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Silicosis: Discovery, Treatment, and Prevention of the Disease in the Tri-State Mining District from 1900-1950

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The mining operation at Picher, Oklahoma was the last successful strike in the Tri-State Area. The Picher Lead Company of Joplin was drilling prospect holes in an isolated farming area somewhere northeast of Commerce, Oklahoma in 1914 and made a rich strike in the area that became known as Picher. The town grew almost overnight as miners and their families flooded into the area to be a part of one of the most successful mines in the area. One *Daily Oklahoman* correspondent called Picher the "last bonanza" of the Tri-State District and said it was fitting that the district's colorful mining history should end in such a climactic way.[1]

The Picher field quickly became the leading producer of zinc ore in the world as well as an important source of lead ore. Roughly, 30 percent of the United States zinc production during the early 1920s came from the 1000 square-mile area that included northeastern Oklahoma, southeastern Kansas, and southwestern Missouri. Lead and zinc were critical minerals used in products that range from steel and brass alloys to batteries, munitions, and gasoline. These minerals were central to the U.S. as a leading industrial power. [2] Despite the fact there were 159 firms open in 1920 and that the district was the leading zinc producer for the U.S., the Tri-State District had a reputation of being a "poor man's camp."[3] Nonetheless, the district was supplied with a steady stream of farmers and their sons from the surrounding rural area due to the promise of high wages and even the possibility of running one's own mine someday.

Unplanned communities continued to spring up between the mines; Picher was one of these. By one account, in the town's early days, it resembled an "old time Western boom mining

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[1] Arrell Morgan Gibson, "Early Mining Camps in Northeastern Oklahoma," *The Chronicles of Oklahoma* 34, no. 2 (1956): 201.

[2] Gerald Markowitz and David Rosner, "'The Street of Walking Death': Silicosis, Health, and Labor in the Tri-State Region, 1900-1950," *The Journal of American History* 77, no. 2 (September 1990): 527.

[3] Alan Derickson, "On the Dump Heap: Employee Medical Screening in the Tri-State Zinc-Lead Industry, 1924-1932," *The Business History Review* 62, no. 4 (Winter 1988): 660.

town with flimsily constructed buildings, and almost total disregard of such civic adjuncts as sewers, sanitary water supply or other sanitation or public health facilities."[4] In addition to the extremely harsh sanitary conditions, miners also faced other dangers. In the mines there was often falling rock, faulty hoisting machinery, dynamite, unguarded machinery, and a number of other hazards caused by numerous accidents underground.[5] In addition, the growing use of power drills and high-intensity explosives created a new hazard with substantial impact on the long-term health of a miner and his family. These new techniques were creating an immense amount of fine silica dust-an extremely potent industrial poison. In 1915, soon after this new mining technology was introduced, miners and their families were developing debilitating and life-threatening lung conditions. Miners were soon at a greater risk of dying from disease than an accident and families were at extreme risk of tuberculosis. One mine owner in the Tri-State District told the United States Bureau of Mines that he had employed 750 men in his mine between 1907 and 1914. One year later only 50 of these men were still living and all but approximately a dozen others, had died from tuberculosis.[6] This newfound district-wide disease was undoubtedly the most feared occupational hazard in the eyes of a miner. This disease was known as silicosis.

Silicosis was a deadly disease that brought fear to the eyes of those living in the Tri-State Mining District as well as a death sentence to miners who lived and worked with the disease. Silicosis derives from the Latin word silex, meaning flint, and first appeared in 1870, although the problem of breathing in dust has been recognized as far back as the Greek and Roman times.

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[4] Derickson, "On the Dump Heap," 660.

[5] Derickson, "On the Dump Heap," 661.

[6] Markowitz, "The Street of Walking Death," 529.

Silicosis is caused by breathing in silica dust, which damages the lungs' dust cells.[7] Symptoms of silicosis include coughing, shortness of breath, fever and cyanosis: cyanosis happens when your skin takes on a bluish tint.[8] In the early years, it was commonly misdiagnosed as tuberculosis or pneumonia. However, with the invention of the X-ray machine in 1895 the misdiagnosis was fixed.

In 1914, the United States Public Health Service and the United States Bureau of Mines began a detailed study that identified silicosis as a separate and distinct lung condition. It was soon recognized as the leading occupational illness of hard-rock miners, granite cutters, potters, buffers, glassworkers, sandblasters, and foundry and steelworkers. It was considered the most important occupational disease in the county by the 1930s. Silicosis was known by several different names: miners' asthma, stonecutters' phthisis, potters rot, and pneumonoconiosis.[9] A clinical characteristic was issued in the Public Health Service Report in 1917: "If we can imagine a man with his chest bound with transparent adhesive plaster, we can form a mental picture of how useless were the efforts at deep inhalation made by these patients."[10]

Eventually, doctors agreed that there were three stages to the disease. In the first stage, there were definite physical signs of damage to the lungs. The second stage was diagnosed when the miner's capacity to work had been affected and the physical signs of damage to the lungs were more pronounced. There is more physical damage to the lungs and the capacity for work

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[7] W.D. Robson, *Silicosis: What It Is and How It Can Be Prevented*, (Canada: Northern Miner Ltd., December 1, 1943), Box 76, Picher Collection, Axe Library, Pittsburg State University, Pittsburg, Kansas.

[8] *Ibid.*

[9] Markowitz, "The Street of Walking Death," 531.

[10] *Ibid.*

has been greatly or permanently impaired in stage three.[11] Listed here are those three stages defined in detail:

1. Stage 1: "beads" or bronchial "buds" increase; bronchial tree increases in density; the "buds" become noticeable throughout the lower section of the lungs.
2. Stage 2: Hilum shadows are large but do not show any more than they do in stage one; diaphragm is humped and numerous bands of adhesions appear at the base.
3. Stage 3: Spots tend to coalesce forming large areas of marked density spreading from the middle out evenly.[12]

This system defined occupational disease in terms of occupational disability: a worker was sick when his capacity for work was diminished. It did not take into account however, the capacity for a miner to carry on his normal life outside of the mine. This system did not classify the severity of the disease when the capacity to play with one's children or walk to church was taken into account.[13]

The American Public Health Association defines silicosis as a disease that is caused by breathing air containing silica dust. It is characterized anatomically by general fibrotic changes and the development of miliary nodulation in both lungs. The clinical symptoms include shortness of breath, decreased chest expansion, lessened capacity for work, absences of fever, and increased susceptibility to tuberculosis. The Health Association stresses that some or all of these can be present with this disease. Most of these symptoms are confirmed with X-ray

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[11] R.R. Sayers, V.V. Merriwether, A.J. Lanza, W.W. Adams, *Silicosis and Tuberculosis Among Miners of the Tri-State District of Oklahoma, Kansas, and Missouri*, (Washington D.C.: U.S. Government Printing Office, 1933), Box 76, Picher Collection, Axe Library, Pittsburg State University, Pittsburg, Kansas.

[12] *Ibid.*

[13] Derickson, "On the Dump Heap," 668.

findings.[14] However, despite the knowledge of the symptoms, there was no way to predict definitely how soon workers exposed to silica particles may develop silicosis because of these three variable factors. These factors are:

1. The percentage of quartz or free silica in the dust
2. The concentration of the dust in the air; number of particles per cubic millimeter of air
3. The extent of the workers exposure; brief exposure periods compared to eight-hour workdays.[15]

Because silicosis develops slowly, miners could have the disease for a long time before developing symptoms and when this happened it was usually too late.[16] Because the nodules that develop on the lung tissue will show up on an X-ray before symptoms show up, it was important that miners have frequent X-rays.

The science behind silicosis is a little difficult to understand. Lungs contain dust cells in them that clean up impurities in the air sacs and carry those impurities into the lungs' tubes where they are then swept up and removed from the body. However, these dust cells cannot get the silica dust out fast enough before they are disabled. Despite other cells trying to help with the removal process, they too are soon disabled. This chain reaction goes on until scar tissue forms around all of these bad cells. This scar tissue is like a cut or burn except for the fact it is inside the body, not to mention the inside of the lungs. The continual build up of this scar tissue is what became known as silicosis. As silicosis develops, breathing becomes more difficult and other cells in the body start to suffer as well due to the lack of oxygen in the body. Because the lungs are now weakened, infections like tuberculosis and even the common cold become very

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[14] Tri-State Survey Committee, *A Preliminary Report on Living, Working and Health Conditions in the Tri-State Mining Area, (Missouri, Oklahoma and Kansas)*, (New York: Tri-State SurveyCommittee Inc., 1939), Box 76, Picher Collection, Axe Library, Pittsburg State University, Pittsburg, Kansas.

[15] *Ibid.*

[16] *Ibid.*

dangerous and, more often than not, fatal.[17] Although very few people actually died from the silicosis disease alone. Most fatalities came from silicotic miners that contracted tuberculosis as well.

Silicosis also presented a public health hazard for the mining community and an economic disaster for the miners.[18] Because the miners were more susceptible to tuberculosis and other diseases and infections, they ran the risk of spreading these illnesses to the public. This hazard was increased due to the sub-standard housing in the Picher Mining Area. Most houses were just thrown up when a miner got to town because they wanted to start work in the mine as soon as possible. In fact, the Missouri Bureau of Labor Statistics commented, "the savings which could certainly buy a comfortable home are dumped into holes in the ground through prospecting for new deposits."[19] In 1914, Dr. Anthony J. Lanza of the U.S. Department of Public Health made a house-to-house visit through the Picher Mining District. He visited 694 homes and noted that most of these were shacks, with little more than a box structure over the ground for a toilet and a pan of water in the kitchen for a bathtub.[20] These poor sanitary conditions lead to extreme outbreaks of tuberculosis. This was especially hazardous when a miner had silicosis. Add the unsanitary living conditions and tuberculosis was an almost certain fate of a silicotic miner. Ottawa County Oklahoma, where Picher is located, had the highest tuberculosis mortality rate in

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[17] Robson, *Silicosis*.

[18] Tri-State Survey Committee, *A Preliminary Report*.

[19] Arrell Morgan Gibson, "A Social History of the Tri-State District," *The Chronicles of Oklahoma*, 37, no. 2, (1959) 187.

[20] *Ibid*.

the nation for years in the early 1900s. In 1942, there were 201.5 deaths for every 100,000 people.[21]

The prevention of silicosis was a continuing process in the early 1900s. Doctors and scientists were continually conducting research to increase their knowledge on the science of silicosis and how it could be prevented or at the very least, abated. The two most common forms of prevention were wet drilling and oiling the mining area. With wet drilling, the mining area would be soaked with water to hold down the very fine silica particles. This was found to be effective but it did not outweigh the rise of humidity in the mine. The excessive water led to the rapid corrosion and destruction of the rails and hardware because of the soluble copper and iron salts present in the large areas of the mine. The second preventative tactic, oiling, was effective but too messy to be of much use. Additionally, when using oil there was extreme odor that was trapped underground and along with that, there was a limitation on the areas that could be oiled down due to the potential fire hazard. It was also costly since the oil soaked into the ground quickly and had to be reapplied frequently. Because of this, oil was substantially more expensive than water and therefore was not used as much.[22]

Additional recommendations were made by the Oklahoma State Health Department in 1940. Adequate ventilation was of utmost importance either naturally or mechanically. The Health Department recommended drilling in the mines after wetting down the area to be mined and to wet down the muck piles outside of the mineshaft. When miners worked double shifts additional hazards were present so additional precautions were to be taken to prevent needless

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[21] Arrell Morgan Gibson, *Wilderness Bonanza: The Tri-State District of Missouri, Kansas, and Oklahoma*, (Norman, Oklahoma: University of Oklahoma Press, 1972) 194.

[22] H.M. Lavender and G.B. Lyman, *Methods of Underground Dust Control*, Mines Division, Copper Queen Branch, Phelps Dodge Division, (Arizona, September 1935), Box 76, Picher Collection, Axe Library, Pittsburg State University, Pittsburg, Kansas.

accidents and careless mistakes. Mines were not allowed more than five million silica particles per cubic foot and the Health Department recommended frequent dust counts to keep the air quality in line with the limit.[23]

In 1922, the Tri-State operators asked the Bureau of Mines to examine their employees and working conditions. The Bureau sent Daniel Harrington, a veteran mining engineer, and his colleague Richard V. Ageton to visit the area. During 1923, Harrington and Ageton visited 46 mines and encountered a significant dust threat in all mines. Many mines were shoveling ore dry and in addition to this hazard, many other procedures were leading to the thorough contamination of the work environment. Mine operators were allowing the dry drilling of holes into which explosives were placed which created clouds of silica dust particles. In some mines, blasting even occurred while employees were still underground. Harrington and Ageton observed

> "Even when blasting is done when going off shift, the heavy nature of the blasting in these mines throws into the air large numbers of very fine dusts and the large volumes of open underground spaces...allow these very fine, very dangerous particles to remain in suspension for hours, even days, unless moved by ventilating currents."[24]

Harrington and Ageton found no ventilation equipment because, although adequate ventilation was found to effectively combat silicosis, operators seldom invested in adequate ventilation equipment.[25]

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[23] E.C. Warkentin and R.B. Ady, *A Study of the Dust and Related Factors in the Zinc and Lead Mining Industry of Oklahoma*, (Oklahoma: Oklahoma State Health Department, 1940) Box 76, Picher Collection, Axe Library, Pittsburg State University, Pittsburg, Kansas.

[24] Derickson, "On the Dump Heap," 662.

[25] *Ibid.*

When the Bureau of Mines received these reports, they insisted that unless drastic corrective measures and preventive practices were adopted, the conditions would grow rapidly worse. Harrington and Ageton recommended a public educational campaign on the nature, causes, and prevention of silicosis in addition to administrative and engineering changes to prevent the disease. Harrington and Ageton also stressed the more systematic use of wet drilling methods, the prohibition of all blasting on shifts and the installation of modern ventilation apparatus. After these recommendations came out, many firms, even the larger ones, tried to follow these guidelines.[26]

In addition to eradicating the causes of silicosis, advanced silicotics had to be released from the mines. Medical screening became a routine practice in the Tri-State area followed up by termination of those found to have the disease. Federal authorities urged all mines in the Picher area to examine all employees at least once every six months. These periodic examinations, along with pre-employment screening of job applicants, were the primary aspect of most medical programs administered by federal employees in the early twentieth century. A small firm could not afford to retain their own medical staff so the Bureau of Mines urged the Ore Producers' Association to organize "a department of true industrial medicine" to serve its employees.[27] The mines were to build clinics to offer these screenings and treatments for the mine employees.

Picher, Oklahoma received one of these clinics in 1924. The Bureau of Mines, Tri-State Zinc, and Lead Ore Producers Association and the Picher post of the American Legion operated the clinic.[28] The clinic began with the arduous task of examining all active employees as well as

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[26] *Ibid*, 662-3.

[27] *Ibid*, 664.

[28] Tri-State Survey Committee, *A Preliminary Report.*

the applicants for jobs in the Picher mines. These first examinations were quite comprehensive. The staff would take a detailed history of each patient that included asking about any previous occupational exposure to rock dust. Then, each worker underwent a thorough physical examination, a chest X-ray, and a whole slew of lab tests.[29] In 1924, a recommendation came out of the clinic that said all miners should be examined for silicosis and other diseases prior to their employment in the mines and each year thereafter. In 1927, the work increased and expanded through an agreement between the Metropolitan Life Insurance Company, Tri-State Zinc and Lead Ore Producers Association and the U.S. Bureau of Mines. The purpose of this increased work was to investigate the general health of miners, "to demonstrate to industry a workable method for diagnosis in preventative measures, and to serve as a model to industries presenting a dust hazard."[30]

During its operation, the clinic and its officials examined 27,553 miners between 1927 and 1932. Of this total, 5,366 were found to have silicosis, 742 had silicosis complicated with tuberculosis, and 320 had tuberculosis without silicosis. They took samplings of the air around the miners at all posts throughout the mine and found that men at the face of the mine had the highest incidence of silicosis. The different jobs they took samples at include the driller, hand shoveler, hopper puller, scraper loader operator, and rope rider. The driller sample was taken at one and one half feet from his face, between his face and the point of drilling. For the hand shoveler the air sample flask was moved up and down in his breathing zone as he preformed his job of filling the mining can. The hopper puller had his sample taken between him and the dumper he work on at the elevation of his nose. The scraper loader operators' sample was taken between his face and the bottom of the ramp at the elevation of his nose, one and one half feet

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[29] Derickson, "On the Dump Heap," 664.

[30] Tri-State Survey Committee, *A Preliminary Report*.

away from his face. The last job sampled was the rope rider. His sample was taken between him and the point of discharge of broken ore from the ramp chute at the discharge end of the loader.[31]

Routine dust count practices like this were instituted in the Tri-State Area in September of 1936. The final report conducted in 1938 by the Division of Labor Standards under the U.S. Department of Labor by the Committee on the Prevention of Silicosis through Medical Control released this statement:

> There is evidence that for prolonged exposure a concentration of more than five million particles per cubic foot of highly siliceous dust is dangerous. Therefore it is now considered good practice to hold concentrations of highly siliceous dust at five million particles per cubic foot or less.[32]

This limit of five million particles per cubic foot was used in the Tri-State Area from then on out. From September 1936 to November 1939, 3,112 air samples were taken. Of these, 2,473 were taken underground and 82 percent of these were below the limit of five million particles per cubic foot.[33]

Silicosis was most certainly very disruptive to a miner's life. Along with the constant threat of silicosis complicated with tuberculosis, the miner always worried about being released from work. Due to the mandated medical screenings, miners did what they could to conceal the signs of the disease during these examinations. If silicosis was largely defined by the inability to work, then clinging to a job meant an individual did not have the disease. Silicotics often transferred to less strenuous jobs underground and some even turned to alcohol and patent

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[31] H.C. Chellson, "Dust Control Technique in Tri-State Mines," *Engineering and Mining Journal*, (December 1939): 29, Box 76, Picher Collection, Axe Library, Pittsburg State University, Pittsburg, Kansas.

[32] *Ibid.*

[33] *Ibid.*

medicines to alleviate symptoms to keep them working. However, a miner could not deceive the radiologic technology of an X-ray.[34]

For silicotic miners in the early twentieth century, knowledge did not bring them justice.[35] The miners, their families and kin, and the public bore more of the burden of silicosis than the mine operators did. A miner had no other option than to literally work his self to death. He had a family to support and went to work every day praying it was not medical screening day. While it is true the government and their different bureau's tried to remedy the situation, they did not enforce it very well when it came to the mine operators. Mine operators very often did not care or they were being paid too much to not care. Extreme advances were made in the prevention of silicosis and they simply turned a deaf ear. It was not "cost effective" to an operator to install ventilation systems or wet drilling methods. They had scores of willing applicants to take the place of those miners who could no longer do their job to the expected standard; they simply replaced the old with the new. Yes, silicosis was most certainly the most dangerous hazard a miner faced in the Tri-State District and because of that, many men and, eventually the public, died due to the mine operators' indifference to the value of a human life.

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[34] Derickson, "On the Dump Heap," 669.

[35] Derickson, "On the Dump Heap," 677.

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