the patient's pulmonary symptoms of his degree of disability, except in rare instances where single or conglomerate masses are critically located and produce obstruction of a bronchus resulting in respiratory symptoms. In general, it is the dispersion of the nodularity which bears a closer relationship to the patient's clinical picture. For example, micronodules, if dispersed throughout the lung parenchyma, are more likely to produce respiratory symptoms than conglomerate masses localized peripherally. The latter is illustrated by the following case.

Patient 9, a 59-year-old man, was hospitalized because of a painful right knee, of one week's duration. Three days before admission, the knee became hot and swollen. There was no history of recent trauma. At the age of 15, he developed an osteomyelitis of the lower third of the right femur, which healed after several months. He has been in excellent health since. Surgical history, review of systems, and family history were noncontributory. The occupational history revealed that he had been a street laborer for 27 years, digging trenches with a pick and shovel. Occasionally, he operated a pneumatic drill and hammer.

Physical examination showed a well-developed, well-nourished man of good color. With the exception of minimal crepitus of the right knee and a depression along the lower portion of the right femur (the site of the old osteomyelitis), the physical findings were essentially negative.

Fig. 11.—Posteroanterior view of the chest of Patient 9, a street laborer who dug trenches and intermittently used a pneumatic drill for 27 years.

Routine blood chemistry studies, peripheral blood count, and urinalysis were normal.

Chest x-rays revealed a normal cardiac configuration, with multiple shadows of varying sizes in both lung fields (Fig. 11). The radiogram suggested metastatic pulmonary carcinoma. Urologic studies, including retrograde pyelography, were normal.

The pain and swelling in the right knee subsided with bed rest, and the patient returned to his former job completely asymptomatic. A chest roentgenogram taken 6 months later showed no change from the film, and the patient appeared to enjoy excellent health.

The clinical impression of metastatic pulmonary carcinoma, strongly entertained during the patient's hospital course, appeared less likely in view of his lack of changes in (1) clinical picture after nine months of observation, (2) serial chest roentgenograms, (3) blood picture, including blood counts and chemistries, and (4) gastrointestinal and genitourinary x-ray series. A more probable diagnosis was pneumoconiosis causally related to his occupation. It is of a particular interest in this case that the relatively large circumscribed masses distributed in the lung fields, especially peripherally, were not accompanied by any clinical abnormalities.

There is a growing belief that the pulmonary function approach provides the best yardstick for evaluating disability. There is a great need to utilize a group of pulmonary function tests, particularly maximum breathing capacity, timed vital capacity, pulmonary ventilation at rest and after exercise, and oxygen diffusion measurements across pulmonary capillary bed to evaluate alterations in pulmonary physiology. Nonetheless, these tests may not reflect the patient's clinical status or his ability to perform at his job. This is particularly true in the early stages of pulmonary dust disease. It has been repeatedly shown that it is often impossible to demonstrate subnormal pulmonary function in men who have extensive simple discrete nodular silicosis, and not infrequently persons who have extensive conglomerate silicosis show only a moderate deviation from their normal respiratory capacity. As some have indicated, it is more important to obtain repeated pulmonary measurements in the same individual and have his initial data serve as a control for subsequent comparison. This is particularly of value for such tests as maximum breathing capacity where the range of normal is very wide. Similar widespread values were observed by Wright in a study of maximum ability for sustained physical energy. The latter study revealed a variation of 25% above and below the mean maximum capacity for exercise as measured in a group of normal persons.[5]

In essence, one must conclude that neither the conventional methods of examination nor the more refined methods of pulmonary function determination can serve by themselves or collectively as a consistent reliable yardstick for the evaluation of degree of disability. This is particularly true for purposes of workmen's compensation where the evaluation of disability is usually based upon the worker's inability to earn full wages in the work at which he was last employed or at which he was exposed to the hazard responsible for the disease rather than a physiologic basis of dysfunction. The physician must therefore be familiar with other factors which are important in evaluating his patient's disability, such as the requirements of the job, the worker's attitude toward his work, his intelligence and neuromuscular coordination. A worker's over-all capacity for his particular job is not predicated purely on his physical ability but in addition is dependent upon his psychological attitudes, such as incentive, his mental capacity, and his neuromuscular function to develop a skill and efficiency for a particular operation.[5] These factors in many circumstances may compensate for the physiologic incapacity.

The physician should, whenever possible, obtain an intimate knowledge of the worker's job requirements. Unfortunately, the practicing physician often lacks such information and he is thus handicapped in his appraisal of the worker's ability to perform at a specific job. Since the physician is

usually placed in a position of determining whether or not a person is physically competent to carry on a particular job, it is evident that he must obtain complete information regarding all of these factors if he is to appraise the worker's disability with any degree of adequacy.

Medicolegal Factors

The previous discussions have been concerned primarily with medical considerations in the diagnosis and disability evaluation of pneumoconiosis. However, the physician must also be aware of the legal technicalities in order to deal with problems of compensation in these diseases. Perhaps the greatest difficulties arise from those provisions in present workmen's compensation laws which fail to recognize the medical facts. These include the legal concept of disability, the limitation of compensation to total disability, and the time limits for filing claims.

Legal Concept of Disability.—Disability, in 20 states that define the term in their workmen's compensation laws, is expressed either as inability to earn any wages in the employment where last employed, or inability to perform any further work in the occupation in which the employee was engaged, or inability to earn similar wages in other suitable employment.

It is noteworthy that the legal concept of disability is based upon ability to perform work or earn wages rather than physiologic loss of function. As already mentioned, the ability to perform work is influenced by factors other than those which affect physiologic capacity. These include incentive, skill, and economic need. Pertinent to the latter, there have been cases in which medical consultants of workmen's compensation boards have recommended awards for medical total disability on the basis of clinical disability and significant dust exposure. Yet, because the compensation benefits for wage loss are insufficient to meet their needs, these workers prefer to remain at their jobs, thereby receiving no compensation except medical payments.[6] It is noteworthy that in cases of hearing loss, awards are being made on the basis of physiologic loss rather than on earning capacity.

Limitation of Compensation to Total Disability.—In 20 states, partial disability for pneumoconiosis is not compensable.[7] However, before any adequate basis for compensation for partial disability in pneumoconiosis can be established, it is essential that the physiologic concept of disability be accepted and that practical and adequate criteria for the evaluation of such disability be developed and applied.

Present-day tests of pulmonary function do not accurately assess the degree of disability. Bronchospirometry can establish the physiological integrity of individual portions of the lungs. However, it is difficult to perform, often unsatisfactory, and therefore impractical for the purpose of disability evaluation for compensation. At best, pulmonary function measurements provide only an estimate of the degree of disability in pneumoconiosis.

Time Limit for Filing Claims.—Probably the most inequitable provision from the point of view of the physician is the time limitation which excludes claims not made within a legally specified interval after exposure. About 18 of the state compensation laws specify such an interval, which varies from 1 year to 5 years.[7] This is unreasonable, particularly where compensation is limited to total disability. In New York State, for example, the law requires that a worker be totally disabled by pneumoconiosis. To obtain compensation, a person must file a claim within 2 years after he leaves the employment wherein his dust exposure allegedly occurred. This application of the statute of limitation is inconsistent with the known natural history of the disease. Clinical and epidemiological studies clearly indicate that the fibrotic process, once initiated, may be progressive even in the absence of further exposure. Disability, therefore, may not appear until long after the person has left the dust exposure.

New York State, recognizing that some diseases may develop long after a worker has left a hazardous work area, has since 1947 excluded from the statute of limitations claims filed for certain occupational diseases such as those due to arsenic, benzol, and ionizing radiation. However, only one pneumoconiotic agent, namely beryllium, has been listed in this group.[8] It would be desirable that the time limitation be removed in the cases of claims filed in connection with diseases due to other pneumoconiotic agents which produce progressive pulmonary diseases.

In essence, the solution to the medicolegal problems in pneumoconiosis is dependent to a large extent upon more extensive epidemiological studies of these diseases and the development of adequate and practical criteria for the evaluation of disability. It is through such pursuits that the necessary data on which to base strong arguments for equitable legislative provisions in compensation for pneumoconiosis will be accumulated.

Summary and Conclusions

Three major problem areas in pneumoconiosis are discussed; these include establishment of causal relationship, evaluation of the degree of disability, and medicolegal factors.

In view of the similarities between occupational and nonoccupational pulmonary diseases, the physician, in order to establish causality, must obtain detailed information of the industrial environment wherein the alleged dust exposure occurred. Frequently this requires, in addition to inspection of the work site, detailed chemical and physical analysis of the air-borne dust and parent compounds to which the worker has been exposed. Cases are cited to illustrate the importance of knowing such factors as the particle size and physical characteristics of the dust and the details of the worker's job.

The establishment of a causal relationship in any one case of pneumoconiosis is also dependent on a complete knowledge of these diseases. Examples are given to demonstrate how a knowledge of the epidemiology, incubation period, and differential diagnosis of these diseases is essential in establishing causality.

Neither the conventional methods of examination, i.e., clinical, roentgenographic or pathological, nor the more refined methods of pulmonary function determination can by themselves serve as a consistently reliable yardstick for disability evaluation in a case of pneumoconiosis. Until such time as more precise criteria for disability measurement in these diseases are developed, the physician frequently must combine all of these approaches before arriving at a decision.

The legal concept of disability, namely, the inability to perform work or earn wages, further complicates the problem of evaluating disability. This is particularly true since the ability to perform work is influenced by other factors, such as incentive, skill, and economic need, in addition to the physiologic capacity.

The limitation of compensation to total disability and time limits for filing claims are additional factors which present problems to the practicing physician. A discussion of these factors is included.

80 Center St.

REFERENCES

1. Eisenbud, M., et al.: Non-Occupational Berylliosis, J. Indust. Hyg. & Toxicol 31:282 (Sept.) 1949.

2. Strutek, J.: Silicosis in Workers Packing Cleansing Power (Accelerating Effect of Oxalic Acid?), Časop. lék. česk. 87:343 (March) 1948.

3. Greenburg, L.: Some Aspects of the Problem of Silicosis, Indust. Bull. 15:195 (June) 1936.

4. Pemberton, J.: Chronic Bronchitis, Emphysema, and Bronchial Spasm in Bituminous Coal Workers, A M.A. Arch. Indust. Health 13: 529 (June) 1956.

5. Wright, G. W.: Disability Evaluation in Industrial Pulmonary Disease, J.A.M A. 141:1218 (Dec. 24) 1949.

6. Mayers, E.: Personal communication to the authors.

7. Analysis of Workmen's Compensation Laws, U.S. Chamber of Commerce, Washington, D.C., Jan., 1958.

8. New York Workmen's Compensation Law, Section 40.

Printed and Published in the United States of America