of manufacture. Methods are constantly changing, requiring corresponding changes in the building long before it is worn out. In this sense again a manufacturers' building is like a machine—its period of usefulness is not always measured by its durability. Some little invention or change in process sends it to the scrap-heap. It may be just as good as new but it is worthless.

This relationship is so important in some lines of manufacturing that the method of considering the building as an investment as above is not worth bothering about except for purposes of book-keeping. The only question asked is—will it reduce the cost of manufacturing sufficiently to pay for itself in a reasonable time?

Now the financial problems of manufacturing usually involve amounts of much greater magnitude than have to be considered in the building or plant. It is quite possible that $100,000 worth of goods could be turned out annually in a $10,000 building. Hence the great importance of the relation of the building to process of manufacture. In this case if 1% could be saved in the cost of the goods produced by increasing the cost of the building 10%, it would pay for itself in one year.

If in a plant employing 100 men it were possible, by cutting a door in a wall, by changing the location of a machine, by taking out an obstructing column or some other device, to save 6/10 of a second of each man's time per minute, or 6 minutes a day, it would mean that 99 men could then do the work which formerly required 100. If the average rate of wages were 20 cents per hour, it would save $600 a year. It can be shown that if the owner were to borrow $2,600 at 5% to make this alteration it would pay for itself in 5 years.

But it may be that through faulty design in the first place, it is not possible to make this change, and as a result of this, the owner is losing $600 a year which in 20 years would amount to $19,846.

Many a manufacturer is losing this $19,846 and much more through carelessness in the design of his plant.

It may be noted here that saving in time in manufacturing is a double saving. Not only is there a saving in workmen wages but the capacity of the plant is increased, as more work can be turned out in a given period. The profit on this extra work must be credited to the change which makes it possible. In addition to this, time in delivery is often a very important factor in securing a contract, and in such cases higher prices may be obtained.

The above discussion is an illustration of what is called Efficiency Engineering or Scientfic Management as applied to buildings, a subject that is attracting a great deal of attention just at present. So fine are some engineers' figuring that it has been suggested that even the time which the manager of a concern spends in looking after and ordering repairs to a building be capitalized and added to the ultimate cost.

Usually, however, more weighty reasons make it unnecessary to go to such refinement. In any new venture, which has a struggle before it with a possibility of failure, the first cost must be kept down to the lowest possible figure even at the sacrifice of efficiency, and questions of future growth, may, within reason, be left to take care of themselves. While it is true many a manager to-day bewails his lack of foresight in not preparing for the rapid growth of his business, still it is better that conditions are as they are than that his business had been wrecked at the start by an overload of debt.

This brief statement of the preliminary problems in the design of Manufacturers' Buildings should make clear at least one fact and that is, that the final plan must be a compromise—a compromise between the "possible" and the "expedient," between the "ideal" and the "practicable." In the completed building there may be many things that at first glance looks like blunders but a deeper investigation will show a carefully thought out purpose.

A good definition of an ideal building is given by Mr. Charles Day in his book "Industrial Plants." He says: It must so conform with all the industrial requirements that "the work of manufacturing may go forward with practically as much freedom as though the building did not exist at all. That is, the workers, whether employed at individual machines or engaged in moving material from point to point, should, to all intents and purposes, be unconscious of the existence of the housing structure." The building that will answer all requirements thus efficiently for the least cost—the period of use being considered—will be the best solution of the problem.

This discussion should also bring out the fact that the design of manufacturing buildings is more of an engineering than an architectural work. It will have been noticed that throughout this paper the name "designer" has been used and not "architect" or "engineer." The reason is that neither of these names, used in their usual sense, give a correct idea of this branch of the profession. A new term has come into use and we now have the "Industrial Engineer."

The average architect is not only entirely incompetent to handle these problems but all his training quite unfits him for this class of work. The ordinary rules of architecture are too narrow to be applied to what is virtually a machine. Besides, in a large number of cases the questions of architecture never enter at all. There are many examples of handsome but inefficient manufacturing buildings. On the other hand there is a great deal of justice in the charge that works designed by the engineer are unnecessarily hideous, and the industrial engineer cannot consider himself properly qualified if he has not a knowledge of the ordinary rules of architecture and aesthetics as applied to buildings.

But, as shown above, the work of the industrial engineer requires more than a knowledge of Architecture and Structural Engineering. He must have at least a general knowledge of applied science in all its branches in order to be able to grasp the salient features of any part of the manufacturers' installation, or his process of manufacture. It is not to be expected that he should be able to advise his client in his own business of manufacturing, but he will often find that his clients' ideas of what he wants are limited by his lack of knowledge as to what is practicable. Here the engineer can be of assistance. It must be admitted, however, that more often the engineer will have reason to feel extremely flattered by his clients' faith in his ability to accomplish the impossible.

In addition to his professional training, the industrial engineer must have a broad mind, free from narrow prejudices, to be able to appreciate the good points in special materials and constructions. He must have sound judgment and a fair talent for prophecy to build for the future. He must be a wide-awake, up-to-date business man with more than enough ability to handle the details of his own work, for the financial problems referred to above require a business acumen not usually expected of an engineer.

After all the preliminary problems in connection with some particular building have been threshed out, the actual work on the design and construction can begin, if the engineer has complete charge of the work.

Then follows in natural order the making of the general plans and specifications, the calling for tenders, selecting