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PROCEEDINGS

of

All Ohio Safety Congress

Held under the auspices of

THE INDUSTRIAL COMMISSION OF OHIO

and the direct management of

THE DIVISION OF SAFETY AND HYGIENE

Published under the authority

of

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1. Free silicon dioxide (usually quartz), in particles less than 10 microns in greatest diameter.
2. Excessive concentration.
3. Long period of exposure.

Particular emphasis should be given to these limiting factors: First, "free silicon dioxide, less than 10 microns in greatest diameter." This means exactly what it says—not calcium carbonates, not iron oxides, not silicates, not even silicon carbide (which is carborundum) but free silicon dioxide. It seems probable that no little confusion has arisen in the minds of plant superintendents and engineers of the time-honored practice by industrial chemists of reporting an analysis in terms of the oxides of the components. For example, a typical reported analysis of Portland cement will show a total silica content of about twenty per cent. Actually, all of this silica is combined in the form of entirely harmless calcium silicates, and it has been conclusively demonstrated that it is utterly impossible to acquire silicosis from exposure to cement dust. It should be mentioned that quartz is not the only form of free silica, though it is apparently the most dangerous and certainly the most common form. The various amorphous forms of the compound, such as flint, tripoli and chert, may also produce the silicotic reaction in the lung, but they are known to be less severe in their effect.

The limiting size of ten microns is also of importance. Particles larger than this do not reach the lungs. Furthermore, the percentage of quartz in a given material will vary greatly with the particle size. A petrographic examination of shale at Saranac Laboratory under Dr. L. U. Gardner's direction, recently revealed 20 per cent quartz. In a special fraction containing only large particles, 40 to 50 per cent quartz was found.

Dr. Gardner writes, "this is obviously due to the fact that quartz is so hard it does not fracture into fine particles." It must, therefore, be emphasized that conclusions as to the hazard existent in a dusty operation cannot be based with confidence on an analysis of the parent rock. Only an analysis of the dust in the breathing zone of the operator will give an accurate picture of conditions.

The second limiting factor is concentration. The exact amount of air-borne quartz that constitutes a dangerous concentration in any particular industry is not easily determined, nor is there as yet any substantial agreement as to what limits of quartz content should be observed.

Dr. A. J. Lanza, Assistant Medical Director of the Metropolitan Life Insurance Company, an outstanding authority on the silicosis problem, gave an excellent summary of what needs to be known about dust concentration in his paper presented before The American Institute of Mining and Metallurgical Engineers, in February, 1937. He said:

"In the present state of our knowledge, it is not possible to establish permissible limits of dustiness for all dusty industries or processes as the variation both in the dust content and in external modifying conditions is so extreme. In mining, however, working conditions are fairly constant and it would be extremely valuable to the industry if the various mining companies that face a silica hazard would establish, with the help of the proper governmental authorities, tentative standards practicable and applicable for their own mines. Some have done so and it is a long step in the right direction."

This recommendation might well be extended to other industries.

The National Silicosis Conference tentatively established a maximum of five million particles per cubic foot as a safe quartz concentration in the case of highly siliceous dusts. This standard is subject to modification as more data are developed by different industries. The National Silicosis Conference report also says, "It is recommended that clinical and engineering studies be carried out as rapidly as pos-

sible to establish the necessary scientific data upon which we may base practical and effective regulatory standards." The report then states that knowledge of three factors is necessary for establishing safe concentration of atmospheric dust:

1. The relative number and size of the free silica and the other particles suspended at breathing levels in the different parts of the industrial atmosphere.

2. The proportion of the workmen's time actually spent in the various dust concentrations.

3. The effects of exposure to environment, as revealed by the occupational and medical histories of old employees, by physical examination and by the roentgenological appearances of their lungs.

Through a knowledge of these three factors, any industry can discover what, if any, hazard it has and what preventive measures are needed. For the past two years, under the direction of Dr. Leroy U. Gardner of the Saranac Laboratory for the Study of Tuberculosis, the cement industry has been making a careful estimate of the health of its workers, according to the plan just outlined. Many of the statements in this paper regarding the effect of mixed or non-siliceous dusts have been based on the findings of these studies.

One of the outstinding conclusions a student of these researches in the cement industry will reach is that concentrations of free silica appreciably higher than the maximum specified by the Silicosis Conference are safe if the silica constitutes a moderate proportion of the total dust. Apparently a mixture of silica with other minerals, if the other minerals are predominant, tends to inhibit the effect of the silica in the lung. It is not yet possible to recommend, without reservation, the dilution of silica with other dusts as a protective measure. It is far better to remove the dust from the atmosphere. Nevertheless, it is significant that in the Portland cement industry, where a high concentration of raw material dust containing up to 10 per cent of free silica is sometimes found, the X-rays and physical examinations reveal no pathological lung condition attributable to dust.

Although no agreement has been reached as to the maximum safe concentration of free silica in the presence of harmless dusts, agreement as to good housekeeping limits is practically unanimous. Industries with a dusty process, even though dusts are harmless, should endeavor to reach a concentration in the neighborhood of 100 million particles per cubic foot of air in the breathing zone of the workers, in the interests of comfort and increased efficiency.

The third factor in the development of silicosis is duration of exposure. The problem of exposure resolves itself into two parts. First, what proportion of the workers' time is actually spent in the dusty atmosphere? It is evident that a hazardous dust will not affect a man unless he is actually exposed to it and will not have as great an effect on a man who is exposed to it one hour a day as on a man continuously exposed.

The United States Public Health Service has developed a formula for calculating the actual exposure in terms of particle hours. They recommend, in Bulletin 217, "The Determination and Control of Industrial Dust," that the particle concentration in any area be multiplied by the number of hours an employee works in that area; that this product be calculated for each hour of the working day and that the total of these products be divided by the number of working hours to give the equivalent of continuous exposure during the day.

For example, a man may spend two hours a day in a concentration of 200 million particles per cubic foot: three hours in a concentration of 10 million particles: one and three-quarter hours in a concentration of 40 million particles and 15 minutes in concentration 1,200 million particles. The man's exposure would be calculated:

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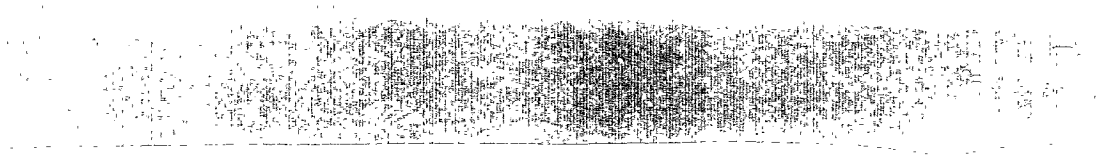
Hours per day	Dust Concentration	Particle-hours (millions)
a	b	a and b
2	200	400
3	10	30
2½	40	110
½	1040	260
Total Hours 8		800

800 particle hours in millions per cubic foot / 8 hours = 100 million particles per cubic foot daily exposure

The application of this formula in a practical problem is apparent. If you find, from a study of concentration and silica content, that in two or three areas in your plant atmospheric dust exceeds safe limits, you will make an analysis of the exposure by the P. H. S. method and attack first that point where employee exposure is the greatest.

How long does it take silicosis to develop? The answer to such a question must be equivocal. Much depends on the physical condition of the worker. A man whose respiratory passages have been damaged so that dust is not readily excluded by the usual protective mechanism, may contract silicosis more readily than a man with normal nasal and bronchial passages. Also a man whose lungs have been damaged by pneumonia or tuberculosis may develop silicosis more quickly. We are probably all familiar with the reverse of this; i. e., that the man with silicosis has much less resistance against tuberculosis than a man with unaffected lungs. This fact, incidentally, suggests one of the outstanding differences between the action of silica and other dusts. Medical authorities state that not only does the silicotic lesion in the lung resemble the lesion in tuberculosis, the silica actually stimulates the activity of tuberculosis and, at the same time, conceals its symptoms until it is far advanced. The seriousness of such a condition may readily be imagined. A tubercular with significant quantities of silica in his lungs may be rapidly getting worse, yet diagnostic symptoms are often lacking. Frequently only a careful X-ray examination can reveal the presence of tuberculosis in a silicotic. Mr. P. N. Bushnell, speaking before the Metals Sections of this Congress last year, emphasized the fact that the real danger from silicosis is not silicosis at all, but tuberculosis. First or even second degree silicosis, uncomplicated by tuberculosis, usually causes relatively slight disability, seldom pronounced enough to interfere with working capacity. No worker should be deprived of an opportunity to earn a living at his regular job just because his X-ray shows some signs of nodulation. The job should be cleaned up by approved engineering methods, of course, but discharge of workers who are perfectly capable, simply because of a non-symptomatic condition which hysterical opinion has magnified out of all proportion, is certainly not the solution of the problem. Inert dusts do not produce the typical nodular lesion, nor do they cause any increased susceptibility to tuberculosis. In the cement industry, for example, only 4% of the X-rays of 1700 employees revealed old tuberculosis lesions and 96% of these lesions were healed or quiescent. Studies of absenteeism over a two-year period, covering the majority of mills in the industry, confirms the X-ray evidence. The mortality rate from tuberculosis of 0.07 per 1000 employees in 1937 is only 8% of the tuberculosis mortality rate of 0.87 per 1000 employed males established by the National Tuberculosis Association in a comprehensive survey in 1930.

The various factors which may influence the length of time required to develop silicosis, if we may recapitulate, are (1) intensity of dust concentration, (2) pro-



of the dust nuisance can be eliminated by systematic routine and thorough clean-up programs. The advantages are obvious. The plant is much better looking and, in addition, the atmospheric dust is reduced.

Medical control is equally important. The only sure way to know that a hazard does not exist is the careful observation of the workers over a period of years. Pre-employment examinations are, of course, also important for proper placement of applicants.

In this paper we have presented some of the salient features of the silicosis problem. We have, first of all, emphasized that only two pneumoconioses are actual diseases, silicosis and asbestosis.

We have pointed out that there are three causative factors of silicosis and all three must be present simultaneously to produce the disease.

1. Uncombined silica in small particles, of which the most dangerous is probably quartz.

2. Sufficiently intense concentrations of the dust to be hazardous. This concentration is set at five million particles (light field count) of quartz less than ten microns in greatest diameter, if the quartz constitutes a high percentage of the material. Studies in the cement industry have demonstrated that, in many cases, appreciably higher concentrations of quartz can be tolerated when inert dusts, as clay or limestone, are intermixed with the silica.

3. Exposure by the employees over a sufficiently long period to high concentrations of silica of the necessary fineness.

The influence of silica on tuberculosis is strong, whereas inert dusts have no effect on this disease. Serious disability from silicosis, especially in the first two stages, usually results from infection, rather than from the uncomplicated disease. If the working environment is adequately clean, a silicotic need not be denied work as long as he is free from infection and is capable of doing his job.

Methods of control of the disease include pre-employment and periodic medical examinations, removal of dust at point of origin, emphasis on good housekeeping and the use of respiratory protective equipment where removal of dust from the atmosphere is not possible.

It should be emphasized that control, especially engineering control, of the silicosis hazard is the phase of the problem that is of greatest importance to those of us who are interested in the practical methods of eradicating the disease.

Dr. A. R. Riddell of the Ontario Department of Health, whose work in the gold fields of Ontario has won for him an international reputation, put the problem squarely up to the engineers when he said: "Silicosis is an occupational disease declining in importance. Its prevention is not a medical problem. As it occurs exclusively through the inhalation of dust containing silica, its prevention depends on the elimination of dusts industrially produced. This is a problem for the industrial engineer. Engineers have met the problem so energetically and with such intelligence that the occurrence of silicosis in many operations now considered hazardous will cease entirely during the next fifteen or twenty years."

(Applause.)

CHAIRMAN WITMER: Has anyone any questions to ask Mr. James? Dr. Obetz, will you please take over the meeting now to discuss this subject?

DR. OBETZ, Medical Director, Industrial Commission: I don't know that I have anything to add or discuss. I would like to have anyone here ask Mr. James any questions that they may have in mind in order that they may fully understand the hazards that are present in the quarry industry.

MR. NEIMAN: I understood the speaker to say something about asbestosis.

MR. JAMES. As I understand it, asbestosis in magnesium silicate—it has been developed that the appearance, as I understand it of a lung affected with asbestosis isn't quite the same as silicosis, but at the same time it has been definitely shown to be a progressive disease in case of magnesium silicate, and that is the only one that has been established as being harmful. Its effect is not as great as silica.

MR. NEEMAN. It struck me particularly, it not being harmful.

MR. JAMES. It is a surprise to a great many people, I believe. Do you care to discuss that any further Dr. Obetz?

DR. OBETZ. No, I can't, I can't give the reason for it, but I know that it is true.

CHAIRMAN WITMER. Anyone else have any questions at this time? If not we will go on to the next subject which is a round table discussion of our most serious accident hazards. Anyone here going to open the subject in an informal round table discussion? Mr. Adams, do you have anything to say on that subject?

MR. ADAMS. I don't think so.

CHAIRMAN WITMER. Well of course we have been talking all along here about serious things like the handling of dynamite, transportation, and so forth, but from reports sent out by the Industrial Commission I note that the major accident rate and the index to the accident figures for the industry, all three of these industries, lime, cement and quarries, has been in the handling of small tools, and that's true in almost every industry, I think. I know last year the subject of small tools was not discussed very fully and I think that some suggestions along those lines in the prevention of that class of accident should be discussed. Has anyone any comments to make? Dr. Obetz, probably you can give us some of those industrial figures on that.

DR. OBETZ. I am sorry, but Mr. Meehan was to be here and conduct that part of the meeting, he was called to another section. Anyone have any thoughts along that line?

MR. RUTHERFORD. I might say that I had missed that in one of the hazards that I had listed there, but in my excitement I overlooked it. We have had some, in talking of small tools, especially in the quarry, from claw bars and mallets, spalls flying off of those striking the men working, and we have eliminated that to a great extent by tool inspection and repair, in other words keep the spike maul so it isn't flattened out and corners breaking off; the same way with the claw bar, where you are driving a claw bar under the head of a spike, you have some trouble there. I think tool inspection goes a long ways in eliminating hand tool injuries.

MR. ADAMS. I might ask one question, if I may. Some of our accident reports read for particle in left eye, or for a particle in right eye. I wonder if we are an exception or whether we are more careless than someone else in the wearing of goggles, or do the rest of the people have the same thing?

MR. L. C. LEWIS, of the Industrial Commission, Division of Safety and Hygiene: I think about every industry I have come in contact with has the same complaint that you have just mentioned, particularly the coal mining industry. They take a pick, strike a piece of coal, piece of steel, the first thing you know something in the eye, and the proper wearing of goggles, that is the proper kind of goggles, naturally would eliminate that condition. There is no question about it. Some mines now are one hundred per cent in the reports of their accidents that they have been sending in to the Industrial Commission; one-fourth or twenty-five per cent of the accidents occurred were from the eye. That one firm has totally elfminated the eye accidents,

at's the Akron Coal Company over in Guernsey County. Now, hand tools, there are quite a number of injuries come from hand tools, and I am glad to hear Mr. Rutherford suggest that proper inspection of tools. I have gone into different plants, and with the hand tools, even the hammer, the hatchet was loose on the handle, men would take it; I have seen the hatchet fly right off when they were trying to drive a nail; I have seen it move sufficiently when they were driving a nail and hold it with their hand, the hammer would hit the wrong nail, consequently it was an injured finger. I think one of the best suggestions that you made is to see that your hand tools are inspected. I have seen crow bars set out in the winter, full of frost, picked up by a man, and to my surprise one day I saw a man, he wanted to take his gloves off, change his gloves, he put the small bar right in his mouth, you know what happened, his tongue was stuck on the bar, he had to wait until it thawed free. I saw another man putting his bar up to his mouth, just that way, moved his cigarette or cigar, whatever it was, and the bar touched; infection set in there, that man was laid up for six weeks just because of an infection that came on his upper lip because of the contact with the frosted steel bar. So if the tools were put in the proper place, kept in the right condition, properly inspected, I think you would eliminate many injuries. Using the goggles, naturally would eliminate the eye trouble, that is at least ninety per cent of it, and I think there should be a rigid enforcement of the proper use of goggles.

CHAIRMAN WITMER: I think Mr. Lewis has very ably answered your question, but I would like to call on Mr. Weber to give you a little more detailed answer with regard to the frequency of that same accident. Mr. Weber, what has been your experience?

MR. F. W. WEBER (Standard Lime & Stone Co., Woodville, Ohio): We have had quite a few accidents, in fact we had our last one about seven years ago, which was a lost eye, and since that we gradually got the men to wear goggles, and of course we tried to make them wear them at first, and we found out during the program that all goggles didn't fit everybody alike, but we finally got the right kind of goggles, and I think we have about four kinds that we use, and they seem to work out very satisfactorily. Some of these goggles are just ordinary large pairs of rim glasses with a shatter-proof glass in it, where they are using the lime, and I don't think we have had any trouble of anybody getting lime in his eye where they wear them. Of course they wouldn't be much good out doors where the wind was blowing a lot, but I must say we have eliminated our eye accidents. Everybody has to wear goggles, even myself, when I get in a bad place I have got to put them on. I have a pair to fit over these glasses, although I wear them lots of places where glasses are permissible. And that also applies to safety shoes, although we haven't got that a hundred per cent, we hope to have before the year is over. Take safety shoes, when they first came out you thought you had to build a pair of shoes and put a piece of iron in the foot and everybody could wear them, but they soon found out different, just like you go in a shop and buy a pair of shoes for Sunday wear if they didn't fit you didn't take them. That was the same way with safety shoes. We finally got around where we could fit most of the men very nicely now, they have got so many good shoes on the market. The same way with other equipment such as respirators, although we don't use those so much any more. We eliminate our dust as much as we can. We don't say we are a hundred per cent free of dust, but we are a whole lot different than we used to be.

MR. LEWIS: Just one question. You mention about the goggles not being used outside, if they have the wire gauze protection from the helmet back to the side of the head that will protect all right.

MR. [illegible]: The wire gauze is all right, we have men who wear them now. They wear them under their helmet and then they use them for chipping only, they are not much protection for dust, I wouldn't rely on them.

MR. LEWIS: They don't protect from the wind.

MR. [illegible]: Not where you have dust around a cement or lime plant.

MR. LEWIS: That question was discussed by a goggle salesman the other day.

MR. [illegible]: The reason we use that one kind for the welder, he used to have a burning goggles and welding helmet, and also another pair for chipping, he was not going to stop to put them on so we got this other type which fits on just like a pair of glasses does, and the minute he tips his helmet back those chipping goggles are right on hand, he goes right on with his work.

MR. CORNELIUS: Southwestern Cement Company. We use a sun-right shade on our goggles. It is a transparent material something like celluloid, otherwise no opening there whatever, we find it very effective and helpful under dust conditions.

MR. LEWIS: That protects against the wind dust?

MR. CORNELIUS: Oh yes. They are open around the inside here, but the sides are closed up entirely that gives a little ventilation around the nose, but it closes up and protects very well against winds blowing dust around like that. We went through a stage a couple of years ago of eye injuries. In one year I think our eye injuries were about seventy-five per cent of our medical cases, foreign particles in the eye. We went through what we call education or the conscious movement, we tried to make all the fellows feel that the eyes were important enough to protect and did everything we could do to make them wear their goggles and follow their helpers, where they had been doing work that there might not be the least requirement for goggles, put them on, there might be a remote chance of having something get in their eye, give themselves the benefit of the doubt and put their goggles on. For the last year and a half or two years our eye cases have been practically nothing. I don't think we had a case last year, a medical case of something in the eye.

MR. LEWIS: And yet prior to the use of goggles it ran as high as seventy per cent.

MR. CORNELIUS: We had goggles at that time, but the fellows didn't use them, but we had to get them to see it, that they absolutely needed the goggles, and we furnished them to them and all they had to do was go to the storeroom and get them and put them on, we made them available at all points where there wouldn't be any excuse that they couldn't get goggles, we eliminated that part of it, then we put it up to them. We got good results from that. So far we have got our eye condition under control.

MR. LEWIS: One statement I would like to make about John Rigby, show you how he went about to enforce the use of goggles in mines. They had been wearing them one hundred per cent. He went away on a coal sales trip with the sales manager, he came back, he saw the goggles piled in the office, 310 pairs of them. The next morning he met the men at the mine. He says, "What is the matter with these goggles?" "We are not going to wear them any more." "Aren't you? All right, that is up to you." They walked over to the gate to go down the shaft, they said: "How are you going to open the gates?" "The gates are not going to be opened, not until those goggles are in you men's possession, and you agree to wear them. I'm not going to be technical, so am I. Your eyes are getting hurt, not mine. If you haven't got judgment enough to protect your own eyes, I don't feel you

have got judgment enough to work for the Akron Coal Company." They went home and the next morning they came back and all the glasses were out of the office before he came. So sometimes it takes discipline to handle the problem.

CHAIRMAN WITMER: Any more comments on this problem of small tools and minor injuries? If not I will call for nominations for chairman for the committee for next year. We have got to nominate a chairman for next years' session sometime, might as well get up and nominate a chairman.

Thereupon Mr. Rutherford was nominated as chairman.

MR. CORNELIUS: I move to close the nomination.

CHAIRMAN WITMER: It is moved by Mr. Cornelius that the nomination is closed. In view of that fact all those in favor of Mr. Rutherford for chairman of next year signify by saying "Aye".

Motion carried.

CHAIRMAN WITMER: Mr. Rutherford has been elected chairman for next year. In past years it has been the experience that the Chairman never acts as chairman, he passes the buck onto the Vice Chairman. Therefore we now hold nominations for the important office, that of Vice Chairman. Do I hear any nominations for Vice Chairman?

MR. RUTHERFORD: I nominate J. R. Weaver.

MR. WEAVER: I believe I will decline to accept that nomination.

CHAIRMAN WITMER: It is still open for nomination. Do I hear any nominations for Vice Chairman?

Thereupon Mr. Cornelius was nominated as Vice Chairman.

MR. WEAVER: I move the nomination be closed and Mr. Cornelius be elected.

Motion seconded and carried.

CHAIRMAN WITMER: Mr. Cornelius elected Vice Chairman. I again express my gratitude to Mr. Rutherford and Mr. James who gave us such wonderful talks here today, and I am sure that we all profited measurably by it. Is there any more business to come before the meeting, or any other remarks?

MR. LEWIS: I would like to say something before the new president takes office. There are quite a number of quarries in Ohio that never send anyone here. I would make a suggestion, it is only a suggestion, I want you to understand that our division of Safety and Hygiene is instructed to help and assist in every way that we possibly can. Mr. Kearns gave me this order, I would suggest that you get a list, your President, Secretary and Vice President get a list of the quarries from the Industrial Commission and write a letter, and if you write a letter we will have it sent out if you wish, mimeographed and sent out from our office to the different quarrymen of the State of Ohio requesting them to get into this section and see if you can't make this one of the real big sections. I compliment you here today, you are bigger here today than you were last year. Now if you go after it right you can get more next year than you have this year.

MR. WEBER: I think so.

MR. LEWIS: Don't you think it would be? In order to get that list from the Industrial Commission and have them type the letter, they wouldn't have to do the work except type the letter.

MR. WEBER: We have a man four miles from us, still we don't see anybody here at these meetings, I have been over to see them, but I can't get them to come unless you drag them in here.

CHAIRMAN WITMER: I might explain that this week the National Lime Convention was held down at Cincinnati and it is still in progress today, in fact at ten o'clock this morning there was a safety meeting down there, and many of the men were attending that convention and stayed down there for the meeting this morning rather than come up here. That's one reason why there are so many of the lime manufacturers there.

MR. LEWIS: Can you tell me if the Alpha Portland Cement Company had representatives down there from Ironton?

CHAIRMAN WITMER: I don't know. If there is no other business the meeting is adjourned.