which so often give marvellous results, and which are neglected simply because more pressing demands leave no time for their consideration. How many intelligent farmers there are who could render the greatest possible service by applying themselves to the new task, if only they could be relieved of the cruel necessity of doing the actual work! Let but a few of them take the first steps and they will very soon have established themselves as a centre of information on the subject.

Moreover, it is agricultural life that furnishes the most remarkable example of what will-power and determination can do to triumph over physical limitation. "Was it not after losing his life, that Huber discovered the most secret marvels of the life of the bee?"

MAINTENANCE OF MACHINERY AND EQUIPMENT AS A PART OF THE TAYLOR SYSTEM OF MANAGEMENT[1]

By H. K. Hathaway.[2]

This paper was written as a report to one of my clients where we are endeavoring now to put it into effect, and I had hoped before presenting it as a paper before the Society to have the plan fully developed and worked out in practice, but to do that will require a longer time than I had counted upon. My chief object in presenting it tonight is to bring up for discussion the subject of maintenance and to try to make everyone realize the true importance of a properly developed maintenance system as a part of the Taylor system of management.

The writer recollects, while an apprentice at the Midvale Steel Company, having seen complete detailed instruction cards covering the operation of cleaning boilers, describing step by step each detail of the operation and the tools necessary for doing the work. These were a part of a system for the maintenance of all machinery and equipment devised and put into operation by Frederick W. Taylor while Chief Engineer at Midvale.

Since becoming associated with the Taylor movement it has been one of the writer's chief desires to re-establish, as a part of the Taylor System, a scheme of plant maintenance such as Mr. Taylor developed at Midvale. In the literature of scientific management the maintenance of standards has been emphasized, and as a matter of fact in all plants operating under task and bonus the maintenance of standards as to condition of equipment is to a considerable extent compelled.

Unfortunately, however, in most plants where the system has been installed the necessity of securing results to defray the costs of installation and operation of the system and the pressure to keep down expenses which do not directly serve to bring about increased production and decreased cost has usually prevented the complete working out and development of a maintenance system as a preliminary to the installation of task and bonus. By the time routing and task and bonus have been installed and these features working smoothly some sort of a makeshift and unsystematic scheme for repairs primarily, and to some slight extent for keeping machines up in good condition, has evolved itself, and it is very difficult then to make the management see the advisability of something more systematic and comprehensive which apparently involves expense and which in view of the fact that they are accomplishing, in their productive work, results which are more than satisfactory, does not appear at that time in the light of a necessity.

The writer's experience, in a plant which has been operating under the Taylor System for about ten years but without a properly worked out maintenance system, has been such as to impress him with the full importance of carrying out such a scheme as is described in this paper, and in the plant referred to he is now taking steps to have the details of the system worked out and put into operation.

His conviction is such that in any future installation of the Taylor System which he may direct he will insist upon the establishment of a maintenance system at the start of the work.

The details of this plan, that is, the forms, instruction cards, etc. are now being worked out in a large plant manufacturing stationery, and it is the writer's intention to have presented in the near future a supplement to this paper describing the mechanism through which the plan described is operated.

The writer's present object is to impress upon the members of the Taylor Society his convictions as to the importance of this long neglected but fundamental feature of the Taylor System. There is nothing original in this plan as it was fully worked out over twenty-five years ago. The scheme for the care and maintenance of belting which is carried out along

[1] A paper presented at a meeting of the Taylor Society in Boston, Mass., Friday evening, March 2, 1917.

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the lines developed by Mr. Taylor and Mr. Barth in a majority of the plants operating under the Taylor system involves in a simpler form the same principles and mechanism.

Work under the Jurisdiction of the Works Engineer	Provision of Light, Heat and Power and Ventilation.
	Operation of Machine and Carpenter Shops.
	Operation of Maintenance Department. (See Chart No. 2).
	Prosecution of Development Work.
	Fire Protection
	Sanitation.

Chart No. 1

Maintenance	Grounds and Buildings including piping and wiring forming a part of the building.
	Machinery in all departments, including Line shafts, piping and wiring pertaining to machines.
	Small Tool Equipment, including machine accessories.
	Fixtures—furniture and other appliances not coming under the other heads.

Chart No. 2

Subdivision of Functions of Maintenance Department

The maintenance department is organized and operated for the purpose of maintaining the established standards as to equipment throughout the plant, upon which depends the performance of each productive operation in accordance with the instructions of the Planning Department, both as to the method to be followed and the time that such operations should consume.

Its function is *preventative* rather than *corrective*, and it is of the utmost importance that this viewpoint be kept constantly in mind by all parties concerned with the carrying on of the work of this department. To illustrate this it may be said (without any particular reference to this or any other particular plant) that the work of a maintenance or repair department has in the past consisted chiefly in repairing damage to machinery and other equipment after it has reached such a stage that it was no longer possible to operate even inefficiently the machine or equipment in question. Ordinarily, under the old scheme the responsibility for the condition of equipment was, in theory, vested in the shop superintendent, who in turn delegated this responsibility to department heads, and they in turn to the foreman. Under such an arrangement the Repair Department did not assume the initiative in making repairs or keeping equipment in order, but made repairs only upon receiving orders to do so or reports of damage to equipment from one of the executives referred to above. This resulted, in frequent instances, in machines being run long after they had gotten into such bad condition as to prevent their turning out their maximum production of work of the best quality. Frequently repairs were put off until a serious breakdown occurred, which prevented the machine being operated. The same may be said with reference to small tool equipment.

Under Scientific Management the Maintenance Department is operated in such a manner as to anticipate and prevent in the greatest possible degree loss in output and interruptions to manufacture as a result of machinery and equipment getting in bad condition or breaking down. Under this system the Maintenance Department assumes the initiative and the responsibility which are thus centralized in one department instead of being divided and scattered throughout the plant. Under the old scheme the maintenance of equipment was only one of a great many things which the executives (superintendent, department heads and foremen) had to look after and it was well or poorly looked after according to the importance attached to it by the various individuals and the amount of time which other pressing duties permitted their giving it. Under the new scheme it becomes the matter of foremost importance to men who devote their entire time and energy to it in a consistent and systematic manner.

The functions of the Maintenance Department may be briefly enumerated as follows:

1. The making of emergency repairs.
2. Systematic inspection of all machines and other equipment at such intervals as will insure the detection of any wear or getting out of adjustment as might result in a breakdown or in impairing efficient operation.
3. Making such adjustment, repair or replacement as the inspection may show to be necessary.
4. The keeping up of all useful records concerning machinery, such as drawings that are of service in making repairs or in planning work, inventories of machinery, fixtures and adjustments, etc.
5. The working out and development of such improvements or changes in machines, fixtures and tools:
   (a) As may be required in order to manufacture a new line of product, or—
   (b) Result in increasing production, reducing spoilage and improving quality.