

perform a real service in this respect and that we may have your suggestions.

H. S. Person.¹¹ I should like to pick up three or four points for emphasis. In the first place it is evident that marked increases in production accompanied by reduced unit costs cannot be attained without the development of methods which give precise control of the factors of production—materials, equipment, conditions, methods.

Likewise, in the second place, a reduction of production, when industrial conditions make it necessary, cannot be attained in an orderly manner without that same control. It is more difficult to back down a precipice than to climb it; in military tactics it is difficult to retreat under pressure without a debacle. It is the same in industry.

In the third place, we have been talking chiefly in terms of large enterprises with some degree of mass production. What of the medium-sized and small enterprise? How will they get something out of this discussion? Surely not by blindly imitating in detail the technique of the large concern. Their procedure is to translate the large-plant technique into principles and then devise techniques adapted to their smaller plants which express the same principles.

Finally, this suggests a word about too exclusive use of the case system in teaching. If the discussion of principles in studying cases is not adequate, the case system may lead to the habit of blind imitation with its attendant dangers.

Ralph C. Davis. The difficulty in the automobile industry is that everyone looks at the assembly line. In the Chevrolet plant, for example, we took care of an overflow production problem in a certain department by the introduction of modern principles of scientific management which enabled us to increase production by about 60 per cent. The procedure bore no resemblance whatever to the methods of control in use on the regular assembly line. Another company that is far from large enough to put in any conveyor system is copying the system of this particular department. There are many methods in the large-scale plants that can be transferred to the small.

John Younger. I want to substantiate that last statement. There is a great deal of flexibility in

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mass production today and it has a great deal to teach even the small manufacturers. You have to remember that the mass production plants are made up of a number of small plants in most cases. If the small plants will study these individual plants they will learn a lot. It is also possible to adjust hours in these plants instead of shutting down completely. The Ford and Chevrolet plants would have been out of business had this not been possible.

Leslie E. Bryant. In conclusion I should like to say that I have tried to make this paper the story of two installations in repair and job shops. I have tried to set it up so that the mass production, the single process or the job shop could apply the material in it. Most of my experience has been in scientific management shops where two to six pieces were the average run. One piece has often been the order and we rejoice when we get an order of twenty-five pieces. We should declare a holiday if a thousand pieces came along, as it would solve so many problems for us.

The variety of mechanical equipment and of work is quite large. Because of this we have classified our products according to the type of work done on them. A gear, a washer, a bushing, a collar, all have certain identical operations performed on them. This classification therefore gives us a degree of mass production on certain operations.

Changes in jobs are another important factor in the shop doing repair work. In our shop machines like drill presses and small engine lathes change jobs on an average of six to eight times a day. In other words there is a complete tool and machine set-up that number of times a day. Occasionally we get jobs that use the same material for a week at a time, but there is always the set-up problem. The cutting time per piece is really a very small element when the set-up problem has been worked out.

Mr. Bleeker mentioned the importance of considering the general economic trend of an industry. I have considered that a general administrative rather than a production problem. It is part of the general administrative function to coordinate the production, sales and other functions. I therefore did not consider that it came within the scope of this paper.

Mr. Younger spoke of the problems of material and product transportation. I have always considered the conveyor one of the mechanisms of control and might have listed it as such. Possibly the reason I did not do so was because I have never used conveyors. To me the principle is the same, however, whether a mechanical conveyor or a move man carries a piece from one operation to the next. I am glad Mr. Younger brought out the distinction between maintenance and service. I have been groping for a term of that sort for quite some time.

The rate of flow, as brought out by Mr. Davis, is I think the same as Mr. Younger's problem. In the mass production industry it is largely a matter of control in the sense of the spirit of control. The mechanism takes care of the rate of flow, provided the spirit of control sees that the mechanism is kept moving.

Mr. Hathaway mentioned the advisability of getting a larger group to attend these meetings. I have been interested to learn of the number of manufacturers who want to send foremen or production managers to see what we are doing at Lancaster. In every case I reply that I shall be glad to have them come *themselves* to observe. My idea is that, while it may do the foreman or production manager a great deal of good to see

an installation of scientific management, he will be considerably hampered in applying what he has learned unless the man to whom he has to sell his ideas is sold also. This business of dramatizing scientific management to everyone along the line, from the top down, is very important. The scrap problem is important with us, since the making of linoleum is a continuous process industry. Our general superintendent wishes he could dramatize this situation for our group.

Mr. Babcock's point about using old machines for new attachments is a very practical one. We were about to scrap an engine lathe in our shop when it was found possible to fit it with an automatic welding head which converted it into a very satisfactory automatic welding machine for our purposes. We have made the same sort of adjustments in several other cases.

The consequences of improvement that were brought out by Mr. Cooke are interesting. I might say that in writing this paper I had in mind its application all along the line, from the top man down. Only when the top man is an educator and can get his ideas across to the men all along the line can you get real utilization of facilities. You must bear in mind that all this is relative. One has to run fast to stand still these days, and to get ahead it is necessary to run still faster.

MODERN industrial methods are modifying and changing some of our concepts of industrial economics. It has always been held by economists and employers that low wages were essential to low costs and unfortunately not a few employers still hold this view. Under handicraft methods this thesis was undoubtedly true, but it is far from being true where the investment in productive machinery is large. In fact, in many instances, low costs and high wages are synonymous, where high intelligence or skill are necessary to obtain maximum production from the machinery of production. The wages of the American working-man are relatively the highest that has ever yet been known but the costs of production in all products produced in quantity are in most cases lower relatively and in some cases such as automobiles, sewing-machines, etc., the value per

man-hour, as has been noted, is the greatest ever known. Somewhat as a corollary it has been discovered that we are our own best customers and while foreign markets are still of great importance our own people are the largest purchasers of manufactured product as witnessed by the 26,000,000 automobiles owned in this country, a proportion vastly in excess of that of any other country. The old theory which kept costs down through low wages in order that goods might be sold at a profit abroad as illustrated by English practice leaves an impoverished working class at the expense of an enriched employing class. Here is a nice problem for the economist and statesman, namely, to determine how the circulating medium should flow from employer to employee as wages and back again to the employer through purchases. (Dexter S. Kimball in *Toward Civilization*, p. 151.)