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## Diatomaceous Earth Pneumoconiosis

### Some Sociomedical Observations

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*An occupational disease hazard became the focus of publicity in the lay press and a strike issue. Subsequent investigation of workmen's compensation records and other aspects revealed valuable information concerning the disease, the administration of workmen's compensation, medical testimony, and related factors. Accelerated steps to abate the hazard followed the events mentioned. Suggestions are made to avoid such difficulties in the future.*

† In a recent issue of the Chemical Worker,<sup>1</sup> official publication of the International Chemical Workers' Union (AFL), the following news item appeared:

The seven-month long strike of ICWU, Local — . . . has finally ended . . .

Many gains were won . . .

Most significant of all, however, was the union's achievement in gaining recognition of the presence of a health hazard in the plant, in which the product diatomaceous earth is mined, and the final agreement by the company to take steps to eliminate the condition.

While many workers in the — plant had contracted pneumoconiosis and while many workers have already died from this dread disease, the company, had, for years, consistently refused to recognize the existence of this work-connected disease.

The main issue in the long dispute between the union and the company was the union's demand for the elimination of this health hazard. They were fighting for a principle and, in fact, for their very lives. . . \*

This news item probably has been seen by no more than a few thousand members and families of the Chemical

Workers' Union. However, the announcement culminates an episode which has deep implications for the public generally and for industry and the medical profession particularly.

The story of this little known disease with the formidable name is an interesting incident in the history of American industrial medicine. The occasion is not appropriate, nor is there adequate space, to attempt to relate it here in any detail.

Rather, this report is an inquiry into some of the factors operative in the progress, or lack of progress, of industrial health. For example, in this disease, there was a long time lag between the first medical publication on the subject and its general recognition as an occupational disease. To be sure, the history of industrial medicine reveals other examples of this: beryllium lung disease has only recently emerged from a somewhat similar evolution and coal workers' pneumoconiosis is at this very moment awaiting general recognition, although the facts have been available for some time.

Downing,<sup>2</sup> as recently as 1952, wrote:

It is apparent in the study, control, and prevention of occupational health hazards . . . that the United States is not on a par with other countries. Lack of recognition of the importance of industrial skin cancer stands out in sharp contrast to the unrestricted and wide publicity given this important matter in England, Germany, and Switzerland, where these cancers are notifiable and compensable diseases and information regarding them, therefore, is relatively reliable. The history of industrial medicine here is full of failures to prevent the unnecessary deaths in industry that have occurred, for example, from

*and subsequent quotations the author has*

chromates, tumors of the bladder due to aniline dyes, osteogenic tumors from radioactive chemicals, and cancer due to carcinogens in the tar industry. All these industrial hazards could have been controlled or eliminated.

#### Diatomaceous Earth

The term "diatomaceous earth" or "diatomite" derives from the origin of the material from the siliceous skeletons of microscopic aquatic plants known as diatoms deposited on the beds of fresh and salt water. The pure mineral is entirely silicon dioxide ("free silica"). It is chemically identical to quartz silica, the cause of ordinary silicosis, but differs from quartz in its microscopic physical structure. The particles are amorphous in the crude state, but after processing a significant percentage of the amorphous material is converted to crystalline silica. The material is quite versatile, having over 200 major uses, such as in industrial filters, insulation materials, abrasives and polishes, building materials, insecticides, and explosives.<sup>3</sup>

The most important source of disease so far recognized has been in the industries that produce the material, although potential occupational exposures exist in the numerous industries that use it. Vigliani in Italy has reported on the disease occurring among makers of filter candles in which diatomite is the principal ingredient.<sup>4</sup>

While deposits of the earth may be found in many parts of the world, most commercially exploited deposits in the United States are in the West—California, Oregon, Nevada, and Washington ranking in this order in amount of production. There are about 1,000 employees in the mining and milling industries of the four western states, of whom about 800 are in California. The labor turnover in the dusty jobs is so high that the number of workers exposed would be most difficult to ascertain.

#### Disease

The pathology and clinical aspects of this pneumoconiosis have been described elsewhere.<sup>4-6</sup> One might summarize in the words of Vigliani: "There are some clinical and pathological differences from classical quartz silicosis, but not to such an extent as to make a distinctly different disease."<sup>7</sup>

The earliest report on the disease in the American medical literature was that by Legge and Rosencrantz in the October, 1932, *American Journal of Public Health* entitled, "Observations and Studies on Silicosis by Diatomaceous Silica."<sup>8</sup> The study was made under auspices of the Bureau of Tuberculosis of the California State Department of Public Health,

... for two reasons—first, because over a period of many years, statements have been made that the — Mine through its employees, were contributing not only to a large number of social and welfare problems in — County, but that many of the patients in the Tuberculosis Department of the — General Hospital were from the — district, and that the families were dependent upon the County as a result of the wage-earner's illness. Second, because of the very nature of the various kinds of work necessary for the operation of the — Mine, if it did create, as had been suggested from many sources, an occupational hazard, it seemed only fair to the — Company and the men employed there to ascertain some facts.<sup>9</sup>

The study, done in 1930, consisted of physical examinations and chest x-ray films on 118 laborers. They found that 81 or 68.5 per cent of the men examined had lung changes of pneumoconiosis. Some had developed these changes after only one year's exposure.

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For 20 years following this publication nothing further appeared in the United States medical press as recorded in the Cumulative Medical Index. However, several European reports on human disease were published<sup>4, 10, 11</sup> and before and after this date some experimental work with animals has been reported.<sup>12-14</sup>

Since 1938 physicians for the industry had been collecting and examining clinical and pathological material (at least 22 lung specimens and 100 cases).<sup>6</sup> This material provided convincing evidence of the existence of a disabling occupational lung disease. Yet, according to Johnstone<sup>15</sup>:

In 1945, Gardner came to California to study the diatomaceous earth industry, to review collective X-ray films of the workers, and to consult with physicians engaged in caring for these men. In viewing the films of men who had worked for years in this material, Gardner wrote later to one of us that "silicosis is conspicuous by its absence."...

It was not until about 1946 that physicians connected with the industry began to acknowledge that diatomite could cause a disabling and sometimes fatal disease.

### Reporting

Under California law employers and physicians are required to report to the State Department of Industrial Relations cases of occupational injury and disease that cause absence beyond the day of occurrence or require more than first aid medical service. Until January, 1952, three physicians' reports and no employers' reports had been made (employers' reports were checked back to 1948).

### Governmental Agencies

Contact of governmental public health and safety agencies with the industry in California began in about 1930 when the Legge study, previously referred to,

was made. Legge<sup>6</sup> reported at that time that,

... a great deal of dust is disseminated in the atmosphere in certain working zones and constantly surrounds the habitations of the workers, as the plant operates night and day ... The menace is due to vast clouds of dust which escape and endanger the immediate workers and are also disseminated by the prevailing winds over the district where the employees reside. ...

At about the same time, it is reported the U. S. Bureau of Mines made a dust study, but no official information about this investigation could be obtained. State Health Department records indicate that certain ventilation measures were recommended to the industry, but no information could be found as to what action was taken.

In 1940 a county health officer in California inquired of the Industrial Hygiene Service (now the Bureau of Adult Health) of the State Health Department concerning a case of suspected pneumoconiosis in a former employee of the diatomaceous earth industry. The chief of the Industrial Hygiene Service visited the industry in question. In his reply to the health officer, he writes that he was informed by the plant superintendent and the plant physician that:

To the best of their knowledge no employee in this plant has ever developed silicosis. Dr. — (then plant physician) stated that pre-employment and annual physical examinations, including chest roentgenograms are made on all employees and that none of these men ever showed evidence of pneumoconiosis even after periods of continuous employment as long as twenty years.

I was unable to obtain access to physical examination or X-ray records, or to inspect the — quarries and mill on October 4, because of the company's blanket requirement that permission to enter the plant must first be obtained from the head offices in New York City.<sup>16</sup>

Active contacts of the Bureau of Adult Health with the industry began in 1944. These were chiefly for dust studies

and medical conferences, no medical investigations being done by the bureau. In 1947 the bureau and the State Division of Industrial Safety discussed the possibilities of thoroughly surveying the industry, but were dissuaded from doing so because of assurance by industry representatives that the situation was well controlled and that publication of their extensive clinical and pathological material would be made shortly.

By January, 1952, the picture in brief appeared to be as follows: The disease was a minor problem, judging by the paucity of official occupational disease reports. The industry had been spending a good deal of money on dust control measures, as well as for a medical program and research. Outside of limited professional circles in the West, few of the profession, not to mention the laity, had heard of the disease. The only American medical publication listed in the Cumulative Medical Index was that of Legge and Rosencrantz in 1932. (Indeed, for the best discussion of the disease one had to turn to the European literature, even though California was the world's largest producer of diatomaceous earth.)

#### Popular Press Publicity

It was in this seemingly tranquil atmosphere that diatomaceous earth, a component of Nobel's original dynamite, exploded into the popular press as a "scoop." First the official organ of the California Tuberculosis and Health Association, *Search*, in its January, 1952, issue featured an article entitled "Death by Dust."<sup>17</sup> Shortly thereafter, the *San Francisco Chronicle* followed with a story entitled "The Story of a Strange and Dangerous Dust."<sup>18</sup> The articles cited cases of deaths and illness from the disease. They also called attention to a high tuberculosis death rate in the area where the largest dia-

tomaceous earth deposits are worked. They accused the industry of "soft-pedaling" information and the public agencies of negligence. *Search* magazine, for example, commented, "a somewhat leaky lid has been placed over all activities relating to hazard, preventive measures, case histories and employment practices. . . ."<sup>17</sup>

#### Strike

In March, 1952, the organized employees at the plant went out on strike. Health protection, an unusual strike issue, was an important issue of the dispute, the origins of which antedated the health publicity.

#### Sequellae

The State Health Department, in conference with the industry and later the union and the Public Health Service, began plans for a thorough environmental and medical study of the industry. The study is now in progress.

The State Division of Industrial Safety, which is a part of the Department of Industrial Relations, immediately issued to the industry legal requirements for reduction of dust concentrations to the maximum allowable levels.

More occupational disease reports were sent to the State Department of Industrial Relations within weeks of the publicity.

In November, 1952, the first medical publication on diatomite pneumoconiosis in a major United States medical journal in 20 years appeared.<sup>6</sup>

According to the Chemical Worker's Union:

A new health and safety program has been instituted which provides for regular six-month X-rays of all employees and the company is committed to the immediate installation of dust abatement equipment designed to reduce the toxic dangers formerly faced by the plant workers.

The company has also agreed to the formation of a joint union-management Health and Safety Committee, thereby giving the union recognition which they have never had before.<sup>1</sup>

### Workmen's Compensation

The newspaper reporters had, among other things, called attention to the fact that there was information to be found in the workmen's compensation records of the state. The author set out to dig into the records of the California Industrial Accident Commission and was able to find 32 claims for compensation for alleged diatomite pneumoconiosis which came before the commission between 1930 and 1951 inclusive. In the course of this search 26 additional cases not in workmen's compensation files came to light. The work was laborious and the period of the study covered only a few weeks. Further cases would probably have been found had there been more time available for the work.

The study of workmen's compensation records was an absorbing experience. Space does not permit presentation of more than fragments of the material. However, where workmen's compensation records are as complete as they are in California—often containing the exact stenographic reports of hearings, as well as correspondence and other documents—these can be a valuable source of information for the guidance of public health programs. For example, I quote a few excerpts from the letter of a private physician presenting medical testimony for a claimant in the year 1944, who closes his statement with a series of recommendations for the prevention of the pneumoconiosis hazard in the diatomaceous earth industry:

1. That the Bureau of Industrial Hygiene in the State Department of Public Health investigate this plant and the dust hazard presented therein.

2. That the dust hazard of the employees'

homes also be similarly investigated. (At that time many of the employees and families lived in company owned houses on the plant premises—HKA).

3. That other cases now available be evaluated with respect to the pulmonary fibrosis of their lungs present.

4. That follow-up of employees who drift away with symptoms of respiratory embarrassment be made.

5. That authorities stop regarding this matter as a closed issue: namely, "Silicosis cannot be acquired in this plant."

6. That the nature of the advice given employees in whose films fibrosis is demonstrated as in this man's case in the years 1938-39, might reasonably be asked from a preventive medicine point of view.<sup>10</sup>

So far as I am aware, these recommendations were buried in the archives of the Industrial Accident Commission until their exhumation following the events in 1952 just described.

In the files of another compensation case,<sup>20</sup> there is a copy of a letter in the year 1946 from a medical consultant addressed to a top official of the industry. The letter contains a statement summarizing findings in the lungs of "six persons who have been employed in diatomaceous plants in southern California for significant periods." The statement declares that "... from the practical standpoint of control, it is apparent that serious dust hazards exist in this industry which demand immediate and vigorous action."

It has been contended by some that the "amorphous" or crude form of diatomaceous earth causes no disablement in contradistinction to the "processed" forms. Therefore, it was of interest to find in the above mentioned document the following comments:

One man — had worked only in the quarry and mines and as a consequence has been exposed to nothing but uncalcined earth. All of the others had mixed exposures to crude and calcined products . . . But if the — case can be taken as a criterion, prolonged and heavy exposure to crude diatomite results in further extension of such reaction . . .

### Characteristics of the Disease

This admittedly limited study makes possible the following generalizations which, if they are not already established facts, at least merit serious investigation.

1. The disease has a high attack rate in those exposed to the dust. This is suggested by the Legge study and by recent data released by a plant physician to the press in which he reports that since 1945 a third of 922 people employed at his plant for at least a year, showed "pathological changes."<sup>18</sup>

2. The amorphous form of the diatomaceous earth can cause symptomatic lung disease, although much heavier and longer exposures are required than from the processed powders.

3. Exposure to the processed diatomite results in disabling disease on the average more rapidly than does exposure to quartz-type silicon dioxide.

4. Diatomite pneumoconiosis, as ordinary silicosis, probably predisposes to tuberculosis infection. Out of twenty-six cases of diatomite silicosis, at least seven also had proved tuberculosis.

5. Diatomite pneumoconiosis probably also predisposes to other lung infections. Smart and Anderson<sup>6</sup> have pointed out that the disease seems to predispose to acute pulmonary infections, such as pneumonia and pneumonitis. The present study of workmen's compensation cases showed that of the 26 definite cases of pneumoconiosis, two also had a mycotic lung infection. Were these coincidence, or do they suggest that pneumoconiotic lungs may be predisposed to other infections as well as the traditional tuberculosis?

6. The disease may occur in industries which utilize diatomaceous earth, as well as in those which produce it. Two of the 32 claims for compensation fall into this category. At least one of these claims was a proved case of diatomite pneumoconiosis.

### Role of the Physician

The compensation records also are illuminating with respect to the role of medical testimony. A few examples are presented as follows:

In one of the claim hearings the Industrial Accident Commission referee summarized the testimony in part as follows<sup>21</sup>:

... Dr. — testified he first saw the patient's chest X-rays in 1940 and made a diagnosis of diatomaceous earth pneumoconiosis with superimposed tuberculosis. Dr. — stated that he had never told the patient anything about his condition and that the patient had never asked.

In 1940 Dr. — advised management to remove certain employees to non-dusty operations. There was care used not to excite fear or hysteria of the men regarding any danger. Dr. — does not discuss condition of employees with them unless authorized by the company who retains him.

The patient was never told his chest disease was due to his work nor was he advised to get out of dust. ...

Another physician testified in three different cases as follows:

In 1939 Dr. — wrote the following while defending the employer or insurance carrier against a claim for diatomaceous earth pneumoconiosis compensation:

Diatomaceous earth is an amorphous hydrated silica. This contains approximately 60-90 per cent  $\text{SiO}_2$ . In this particular mine in which he works there is an associated aluminum preparation. According to the work of Irwin and his associates at the University of Toronto, they have found that very definitely metallic aluminum acts as an antidote with the formation of hydrated alumina and reduces the solubility of silica so that it is an innocuous preparation. It is a reasonable assumption to feel that if aluminum acts in such a manner with crystalline silica that it would have the same effect upon non-crystalline silica such as what we are dealing with in this particular case. Furthermore, since there is no evidence of silicosis either by the physical or by the roentgen examination, we must conclude that the dust is not provocative of this disease and we must fall back on the diagnosis of emphysema and bronchitis, and as stated previously, this has no occupational connection.<sup>22</sup>

In 1951 the same doctor presented the following testimony, again for the defendant employer in connection with a claim for compensation for diatomite pneumoconiosis<sup>23</sup>:

Here is an individual who has had an exposure for a long while (11 years) in an industry in which amorphous silica is a factor,

which must always be given some consideration. It is rather gratifying to know that this man can have an exposure over a period of years and the condition is not related to dust inhalation.

In this particular instance, we are dealing with a condition which has all the earmarks of tuberculosis. . . . I think we can with certitude rule out the presence of a silicosis. . .

Since we have eliminated in our own mind the presence of silicosis, and since the dust, if it were a factor, would cast an X-ray pattern which would antedate the tuberculosis, we can readily assume that the dust is not responsible for his present incapacity. I have held to the belief for a long period of time that in silico-tuberculosis, the silicosis antedates the tuberculosis and in the absence of any of these factors, we must assume that the dust did not aggravate or predispose to his condition.

Later in the same year, 1951, the same doctor presented testimony for a claimant (employee) for compensation for this pneumoconiosis. At this time his statement was as follows <sup>24</sup>:

Here is a man who has had a two year exposure to dust that was in fairly high concentration. As you know, the dust to which he was subjected is diatomaceous earth, and the usual silica content is from 90-92 per cent. This silica is an amorphous form in contradistinction to the crystalline form which is the ordinary offender in producing the disease silicosis. Approximately 12 years ago I stated that this was a cause of death in these cases, and it did produce silicosis. . . . It is very possible that his tuberculosis existed for a good many years and may have antedated the exposure to the amorphous silica. . . .

#### Administration of Workmen's Compensation

The workmen's compensation study threw light on the administration of workmen's compensation at least in so far as certain types of occupational disease are concerned. It will be remembered that workmen's compensation is the earliest form of social legislation in this country. Its objectives are generally agreed to be to provide equitable

compensation for workers injured in the course of their work; to take injury suits out of the courts and thereby lighten the burden of litigation upon the employee; to reduce the burden of occupational injury on the general community; and indirectly to stimulate preventive measures.

The findings of this study would indicate that in all of these respects workmen's compensation did not measure up well to its objectives. For example, of the 32 claim records analyzed, at least 26 in the light of our present knowledge were for definite cases of diatomite pneumoconiosis. Yet, only eight of these claimants received full awards according to the record at the time this study was concluded. The average length of litigation until a settlement was reached was 16 months for the total group, with the shortest two months and the longest 56 months.

From the fragmentary data available, it is not possible to assess the entire financial burden on the taxpayer of this industrial disease. The few cases cited in a letter from a county hospital to this author cost the public at least \$20,000.<sup>25</sup> This figure does not include expenditures by the Bureau of Vocational Rehabilitation and the welfare agencies. One can only guess how much the community has paid for the forgotten men of the Legge study in 1930 and the nameless victims, many of them illiterate Mexican immigrants, who succumbed to the wasting disease in former years.

Possibly this limited experience with workmen's compensation is not atypical. In a recent appraisal of the subject, Kossoris concludes with the statement:

There is need today for stronger public concern with the inadequacies of workmen's compensation legislation and its administration. In spite of the tremendous forward strides in other social and economic areas, our compensation legislation and administration, on the whole, lag far behind.<sup>26</sup>

## Comment

The outcome of this episode has been good. In this particular industry strong measures are being taken once and for all to prevent this preventable disease. However, is it not regrettable that apparently this came about—or at least was greatly accelerated—only after popular press publicity and organized labor forced the issue? Would not progress have come more surely and more quickly if there had been an orderly and scientific approach by all concerned, namely, the private and industrial physicians; the industry; and the professional personnel of the governmental agencies? Could not this and similar episodes have been avoided by systematic investigation of the facts; by prompt publication of the facts in appropriate scientific journals; and by early implementation of the preventive measures indicated by these facts? Is not this approach the essence of public health?

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