ARITHMETIC IN A MASSACHUSETTS INDUSTRIAL SCHOOL.¹

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Before beginning to explain how arithmetic is taught in one of the industrial schools of the state it might be well for me to explain the aim of the school, as the aim determines very largely the methods of instruction.

The Lawrence Industrial School provides for three distinct classes of students. First. That of offering to children who have reached the age limit of compulsory education in the grades, a further education which aims to prepare them to go into some form of industrial occupation, as the high schools prepare them for professional work. Second. To offer to young men between fourteen and twenty already employed, part time instruction in which the employer gives the time out of the working day. Third. To offer to adults already at work, an opportunity for further study which will aid them to become more efficient workers.

While the day school offers a three year course in the textile arts for boys, mechanic arts for boys, and the domestic arts for girls, it recognizes the fact that the majority of children cannot afford to give so much time to education beyond fourteen years of age. Hence, the arithmetic is planned with the other work, so that the work of each year is so far as it goes complete in itself; it is not taught on the theory that it will be of value at some later period in the course.

The class of children that have attended the day school may be divided into four grades. The first grade includes those who have attended the high school for two or three years, and whose parents do not feel that they can afford to give more time to the child for purely academic work, and yet feel that they can afford to send the child to school a year or more in order to aid him in getting started in some form of skilled industrial work. The second grade includes the children who do not like to study, who want to do things, who want to see and know the use of things, who are of a practical rather than an academic mind. Third grade, pupils who have graduated from the grammar school and desire to "learn a trade." Fourth grade, children fourteen years of age who are in the grammar school, and whose parents feel that the child has wasted his time in school, and are anxious that he should make better use of his time.

¹Read before the Association of Mathematical Teachers in New England, April 16, 1910.

The arithmetic work in the day school consists of a thorough drill in practical problems in the metal and wood trades for those taking the mechanic-arts course and a drill in practical mill problems for those taking the textile course. Problems dealing with wages of different employes, services for hours, days, weeks, and so on, followed by the problems and calculations involved in each operation that takes place in the mill and shop. Each operation is explained in detail by means of models of gears, wheels, bolts, and so on, and by specimens of raw cotton, wool, yarn, and cloth. These problems involve the operations of addition, subtraction, multiplication, division, fractions, rule of three, alligation, percentage, square and cube root. So that a thorough drill in arithmetic is given. The propositions in geometry are assumed to be true, and practical problems involving their use are given. Algebra is introduced incidentally, to abbreviate rules, in connection with the work in arithmetic. Practice is given in setting up formulas from rules and interpreting a formula.

Each course has a separate text-book written by an instructor, and the problems are taken from the local industries. In this way a thorough foundation in arithmetic (including the use of square and cube root tables) is obtained the first year. Pupils who find it difficult to understand arithmetic in the grades have no difficulty in understanding it when it is presented in the concrete form. During the second and third year arithmetic is taught only as the problems are met in the actual shop and mill practice.

Objection may be made to this mechanical, rule-of-thumb method of teaching arithmetic. My answer to this is that the success of a nation depends upon the ease with which the industrial workers can adapt mathematics and science to industrial matters. In fact, the graduates of technical schools fall easily into the rule-of-thumb methods as soon as they become part of the industrial world.

I do not mean to say that we stifle the pupil's desire to know the reason why, but rather encourage questions about the work. I believe that the logic of mathematics should follow the practice rather than the practice the logic, for a great many, if not the majority, have not the mental equipment to get much training from the logic of mathematics. But I am sure that all can get the practice of mathematics, particularly when they see an incentive for its study.

Instruction in arithmetic for adults who are working at the trades cannot be taught as systematically as it is taught to chil-

dren in the day school. The former attend school to satisfy a definite need and have intensely practical aims, and are unwilling to study systematically the entire subject of arithmetic; even when they know they are deficient in the fundamentals they demand that the instruction shall deal with the specific problem which they have in hand.

This has been done by classifying our evening pupils according to their trades. For example, there is a class in arithmetic for engineers and a class in the same subject for boiler firemen. They are taught arithmetic by taking problems that occur in their daily work and solving them. These problems involve addition, subtraction, multiplication, division, fractions, percentage, and the use of a formula. In working out the problems the instructor at the same time teaches the operation of multiplication, and so on. A formula is briefly explained as an abbreviated rule to assist one to see at a glance the required operations embodied in the rule.

The machinists have a separate class. The textile designers have a class in arithmetic called cloth calculations. In this way the instruction in various branches of mathematics is adapted to meet the needs of the mill operative, the machinist, and the steam engineer. The terms used in the class room savor of the shop and mill. For example, the problem of finding the heating capacity of a boiler does not appeal to the weaver in the mill. On the other hand, how to find the size of a pulley for a certain loom does not awaken the interest of the steam engineer as much as the problem involving the same operations dealing with a problem in the engine room. Special text-books along this line of work have been edited by the school and published by the state.

Statistics show that eighty per cent of girls will eventually marry and become housekeepers. The problem is to give them preparation for that life and to prepare them for the work they must do to earn their living between the time they leave school and are married. In the girls' department arithmetic is taught by means of problems dealing with the ordinary affairs of life, that is to say, problems that a girl or woman would meet in the trade in which she is engaged, and in the home.

The subjects of the problems are chosen within the limits of reality. Every woman, no matter what station of life she holds, has more or less business transactions. She has been taught interest in the grammar school and can find the amount of \$999 for nine years, nine months, nine days at nine and a half per cent,

but how many girls can tell you what \$500 deposited in the Lawrence Savings Bank, January 1, 1905, would amount to to-day? The girls are taught how to read gas meters, and to figure how much is due the gas company, if the bill is paid early enough to get the discount.

Grammar school arithmetic teaches how to find the amount of a note, but does not give the penalty or inform pupils of the responsibility attached to signing a note.

Problems in the cost of living are firmly impressed. For example, how will a woman divide her income to dress decently even when that income seems too small to divide?

REPRESENTATIVE PROBLEMS.

1. I put \$500 in the Lawrence Savings Bank, January 1, 1905. I have drawn nothing out. How much have I in the bank?
2. A man buys property worth \$3,000. Takes out a \$2,000 mortgage. What will the interest on the mortgage be? If he does not pay the interest how long can he hold the property?
3. Many are asking for lemonade at the lunch counter. What must we charge to cover the cost? (Little or no data given.)
4. How much Hamburg do you need for the ruffle on your petticoat? What will it cost?
5. How much long cloth will you require to make a 10-inch flounce on your skirt?
6. Make a list of articles for wearing apparel you will need for a year. Keep the cost within \$50.00.
7. Which is the better off financially; a girl earning \$4.00 a week as a housemaid or earning \$7.00 a week as a salesgirl?

A considerable number of arithmetical problems set for girls deal with household things, domestic economy, and the results of thrift. When this industrial arithmetic for girls is well taught, it helps to introduce into the homes that methodical spirit which regulates expenses by receipts, inspires foresight, and makes the produce of thrift fruitful.

OIL LANDS WITHDRAWN.

A withdrawal of 5,760 acres of supposed oil land in California was made on the recommendation of a chief of field division of the General Land Office, making the total outstanding oil withdrawals 4,660,650 acres.

COAL IN UTAH.

The areas in Utah known to contain workable beds of coal are estimated by M. R. Campbell, of the United States Geological Survey, to aggregate 13,130 square miles, and there are 2,000 square miles of which little is known but which may contain workable beds of coal. The original contents of these fields are estimated by Mr. Campbell to have been 196,458,000,000 short tons of coal.