

ing and metallurgical plants. We see its results in the accident records of plants, where too many men are under the supervision of a single foreman to permit really good supervision. I long ago became convinced that it was poor economy to attempt to save the wages of another foreman by allowing men to work under inadequate supervision.

I am extremely glad that Mr. Archbald's paper has been presented before your Society, for I think the mining industry needs your cooperation and I hope the day will come when such papers will be a common feature of mining engineering societies.

MR. WALTER POLAKOV: I have had the pleasure of both reading and again hearing the very able presentation by Mr. Archbald. It describes a typical condition of mismanagement of our coal industry. I don't think, however, that coal mining is very much worse, so far as management is concerned, than most other industries; but the particular importance of this bad mismanagement in this instance is due to the fact that the coal is the foundation of all our industries; in fact, of our entire so-called civilized life. Without coal we cannot live; without coal we cannot live even a very few hours in the mode of living we are accustomed to.

Of course, a natural question for me to ask is, not whether the Taylor system or any other system of scientific management will do any good—that is obvious—but whether there is any chance under the existing mode of ownership of the mines to introduce such. That is, whether the betterment of conditions and the elimination of losses is desirable from the viewpoint of the owners of the mines. This, I believe, is the most important question we should put before ourselves.

The question is, whether it is profitable to the mine owners to operate mines economically or not, and the answer to this question seems to be perfectly obvious. There is no need of making any kind of studies to support this conclusion by any new facts or statistics. If it were profitable to eliminate wastes, the conditions would be different. They are not different because it is not profitable to some coal operators to operate their mines more economically. So long as the industry is not carried on with the viewpoint of delivering the goods and benefiting society, the things are going the way Mr. Archbald told us. In other words, it is more profitable to the coal operators to leave the

things alone as they are and make the community pay for waste and mismanagement. It sounds like an absurd statement but let us consider whether it is so or not.

One ton of coal that is mined today is being sold in the raw state. It is not manufactured. It is about the same thing as if we should eat wheat as we get it from the field. We just get the coal out of the mine and we burn it—such barbarous, such a ridiculous way of destruction of our national resources is incredible and unpardonable!

Coal can produce—and does produce if it is subject to certain manufacturing processes—I will call it destructive distillation—several by-products which are probably the chief products, such as ammonia sulphate, a very essential factor in fertilizing, benzol, which is fuel perfectly adapted for the internal combustion engines, tar, for various chemical purposes, coke, for steel-making as fuel, etc. We don't do that. Here the cumulative value—I mean by that social value, the benefit that society can derive from this product—is enormous. I haven't got with me the data I sent to the Hon. Secretary Lane on the subject, but I see here a gentleman who has given a great deal of study to this subject and he probably will be called to give more detail on the subject—Mr. Scott. I have asked him to give you figures I have prepared from the researches of the Smithsonian Institute on this point.

The wanton destruction of coal in the crude state does not stop at the mines, either. It goes further. When it is used, let us say on the railroads, it is used with only something like five per cent efficiency. Out of one hundred pounds of coal we burn on the locomotive we get only five per cent useful work, and of course all of these losses are not preventable so long as we have such an imperfect mechanism as steam locomotives. But at least one-third of the amount of coal that is used today on the railroads and in central stations and in private power plants can and actually is saved without exception in every case where the manufacturer feels that it is profitable for him to do so. But there is again the same vicious circle. It is not profitable to the manufacturer to conserve the foundation of our life and prosperity so long as he can get profit in another way. "What is the use," one of the manufacturers of Bridgeport told me, "What is the use for me to save thirty per cent of my coal bill when by an advance of one-half a cent per pound of my product I will get at the end of the year twelve times as much without any labor whatever?"

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Therefore, the future of our society is sacrificed to the immediate profit of those who have control of the things, but who have no social responsibility.

Coming a little closer to the subject, that is, of operating the mines, not in such slipshod, shocking ways as described by Mr. Archbald, but with a little bit better care for both workman in the industry and the people of the country at large, I fully agree with Mr. Archbald that such things as stop watch and unit time study would appear in the beginning as a needless refinement. The point that strikes me in this case was brought home by the fact that today the miners are on strike and neither the Government by injunction nor any other force that has been brought to bear has forced them to go back into mismanaged mines. There must be something back of it. Somebody is agitating them. There is something that keeps the men out of work. What is that sinister influence which cripples our industry and endangers our life and prosperity?

The answer is clear. It was given by Mr. Archbald. The industry is mismanaged to such an extent that the workmen cannot afford to go back. Therefore, this sinister influence is Mr. Coal Operator himself.

MR. HOWARD SCOTT: The question of coal, the same as any other product, goes back to its origin and uses. Taking the Government statistics there are 762,000 miners engaged in mining in our coal fields. Their average is 794 tons. It does not matter much about the wages. That is a pressing immediate condition. The others speakers have stated that. This is something different. Out of the total amount of bituminous coal mined in 1918, practically 500,000,000 tons were used in the production of power—that is, in steam and such power. The average value of that coal at the mine mouth was \$1.32 a ton, according to Government bulletins. That is \$650,000,000; you can add it up for yourselves. The multiple product value of that same amount of coal is over \$9,000,000,000. That is a waste of \$8,500,000,000. Not very much! It only represents one third of the total capitalized cost of all manufacturing plants in the United States. Think it over.

You still have another way of looking at it, that is of evaluating these figures into something which you use. There are over 5,000,000 tons of ammonium sulphate blown off into the open air. These are equivalent, at 115 pounds of nitrogen to the acre, to approximately 500,000,000 additional bushels of wheat with the same acreage and the same amount of labor that we expended in raising wheat last year. Then 1,000,000,000

gallons of benzol—you can figure its value (and its truck haulage I won't waste time going into) nor the 4,000,000,000 gallons of tar, of which you all know the uses and the current value.

But someone says "Why can we not use this?" You have a very simple answer. One third of the freight carried on all common carriers in the United States is bulk coal. Seven hundred thousand security holders of United States railroads have an average holding of thirteen thousand apiece, a total of nine billion one hundred millions of railroad securities, and banks and insurance companies hold three billion five hundred and six million. This gives you a total of twelve billion six hundred and six million held by .63 of one per cent of the population of the United States. Seven hundred thousand people, or .63 of one per cent, are not going to eliminate one third of the dividend earning capacity on that twelve billion dollars by instituting any social saving to the country at large.

There are over ten railroads in the United States that would practically go out of business. These are roads east of the Mississippi. Take the Kanawha River and the Kanawah-Michigan Railroad. During 1916 there were one million and some odd hundred thousand tons of coal carried on the Kanawha River, while the Kanawah-Michigan Railroad, which parallels it for a considerable distance, carried over three times that amount, and as coal men know, your river mines are operated much more intermittently than your railroad mines, because of high water and so on. The preference is given to forms of transportation which are at present in vogue, which are obtaining profits, and will continue to do so. There is no remedy for this situation other than a complete coordination of all industry, because you have to go back to the origin of a material, and the method of its production, and its relativity; these, as I have shown, effecting another tremendous basic industry in this country, which apparently we are leaving out of the coal problem.

I omitted one thing. In the use of coal by this technical method you would obtain over one hundred per cent greater power. This means that if coal were used scientifically over five hundred thousand men that are now mining it would no longer be required. This brings another consideration. You cannot, today, put those five hundred thousand men at anything else. You have not the control of the situation which allows that to be done. Therefore the United Mine Workers, or any other mine workers, are going to mine coal because they cannot work at anything else.