No 6 Bureau Labor Standards

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Dr. Alice Hamilton, of the Division of Labor Standards, was introduced by Dr. Freeman, and spoke on the subject of industrial poisons.

Dr. Hamilton. There is not a very large number of workers employed in poisonous trades and some of you may not deal with any industrial poisons in your work as factory inspectors. The number of workers exposed to dangerous dusts is very much greater, and I suppose there is no comparison at all between the number of workers exposed to poisons and those who are exposed to heavy, exhaustive work and excessive heat. The reason why we have to pay a great deal of attention to the poisonous trades is that we know a great deal about them, much more than we do about the dusts, for our knowledge in that field is still very limited except with regard to silica and asbestos. In connection with poisons, we know a great deal, especially about the common ones; they have been studied for more than a century. Therefore there is a greater responsibility on the part of the physician and the community to control the poisonous trades than the trades we know less about. That is why we have to devote so much time to the poisonous trades. In an hour I can only touch on a very few spots, but there are some things I want to say about poisons in general. One of these is of great importance—the various ways that poisons can enter the body, and because this is not generally understood, wrong advice is given on the question of prevention of occupational poisoning with amazing frequency.

Just a few years ago a great smelting and refining plant employing several thousand men here in the East found that it must do something about lead poisoning because the State had passed a compensation law. As is the case with many employers, that event first opened the eyes of the management to the amount of danger from lead poisoning. They consulted two very good physicians, who told them to build a large welfare house with shower baths, clean wash rooms and lunch rooms that could be approached only by going through the washrooms and even regulations regarding the washing of overalls at regular intervals. The management did all of this, spending a great deal of money, but they did not have any falling off in their lead-poisoning cases; the number was as great as ever, simply because the men were still breathing the same air they had before. If the same amount of money had been spent on cleaning the air instead of on provisions for washing the hands, much more benefit would have been derived.

After all, a man cannot be seriously poisoned by the dust that gets on his hands or his face. A man does not suck his fingers or wash his hands in his soup. As I said, it is a matter of great importance to have clearly in mind the way in which the poison enters the body, because unless you do that you will be falling into all sorts of error

when you give advice to the management of the plant. A great majority of the poisons pass in through the air that we breathe. Of course, that is true of all the gases—carbon monoxide, hydrogen sulphide, and sulphur dioxide—all of which are industrial gases. It is also true of the volatile poisons, like benzol and petroleum distillates, methyl alcohol and the new chloroform-like solvents and degreasers. What about solid poisons, such as mercury, lead, manganese, zinc, and all the other metallic poisons? How do they enter the body? With mercury, the experience of the medical profession has convinced them that in general mercury enters chiefly through the skin, but in industry we find that the most important mode of entrance is through the inspired air, although skin absorption plays a part.

Of course, mercury volatilizes at all temperatures above 0° F., and in the practical protection of workers in a plant where mercury is handled, the fumes are the thing to think about. This means that there must not be any open receptacles of mercury or any droplets scattered over the floor and, of course, no escape of vapors from heated mercury.

With the solid metals, there are two things to think about, the contamination of the air by dust and by fumes. Take lead, which is by far the most important of all. When lead is first cast, it is shiny and clean and there is almost no lead poisoning in casting or molding lead. But as you all know, lead is gradually coated over with a dull grayish powder, which is very easy to absorb and very poisonous. It is the suboxide of lead. When you enter a plant where metallic lead is cast, look at the lead kettle and you will see a dull wrinkled surface, or if there is any old lead lying around, it too will acquire that fine dusty coat, which is easily detached and blown about so that the air is contaminated with finely divided lead suboxide. There should be a rule in every State that every receptacle of molten lead should have a hood with an exhaust.

You will find that in storage-battery plants the casting is the safest part of the work, for the freshly cast grids have not yet been oxidized and lead is not dangerous as long as it has not become coated.

In a printing plant the danger is lead oxide dust and fumes from the lead kettles and the sweeping which often goes on all day. There is often a bad and unnecessary mixing of jobs. The melting pot may be right beside a linotypist or a compositor. Some old, experienced printers will not allow that. It is well to see how much accumulation of lead dust there is on the floor and on the shelves and to ask how they blow out their old type cases. The best way is to use a vacuum cleaner with a mild suction. What they usually do is to have one of the boys carry the cases out on the fire escape and blow them clean with a bellows.

The stereotypers are more exposed to lead than any other kind of worker in the printing plant, for they melt down large stereotype plates. These are covered with oily ink, and in heating the oil is driven off, making very irritating fumes. The men lower the hood during this stage, but they are very likely to lift it about the time the lead begins to give off fumes, for by then the irritating fumes are gone.

On the other hand, monotyping is perfectly safe, and linotyping you need not pay any attention to unless you are looking for carbon monoxide fumes from the gas under the linotype pot, since the lead in the pot is not hot enough to give off fumes.

I want to say something about the second danger and that is lead dust. I am sure each of you must have at least one lead junk shop in your district, and many of these are very dangerous. The worst kind of lead scrap accumulates in those places, old storage battery grids, which are covered with a brown peroxide of lead that can not be touched without raising a lot of dust; heaps of dross and skimmings; waste from white lead or oxide plants.

All of these dusts are very poisonous and all should be wetted down before they are disturbed. Any head of a refining plant who says this is impossible has not tried it because it has been done in hundreds of cases.

The industry which, in my opinion, is responsible for the greatest number of cases of lead poisoning is storage-battery manufacture. Although we have insufficient statistics to prove it, that is the case in England, where they do have complete statistics, and in Germany, although the German method of manufacture is less dangerous than ours, for they make mostly permanent storage batteries and we make mostly short-lived ones for automobiles. I feel quite sure that we have more lead poisoning from that industry than from any other—and there the cause is not fumes, but dust. The only way to avoid it is to insist upon wetness, for in every single process there is lead dust. In Indianapolis I visited a plant which was the safest I have ever been in. Everything was wet. The floor was covered with wet sawdust and the benches were wiped off regularly with wet sponges. Even the traveling belts were wet; and once the plates were put into receptacles to be carried to the storage room they stayed in those receptacles. Strange to say, however, they did have some cases of poisoning; for the physician told me that they [illegible]. Apparently it is not possible to provide complete protection against lead in this kind of work.

Now about the painter's trade. How does the painter get lead poisoning? This is one of the lead trades where we find the slow, chronic form of lead poisoning, from tiny doses repeated. The painter often gets lead mixed with oil on his skin, and it is possible that he may absorb it in this way over a period of 30 or 40 years. He may also get the lead into his mouth if he does not wash his hands before eating. But the greatest danger to the painter is lead dust, from sandpapering dry lead paint or rubbing it with steel wool, from dirty caps, cloths, and dirty overalls. We believe that in the painter, also, breathing the dust is the chief cause of lead poisoning.

The plumber handles some lead pipe. His chief danger is in what he calls joint wiping, which means connecting joints with molten lead. The potter is exposed to dust from white-lead glaze. There, too, the work can be made safe by moisture for there is no trouble from fumes, but a great deal of dust unless it is kept down by wetting. In all cases the air must be kept clean if lead poisoning is to be avoided.

There are some poisons, not very important, that enter, by preference, through the skin. Turpentine is absorbed through the skin, but the fumes also are important. We discovered during the war that the coal-tar derivatives passed through the skin, and poisoning took place in that way *more than through breathing the fumes.*

In the munitions plants making TNT, etc., we began by insisting that the fumes must be prevented by seeing that kettles were closely covered and that there were exhausts. But we were told by the British that we would not get very far with that; that there must also be scrupulous cleanliness to prevent absorption through the skin. The men must be given every facility for washing and the benches at which they work must be clean; they must not come in contact with the stuff. It was very interesting to discover that there was more danger in the amatol factories than in the TNT factories; and that was because though amatol contains only 20 percent TNT, the remainder being ammonium nitrate, it is hygroscopic, taking up moisture from the air. The men's hands were thus kept moist all the time, and in that way they absorbed a greater amount of TNT.

The first rule in the prevention of poisoning is that there be no escape of dangerous fumes and dust; if that is not possible, then there must be an exhaust to carry off the fumes as they escape and to carry off the dust as it is formed; if that is impossible, if you are told that exhausts cannot be placed so as to catch the fumes or dust and you know that there will be some exposure to fumes, then try to dilute them; insist that workrooms be very much larger than usual so that there is much more abundant ventilation. For instance, I have seen Pullman cars sprayed with coating out in a huge shed on the shore of Lake Michigan, where the ventilation was abundant, enough to dilute the fumes. Of course, it would be impossible there to have local exhausts. If you cannot do any one of these three things (and I am thinking now of such jobs as the cleaning out of flues from a lead smelter or the stripping of white lead in a corrosion plant), then you have to provide personal protection for the men. You may not be able to control the general environment, but you can control the air they breathe. Jobs like those can be done safely only with an air-line helmet. If for some reason you cannot use the air-line helmet, then you must face the fact that this is a dangerous situation. The last measure you can urge when all else proves impracticable is to cut down the exposure. A man will breathe a certain amount of contaminated air in 1 hour, twice that amount in 2 hours, and so on. When there is no way of protecting him from poisoned air you can always turn to this; you can say that although that job has to go on in the plant, the individual does not have to keep at it long enough to get poisoned; he can be shifted and another take his place.

Remember then, that if you cannot keep the fumes or dust from escaping or if you cannot dilute them to the point of safety, you can add fresh air to the man or you can shorten his exposure.

There are certain things that increase the incidence of poisoning aside from the quantity of poison to which the workers are exposed. I cannot say anything about general living conditions and the effect

of low wages because our knowledge is too vague. One would suppose that heavy work, very fatiguing work, with a low wage (which always means poor housing, poor food, poor clothing, and so forth) would lower the resistance to a poison, but that is all mere supposition. Fatigue does not make a man more susceptible to a poison. Lead, heavy work favors poisoning, but here it is a question of depth of respiration. The man who does heavy work breathes more deeply and therefore absorbs more poison, but we cannot accuse fatigue of being a factor in industrial poisoning.

There are other factors which are important. One of them is long hours of work, for if there is so much lead dust in the air, and the man can work only 6 hours without passing the safety standard, then longer hours, 8 or 10, mean poisoning. There are certain things about the individual himself that decrease the resistance to poisons. How much has youth to do with it? We think it has a good deal. There are a number of States that specify the age at which young people may go into the poisonous trades because they have less resistance to poisons than adults have. We found that out during the war. The men who were over 25 could work much longer without getting what we called TNT sickness than the men who were under 25. We have so few young people employed in the dangerous trades in this country that we cannot use our own figures to prove the greater susceptibility of the youthful, but we do know that children who apply for working papers at 12 or 14 years of age are not the children best fitted to resist dangers in industry. We base our opposition to child labor on that fact. It is not the child who has led a normal and healthy childhood who is likely to go to work at the earliest age the law allows. It is the child who has come from the poor home where there has not been enough to go around—not enough food, not enough beds, not even privacy and quiet. The cardiac disease of children, we are told, is as much a class disease as is tuberculosis. Those children are the ones who present themselves for working papers, and they are the ones who should not be allowed to go into any of the poisonous trades. In this country, however, that is not a great problem. I think I have seen very few lads employed in lead work, but one does find young girls working with dangerous solvents.

In every poisonous trade you will be perfectly safe in saying that no one under 18 years of age should be employed.

What about sex? There have been some very chivalrous efforts made to rule women out of the dangerous trades. I do not think myself that there is any basis for excluding women from many of the poisonous trades. It has been urged that women should be forbidden to work where carbon monoxide was present. That would throw out many women from industry, from pressing with gas-heated irons, cooking, baking, laundry work where gas is used, from the printing trades, and many more. Yet we have no figures to show that those fumes are more dangerous to women or that women are more susceptible to them than are men.

There are, however, some poisons which injure the offspring, to which a pregnant woman should not be exposed for fear she may miscarry or bear a dead child. Inasmuch as the employer cannot tell whether a working woman is pregnant, women at the child-bearing age should be especially protected from those poisons that

injure the offspring, the worst of which is lead. Lead causes abortion, and it causes sterility; it is a race poison. The same thing should be said of mercury. Benzol is another poison that is more harmful to women than to men, for it causes hemorrhages, and if the woman is pregnant she is likely to miscarry. It is dangerous for young girls, in whom it may cause fatal anemia.

Race does not seem to count except in regard to the poisons that enter through the skin. Negroes are much less susceptible to these. Individual susceptibility is an extremely important factor. It is perfectly natural that an employer should resent being held responsible for a case of lead poisoning when 20 other men in the same room have not suffered from the lead at all. He naturally feels that something the man did was responsible for it. Yet that same employer would not think it strange at all if out of a whole family only one member was susceptible to ivy poisoning, or if there was an epidemic of influenza, and it only struck 5 percent of the people in his city. These things he recognizes, and he will have to learn to accept the others, namely, that there are men and women overly susceptible to certain poisons. It is impossible to recognize them, to detect oversusceptibility by any kind of medical examination except with regard to those poisons which affect the skin. There you can have patch tests made.

Physical examinations are necessary, and if the physician is wise he will divide the men he accepts in two classes; class A will consist of men physically fit who can be put on any job; class B of the less fit, those who have chronic constipation or dyspepsia or perhaps the urine is a little dubious or the lungs are not very sound. Those men should not be put on a dangerous job. If the physician is wise, he will watch the men in class A very carefully during the first month so that he may discover and weed out the susceptible ones. All men working with poisons should be under medical attention. But one cannot insist that a worker who once is poisoned may never go back to his job. That may cause too great a hardship. A man who has a skilled job and has a great pride in that job, when told that he has lead poisoning and must give up his job and take some safe outdoor work, resents it deeply. He would far rather go back to his old job and perhaps live a few years less than be thrown on the scrap heap or put on a job he despises. We must look at it not alone from the medical side but from the human side as well.

The influence of food and drink has been stressed very much in connection with the poisonous trades, especially the lead trades. Food certainly counts very much in the prevention of lead poisoning. The acidosis of starvation or of acute indigestion will mobilize lead from the bones. The presence of food in the stomach, taking up the hydrochloric acid, helps to keep the swallowed lead from changing to the dangerous chlorides. Alcohol has the same action as many of the industrial poisons and therefore it aids in their action. During the war men found out themselves that if they were suffering from TNT poisoning they would get a very severe attack if they drank. You see they had the effect of the TNT already and the alcohol came as the last touch. They would fall unconscious after one drink of whisky or one bottle of beer. It was a case of double poisoning. Alcohol has much the same effect on the kidneys that lead has, and

the danger is increased if alcohol is taken into the system. The tremor of mercury poisoning is increased by alcoholic drink.

If there are any questions you would like to ask, I shall be glad to answer them.

Question. There seems to be quite a growing tendency to poisons from the fumes of kerosene stoves, those fumes that have no odor to them. What is the cause of that?

Dr. Hamilton. Would not the danger there be carbon monoxide? I remember some serious carbon monoxide poisoning in a tunnel in Montreal some years ago. At first they thought it was kerosene fumes, but then they found it was carbon monoxide. Carbon monoxide never reveals its presence by its odor.

Question. In the felt-hat manufacturing industry in the third stage, isn't the mercury hazard quite bad?

Dr. Hamilton. There is some mercury in the last stage because the finishers use a hot iron, but the greatest danger there is from silica dust, which is very fine. Some mercury is volatilized at this stage. We took felt at different stages of the process and analyzed it for mercury, and we found there was a loss of mercury between the last stage before finishing and the finishing.

Dr. Williams. This has been very interesting to a health officer. Would you tell us in a few minutes your views about which way a city health department or a State health department might best point in trying to meet the industrial hygiene problem, assuming that the tracks were pretty well cleared for splendid cooperation between State labor and State accident-prevention departments? We have very fine team work, but we haven't enough personnel or money.

Dr. Hamilton. You should take one man and train him in industrial toxicology so that when he goes into a plant he will know all about it. He should have expert knowledge. I think employers are entitled to that. If the employer is going to be told what to do and put to a lot of expense and trouble he should know that the advice given him is the best available; and you cannot expect an ordinary inspector, a man who has to go in and count wash basins and look at toilets and such things, to know all this. He has too much to do. One man should be well trained for the job. He should know how to make dust counts when it is necessary to make such counts. I think that every worker is entitled to clean air to breathe, and the inspector should know when a dust count is necessary.

[A summarization of the discussion of safety and health conditions in plants inspected on the previous day follows, by industries.]

PLANT 4—COOPERAGE

THE INDUSTRY

This very old industry lends itself well to small plants of moderate capital investment. Improvements over old methods lie essentially in the use of power-driven, manually operated woodworking tools but not by the development of gang or multiple machines. The fluctuating demands of the liquor industry, together with the great increase in other forms of packaging, including the development of steel drums, constitute serious handicaps. As a result of all these conditions establishments are usually housed in old or otherwise substandard buildings with operations arranged to *fit the building rather than the building planned to best suit the operations involved.* Equipment consists primarily of more or less specialized saws, planers, trimmers, shapers, sanders, and assembling and heading machines.

Materials.—Seasoned woods and hoop steel.

Process.—The lumber is normally carried through the operations on ordinary shop trucks, handled by hand to and from machines, and loaded out by hand. Hoop steel is cut, punched, and riveted on special machines. A considerable degree of manual skill is required for most of the operations. Piece work is usual.

POTENTIAL HEALTH HAZARDS

Dust.—Sanding produces much dust. Individual exhausts can be simply applied, are effective, and are commonly in use. Shavings and dust from planers, shapers, etc., are normally removed by exhausts.

Fumes from charring.—The charring of whisky barrels is often carried on in the shop by the use of *oily shavings. Unless* properly exhausted, the fumes are annoying, but probably carry no serious hazard unless in high concentration.

Painting or coating barrels (for special purposes) may involve the use of pigments or chemicals that are hazardous. In each such case the materials used should be ascertained and the conditions of their use studied.

Carbon monoxide.—Dryers, usually gas fired, are a possible source of carbon monoxide. A check-up of the means of disposal of the products of combustion and of the possibility of gas leaks is advisable.

ACCIDENT HAZARDS

Housekeeping and order.—The standard in this respect is apt to be low. The pressure of work, normally a part of piece-work methods, does not make for neatness on the part of the workers, and the management keeps to a minimum the pay roll it reports as "unproductive", such as cleaners, janitors, and others.

Congestion is often serious. The materials and products are bulky. The relatively unsubstantial nature of many of the establishments and the keen competition are conditions that make for crowding.

Machinery.—Special point-of-operation guards are advisable for substantially all the machines. Particularly with the type of machine used it is necessary to use especial care to suit the guard to the needs of the work and to "sell" the operators the advantages of using them faithfully.

The necessity for high rotational speed in woodworking makes the use of belt drives universal with usually a separate motor for each machine.