Journal of the Minnesota Academy of Science

Volume 2 | Number 3 Article 4

1881

Industrial Education

W. A. Pike

dwell only two or three persons. I would not be surprised to find that the greater amount of zymotics of Minoeapolis were due, in part, to the contamination of the river water.

There is a supply of water that is above reproach in 999 towns out of 1,000, and that is the supply we gather from the roofs into our cisterns. If the cistern is properly made and sealed, neither diphtheria, dysentery, typhia or cholera can come to us through the water supply, because the poisonous germs which produce these diseases cannot get into such a receptacle. Care should be taken, however, to let the water that first runs off the roof run to waste, or insects may be conveved into the cisterns.

The speaker stated, too, that water may be purified by the use of a chain pump, which distributes air through the water; and closed by recommending that we should do all in our power to aid Dr. Hewitt and the board of health to bring about better public sanitary conditions; that cesspools should be sealed cisterns, and the matter not allowed to percolate through the soil and spout.

INDUSTRIAL EDUCATION.

BY PROF. W. A. PIKE, OF THE UNIV. OF MINN.

There can be no question as to the fact, that in these days of special machinery there is a demand for some means by which the young man who wishes to devote himself to mechanical pursuits may receive an education which shall fit him for such work. In the days gone by when there was a regular system of apprenticeship and the number of special tools was very much less than now, it was for the interest of employers to give their men thorough instruction in all the various processes of their business and to make them expert artizans, and therefore no public system of industrial education was needed. Now, however, things are very much changed,

and the same inventions which have done so much to civilize and elevate mankind as a whole, have had the result of narrowing very much the sphere of individual mechanics. It is now for the interest of the employer to make each man proficient in the use of some one tool, and having done so to confine him closely to its use. The result of this system is that while the work done is better and produced at less cost than would be the case under the old way, the mechanic is but a man with one idea, and if for any reason work at his specialty gives out is obliged to begin again at the foot of the ladder. What therefore seems to be needed is some general system of education which shall broaden and render intelligent the man while fitting the mechanic for a career of usefulness in the shop.

Granting then the need and demand for some means of industrial education let us see how that demand can most economically be met, remembering that economy of time is as necessary as economy of money.

The plan which has been in operation longest, but which I think is not the best, is that of establishing, in connection with some school or college, a manufacturing establishment, with a regular force of men, where a regular business is carried on and into which students are received as apprentices during stated hours, and where they receive such instruction as can be given in connection with whatever work may be going on. The greatest objection to this method is that when an educational institution undertakes to do a manufacturing business it must manage it on business principles and place the work with reference to the construction of some article rather than the instruction of the students. Thus it will be seen that whatever educational results are obtained must be to a certain extent incidental and secondary to the other work. Another result must be that the student will spend much time in repetition of processes as far as his instruction is concerned, though such work may be very necessary in the production of the article to be manufactured. Another ob-

jection and one that is of weight in connection with any general or public system is that as the scope of these manufacturing establishments is of necessity confined within quite narrow limits, so also must be the skill obtained. In short, if any trade is to be taught, justice seems to require that all trades should be, at least in any school dependent upon the public for support.

These objections being deeply felt by many interested in this matter it has beeu with great interest that the application in this country of the method in use in the Russian mechanical schools has been watched. This system consists of the establishment of a series of shops or laboratories in which the work shall be planned solely with reference to the instruction of the students, and where the aim shall be to teach the arts underlying the various trades rather than the trades themselves, and thus make the instruction general and the knowledge obtained that of principles and processes instead of the minor details that distinguish one trade from another, and which can best be learned in a construction shop. To fix our ideas upon the plan to be followed, let us analize the work done in the manufacture of almost any article made of metal, for example. We see that whatever the article may be it will have been the subject of one or more of the following operations; casting, forging, vise working, machine-tool working, etc., and that the methods employed in these various operations are essentially the same whatever the final result. Still farther, if we examine into each one of these general processes we see that they are capable of subdivision, as in vise work for example. Vise work can be divided into filing, sawing, screw cutting, tapping, etc. In order then to give the student the most thorough drill in the shortest time, a series of lessons have been devised in which these various processes are taught, the lessons begin with the simplest processes and advance by degrees to the more complex and difficult ones. The instructor is also required to explain why certain tools are used in certain operations and why these tools are shaped

as they are. As we always keep in mind one object, namely to plan the work wholly with reference to the students' advancement, it can readily be seen that the work can be made progressive, so that every stroke the student takes may teach him something. The claims that are made for this system, and that trial has proved to be well founded, are that the instruction given in shops on this plan is of general application, that it furnishes a valuable preparation for the work of most any trade and that the skill in the use of tools is obtained with greater economy of time and money than by any other method. It should be understood that it is not claimed that young men taking these shop courses become finished workmen, in any trade, but that a young man after passing through the proper instruction shops is able at once to make himself useful in his chosen trade, and that he will in a very short time pick up in the manufacturing establishment the details and special manipulations of his particular trade. When a young man has received such training as I have indicated he will be familiar with more than the one process he is engaged upon and will be enabled to adapt himself very readily to a change of work when it becomes necessary.

So far, reference has only been made to the value of this system as a preparation for the various trades, but the value of such training to the engineer who is to design and superintend the construction of machinery, roofs, bridges, etc., can not be overestimated. A limited amount of education of the hand and eye together is of value to any one in this busy practical world.

To illustrate the actual working of this system of manual instruction, I have brought here to-day specimens of the work of students in the Maine State College, in the courses in vise-work and in forge-work, and will explain quite fully how the plan has been actually carried out.

COURSE IN VISE-WORK.—In this course the students are provided with a stout vise, set at the proper hight for work,

a set of tools, consisting of files, cold chisels, hack saws, calipers, squares etc., and a set of blanks to be worked in various ways.

The first lesson, which is in filing to line, is given to the student in the shape of a rectangular block of cast iron, 2 in. by 4 in. by 1 in. with the top face rough, as it came from the foundry, and with a line on either side about an eighth of an inch below the surface. The problem before the student is to file it down to a plane surface between these two lines, the surface to come just to the lines but not ro efface them. In this lesson the student receives instruction as to the proper manner of placing the work in the vise, the proper way to hold the file and the sort of motion to give to it. This piece, it will be noticed, has a broad flat surface to rest the file upon, thus guiding the hand of the beginner and tending to prevent the rocking motion of the file which is so common. The next lesson covers the filing off of the corners of a square prism, converting it into a regular octagonal prism, the lines to be filed to being previously marked on the square. This lesson differs from the first only in that there is no guide for the file, as the filing begins on the sharp corner to be filed off. The third lesson brings in the use of the try-square as only one line to be filed to is given, and it is required that the filed surface shall be at right angles with the upper surface of the piece. Lesson number four is inside work requiring also the use of the square, being the filing of a square hole in a block of iron which has previously had a round hole drilled in it. The fifth lesson, the filing of an oval hole in a block involves the use of round and half round files, tools not used before. The next three lessons are exercises in fitting two pieces together so that they may be perfect fits and yet move easily on each other. The ninth lesson consists of filing a piece of wrought iron to exactly correspond to a hardened steel template, work very common in shops where exact duplicates are required. The last six lessons, in filing, consist of free hand

work, in which the piece is no longer stationary in a bench vice but is held either in a hand vice or in the hand alone, these lessons consist of the filing of a ring, cutting a screw thread pointing a piece of steel wire, filing a shoulder on a cylinder, filing an acorn and executing a piece of cross filing such as is seeen in guns. The remaining seven lessons in this course are exercises in the use of cold chisels on cast iron and steel.

These speciments have been examined by many mechanics and others qualified to judge, and the verdict always has been that it is "splendid work," &c. Yet such work as this can be done by any young man, who has a mechanical turn, in one hundred and twenty-two hours, which is the shop time of about two weeks, time in which a boy in a construction shop would hardly have learned anything, except possibly to chip castings.

Without explaining, in detail, the course in forge-work it will be seen on a little thought that all forging consist of a comparatively few operations either alone or combined, such as bending, upsetting, drawing out, welding, tempering, &c., and accordingly a set of lessons have been gotten up in which these various operations are taught. Specimens of this work can be seen on this frame.

A most important factor in the application of this system is the method of marking. After a piece has been decided upon for a lesson the instructor carefully examines the piece and decides what things it is most important should be accomplished, and makes these the basis for making the piece, giving each point a numerical value dependent on its importance. For example, in piece number one, in the course of vise-work, the points are as follows:

Down just to line, one side,	20	per cent.
" " other "	20	"
Straight crossways	20	"
" lengthways	20	"
No cross-marks	20	"
	100	

The points for each piece are posted before work begins upon it, and each student then knows on what points he should exercise most care, in this way avoiding many mistakes. When a piece is finished the instructor examines it carefully, and gives the student credit for that fraction of the value of each point to which his work entitles him and again posts the list. The student, now examining the mark he has received for each point, knows just where he has failed and puts himself on his guard in future work. Moreover, it is held that these points will be so impressed on the students mind as to serve for guides in the practical application of these processes.

From what has been said it will be seen that to insure the best results it is necessary that the instructor in each shop shall be an expert in his work, in order that the instruction given may be of a nature that can be readily applied to practical work when the student acquires the details of the trade in which the skill is to be used.

I have been able to show specimens of work in but two courses, but the same method applies equally well to other work. The system has been applied, and in all cases successfully, to the following branches of work: vise work, forge-work, foundry-work, lathe-work, general wood working, pattern making and wood carving. The method has had a fair trial, many young men now trained in this way are successfully applying their skill in construction shops, and I cannot help believing that this system, liberally carried out, is to settle the question as to how we shall train our young men for industrial pursuits.