

fume, which are the two curses of the lead industry. The minute particles of dust are surrounded by a layer of moisture which renders them more liable to absorption by the respiratory mucous membrane, or, when mixed with saliva and swallowed are absorbed by the stomach.

I cannot emphasize too strongly the necessity for the education of the workmen and for factory discipline which will eliminate the habitually careless from the industry.

Dr. Patterson then illustrated by lantern slides and by moving pictures the various methods in force for the prevention of lead dust and fumes, and various welfare rooms and houses where the employees had ample washing facilities and dining rooms.

THE CHAIRMAN: Dr. Alice Hamilton, of Chicago, will now discuss Dr. Patterson's paper.

I took the title of Doctor Patterson's paper in the larger sense of the status of the prevention of lead poisoning in the lead industries in general, and, after all, Doctor Patterson has so thoroughly taken up the subject of prevention in the white lead industry that there would be no need for me to say anything more about that. I think perhaps I had better take the few minutes at my disposal to speak of the lead trades in general, and of the principles which should govern the prevention of lead poisoning in these trades.

As of course you all know, lead is the industrial poison par excellence. There is hardly any great manufacturing concern into which lead does not enter in some form or other—either metallic lead or some salt of lead—and every form of lead is more or less poisonous, although the salts differ a good deal in the degree of their poisonousness.

The most important, I suppose, as well as the most dangerous, is probably the sub-oxide of lead, that fine gray powder that forms on the surface of lead very slowly in the cold, rapidly when it is heated, and that comes off in the form of lead fume when lead is heated to the fuming point. That is the form of lead to which lead smelterers and refiners are exposed, as well as all of the workers in metallic lead, the makers of wire and cable and sheet lead, and type founders and type setters, and casters of lead of all kinds. This sub-oxide is really, I suppose, very much the most widespread of all the lead salts, and, as I said, one of the most poison-

ous, if not the most poisonous, partly because it reaches the atmosphere in a state of very fine sub-division and can therefore easily be breathed in and absorbed quickly when it reaches the human victim.

Next to that we should place either the basic carbonate or the higher oxide, litharge and red lead; and there is a difference of opinion as to which of these is the most poisonous. White lead, the basic carbonate, is the most soluble, but the oxides are dustier and fluffier, litharge especially, and therefore work with the oxides is considered by many to be more dangerous than work with the basic carbonate.

My own experience leads me to think that, because I found a greater proportion of poisoning among red lead and litharge workers than among white lead workers. I remember one plant in which both were manufactured where I found fourteen cases of poisoning among sixty-five white lead men, but as much as seven cases among twelve red lead workers.

Much less poisonous than these salts, and yet distinctly poisonous, is lead sulphate, the oxy-sulphate or sublimed lead, as it is often called. It has been often stated that this compound is almost non-poisonous, but that is a great mistake; it is not so poisonous as the ones I have mentioned, but there will be a great risk if men are allowed to handle it with carelessness under the impression that it is not dangerous.

We found in the two lead plants in which sublimed lead is made in this country, that during the year preceding the investigation about one man in three had suffered from lead poisoning in the course of their work. Lead sulphide even, is poisonous, although it is usually considered entirely safe. No less than 25 cases of lead poisoning were treated in one St. Louis hospital during 1912, and the men all came from the lead belt southeast of Missouri, where the ore that is mined or milled is practically pure galena.

Now it is immensely important in considering the protection of men from lead poisoning to know just how lead enters the system, because obviously we shall institute different methods of protection if we must think of the skin as the most important portal, or the lungs or the intestinal tract. I think we may eliminate the skin altogether—at least, that is what the best European authorities tell us. When I went over the white lead plants in England (and

I have no doubt Doctor Patterson noticed the same thing) I saw workmen smeared with white lead paste up to their shoulders, but the inspectors were quite indifferent to that, provided the men washed off thoroughly at the end of the day's work. In my own experience I have found that lead poisoning was much greater among the enameleders of sanitary ware, who are obliged to breathe a powder which is not very rich in soluble lead—it contains only a small quantity of soluble lead—but the lead poisoning is much greater among them than it is among the pottery dippers, who have their hands and arms soaked all day long in a glaze, which contains a large proportion of soluble lead. In the one case it is a dust which the men inhale; in the other case the slime is smeared with it, but the first trade is the more dangerous.

The skin, therefore, I think, can be left out of consideration as a portal of entry for lead, although I realize that it will be hard to make a great many practical lead men in this country believe that. They all think that there is more lead poisoning in hot weather than in cold weather, and explain it on the ground that the skin absorbs more actively in summer. In the smelting industry I was told this all the time; so I took records of some 2,840 cases of lead poisoning in the smelter industry and charted them according to the months in which they had taken place, and I found that the heaviest month was a summer month—but it was June, and not July or August, and of course June is not our hottest month. To me it seemed that those June cases were to be explained on the ground that during the early spring months a great horde of green men come into the smelting works to take the place of those who have left to go into farmwork, and that these men have just had time to develop poisoning by June.

As to the lungs, we may eliminate them as an important portal of entry, but that does not at all mean that dust is unimportant. Of course you all know that lead dust is a great danger, dust and fume, for after all, fume is only finely suspended and finely divided dust. That is the greatest danger of all and the most rapidly developing, and by far the most serious causes of lead poisoning come from dusty work. But this does not mean that the dust reaches the lungs and does its harm there. It means that the dust that is breathed in becomes mixed with saliva and swallowed; and as it is so very finely divided it is very quickly absorbed, so that essentially

a man is poisoned in the same way whether he breathes in the dust or fume or whether he smears it on his food and tobacco and takes it into the mouth in that way. Only, of course, he is breathing all day long, and he is eating his lunch and chewing his tobacco only at rare intervals, so that it comes back to the breathing of dust and fume as the great peril.

The prevention of lead poisoning then in the lead industry depends first on keeping the air clean by installing an exhaust to carry off fumes; in keeping down dust through sprinkling, and, where this is impossible, installing exhausts; and finally, if none of these are practicable, to do the only thing left for you to do, to expose the men for as short a time as possible to such work.

I can think of certain processes, such as cleaning out the flues or the bag house system of a great smelter, and repairing furnaces or repairing apparatus of all kinds, where it seems impossible to keep down the dust. In those cases all that you can do is to allow the men to work for short periods only, because, please don't ever think that you are protecting a man adequately when you give him a respirator. No respirator through which a man can breathe can keep out all of the dust.

Second in importance I would put the provision of proper wash-houses and bathhouses and proper working clothes. That is important, but not nearly so important as the first thing. The amount of lead which a man gets into his mouth from his lead smeared hands may be very great in the case of the white lead industry, or in the making of storage batteries, or the manufacture of the oxides. Where, however, a man has to work with metallic lead, either in a hard or molten condition, it is dust and fumes that count.

I can remember in particular one large smelter in which the company spent a great deal of money in building a good comfort house, with every possible equipment, and yet lead poisoning among the men did not diminish, because dust and fumes continued, and no matter how much the men bathed that did not protect them. Dust and fume are dangers for which the management is directly responsible.

Doctor Patterson has spoken to you about how difficult it is to get the men to avail themselves of the opportunities for cleanliness that you give them. I think that is perfectly true, but I do think you ought perhaps to take into consideration the fact that in certain

industries you employers are very especially responsible for your men. I think if we leave out the men employed in highly organized lead industries, such as the printers, the plumbers, the painters, the white ware dippers and kilnmen, we have in the lead industries in general newly arrived immigrants who are unorganized, and toward them I do think that your responsibility is greater. You are, after all, are you not, getting the benefit of a force that accepts low wages, that is willing to work for longer hours, perhaps for seven days in the week; that is docile to a great extent—at any rate, free from the interference of the trade unions. Then, having the advantage of these child-like and docile employes, you ought to be willing to treat them as children, and not look upon them as entirely responsible for their own stupidity and their own obstinacy that comes from slow wittedness—defects which are inherent in the very virtues for which you have employed them.

I would like to say a word in appreciation of the work of Doctor Patterson in the Harrison Brothers White Lead Company, of which he has told you. I do not feel that I can stop without saying that, for I saw the plant back in 1911; and if Doctor Patterson was connected with it, I assure you if he could have shown you the pictures of the plant as it was then and compared them with the plant as it is now, you would agree with me that its own mother would not recognize it if she could see it today. (Applause.)

THE CHAIRMAN: Gentlemen, I greatly regret that we could not have given Doctor Alice Hamilton more time. I would have especially liked to have her explain how we would recognize the mother of a red lead plant. (Laughter.) But I have been given orders—I have been furnished here with a cut and dried schedule and have been ordered to run the thing as per schedule. You are to bear in mind that there are three moving picture films that are to be shown at five or soon thereafter, one on Safe and Unsafe Practices, another a continuation of the lead talk that you had, and the third the Assembling of an Automobile. They have the right-of-way at five o'clock.

Now we are ready for general discussion. The discussion will have to be brief. I would suggest that if we could have terse observations and suggestions that it would be immensely helpful and that it would not consume too much of this overloaded pro-