PLAINTIFF'S
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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

The Industrial Commission of Ohio

Neil House
Columbus, Ohio
April 20, 21, 22,
1937

THE F. J. HEER PRINTING CO.
Columbus, Ohio
1937

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Eighth All Ohio Safety Congress

Neil House

Columbus, Ohio

April 20, 21, 22, 1937

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IS DUST A PROBLEM?

MR. P. N. BUSHNELL,
Safety Engineer, Portland Cement Association, Chicago, Ill.

Mr. Chairman: I am going to refer to a paper quite frequently, almost continuously, because this subject is so full of dynamite and so open to misinterpretation, as I am sure most of you know, who have come in contact with it. I want to preface my remarks by stating I am a layman; I am not a medical man or hygienist or dust technician. I am giving opinions based upon studies with which I have been connected and work I have done. The subject, "Is Dust a Problem?" is rather inclusive. Even if I were to try to briefly review the literature on various aspects of the problem it would take from two to three days to read it. I have chosen to offer you some conclusions on the work that the medical and other experts have done in this field.

Out of the maze of conflicting theories, opinions and ideas about the industrial dust problem one truth seems to be slowly emerging and it is being accepted. It is that the so-called dust problem as it relates to diseases, is and has been greatly overrated. This country has had a regular procession of fashionable diseases and physical ailments which have served very well for neurotic individuals who just must have something to satisfy their morbid interests. It was amusing and at the same time pathetic, to read a letter published a few days ago in a large metropolitan newspaper. The letter explained that the newspaper would be discontinued by the family of the writer even though the entire family enjoyed its many fine features and had done so for years. The reason was that "Aunt Emma" was a little on the neurotic side and after reading the daily health column insisted she had all the diseases mentioned in the articles.

The public state of mind is something like that of "Aunt Emma" of the newspaper letter. Always eager and willing to exaggerate scientific facts and with the aid of dramatic newspaper stories we, as a people, suddenly developed a popular belief that dust was deadly to health, that workers in various industries quickly contracted an insidious disease of the lungs which was certainly fatal and that in some cases these workers actually dropped dead in their tracks.

It is important in any discussion of the so-called dust problem to recognize and make allowance for a minor wave of public hysteria because out of it has grown misunderstanding which in turn is responsible for fixed opinions that tend to obscure the truth.

Let me briefly point out a popular misconception. It is that all dusts are harmful to health. To accept that misconception as a true fact would be to deny a great mass of scientific evidence. It has no more basis in truth than the statement "No dust is harmful." Yet popular hysteria has actually dictated laws recently placed on the statute books of at least one state which make dust, any kind, type or degree of dust, equally guilty as the causative agent of disease. Truly, we are all mixed up in our conceptions of dust, its make-up and its effects.

Let's start at the beginning and admit that the dust problem can be generally divided into two parts. One part of the problem is familiar to every housewife—it is simply a nuisance. In industry, much if not most of the dust, is purely and simply a nuisance. Its affect on human beings is limited entirely to personal comfort. Exposure to it does not presume a resultant organic disease. It may not be pleasant but a good bath will wash away all evidence of the exposure and there is nothing else to it.

Another part of the dust problem comes from dusts which are definitely harmful to the respiratory system when inhaled in sufficient quantities. I am sorry I can't go into detail every question me afterwards ii discussed dusts are those to them.

What are these dusts varieties?

The answer to these groups in particular:

1. Medical professioning pathology unless he k: that the doctor should find been exposed to and then reverse should be true. It experience with dust and : diseases that did not exist '

2. The employer—beca hazard in his operations.

3. The employe—beca ing environment and shoul furnished him.

4. State industrial con sible for enforcement of re

5. Legislators and legi of imposing just, reasonabl employes alike.

We cannot talk about that they do. Many names lung damage due to dust. asbestosis are the two basic of dust. The best known d

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With the knowledge th proceed to identify potential danger.

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BUSHNELL,
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can't go into detail every time I make one of these statements. I trust you will question me afterwards if you wish any additional information. The most widely discussed dusts are those which affect the lungs and I will limit my discussion to them.

What are these dusts and how can they be differentiated from the harmless varieties?

The answer to these questions should be of extreme interest to the following groups in particular:

1. Medical profession—because the doctor cannot be sure he is properly identifying pathology unless he knows the causative agent. I don't mean by that to infer that the doctor should find out what kind of dust the patient he is examining has been exposed to and then proceed to name a disease based on that exposure. The reverse should be true. It is a fact that a number of doctors that have had little experience with dust and industrial occupations and so on,have tended to diagnose diseases that did not exist because they were misinformed.

2. The employer—because he wants to control or eradicate every possible health hazard in his operations.

3. The employe—because he is naturally interested in the safety of his working environment and should be acquainted with the reasons for protective devices furnished him.

4. State industrial commissions and similar agencies—because they are responsible for enforcement of regulations governing work places.

5. Legislators and legislative advisory groups—because with them lies the power of imposing just, reasonable and workable laws for the protection of employer and employes alike.

We cannot talk about the dusts that are harmful without discussing the harm that they do. Many names and combinations of names have been used to designate lung damage due to dust. There is general agreement, however, that silicosis and asbestosis are the two basic and definitely known disease entities caused by inhalation of dust. The best known definition of silicosis is:

"A disease due to breathing air containing silica (SiO^2), characterized anatomically by generalized fibrotic changes and the development of miliary nodulation in both lungs, and clinically by shortness of breath, decreased chest expansion, lessened capacity for work, absence of fever, increased susceptibility to tuberculosis (some or all of which symptoms may be present) and by characteristic X-ray findings."

It is important to remember that silicosis cannot possibly occur unless there has been exposure to free silica usually in the form of quartz. Asbestos, a magnesium silicate, is the only silicate known to produce lung damage. From this we conclude quite logically and truthfully that unless free silica or asbestos is present in dust there is no danger of lung damage. However, we know that silica is the most abundant constituent of the minerals and rocks that make up the crust of the earth. Perhaps because silica is known to be so abundant the idea has taken root that practically all dusts are siliceous and therefore harmful. The error in this assumption lies in the failure to differentiate between combined silica, or silicates and free silica most commonly found as quartz.

With the knowledge that only free silica is potentially harmful how do we proceed to identify potentially dangerous dusts and how do we measure that potential danger.

First—dust to exert any harmful action must reach the fine air spaces of the lungs and the natural defenses of the respiratory tract prevent particles larger than 10 microns from reaching these spaces. A micron, as you probably know, is 1/25,000 of an inch, and of course, that is microscopic size. . It follows that the visible dust is harmless and that it cannot reach the fine air spaces of the lung. In-

vestigators are now tending to place the dangerous particle sizes between the limits of .5 to 5 microns.

Second—the human body can apparently tolerate a continuous exposure to pure silica or quartz dusts of five million particles (less than 10 microns) per cubic foot of air. In other words, clinical and X-ray studies have failed to reveal evidence of silicosis in any workers exposed to this concentration regardless of extent of the exposure.

Therefore, to identify a potential dust hazard we first must determine the percentage of free silica in the dust under consideration. One procedure commonly followed has been to make these determinations from samples of settled dust. That is, dust that you can scrape off floors or ledges or wherever you can find enough to make an analysis. For a true determination of the content of actual atmospheric dust, however, samples should be obtained at or near the breathing levels in the working environment. Naturally, if you are testing a dust, you want samples of the dust being breathed. A small suction motor and dust bag is an excellent device for this purpose. I may say here that in determining the full silica content of a dust sample it should be done by petrographic methods. The chemical method may be used to check against the petrographic results.

After determining the free silica content of the dust it then becomes necessary to measure the concentrations in terms of particles of 10 microns and under per cubic foot of air. It should be mentioned here that trapping and counting of dust particles should follow the standard technique of the U. S. Public Health Service. This for the simple reason that most of the accepted, comparative data in the United States have been developed from findings using this technique. It would be obviously foolish, for instance, to try to compare dust counts made under dark field illumination with counts made by the light field method. The 5-million particle concentration previously referred to is a light field count. There are dust counting devices on the market suitable for comparative checks to see if there is any wide fluctuation in the dust concentrations, but to make the initial, basic determination follow the standard technique of the Public Health Service.

After making these basic determinations supposing you find that five per cent of the atmospheric dust is free silica and that you have a concentration of 200 million particles per cubic foot of air. The natural assumption would be that you exceeded the safe limit of silica and therefore a hazard would be present. This may or may not be true, and would depend on the kind of dust present with the silica particles. I would like to say that I have seen what appeared to be a dangerous silica exposure where there was a silica concentration of 30 or 35 million particles per cubic foot of air. Actual clinical and X-ray evidence gave no evidence that the silica was doing any harm to the lungs of workers. Microscopic examination showed that each one of the silica particles was completely coated with clay. Investigators have found that the clay exerts a protective influence and probably inhibits the action of silica.

Medical investigators have classified dusts into three general divisions. First, absorptive, that is, dust which is readily carried away and disposed of without creating any organic reaction; second, inert, that is dust which remains inactive in the tissue cells but causes no harmful reaction; and third, proliferative, such as free silica which reacts in the tissue cells and causes trouble. It is definitely known that mixtures of these various types of dust react differently, one type modifying the effect of another. Thus, for instance, we have calcium which apparently exerts a protective influence and modifies the effect of pure silica when the two are introduced into the lung together. Compare the X-ray pictures of the lungs of individuals exposed to high concentrations of pure silica and those exposed to mixtures of silica and other dusts and you will find different characteristics. Always, however, the

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edges or wherever you can find enough to
ion of the content of actual atmospheric
d at or near the breathing levels in the
re testing a dust, you want samples of the
or and dust bag is an excellent device for
ermining the full silica content of a dust
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lits.
ent of the dust it then becomes necessary
f particles of 10 microns and under per
here that trapping and counting of dust
ique of the U. S. Public Health Service.
: accepted, comparative data in the United
sing this technique. It would be obviously
st counts made under dark field illumina-
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cks to see if there is any wide fluctuation
he initial, basic determination follow the
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s supposing you find that five per cent of
, you have a concentration of 200 million
.l assumption would be that you exceeded
ard would be present. This may or may
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ppeared to be a dangerous silica exposure
30 or 35 million particles per cubic foot
ce gave no evidence that the silica was
Microscopic examination showed that
tely coated with clay. Investigators have
ıfluence and probably inhibits the action

usts into three general divisions. First,
carried away and disposed of without
·rt, that is dust which remains inactive
eaction; and third, proliferative, such as
nd causes trouble. It is definitely known
ust react differently, one type modifying
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:t of pure silica when the two are intro-
X-ray pictures of the lungs of individuals
ı and those exposed to mixtures of silica
ıt characteristics. Always, however, the

free silica is the harmful ingredient. If free silica is not present even extremely high concentrations of dust will not produce silicosis or any other damaging lung condition. There has been a tendency to call a concentration of 100 million particles of non-siliceous dust under 10 microns per cubic foot of air dangerous to health. This concentration has not been proved to be a hazard by clinical and experimental evidence and therefore there is no justification for its control on medical grounds. Any attempt to do so is to imply a health hazard and thus to create an unwarranted fear on the part of those who may be exposed.

If I may be permitted to refer to the types of dust with which I am most familiar with actual experience, let me point out that in very careful and scientific studies in the cement industry we have been unable to find the slightest iota of evidence that long exposure to high concentrations of cement dust has caused any type or kind of lung damage or damage to the respiratory tract.

It may be interesting in passing to briefly enumerate the things that the cement industry has done in an honest effort to determine whether or not cement plant dust was or is in any way harmful. Dust counts and dust analyses have been made in many mills in various locations. The workers in these mills have undergone a rigid physical examination with stereoscopic chest X-rays. In the mills thus far studied 20 per cent of the employes are over 50 years of age and 33 per cent of the total of all employes examined have been employed in the cement industry more than 15 years with individual periods of service ranging up to 45 years. It is inconceivable to believe on the basis of these clinical and X-ray findings that any possible health hazard could exist without being discovered. Yet in the face of this evidence and in the face of evidence from similar surveys of other industries, there are those who still maintain that dust per se is harmful. The investigations were carried on by an outside agency. The industry had nothing to do with the findings.

In addition to making studies on the composition and concentration of dusts and of the physical condition of employes, the cement industry tabulated death rates of cement workers from records of sick-benefit associations and group insurance. As tuberculosis is the most dependable indice of a hazardous dust exposure it is one of the important things to remember in any consideration of a dust problem. Tuberculosis is a revealing indicator of hazardous dust. It was naturally gratifying to find that the tuberculosis death rate of cement workers was much lower than that of the general population and of other industrial groups. As a further check on the various findings a careful tabulation has been made of absenteeism causes and the morbidity rates show no abnormalties. In other words, we started from scratch. We made dust counts and analyses of dusts, made physical examinations to see if there were any physical deviations or abnormalties, made interpretations from stereoscopic X-rays, and after that we were not satisfied and took the absentee reports throughout the industry to see if any abnormal rate of any type of illness existed and to see if any health hazard was overlooked.

I would be glad to give detailed information on procedure and findings to anyone interested but my main purpose in mentioning this work has been to indicate how unfair it is to accuse dust of being damaging without attempting to get the facts and incidentally without knowing the facts.

No discussion of the dust problem would be complete without some mention of the erroneous conception of silicosis as a disabling disease. Search the medical records and you will have difficulty in finding a reference to death caused by pure uncomplicated silicosis. The layman, and to be sure many of our medical brethren, accept the fact that silicosis as demonstrated by X-ray is disabling and usually results fatally. The effect of this conception is to strike fear into the heart of every worker who may have simple uncomplicated silcosis, whereas in reality there is no reason why he should not work out his normal span of life. All of this scare about

silicosis has had an unfortunate social effect. When you imply because a man has silicosis and it is disabling and it is some insidious disease that is going to kill him, he is all washed up, and it is a pity, gentlemen, but it is true that the workers have been kidded into thinking they were disabled, and if they believed they were disabled and it was advertised they were disabled it would make it very, very difficult for them to get gainful employment. In almost every instance silicosis becomes disabling only when tuberculous infection is present. I should say in practically every instance it is impossible to find any incapacity or disability unless tuberculosis is present in the lung. Knowing this fact, it is safe to say that absolute protection can be given to the old employes who may in the past have been exposed to high concentrations of free silica by removing from employment those who have tuberculosis. No one can have a quarrel with that proposition. If he has active tuberculosis certainly he would not want to continue working and jeopardize his chances of curing himself, and then there is the danger of mingling and mixing with the other men. He should be removed because he is a sick man, and if he is removed it is for his own and the good of his associates. It is quite likely that if tuberculosis is stamped out the problem of occupational disability from dust will be solved. The silicotic not infected with tuberculosis should be kept on the job and the employer should be protected against unwaranted and unjust claims brought on the basis of an X-ray picture.

This is not to say that dust control measures are unnecessary in many locations. Where dangerous concentrations of free silica or asbestos dust exist in the working environment, methods of dust removal and elimination should be provided. I mean to say if you can eliminate tuberculosis you have very little danger, or practically no danger of disability from dust in the air. That is no reason why you shouldn't clean up dust, and there is every justification in the world for cleaning up silica dust. It would be impossible to attempt to recommend, even if I were capable of doing it, specific measures of dust control for the wide variety of operations and conditions in industry. However, the matter of good housekeeping cannot be stressed too strongly. It is surprising how much dust can be eliminated and how much more pleasant the working place can be made by simple measures and by regular and consistent clean-up. It is unnecessary, perhaps, to point out that a vacuum cleaning system is very effective in removing dust collections from beams and ledges and from the floor. Every employer has his own problems to work out. If he suspects a dangerous dust concentration he should study the possibility of substituting non-hazardous for hazardous materials. Frequently he can isolate particularly dusty operations without a great deal of revision. Often simple improvements can be made in the ventilation system which will keep the dust down to safe levels. The possibility of using local exhaust systems should not be overlooked and in this connection let me refer you to a recent publication of the American Standards Association entitled, "Design and Operation of Exhaust Systems." Certainly any exhaust system should be carefully tested for adequacy and efficiency. It should have frequent inspection and should be regularly rechecked to make certain that it is doing the job it is intended to do. I recommend that highly to any of you interested in finding out the best process for eliminating dust at its source. It is quite recent. I think within the last couple of months. I have a copy with me if anybody would like to see it, put out by the American Standards Association, 29 West 39th Street, New York City.

I have skipped over a number of different things and realize full well that this discussion has left many important things unsaid about the dust problem, and I fear that I have mentioned things that should be interpreted in more detail. We could go on all night telling about the medical aspects of dust diseases, the engineering

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problems of dust control and the medico-legal problem. I have chosen to be rather arbitrary in spots and now present my conclusions:

1. The dust-health problem in industry has been greatly over-rated.
2. All dusts are not harmful to health.
3. Free silica is the only causative agent of silicosis but the presence of free silica does not mean that a silicosis hazard exists.
4. Admixtures of certain dusts modify the action of free silica on the lungs.
5. There is a difference between "medical" silicosis and disabling silicosis. Uncomplicated silicosis is seldom if ever actually disabling. Silico-tuberculosis is the thing to fear and to be avoided.
6. Eliminating the cases of active T. B. will go far toward solving the problem of lung disability caused by dust.
7. Silicosis can be entirely controlled by dust control measures but there is no justification for forcing control measures on operations unless the dust is really hazardous to health.
8. To determine a hazardous exposure it is necessary to determine the mineral composition of the dust and the concentration and particle size range. If this is suspicious confirmatory evidence should be obtained from physical examination and X-ray findings. In other words, you have to check one against the other before you can be sure.

In closing I would like to emphasize the importance of X-ray interpretations, and of course, importance of proper technique in taking X-rays. After all, an X-ray is only a picture just like any other photograph. The lights and shades play tricks, and it is possible for the pictures to be distorted. In all studies we have tried to use stereoscopic X-ray pictures, double pictures which give a third dimension.

MR. J. J. MASON, Fisher Body, Cleveland: Mr. Speaker, could you tell us about emery dust? The men complain about that.

MR. BUSHNELL: I must beg off as far as actual knowledge is concerned. I doubt if that is harmful. I am not sure, but it would seem it would be a simple matter to apply a local exhaust on a wheel and control that dust. If it is impossible to control, it would seem to require that the employee use a respirator. I am not sure about emery dust, but I don't think it is harmful. I don't want to put myself on record without being sure.

MR. MOORE, Fisher Body, Cleveland: I listened to your talk. You failed to tell us what you have done in the industry to protect your men. You speak about controlling this dust problem at its source, which is a very good thing, but could you tell me what you have done in the way of protecting your men?

MR. BUSHNELL: I thought I made it clear that cement plant dust is non hazardous and therefore no protection is needed. We have examined men who have worked periods up to forty-five years and haven't been able to find a trace of pathology or health hazard in the industry. However, as a matter of cleanliness and housekeeping that is not to be associated with the medical problem, we have carried on housekeeping campaigns. If any of you are in the cement business you know we are in the business of making dust. All the way through the operation dust is in the process of manufacture but this does not mean that excessive dust is present in the working environment. Respirators are used occasionally as a matter of personal comfort. We do not have a health hazard. We have made careful investigations to determine whether we did have, and if we did, we would take steps to protect the men but we do not have a health hazard, and the men do not need to wear respirators in their ordinary routine operations. In the packing department where the dust would logically be the heaviest we have local exhaust systems to carry the dust in case a bag splits and in a few of the mills they have dust collectors throughout the

mill. I want to make it clear that the reason we made these studies was to determine whether or not we had a health hazard.

MR. J. R. BYRUM, American Rolling Mill Company: For the purpose of a check, does anybody have information on silicon brushing? So far as we have been able to determine, there is no hazard but for the purpose of a check I should like to have information any of you may have on silicon brushing operations.

MR. BUSHNELL: Do you know what the constituent is?

MR. BYRUM: I can't give it, no.

MR. BUSHNELL: It is probably not free silica.

MR. BYRUM: It is a manufactured product. So far as we have been able to find out there is nothing harmful to it, but there is a lot of dust in the crushing plant.

MR. BUSHNELL: Has there been any sort of a test made?

MR. BYRUM: We have been unable to find any of harmful size.

MR. BUSHNELL: It is very important to determine whether you have hazards. You go into some operation and it looks dusty and dirty and it may be harmless dust. The dust that does harm you cannot see with the naked eye. I am sure all of you have noticed a beam of light containing some fine material which is microscopic in size. Unless the dust is under ten microns (1/25,000) of an inch, it can't get into the fine air spaces of the lung. I would suggest that you determine the particle size, make a count and see what the actual physical condition is and then it would be well to have a petrographer look at the material. He can tell in a moment whether there is any free silica present.

MR. BYRUM: Our determination was made at Harvard. As far as mining is concerned, we are O. K. I was just wondering if anybody else had a check made and what their findings were.

MR. BUSHNELL: I suppose you had Esper Larson at Harvard do that.

MR. BYRUM: Yes. The fact of the matter was there was a slight suspicion there was some medicinal quality in the dust.

MR. BUSHNELL: That is a funny thing. I didn't want to go into that but in some of the early studies made in the cement industry in Germany it was determined that the calcium in it had a very beneficial effect on tuberculosis but we are not going to sell it in five cent bags.

MR. HENRY: Anybody else have any further questions? I am reluctant to pass this subject, as I think we are all concerned with the proposed legislation in Ohio at the present time. If you have any question, I know that Mr. Bushnell can answer it. We are fortunate to have had him here and we thank him very sincerely for the excellent manner in which he has presented his paper and discussion. Does anyone else have anything to add?

Mr. Heyne of the Industrial Commission would like to know how many would like to go to the banquet. If you will raise your hand it will give him a better idea of how many to prepare for.

I think a Nominating Committee has been appointed, consisting of Campbell Allen of the American Rolling Mills, Mr. J. W. Gourley of the Timken Roller Bearing Company and E. K. Troll of the Empire Sheet and Tin Plate Company of Mansfield. I might say before we have our next speaker that we have endeavored to have interesting programs. It is hard to find what you want. Some of us old timers have been attending a lot of meetings. We know what we like. If anybody has suggestions as to what they would like to have included in the program, if you will write the Secretary you elect indicating your choice of what you would like to have discussed I am sure it will be appreciated.

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I may say that the next subject we have on the program is going to be very ably presented by Campbell Allen, Safety Director of The American Rolling Mill Co., Middletown, Ohio. I think the American Rolling Mills were the first to adopt the idea of training both foremen and workers. Mr. Allen has presented this topic at numerous safety meetings, both National and State Congresses.

TRAINING FOR SAFETY

MR. C. M. ALLEN,
Safety Director, The American Rolling Mill Co., Middletown, Ohio.

Mr. Chairman, Members of the All Ohio Safety Congress:

There is not anything particularly new in the training and in presenting this subject to you this afternoon, I want to say first that I am not a teacher, I am not a professor, I don't know anything about academic training. Training in industry is made up of academic work and all kinds and phases of it. I am going to attempt to discuss with you what I think is the crux of the whole thing, and that is the Foreman, and the Foreman as a Trainer, because after all is said and done, if you want to have Safety Training, there is no one man in your organization who can do it better than your Foreman. I will read part of it and I will comment as I go along.

Your chairman asked me to talk on "Methods of Job Training and Their Relation to Accident Prevention." We, at ARMCO, believe that the majority of accidents are the result of improper job instructions and the only means to correct the situation is through better trained supervision. We have tried all kinds of training courses but our best results were obtained through a series of foreman-manager courses prepared by our own Personal Relations Staff. For many years we have stressed "understanding" and we mean by "understanding" that all supervisors must know ARMCO policies, job costs, quality, safety, production, equipment and men. Once the foreman is trained it is a simple matter to job train the crew which is the second step in a training program.

I don't believe that you are particularly interested in the details of job training and its application in reference to the type and our method of doing it. What I think you are interested in is how we sold the foreman that the training of his men was up to him.

There isn't any doubt in my mind that the foreman's job is the most important factor in the present industrial link and he is the one person who needs the most help. A lot of new fangled ideas have popped up during the past few years and between red flags and red ink a foreman has had a pretty tough time holding his job. The average foreman wants help and wants it bad. Now he may be the "Bull of the Woods" on the job but he is pretty timid and very tame when his short comings are properly pointed out to him. If you, as a safety engineer, really want to prevent accidents the best place and the most fertile field to start is with the foreman.

Have you ever analyzed the foreman's job? Not from the standpoint of what a foreman does but from the standpoint of what he is expected to do. Several years ago I analyzed the foreman's job with respect to job qualifications and personal qualifications. I discovered, regardless of the job he had to do, it took a pretty good man to be a foreman.

Job Qualifications

1. Company policies	Familiarity with and understanding of company policies and properly interpreting and applying them.