they are switching from one job to another all the time in order to keep the loudest howlers quiet and are getting nothing really done nor working at anything like their full normal capacity."

The contractor asked the engineer if he had been up to the mill and had seen these things. "No," said the engineer, "I have not, but I know how these things go; I have been raised in the manufacturing game, so to speak, and have learned a lot about how not to do things. If you go up to the mill that is what you will find if they let you ask questions and look into things at all."

The contractor went up to the mill and when he came back reported that upon going into the office the proprietor said, "I am mighty glad to see you and hope you will look around and see for yourself how hard we are trying to make shipments to you on time. The fact is that I can't get much of anything out of that factory. The work just dribbles through, in spite of the fact that the men seem to be busy all the time, and I can't make decent shipments nor make shipments on time. I wish you would go out and see for yourself how it is."

The contractor went out, met the superintendent, and asked him what was the matter. "Matter!" said the superintendent, "Matter! Why there is nothing else. We can't get anything done. The factory is chuck jam full of work, most of it half or less than half done. We no more than get fairly set and going on one job than the boss comes out with an ugly letter just received from a builder. He is all worked up and says 'we must drop everything else and get onto that work right away and get some of it into the cars.' All right, we change and get going; then the mail brings in a still uglier letter from another builder and the boss goes up in the air higher than ever. He comes out of the office waving the letter, and showing me the ugliest parts of it, wants to know why we 'must keep him in hot water all the time' and 'why we can't get something done.' I am getting fed up on that kind of thing and am thinking of getting into something else where I can take some satisfaction in being alive. Life is not worth living here as it is."

To get away from such mismanagement as that, and as far away from it as possible, is the object and effect of what has come to be called scientific management. In the latest development of that science, every separate element of a contract or of a job would be put on a Gantt chart, showing graphically and at a glance just when each element should be started on its course through the factory, the date when it should be finished and its daily progress toward completion—not in figures to be pored over and laboriously compared, but graphically, by straight horizontal lines, revealing all the salient points about all the jobs and the relation between their progress and the flight of time. And as all elements of all the jobs are thus scheduled there is no interference of one job with another—the boss can always refer to these charts and know readily just when he can start work on a new contract. No job interferes with any other job; there is no trouble except by some misfortune; and every one about the place can work steadily and effectively.

When the Federated Engineering Societies were organized in Washington, Herbert Hoover, who was the first president of the organization, gave a dinner to the delegates representing the component societies. At that dinner I was surprised and delighted with Mr. Hoover's announcement that, in a recent conference with Samuel Gompers, Mr. Gompers had said that organized labor was ready to co-operate in extending scientific management in the industries of the country.

As perhaps a first step toward that end, Mr. Hoover, a little later, suggested that the engineers co-operate in finding out, as nearly as possible, what were the wastes in industry, the extent of them, the nature of them, the cause of them and thus, more or less necessarily, the remedy for them. This resulted in a lot of hard work and a very considerable expense for a number of engineers and finally, also, in a book, now grown famous here and abroad, known as "Waste in Industry."[5] A part of the introduction follows:

> In making the studies upon which this report is based and in preparing the report itself there has been no purpose or desire to place blame upon any individual, group or class. The wastes revealed are the results of methods, tactics, and relationships of long standing in industry, and the Committee has merely desired to indicate the main opportunities for eliminating waste and to show whose opportunity or responsibility it may be to adopt proper measures for such elimination.

[5]Federated American Engineering Societies Committee on Elimination of Waste in Industry, McGraw-Hill Publishing Co., New York, 1927.

This paragraph shows, I think, the spirit in which the work was carried on. All previous prejudices, impressions, opinions, accusations and recriminations were entirely disregarded and, by conference, a method of study was developed which was designed to bring out actual pertinent facts concerning the conduct of industries; shortcomings which were the result of delays; needless expense and loss when compared with the practice that had already been attained in the industries studied; not, mind you, with perfection, for we all knew that we did not know perfection and that no archangels are to be found in our industries, either as employers or employes. We simply compared what was being done in a given case with the best that had been or was being done in the same industry elsewhere.

As most of you perhaps know, considerable indignation was manifested in certain quarters when the report was published and showed that, of the total causes of wastes in industry, deficient management was responsible for more than twice as much as labor was responsible for. Management was responsible for over fifty per cent and labor for less than twenty-five per cent of the total wastes. This indignation has largely subsided, however, as the report has been studied more and blindly assailed less, and it is now quite generally conceded that its conclusions rest upon a pretty solid foundation after all.

The fact is, however, that there was no intention to fix moral responsibility for waste but only to show such actual responsibility as could be based upon the undeniable fact that a given cause of waste was avoidable, removable or curable by management or by labor as the case might be.

I have referred to a recent study of wages of machinists fifty years ago compared with present day wages. In that connection let me say that I think a possible contributing cause of increased wages has been generally overlooked. At least I have seen no mention of it. And part of this cause is scientific management, by itself considered and without reference to any such working agreement as that between the Baltimore and Ohio Railroad and its shop men; for scientific management means, essentially, avoidance of wastes in industry.

Let us go back for a moment to the ditch diggers using hand shovels, where practically all the outlay is for labor, and then compare ditch digging with a powerful machine, driven by an engine and cutting a trench somewhat as a circular saw goes through a log of soft wood; then the expense of digging is not mainly labor but is mainly for the machine, its operation, maintenance, insurance replacement when worn out, and so forth. Something analogous to that has been going on during the past fifty years in the machinery building industry particularly, and in all industries to a greater or less extent, so that in general, I think it is true that wages have declined in proportion to the value of the product while other costs of manufacturing have relatively increased.

A recently completed special study by the U. S. Department of Labor shows that the output per man in automobile plants was twenty-one per cent greater in 1925 than it was in 1914; in the iron and steel industry forty-nine per cent greater and in the pulp and paper industry twenty-six per cent greater in the same period.

Scientific management, high-speed steel, automatic machine tools in place of hand operated ones, much better and more expensive shop buildings to pay for, maintain, heat, light and insure, and mass production where applicable, have all combined to increase the proportion of that part of manufacturing cost which is variously termed "overhead," "burden," or, as I prefer to call it, "operating cost."

I do not think interest on investment should be included as a part of manufacturing costs but certainly cost of power, insurance, supervision, clerical help, depreciation of values or equipment by wear and obsolescence, which mean eventual replacement, should all be included and these costs, by the introduction of better management methods, improved appliances and high-speed steel, have all been increased relatively to direct labor costs; while the cost of direct labor has, per contra, been relatively decreased. And these things are economically justified, of course, or they would be avoided, as in fact they are avoided by the timorous, the reactionaries and the incompetents.

I am convinced that herein lies a part, I cannot say how much, but certainly a part, of the reason for increased wages in machine shops and probably in other lines where similar advances have been made. Few employers will resist a tendency