

utilize, because of the war expansion, lessened exports, and a timid domestic market. Costs are high; wages are at a new high level because of the war and show no tendency to decline. It has been the tendency in past depressions for wages to run along on a level even after depression has set in, although earnings will follow fairly closely the line of depression.

This new production capacity, the new standard of what industrial managers think is the normal output of their plants, has put an added pressure on the production organization for economies and lowered costs, the like of which we have not seen for years. It has likewise put a pressure on the sales organization for greater volume, new products and new markets. It has put a pressure on the financial, accounting and controlling organizations for exact knowledge of internal and external conditions, by which they can establish policies and lay out their courses. At no other time have the exactions been so great in that respect.

How has scientific management aided both in expansion and in contraction of business under these conditions? I propose to consider these questions with respect to *first*, manufacturing; *second*, industrial relations; *third*, selling and *fourth*, control. What have been the outstanding tendencies and results?

I. Developments in Manufacturing Problems

A. Plant Location

The engineering, the scientific point of view which Taylor inspired in management has put new emphasis on the importance of studying the plant, both location and construction. Traditions have been departed from more in the last few years than ever before. The high freight rates and the importance of being near either the sales market or the raw material market have made new studies necessary in the geographical location of plants. High freight rates, social legislation in the northern states, and the drift of the center of population and of purchasing power steadily westward have affected, for instance, the textile industry; and there has resulted a tendency to study scientifically the problem of location with respect to long-time policy. Many mills are moving south; some even to the west. Paper mills have a similar problem with respect to supply of wood pulp. The paper mills of Wisconsin, where it is estimated there are but

eight years of pulp wood left, the Maine mills and New Hampshire mills have a problem and in consequence there is an unceasing tendency to develop in Canada to be adjacent to raw materials.

The power problem resulting from the high price of coal and the danger of interruption of the coal supply, the problem of labor supply and cost, the cost of living, the cost of owning homes—all of these facts have been given new study with relation to the location of mills and of plants.

B. Plant Construction

There has been a departure from tradition in the buildings, even in such an industry as cotton manufacturing, which has the tradition of years back of it. The history of progress in cotton mill machinery gives 1887 as the last time when any improvement of consequence in textile machinery was made. Cotton mill buildings until a very few years ago were similarly built according to an early standard. Within the last few years departures have been made. One textile firm studied the flow of the work and, departing from traditions, put in mechanical and gravity conveyors—an adaptation of the Ford idea to cotton manufacturing for the first time.

Recently a hat company in Connecticut felt that they needed to put themselves in a strong competitive position with the best equipped plant possible. They made very careful studies and decided that instead of revamping their present buildings, they would build an absolutely new plant, requiring a large investment, although their present equipment is quite up to the standard of their competitors. They employed production and mechanical engineers and mill architects who are working together to produce the very best plant possible.

In modern plant design new consideration is being given to the comfort of the workers. The war strengthened the position of labor and created an additional incentive for employers to turn more than ever before to a study of the labor situation within their own plants and of general labor tendencies; and the more enlightened managers show, in their building design, greater consideration for the comfort and the pleasure of their employees at work. Recently I visited the new plant of the President of this Society, and was surprised and pleased to see the amount of floor space which he had deemed it wise to give to the comfort and

recreation of the employees. Engineers are thinking in those terms now for almost the first time.

C. Machinery and Equipment

I have not very much to say about machinery and general equipment except that high wages and keen competition are giving a new impetus to a study of labor-saving machinery and its economical arrangement and utilization, and to mechanical and gravity means of internal transportation. The increasing use of machinery has been one of the most conspicuous aspects of the development of manufacturing during the past half century; the most noteworthy feature of the past decade has been simply a more intense development due to more intense competition and ever increasing costs. The constant effort to substitute labor-saving equipment for labor has far-reaching effects. One concern found that the introduction of new equipment at one point in processing so influenced the volume of flow at that point as to necessitate adjustment through new or additional equipment at other points and an intensive study of the methods of operating and of handling material.

D. Purchasing and Materials Control

The scientific attitude towards management problems has given impetus to the study of the operating problem, and this phase of management has made a good deal of progress in the last ten years. And in purchasing a closer relationship between stores control and purchasing has been generally recognized.

One of the companies in which I am interested set up for a goal a few years ago a stores or inventory turnover of six times a year, as against the best previous practice of perhaps three or four times. That was accompanied by a closer relationship between purchasing and stores, a study of materials, of markets, of times of delivery, and of business conditions in the industries from which we purchased. We have been meeting that six times turnover for about two years. It released \$50,000 of working capital for uses related to an expanding volume of sales. What does that sort of thing mean if carried out as successfully, or more so, in for instance a concern like the General Electric Company, which advertises to sell 420,000 different articles and carries in stock between 4,000,000 and 5,000,000 parts?

A large company may find economies in setting up a special research and statistical department. One of the largest industrial companies—which I regard as the best managed large industry in this country—has within the last two years added an economist from one of our big universities to its staff. The comptroller of that company told me that while he had not expected to get any good from the studies of that economist until he had been there a year or two, in his first six months he made studies in fundamental tendencies in commodity prices, and the suggestions that he made to their purchasing department had already saved them several hundred thousand dollars.

Industry is not always willing to take the advice of such specialists, as the following statement from a large rubber company suggests:

It would seem right to say that our statistical researches have not always been adopted. An example of this was the last coal strike in 1922. We presented studies showing that a sharp rise in bituminous coal prices in the past has always taken place when surplus stocks reached 20,000,000 tons, and we predicted that this point would be reached July 1st, 1922. This forecast was within 15 days of being correct. Prices began to rise sharply on July 15th, 1922 with the result that we paid around six and seven dollars for our supplies for the months of August, September, October and November. We have completed studies on the present outlook on coal and our people have adopted our recommendations not fully but about eighty per cent. This study shows that there will be a strike on April 1st, or if not, there will be an interruption of production. The coal stocks are around 65,000,000 tons, so that about June 10th, 1924 the 20,000,000 tons surplus mark will be reached, prices will rise sharply and will continue at high levels until production is resumed and there are surplus stocks of 30,000,000 tons. This production follows our forecast in October that the time to contract for winter supplies of bituminous coal would be just before President Coolidge's message to Congress or about fifteen days after. This prediction proved correct information on coal. Our executives have adopted this suggestion and we now have in our storage yards 15,000 tons of coal.

1. Joint Research in Purchasing

Statistical research has been accelerated a good deal in the last ten years—both by companies themselves and by organizations. The Retail Research Association, established seven years ago for the benefit of certain non-competing dry goods department stores, with a membership of seventeen companies, is studying their organizations, methods and sources of supply, and is now running on a budget of \$500,000 a year. It represents the purchases for sales that amount to \$225,000,000 a year. Recently