

UNITED STATES BUREAU OF EDUCATION
BULLETIN, 1913, NO. 50 WHOLE NUMBER 561

THE FITCHBURG PLAN OF COOPERATIVE
INDUSTRIAL EDUCATION

By MATTHEW R. McCANN
PHYSICS DEPARTMENT, ENGLISH HIGH SCHOOL
WORCESTER, MASS.



WASHINGTON
GOVERNMENT PRINTING OFFICE
1913

CONTENTS.

	Page.
Letter of transmittal.....	5
Historical sketch.....	7
Fitchburg and its activities.....	7
Making the start.....	8
Varieties of occupation.....	8
The general arrangement of the plan.....	9
Compensation for work.....	9
Relation of the industrial pupils to the other pupils.....	10
School course not controlled by the employers.....	11
Course of study: Shop course with correlated school studies.....	11
Academic subjects studied by industrial students.....	13
Contract between the boy and his employer.....	20
Practical suggestions.....	22
Results of the cooperative plan.....	23
Standing of the industrial graduates in academic subjects.....	25
What the boys think of the plan.....	26
Statistics.....	28

ILLUSTRATIONS.

	Page.
Plate 1. Fitchburg High School.....	Frontispiece.
2A. Lathe work; Blake Pump Works.....	8
2B. Lathe and bench work; Fitchburg Steam Engine Co.....	8
3A. A student at work in a machine shop.....	8
3B. A group of students, graduates, and employers.....	8
4A. Drawing class in the school.....	16
4B. Students drafting in the Putnam Machine Works.....	16
5A. Shaper work; Bath Grinder Co.....	16
5B. At a lowswing lathe; Fitchburg Machine Co.....	16

LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
BUREAU OF EDUCATION,
Washington, September 23, 1913.

SIR: One of the most successful attempts to give instruction in the trades in the public high school and at the same time to preserve the best of the traditional high-school course is that begun at Fitchburg, Mass., five years ago. The cooperative plan, adopted in imitation of that in use in the college of engineering of the University of Cincinnati, has become widely known as the "Fitchburg plan." There is a demand from high-school officials and others interested in secondary education for fuller and more accurate information about the plan, the methods of its application, and the results obtained than can be had from the many brief partial accounts which have appeared in the magazines and school journals. The plan is, I believe, based on sound principles of pedagogy and might well be adopted, with necessary modifications, in many other cities and towns. I therefore recommend that the manuscript prepared by Mr. M. R. McCann, of the physics department, English High School, Worcester, Mass., be published as a bulletin of the Bureau of Education.

Respectfully submitted.

P. P. CLAXTON,
Commissioner.

THE SECRETARY OF THE INTERIOR.

THE FITCHBURG PLAN OF COOPERATIVE INDUSTRIAL EDUCATION.

HISTORICAL SKETCH.

At a meeting held in New York City in the spring of 1908, Prof. Hermann Schneider, dean of the college of engineering of the University of Cincinnati, presented to a group of metal manufacturers gathered from all parts of the country the plan of cooperative industrial education used successfully under his direction, by which arrangements had been made with several shops of Cincinnati to give the students in engineering the larger part of the practical training required for graduation. Among those who were present was Mr. Daniel Simonds, manufacturer from Fitchburg, Mass., a broad-minded and public-spirited citizen of one of the most successful industrial centers of Massachusetts. Immediately he saw the possibility of adapting the plan to his home town, and through it of solving the problem of industrial education for boys of his city.

Mr. Simonds returned to Fitchburg and presented his ideas to the school authorities. The feasibility of the plan was conceded, and a committee was appointed to inspect the work in operation in Cincinnati. The committee reported in favor of the immediate adoption of a similar plan in connection with the high school of Fitchburg. Several employers of skilled labor in Fitchburg came forward to assist in the movement and to give that phase of cooperation without which the course would be impracticable, namely, the use of their shops and machinery.

FITCHBURG AND ITS ACTIVITIES.

The city of Fitchburg is situated 50 miles from Boston, among the rolling hills of north central Massachusetts, on the Nashua River. Its interests are largely manufacturing, and the diversity insures ample means of gratifying the aptitudes of a large body of students. According to the latest census, the city has a population of 37,326 and is the center of a district of 150,000 people. It ranks high in its advantages for health and education, industry, trade, and transportation. It has skilled labor, adequate capital, and an abundance

of electric power. Fitchburg has a national reputation for the production of such articles as revolvers, bicycles, saws, paper, steam engines, screen plates, iron and brass castings, steel horse collars, woolens, and gingham.

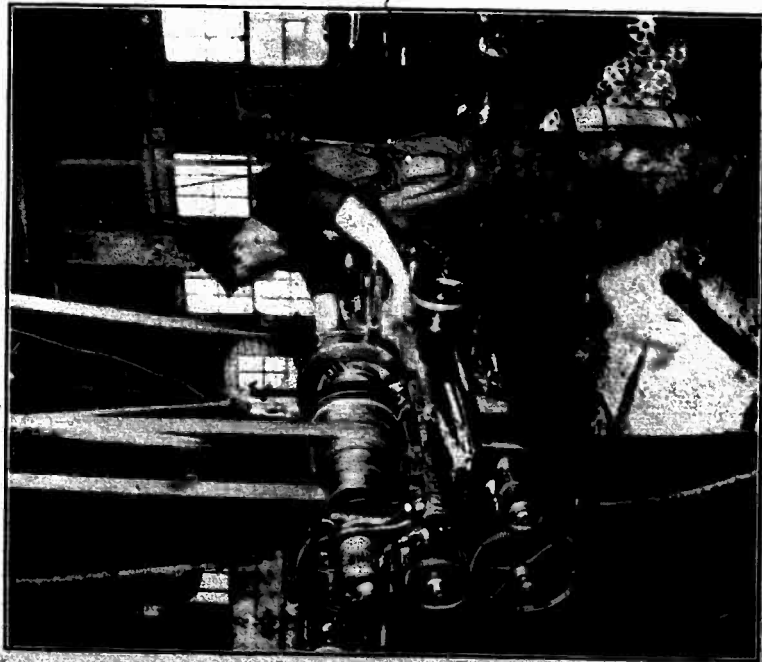
MAKING THE START.

After the city council, school department, and employers decided to adopt the cooperative industrial plan it was decided first to secure a director who had adequate qualification. It was agreed that such a man must have had a technical education and also actual experience in shopwork. In August, 1908, Mr. W. B. Hunter was engaged, and to him was given much latitude for the development of the work. It was realized that the inauguration of the new plan would require extensive change from the ordinary high-school routine and that this change was essential to the success of the cooperative industrial course. Mr. Hunter was given the general plan of the course that had been decided on by the school authorities, and he was left to work out the details.

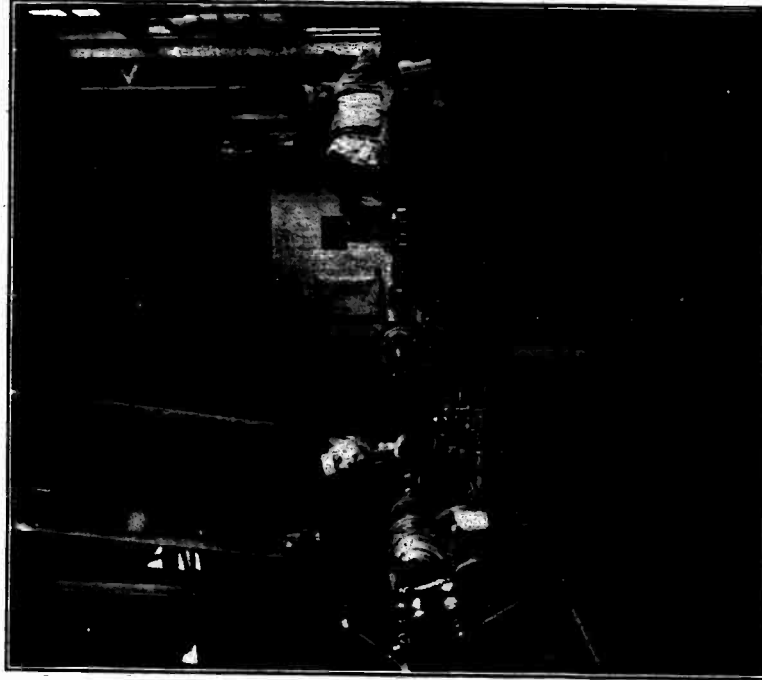
It was determined to put the scheme into operation in September, 1908, and the public was so notified. Early in August Mr. Hunter began interviewing applicants for entrance to the industrial course, and their parents. Boys who wished to follow the trades as a permanent occupation were selected in preference to others, and 18 were chosen to start the course. By daily visits to the shops during this period the arrangements were made for beginning, and by the opening of the school in September these boys were all at work. The pupils were paired, and during the first week half of them remained at work, while the rest attended school. Those who attended school the first week spent the second week in the shops, and those who remained in the shop the first week attended school the second week. This alternation continued throughout the year. The director had no trouble making final arrangements with the employers, as they had already signified their willingness to cooperate as soon as Mr. Hunter was ready to take up the work.

VARIETIES OF OCCUPATION.

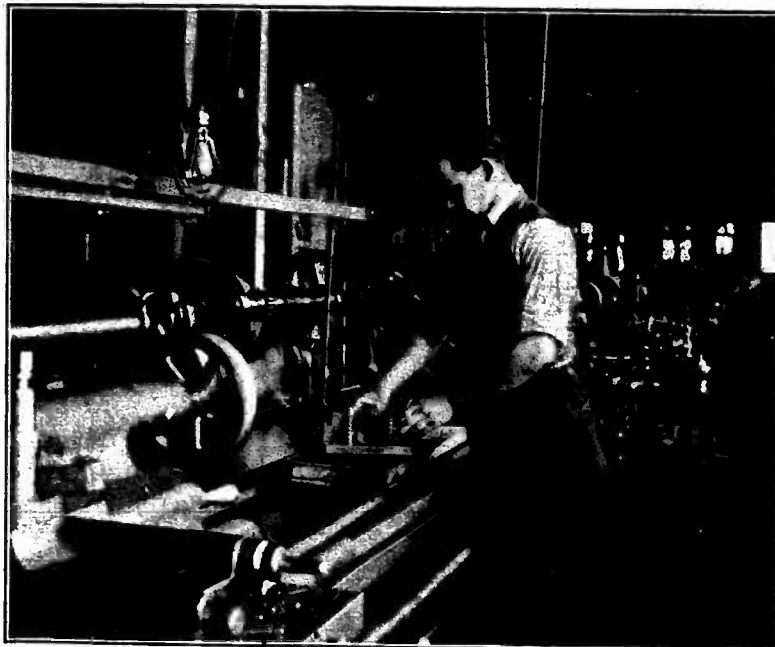
The main idea of this course is to provide an opportunity for learning a trade and obtaining a general education at the same time. The plan of spending each alternate week in some occupation in the industries of the city has been continued throughout each school year since the beginning. Continuous work during the vacation periods is provided for every boy who cares to work. The boys are employed in industries offering such occupations and trades as machinist, pattern-making, sawmaking, drafting, iron molding, tin-smithing, piping,



A. LATHE WORK: BEAKE PUMP WORKS.



B. LATHE AND BENCH WORK: FITCHBURG STEAM ENGINE CO.



A. A STUDENT AT WORK IN A MACHINE SHOP.



B. A GROUP OF STUDENTS, GRADUATES, AND EMPLOYERS.

printing, textile and office work. The concerns cooperating in 1913 were the Bath Grinder Co., Blake Pump & Condenser Co., Brown Engine Co., C. H. Cowdrey Machine Works, H. M. Downs Printing Co., L. H. Goodnow Iron Foundry, the Jennison Co., Fitchburg Machine Works, Fitchburg Steam Engine Co., Grant Yarn Co., G. M. Parks Co., Parkhill Manufacturing Co., Putnam Machine Works, and the Simonds Manufacturing Co. In response to the increased demand it is the intention of the director to include even more industries in his course for the coming year.

THE GENERAL ARRANGEMENT OF THE PLAN.

Under the present arrangement the industrial course is of four years' duration, the same as the regular high-school course. The first year is spent wholly in school; in the next three years the boys alternate weekly between shop and school. Three summers are spent in the shops, beginning with the close of the first year in June. The first summer is a trial period of two months and is given to each candidate to determine if he is adapted to the particular trade he elects. Allotments to the various shops are made in June by the director of the course, and, as far as possible, the desires of the boy are met. The parents sign an agreement whereby it is agreed that the boy shall complete the full course, unless prevented by unusual circumstances; and the manufacturer, on his part, agrees to teach him the trade designated in the agreement. The manufacturers and employers take the boys in pairs, so that, by alternating, one of the pair is always in the shop during the regular shop hours while the other is in school. On Saturday the boy who has been at school during the week goes to the shop and works during the morning, so as to be prepared, on Monday to continue without interruption the work on which his mate has been working. The two boys work together during the morning, and the afternoon is given to them for recreation. During the year each boy spends 5 days a week for 20 weeks in the school and the equivalent of 5½ days a week for 20 weeks in the shop. In addition he spends 8 weeks of his summer in the shop, 2 weeks being allowed for vacation.

COMPENSATION FOR WORK.

Boys receive pay for their actual work at the following rates: First year, 10 cents an hour; second year, 11 cents an hour; third year, 12½ cents an hour; making a total of approximately \$550 for the three years of shopwork. These rates are higher than apprentices have received in the past, the employers having of their own accord raised the wages. This compensation is a strong inducement for the boy to continue in the course. He can go to school and at the same

time earn as much as he could get from the ordinary employment in stores and offices. For those parents who can not afford under ordinary conditions to keep their children in school this furnishes a means by which the boy contributes to the family's support and thereby gives him the opportunity to continue his education. When there is vacation for a week in school, work is provided in the shops for those who wish to work and their earnings are correspondingly increased. Since the plan has been in operation the employers have shown great willingness to take the boys during school vacations, and no boy has yet been obliged to be idle if his ambition is to work and earn. The trial period of two months during the first summer for those electing the industrial course occupies the months of July and August. If the pupil likes the work and shows an aptitude for the trade, he continues with the course; otherwise he is tried in some other line, or, if he chooses, takes up some other course in the high school. The opportunity to find himself is thus given to each boy, and the choice of his vocation is worked out largely by the individual under the trained eye of shop foreman, with the kindly advice and timely suggestions of the director.

RELATION OF THE INDUSTRIAL PUPILS TO THE OTHER PUPILS.

It might be thought too great a physical strain for young boys to work steadily for a week at a time with regular shop hours—for the boys in this course have no special privileges in the shops; they are subject to all the shop rules and must abide by them in the same manner as any journeyman or regular apprentice. Such is not the case. Those in charge have not received a single complaint that the work is too hard or that the hours are too long. The physical development of the boys is much more pronounced than that of their associates in other courses. Of the boys in the various athletic teams, a large proportion are connected with the cooperative industrial course. They constitute the major portion of the football, basket ball, and baseball teams of the Fitchburg High School.

The social standing of the boys in this course is fully as high as the standing of those in the other courses offered by the high school. The cooperative industrial course is distinctive, yet not segregative. The pupils in it bear the same relation to the school, its traditions, history, and life as the pupils associated with the college preparatory, the technology preparatory, or the general course. They are housed under the same roof, have the same periods for class and recreation, use the same classrooms for recitation and study, associate with others in the various courses as freely and unrestrainedly as any pupils of the high school. Much stress is placed upon this close association with pupils in other courses, and it is the intention

of the school authorities of Fitchburg to continue those relations even when the numbers are far greater. In this city there is but one high-school building, with an enrollment of about 900 pupils. When the time comes for new buildings it is not the intention to erect one for the sole use of pupils of the cooperative industrial course. Intimacy and contiguity with other pupils is of decided advantage in perpetuating the school spirit and in fostering the inclination to continue in school life. The boys of the cooperative course hold office in their class organizations and are evidently very popular among their classmates.

SCHOOL COURSE NOT CONTROLLED BY THE EMPLOYERS.

An objection to the entire scheme has been raised by persons who fear that the employers will eventually assume full control of the course and will then use it for their own selfish gain. Investigation, however, does not show any real danger of this. The manufacturers and employers are hiring the boys and have a right to expect an adequate return for the wages paid. It is not entirely philanthropic on their part, but the boy and his parent know what they are undertaking, and if they in turn get what is contracted for, there can be no reason to assume that they are not treated fairly. The employers do not interfere in the management of the cooperative plan, but insist that the course be practical and that a practical shopman be the director. Each year there are many social functions, fostered largely by the manufacturers, to which the boys are invited, and in each of the past three years the graduating class and alumni have been entertained by the employers at an outing in which both the old and young entered with unrestricted spirit.

COURSE OF STUDY: SHOP COURSE WITH CORRELATED SCHOOL STUDIES.

As an illustration of the sort of work given the boys, the shop course of six of the trades, together with a suggestion of the school work correlated, is given below:

MACHINIST TRADE.

Shop work.—Starting, running, cutting-off machines; chipping or rough-filling castings; tapping, hand reaming, and burring; rough lathe work, turning stock oversize for finisher or grinder, b ring, polishing, and hand milling; lathe practice with increased accuracy, using micrometers, taper turning, thread cutting; drill press, laying out holes, use of jigs, tapping, reaming, lapping; planer or shaper—methods of strapping work to table, rough planing, finishing, taper work; grinding of tools—planer, lathe, drill—both by hand and machine; grinding machine operation, external and internal work, wet and dry, use of magnetic chuck; setting up, floor work, fitting parts, fitting keys;

milling machines—plain milling, form cutters, indexing, iron and steel parts, jigs, and fixtures; boring mill, drafting room. In shop work use blue prints for directions.

Correlated school work.—Complete analysis of shop tools and operations; freehand sketching with dimensions from machine parts, followed by mechanical drafting of same, throughout the four years of the course; shop figuring, gearing, screw cutting, speeds, feeds, belting, chain drive, etc.; properties and chemistry of metals; steam engines; physics, elementary applied mechanics; electrical drive and apparatus; English, description of shop processes and machinery; precision measurements and instruments; geometry and trigonometry used in shop work.

DRAFTSMAN:

Shop work.—Tracing, blue printing, lettering, detailing, simple design from foreman's sketches, changes, measuring shop tools for alterations, jig design.

Correlated school work.—Drawing and freehand sketching, drawing room procedure; methods of representation, strength of materials, properties and chemistry of metals; English, descriptive of work and processes; analysis of shop tools; pattern making; chemistry and physics same as machinist; geometry and trigonometry to solve gearing and stress problems.

MOLDING TRADE.

Shop work.—Mixing sand; core making, heat ovens; helping floor molders, ramming molds, pouring light parts, molding simple pieces, increasing in complexity.

Correlated school work.—Chemistry of iron; chemistry of sands; physics; shop tools and operations; core ovens and making, venting, etc.; gases; mathematics.

PATTERN-MAKING TRADE.

Shop work.—Kinds of stock; use of saws, planers, sanding, gearing, lathes, etc.; turning, chuck work; solid work; built up patterns; loose pieces, core prints and boxes, pulleys and gears; working from blue prints.

Correlated school work.—Drafting; gearing; mathematics; machine shop and molding processes; cutting tools, saws, planers, etc.; properties of wood, "draft," fillets, etc.; chemistry of iron, glue, etc.; physics, same as machinist.

SAWMAKING TRADE.

Shop work.—Gauging stock; punching and reaming arbor holes; grinding to thickness and clearance; hammering to clear lumps and straighten stock; hammering after hardening for tension according to use of saw; blocking or final finish.

Correlated school studies.—Properties of steel; chemistry and physics as for machinists; hardening and tempering processes; precision measurements.

SHEET-METAL TRADE.

Shop work.—Helping journeyman; cutting off stock; bending and crimping; soldering and hammering; sheet iron, steel, copper work; making ventilators, cornice work, and odd jobs; laying out sketch as design of ventilators.

Correlated school studies.—Sheet-metal, drafting; iron and steel properties; chemistry of metals, solders, gas appliances; physics, mechanics, etc.; practical geometry; heating and ventilating; cutting tools.

ACADEMIC SUBJECTS STUDIED BY INDUSTRIAL STUDENTS.

Of the 40 weeks in the school year, 20 are taken up with actual work outside the classroom and school building, while the remaining 20 are devoted to the academic work of the course in the school. It is evident that only such subjects as are of practical value to the student in the pursuit of his trade, looking always to advancement, can be included. From the first the employers who offered their assistance insisted that the course be such as to make those going into it better mechanics, capable of advancing to the highest possibilities in the trade. The prescribed studies of the ordinary courses that were included in the cooperative industrial course were, as a rule, changed in form and structure. Many of the time-honored subjects were carefully shelved, and such subjects were selected as would fit the students to be intelligent mechanics and thoughtful artisans. The course of study in operation in connection with the cooperative course is not as well defined as the ordinary courses of the high school, nor can it be, because of the nature of the training. Great care has been taken in the selection of textbooks, and the most practical ones have been chosen, yet the demands upon the course are so engrossing that the books very often play but a small part.

Schedule of studies for the Fitchburg cooperative course.

First year (all work in school) :	Periods per week.
English and current events.....	5
Arithmetic, tables, and simple shop problems.....	5
Algebra.....	5
Freehand and mechanical drawing and bench work.....	8
Second year (school and shop work alternately) :	
English.....	5
Shop mathematics, algebra, and geometry.....	5
Physics.....	4
Civics.....	2
Mechanism of machines.....	5
Freehand and mechanical drawing.....	6
Third year (school and shop work alternately) :	
English.....	5
Shop mathematics.....	5
Chemistry.....	4
Physics.....	4
Mechanism of machines.....	5
First aid to injured.....	1
Freehand and mechanical drawing.....	6
Fourth year (school and shop work alternately) :	
English.....	5
Commercial geography and business methods.....	2
Shop mathematics.....	4
Mechanism of machines.....	4
Physics, electricity, and heat.....	4
Chemistry.....	6
Freehand and mechanical drawing.....	5

The details of several of the courses are as follows:

Mathematics.—Arithmetic, algebra, geometry, and trigonometry all have their place in the course, including simple propositions in mensuration, fractions, metric system, and circular measure; general shop mathematics dealing with problems of cutting speeds and feeds; belting, gearing, strength of materials, and general cost figuring. The aim in the mathematics course is to train the student to use figures that his trade and everyday experience demand. To this end those elements that are in general use are emphasized rather than the theory of mathematics. For example, in trigonometry "functions" are omitted and the solution of right and oblique triangles is emphasized. During the freshman year tables of angles, measures, etc., are reviewed and the metric system is studied, because American manufacturers are engaged in foreign trade, and a knowledge of metric measurements is demanded of the mechanic. As the mechanic has to use formulæ from handbooks to solve many shop problems, it is essential that he have a good knowledge of algebra; to that end a rather complete course is necessary and is not unlike that outlined by the ordinary first-year algebra books.

First year:

Arithmetic—Textbook, Stone & Mill's Secondary Arithmetic; tables, metric system; shop or concrete examples, pulleys, etc., mensuration.

Algebra—Textbook, Stone & Mill's First Year Algebra; fundamental operations; manipulation of formulæ; quadratics.

Second year:

Arithmetic—Review mensuration from International Correspondence School Handbook; problems on sizes and speeds of pulleys.

Algebra—Manipulation of formulæ from practical shop problems.

Geometry—Textbook, Stone & Mill's Plane Geometry; textbook is sufficient to take up the practical features of shop geometry.

Trigonometry—Angular measure, degrees, radians, ratio of sides, sine, cosine, tangent, cotangent, solution of right triangle with logarithms and without; solution of oblique triangle; law of sines, tangents; logarithms; cologarithms, use of tables.

Third year:

Applied mechanics—Textbook, Morley & Tuchley's Elementary Applied Mechanics.

Trigonometry—Review of logarithms.

Fourth year:

Applied mechanics—Steam engines.

Algebra—Review with application to formulæ.

Physics.—Physics is taught in the second year of the school course. The year is devoted to a general introduction to the various phases of the subject, and is followed in the third and fourth years by applied mechanics and electricity.

Second (sophomore) year:

Physics—Textbook, Carhart & Chute's First Principles of Physics; properties of matter; Newton's laws of motion; mechanics of solids; forces, resultants, velocity, gravity, weight, falling bodies; equilibrium; stability; circular motion; work and energy, power, machines, levers, wheel and axle; inclined plane; fluids and gases; heat-measuring instruments; sound—character, reinforcing mediums; light—nature and propagation, photography; heat—nature and propagation; electricity and magnetism—nature and general characteristics.

Third (junior) year:

Applied mechanics—Textbook, Morley & Inchley's Elementary Applied Mechanics.

Fourth (senior) year:

Applied mechanics—Steam; textbook, Ripper's Heat Engines.
Electricity—Textbook, Tumble's Elements of Electricity.

Chemistry.—The course is two years in length; the first year is general, taking up the phases needed principally by the mechanic; the second year is applied chemistry. Laboratory experiments are required throughout the course.

Third (junior) year:

Textbook, Hessler & Smith's Fundamentals of Chemistry; nature of chemistry—physical and chemical changes; elements—study of common elements and chief characteristics; acids and bases; water—steam, ice, impurities; saturation, crystallization; chlorine, bleaching; acids—sulphuric, nitric, hydrochloric; methods of manufacture, symbols and formulae; carbon, presence and uses; electrolysis, batteries, storage, etc.; copper sulphate and plating; mercury—study of uses and properties of.

Fourth (senior) year:

Analysis, iron, etc.; milk, coal, etc.; soap manufacturing, dyeing, etc.; sizing, glues, color matter, test paints; gas manufacture; commercial processes of manufacture of acids, etc.; hardening and tempering compounds; cyanide properties; electric furnaces, gas furnaces.

Drawing.—Drawing is the sign language of the mechanic, and particular stress is therefore laid on free-hand work throughout the four years of the course.

First year:

First half—Free-hand sketching from plane objects as rectangular block, followed by triangular and stepped blocks, then cone, etc., and finally simple machine parts; lettering; accurate dimensioning and plain sketches are insisted on.

Second half—Free-hand sketches followed by mechanical drawing.

Second year:

Machine part sketching; sectioning and mechanical drawing from sketch.

Third year:

Sketching and instrument drawing, assemblies; laying out curves and application of same to practical use.

Fourth year:

Laying out of cams, gears; inking.

Mechanism.—This subject aims to study and discuss actual shop problems that the boy meets in his daily work, and the texts are used as basis of discussion and broadening by showing different methods of operation. Each shop tool and operation is analyzed and discussed from various standpoints, and the different methods in vogue in various shops are described by the students for the benefit of their fellows.

The International-Textbook Co.'s texts are used in pamphlet form. Catalogues of various manufacturing and trade journals are also used.

Second (sophomore) year:

Lathe work; drilling and boring; application to shopwork; discussion of shop problems; planer work; bench and vise work; shop catalogues, etc.

Third (junior) year:

Milling machines; boring mills; slotters; grinders; special machines; precision measurements; materials of construction; treatment of low-carbon steel; iron forging; hardening and tempering.

Fourth year:

Jig design.

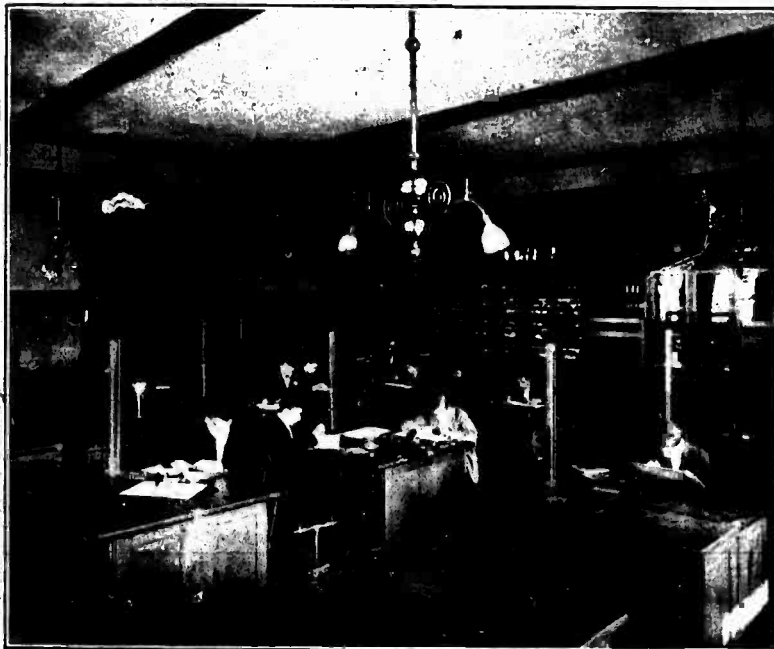
Civics and American history.—These are essential to good citizenship, and a careful study of the city, State, and National Government is necessary for intelligent and progressive work. The course is given in the second year.

First aid to the injured.—There is no place where accidents are more likely to happen than in the shop, and some knowledge of how to care properly for an injured man is a valuable asset to the mechanic. This instruction is in the third year.

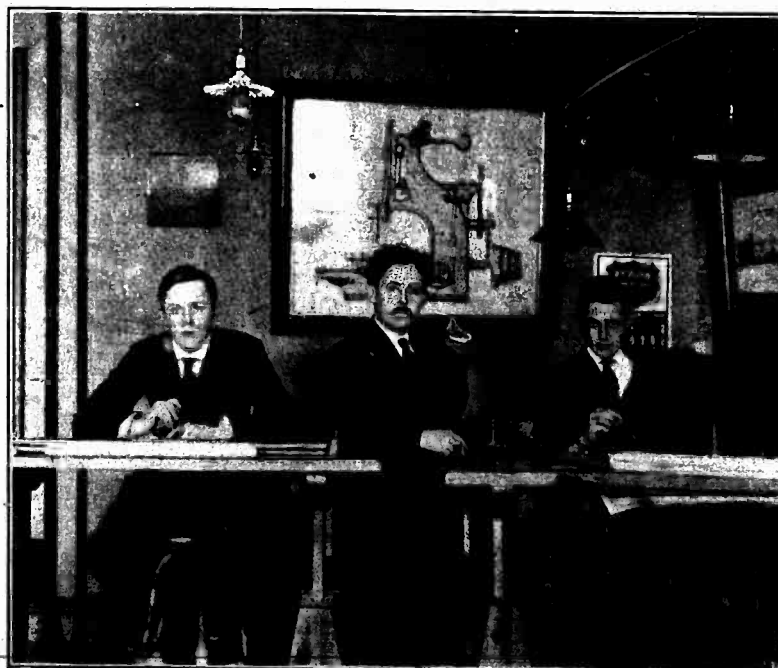
Business methods.—General office work and the study of the organization of shop systems, including receiving materials, laying out work, tagging, inspecting and routing work through the shop, are subjects that have a place in the course and are fourth-year work.

Commercial geography.—The source of supply of the raw materials at various industries, preparation, and methods of transportation, cost of materials, railway systems, and waterways are included. This is fourth-year work also.

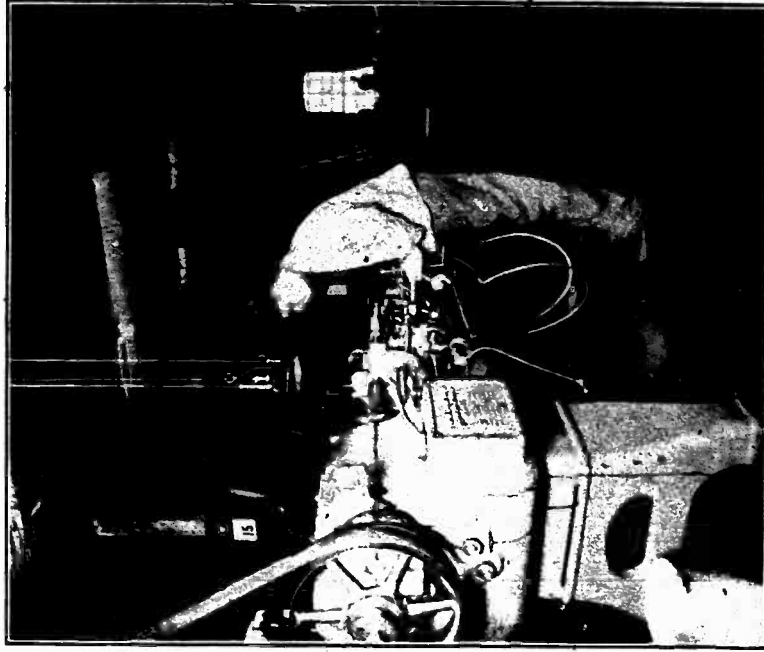
English.—A knowledge of good English is most important, for by its use as a vehicle to convey his thoughts he gives expression to his aims, ideals, qualifications, etc., when conversing with others. By its use one procures a job, gives orders, and expresses his personality; and by reading one extends his knowledge of affairs and broadens his mental and æsthetic horizon. The aim, therefore, of this course is not only to cultivate a taste for good reading, but also to give



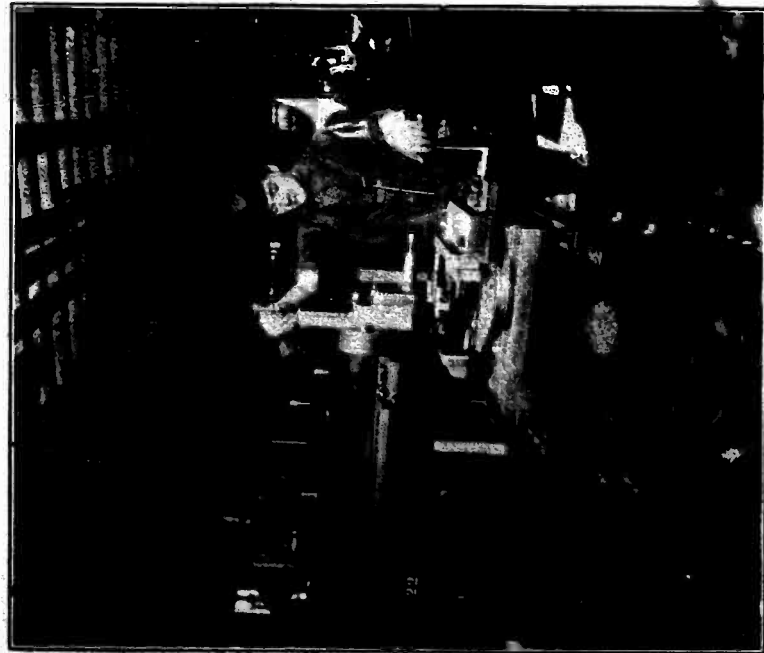
A. DRAWING CLASS IN THE SCHOOL.



B. STUDENTS DRAFTING IN THE PUTNAM MACHINE WORKS



B. AT A LOWSWING LATHE; FITCHBURG MACHINE CO.



A. SHAPER WORK; BATH GRINDER CO.

the pupil the ability to express himself orally or in writing. In the first year the English is made practical by visits to shops, printing plants, foundries, offices, works of construction' (bridges, buildings, etc.), and writing themes and giving oral description of same. Much attention is given to training the perception, noting objects and events happening about; reading aloud in classroom by student for practice in enunciation and understanding of content; spelling, writing, and punctuation practice; reading in classroom by teacher of the history of successful men and selected biographies with comments on same, such as Elbert Hubbard's Little Journeys, students taking notes and writing on same.

Collateral reading is required from books on trades, such as the following:

- Young Folks' Library of Vocations. Boston Hall & Locke Co.
- Vocation for Girls. Houghton & Mifflin Co.
- Bulletins of Vocation Bureau of Boston.
- Harper's Electricity Book for Boys. Adams.
- Harper's Machinery Book for Boys. Adams.
- Boys' Book of Inventions. Baker.
- Boys' Second Book of Inventions. Baker.
- History of the Telephone. Casson.
- Romance of Industry and Invention. Cochrane.
- Romance of Modern Electricity. Gibson.
- Romance of Modern Manufacture. Gibson.
- Life Stories of Undistinguished Americans. Holt.
- Triumphs of Science. Lane.
- Careers of Danger and Darling. Moffat.
- Hand Work in Wood. Noyes.
- Harper's How to Understand Electrical Work. Onken & Baker.
- Artist's Way of Working in the Various Handicrafts and Arts of Design. Two vols. Sturgis.
- Story of the Railroad. Warman.
- Romance of Modern Engineering. Williams.
- Romance of Modern Invention. Williams.
- Romance of Modern Mechanism. Williams.
- Romance of Modern Steam Locomotion. Williams.
- The Workers. Two vols. Wyckoff.

During the year Brook's English Composition is used. Pupils discuss current events, taking care that correct speech is used, with sentences complete and all slang eliminated. The books read in class during this year are Lady of the Lake, Treasure Island, and Ivanhoe. The textbooks used are those which have been found best adapted to the work and capable of serving as models.

Second year:

Textbook, Lord's Modern Business English, to page 156.
 Letter writing: Business letter, general correspondence, sentence structure, correct use of words.
 Shop reports on printed forms and corrections of same.
 Three-minute talk Monday morning on work in shop by each boy.
 Drill in spelling, variety of expression.
 Short one-page themes descriptive of shop tools, etc.
 Reading of mechanical journals, biographies of successful men.
 Current events.

Third year:

Textbook, Lord's Modern Business English, continued.
 Shop reports on printed forms, continued.
 Weekly themes descriptive of shopwork, etc.
 Writing of one or two longer essays on such topics, as—
 History of iron industry in America.
 Manufactures of Fitchburg.
 Railroads and their influence on Fitchburg.
 The industries along the Nashua River in Fitchburg.
 The new trunk-sewer-system.
 Flying machines.
 History of transportation.
 Rise, decline, and future possibilities of apprentice system.
 Advantages of apprenticeship systems in America.
 The steam engine.
 Three-minute talks Monday on shopwork by each boy.
 Five-minute or longer talk on information read in Daily Trade and Consular Reports.
 Designing an advertisement relating to product of shop where employed.
 Study of Autobiography of Franklin, Webster's Bunker Hill address, Washington's Farewell Address, Lincoln's addresses.

Fourth year:

Textbook, Whooley's Handbook of Composition.
 Oral themes, shop talks, and consular reports.
 Editorials, advertisements.
 One long theme on topics of interest connected with pupil's experience.
 Descriptive themes.
 Study of Burke's Conciliation; Shakespeare's Julius Caesar and Twelfth Night.

During the entire course each boy is required to read one book each week that he is engaged in shopwork, and to report on it the following week in school. The books read are from a selected list of fiction, including books by standard authors of the past century and of the present day. Shop reports are required each week on printed forms. These reports are corrected and discussed in class. A sample report is here given, the script giving the exact words used by the boy. The sketch is a refined reproduction of the one in the boy's report. As the boy's sketch was made with a pencil it could not be reproduced exactly; it has been engraved in conventional form.

FITCHBURG HIGH SCHOOL.
INDUSTRIAL DEPARTMENT.

- Report of Oswald Fischer for week of Sept. 25-30.
Employed by Bath Grinder Co. Trade, Machinist.
Kind of work (lathe, planer, chipping, blocking, grinding, etc.):

My whole week's time was spent on Bath Grinder grinding.

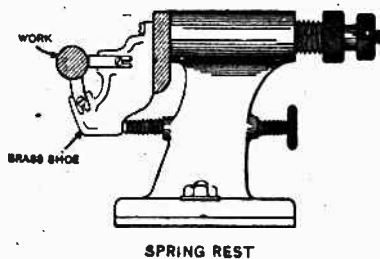
Description of work (size, shape, kind of metal, etc.):

Ground surface of hardened tool steel washers of following sizes: (100) $1\frac{1}{2}'' \times \frac{1}{4}''$ st'd pump washers; (200) $2'' \times \frac{3}{8}''$ ball-bearing thrust washers; (90) hand wheel nuts; (50) cone pulley shafts $14'' \times 1\frac{5}{8}'' - .0015$.

Description of machine (rough sketch parts, etc.):



CONE PULLEY SHAFTS



Tools used, facts learned (speeds, feeds, time, etc.):

Learned more about magnetic chuck, dry grinding, surface speeds and cast iron grinding.

Comments:

Hours worked	{	Mon.	Wed.	Fri.	Total for week
		Tues.	Thur.	Sat.	

CONTRACT BETWEEN THE BOY AND HIS EMPLOYER.

What is believed to be a strong feature of the industrial cooperative plan is the contract entered into by the boy and his employer upon the approval of the parents or guardian of the boy. It is proverbial that the modern boy is a very unstable individual; he tries this and that and is very loath to settle on one thing. In the cooperative plan the boy is given a trial period of two months in a shop at a trade, as has been previously stated. Before beginning this work he and his parents sign an agreement that he shall stick to the trade for the three years required for the completion of the cooperative course, provided that after the trial he is satisfied that he wants to learn the trade. The employer on his part agrees to teach the boy the various branches of the trade and to pay him a stipulated amount per hour for approximately 1,650 hours per year for three years. This arrangement is mutual; both the boy and the employer are bound by it to give each other a square deal. It is a business contract, and the boy, perhaps for the first time in his life, realizes that he is morally bound. Following is the agreement or contract submitted to the employer and to the boy who is to take up the machinist trade. The majority of boys in the course are following this trade. For those in other trades a similar contract is made, changing the work specified under section 2 from lathe work, planer work, etc., to the proper subjects in the other trades. The diploma given to the boy by the school board of Fitchburg upon his graduation bears the signature of an officer of the company in which he served his apprenticeship.

RULES AND CONDITIONS

Under Which Special Apprentices Taking the Four-Year Cooperative Industrial Course at the High School of Fitchburg are Received for Instruction at the Works of

 First. The applicant for apprenticeship under this agreement must have satisfactorily met requirements for entrance to this course at the high school.

Second. The apprentice is to work for us continuously, well and faithfully, under such rules and regulations as may prevail at the works of the above company, for the term of approximately 4,050 hours, commencing with the acceptance of this agreement, in such capacity and on such work as specified below.

LATHE WORK.

PLANER WORK.

DRILLING.

BENCH AND FLOOR WORK.

AND SUCH OTHER MACHINE WORK, ACCORDING TO THE CAPABILITY OF THE APPRENTICE, AS PREVAILS TO OUR BRANCH OF MANUFACTURING.

This arrangement of work to be binding unless changed by mutual agreement of all parties to this contract.

Third. The apprentice shall report to his employer for work every alternate week when the high school is in session and on all working-days when the high school is not in session, except during vacation periods provided below, and he shall be paid only for actual time at such work.

Fourth. The apprentice is to have a vacation, without pay, of two weeks each year during school vacation.

Fifth. The employer reserves the right to suspend regular work wholly, or in part, at any time it may be deemed necessary, and agrees to provide under ordinary conditions other work at the regular rate of pay for the apprentice during such period.

Sixth. Should the conduct or work of the apprentice not be satisfactory to employer or to the high-school authority, he may at any time be dismissed or suspended for a time by the employer without previous notice. The first two months of the apprentice's shopwork are considered a trial time.

Seventh. Lost time shall be made up before the expiration of each year, at the rate of wages paid during said year, and no year of service shall commence till after all lost time by the apprentice in the preceding year shall have been fully made up.

Eighth. The apprentice must purchase from time to time such tools as may be required for doing rapid and accurate work.

Ninth. The said term of approximately 4,950 hours (three-year shop term) shall be divided into three periods as stated below, and the compensation shall be as follows, payable on regular pay days to each apprentice:

For the first period of approximately 1,650 hours..... 10 cents per hour.

For the second period of approximately 1,650 hours..... 11 cents per hour.

For the third period of approximately 1,650 hours..... 12½ cents per hour.

Tenth. The above wage scale shall begin the first day of July preceding the apprentice's entrance upon the first year of shopwork of the high school industrial course.

These papers, subject to the two months' trial noted in paragraph 6, shall be signed by the two parties to the contract at the time the boy enters the shop.

The satisfactory fulfillment of the conditions of this contract leads to a diploma, to be conferred upon the apprentice by the school board of Fitchburg upon his graduation, which diploma shall bear the signature of an officer of the company with which he served his apprenticeship.

AGREEMENT BETWEEN PARTIES.

THIS AGREEMENT made the..... day of..... A. D., 191...
 by and between..... of..... party of the first part,
 (Employer.)
 and..... of..... party of the second part.
 (Apprentice.)

Witnesseth, That the party of the second part shall from the date hereof, for the term of three years (4,950 hours divided into three periods of 1,650 hours a year, as stated in the "Rules and conditions"), and so much longer as may be necessary to make up lost time, become and be the apprentice of the party of the first part to the art or trade of..... and that said parties of the first and second parts will well and truly do and perform all things required to be done and performed by them in and by said rules and conditions of the cooperative industrial course.

In witness whereof said party of the first part has caused these presents to be signed and sealed by.....Its.....for this purpose authorized, and said party of the second part has hereto set his hand and seal this day and year first above written.

Signed and sealed.....
(Employer.)

In presence of.....

Signed and sealed.....
(Apprentice.)

In presence of.....

AGREEMENT OF RELATIVE OR GUARDIAN.

I.....of the above named
(Relative or guardian.)

.....do hereby give my consent to
(Apprentice.)
his entering the employ of the said.....
(Employer.)

upon the terms named in the above articles of agreement; and I further agree that in consideration of such employment the wages or earnings of my said.....shall be paid directly to him, and I hereby release all
(Son or ward.)
claim that I now have or may have hereafter thereto.

Dated at.....this.....day of.....191....

Signed and sealed.....
(Relative or guardian.)

In presence of.....

This is to certify that the within named.....
completed his term of apprenticeship.

[SEAL.]

PRACTICAL SUGGESTIONS.

Each boy when he enters shop work is presented with the following suggestions:

CO-OP INFORMATION.

Read this carefully. It will save you and us trouble.

Remember that the object of work is production. Your foreman measures you by the quantity and quality of your work. Social position does not enter. In the shop you are not a high-school boy; you are an apprentice. Wear clothes accordingly. If you get the mistaken idea that any work given you is beneath the dignity of a high-school boy, just remember you are an apprentice and get 100 per cent busy.

It is *your* business to get along smoothly with the workmen and foreman; not *theirs* to get along with you.

Do not expect any personal attention from the superintendent. He will probably ignore you entirely, but he knows whether or not you are making good, and in most cases his idea of you depends upon your ability to please your foreman.

Don't be a kicker and don't continually bother your foreman for higher wages. If you are not receiving your raises as agreed upon, or if you have other grievances, let the director adjust matters through the firm's office.

An *idle machine* means a cash loss to the firm. Let yours never be idle without previous arrangement. To "lay off" without permission is a serious offense for a workingman and is just as serious for an apprentice, regardless of the relative importance of the work he does.

The foreman always plans ahead for every man's work, yours included. Therefore, notify your foreman before you leave on any regular vacation. A little thoughtfulness may prevent serious misunderstanding. And always, if sick and unable to report in person, send a telephone message to your foreman. He can arrange then to have your work done for you; otherwise he will naturally cease to depend on you.

Never try to conceal defective work. Take your full measure of blame, and do not make the same mistake twice.

Watch, in a quiet way, what things are being done around you, and don't be afraid to ask *sensible* questions. A good rule is to think over a question twice before asking. A reputation for having "*horse sense*" means that you are making good.

Foremen and workmen will take pleasure in showing you, if you show yourself genuinely appreciative of little attentions. If they tell you something you already know, don't spoil their pleasure by telling them you already know it, but let it be impressed on your mind all the deeper; for the conversation may lead to something which is entirely new to you.

If your foreman refuses to grant any requests, and you value his good will, do not refer the matter to a higher official. Let the director, Mr. Hunter, help you.

The fool act of one co-op hurts every co-op. See that your actions in and out of the shop do not bring discredit on the co-op course.

Confer freely with Mr. Hunter about your work. He is here to help you do the right thing and be a *success*.

RESULTS OF THE COOPERATIVE PLAN.

The plan at the close of the school year in June, 1913, had been in operation five full years. It is not possible to say, therefore, with positiveness that it is an unqualified success. Time enough must be allowed to elapse for its success in teaching the trade to be judged by a comparison of the work of a reasonable number of its graduates with that of other boys trained in the trades without attending school at the same time, including boys whose schooling ended with the work of the elementary grades, those who completed part of a high-school course, and those who were graduated from a high school.

The plan appears to be very successful. The opinions of all who have had an opportunity to judge by the results already obtained are unanimous in its favor. The following are statements of some of the employers and foremen who have had under their charge old-line apprentices and boys of the cooperative industrial course:

On their graduation we find that the high-school boys are practically of the same intelligence so far as shop work goes, possibly not quite as keen in touch as the ambitious boy who serves his time on the old plan, but they have a mental equipment from their study in the schools that would give them in a few months' time in the shops the same touch with the addition of the school

training. They are better boys without any question. They are more manly and have wider vision, and we prefer them to the boys who are taught the trade without the school experience.

The industrial course seems to me to fill a long-felt want, because it takes up the "why" and "because" of the task of the boy. I have had several of the boys under my care and find this true. They seem to take more interest in the shop work than the regular apprentices. I regret that I did not have the chance to take a similar course while attending school.—A. Anderson, superintendent Bath Grinder Co.

It is the biggest boon that has ever come to the boys of Fitchburg. Since the opening of the course the employers are taking a more sincere interest in the boys, and the growing kindness of the employers is very manifest in many ways. The course is most commendable, and the boys who graduate from the high school after having followed the cooperative industrial course are bound to be our future foremen and superintendents.—Mr. H. Jennisen, manager of the Jennisen Co.

The boys of this course want a high-school education, and many of them could not take the course if they did not earn money to help out. Many more desire a higher mechanical education and can earn a part of the cost by taking the course, which gives them practical experience as well as money. Another important advantage of the industrial course is that the boys who take it are very popular, and are looked up to as leaders of the school and society. As a matter of fact, it has been easier for the past three years to get regular apprentices, or all-time boys, than before the industrial boys came to the shop.

There is no question that this course stimulates the boy to do his very best, gives him a brighter and wider outlook, and increases his manliness and efficiency.—Mr. Charles Fosdick, superintendent of Fitchburg Steam Engine Co.

The discipline at the school helps the shop and doubtless that of the shop helps the school, both keeping the boy traveling along the right road all the time. The shop is benefited in that there are two boys in the course when there was only one before. This gives the prospect of two recruits at the trade, while there was only one under the old apprenticeship system.

After 33 years of experience, 23 years of the time as foreman, I would prefer this course, with its practical experience, to any technical course, without the practical experience that I know of.—Mr. E. J. Tilton, foreman of metal planer and hydraulic press departments of Putnam Machine Co.

In my opinion, based upon contact and extended investigation, the benefits of this course to the boy who wishes to advance excel those given pupils through any other educational course.—Mr. R. D. Redfern, secretary of Fitchburg Board of Trade and Merchants' Association.

We have these boys in our machine room, in our drafting room, learning the sawsmith trade, and in our office. All of them are doing nicely.

It is a great pleasure for us to uphold what we consider the best plan of education that has ever come to our notice for a boy of limited means, whose main object is to fit himself to earn a living at the earliest possible date. The boys are learning a trade and getting an education at the same time. Judging from their efficiency, we feel they have learned as much of the trade by alternating in the shop and school as other boys did under the old plan of apprenticeship by being all of the time in the shop. The boys whom we have in the shop will have an education at the end of four years, will have a trade, and will be earning as much as they would if they had served only their three years' shop work. They will have a foundation on which to go further than would be

possible for a boy who had to start in with common-school education, and sometimes less.

There are a great many schemes of industrial education; all of them are good. They all help, but we believe this is the best of them all. The boy gets the benefit of actual contact with the students and faculty of the public-school system, which, to our mind, is a decided advantage over a private tutor. He learns to mingle with his fellows and sees life as it is in the school; then he goes to work in a commercial establishment where the activities of life are performed in a truly commercial way. The tools must be kept up to date. The foreman must give the boy enough individual attention to see that he knows what he is going to build and to see that he does it in a most efficient manner. It is the same with him as with any other boy or man that is hired in a commercial establishment. He must earn his way, as it is evident the business could not be founded on philanthropy. He, too, is surrounded by men who are masters of the art, and learns from them by observation and personal contact. When he finishes school he knows what he is going to do and knows what he can do. When the average boy who goes to the high school finishes his course and applies for a position he is asked what he can do, and his reply will probably be, "I don't know."

This course gives the manufacturer a thinking mechanic. It gives the boy of the laboring man a chance to become a thinking mechanic; gives him a chance with the education he obtains to become a manufacturer, if he has the energy and determination to carry him so far. It gives a man the education that enables him to think clearly for himself, and he does not have so many troubles that he can not overcome without assistance. It places him in position to compete with anyone. Manufacturers will tell you that they are constantly looking for men who are capable of taking "thinking parts" in overseeing and managing their business, and they do not always find what they are looking for. A system of education such as this can not fail to relieve this situation.

In conversation with men who have been to an Institute of technology they have said, "Wish I had had this course, and I would have gotten more out of my tech." We feel very certain that the very great majority of taxpayers will get more for their money in this way than they received from the purely academic instruction that has prevailed.

In conversation with our superintendent of schools he tells us that, while he does not know positively, he feels very certain that 100 of the 800 or more pupils who will start in our high school next year never would have gone further than the 8th grade, or the first year in high school, had it not been for this course. The fact that the boy is able to earn a certain amount of money, which helps his parents (and very often they need this help), makes it possible for them to allow him to spend the extra three or four years necessary to graduate, having in mind that when he graduates he will be as well equipped for life as if he had stopped going to school and spent his whole time learning the trade.—Mr. H. B. McDonald, superintendent Simonds Manufacturing Co.

STANDING OF THE INDUSTRIAL GRADUATES IN ACADEMIC SUBJECTS.

The success of the plan depends not alone on its merits in teaching the trades, but also in giving a general education. The results from this viewpoint can be determined by a comparison of the industrial-course graduates with the other high-school graduates in regular courses. An opinion concerning their standing in the academic work

is given by Mr. Charles T. Woodbury, the principal of the high school, and Mr. Joseph C. Edgerly, superintendent of schools of the city of Fitchburg.

Mr. Woodbury says:

Among cooperative industrial students we have some excellent students, some average, some who do barely passing work, and a few failures. I see little difference in academic standing of pupils of the industrial course as compared with pupils of other courses. Some pupils who have done fair or poor work in other courses have done good or excellent work in the industrial. Some who have been failures in the other courses, or who have dropped out of school, have done fair work in the industrial.

Mr. Edgerly's evidence is as follows:

The boys have maintained good standing in their classes at school. In July of last year I attended a convention at Castine, Me., of high-school principals and school superintendents of that State. I addressed the convention with reference to the work of this course in the Fitchburg High School. I read papers that had been prepared by members of the senior class. The papers or the essays which were selected were read verbatim as the boys had prepared them. They prepare such papers regularly each week. These essays were upon subjects connected with the shopwork of the boys. Many of those who listened to the reading said that such essays would have done credit to a class of seniors in any college. The training in English is practical, for the boys write upon topics which appeal to them.

It is extremely doubtful if 10 per cent of the members of these classes would be in school if this course had not been established.

WHAT THE BOYS THINK OF THE PLAN.

The opinion of pupils who have undertaken the work of the course is of considerable value. Certain questions were asked of boys in the school; a few of the replies are given. Following are three replies in answer to the inquiry, What induced you to select this course?

(1) "I selected this course as an advantage for future life. This course is instructive and profitable. The reasons in general are as follows: Because after I have graduated from the Fitchburg high school I will not be a loafer in the world. I will have a trade to fall back on."

(2) "I took this course because I always did like the machinist's trade and thought it a good chance to learn it and get an education at the same time."

(3) "I selected this course because I thought it would be of greater use to me than any other course in the high school."

Four of the replies in answer to the request, Please state in what particulars you are profited by the course, were:

(1) "It gives me money and helps me to be self-supporting. It gives us high-school boys a chance to show that we are not afraid of soiling our hands. It also gives us a liberal education."

(2) "I am profited by the course financially and have learned more in this course while I have been in it than all I learned in three years of regular high-school work."

(3) "If I had simply been apprenticed at a shop I might become a good machinist, but with our school work behind us I am sure we would have a great advantage over the plain machinist."

(4) "Through my association with practical men, thereby gaining practical knowledge along with the theoretical side at school."

Three boys thus answer the question, What do you intend to do after completing the course?

(1) "To follow it up and understand a little of the large study of mechanics."

(2) "When I have completed this course, I expect to go out as a draftsman, machinist, or boss machinist."

(3) "I intend to keep on with the trade that I shall have learned by that time."

At a meeting of the Merchants' Association of Fitchburg two of the boys of last year's graduating class made the following remarks about their course. One boy said:

I think at the present time not more than one-half to one-third of the students of the high school of this or any other city know what they are going to do when their school days are over. The other half either have to learn a trade or go into some store and there work some time before they can earn any sort of wages.

Now, with the industrial cooperative course there is a way in which a student may learn a trade which will give him a living if he wishes to follow it. This course is so arranged that if the student wishes to go away to some higher school he may do so and he has only to take up a foreign language outside.

I think that this course is about the best thing for a boy, as it gives him the knowledge that he should have, also the shop practice that, even though he does not follow the trade, will come in useful to him in after life. I have heard many men say that if they had had the chance that we are having they would not be where they are now.

Another boy said:

When the manual training course in the high school was dropped it became necessary for me to elect a new course, and I elected the technical, not because I wished to, but merely as a poor substitute for what I had been taking. However, it was my good fortune not to have to start in that course, as the industrial course was started in this city at that time, and I elected it.

Immediately upon starting my work in the shop I felt the pleasure of really making something that was of commercial value. My work in the shop has consisted of drawing and tracing various parts of engine lathes, planers, driving-wheel lathes, steel tire turning borers, axle lathes, car-wheel borers, and hydrostatic wheel presses. I have been also figuring out trains of gearing to be used in connection with belt drives and various motor drives to give the desired feeds and speeds, and also the width of face and pitch of gears to use to transmit a given amount of horsepower.

At school we talk over the problems of the previous week which have come to each individual in the various shops. We receive instruction in mechanical drawing, including machine design, gearing, cams, etc., mathematics, including algebra, geometry, applied mechanics and trigonometry, chemistry, physics, English, business methods, commercial geography, and mechanism of machines.

Taking the theoretical side of problems which we are taught in school, to-

gether with the practical side which we receive in the shops, I believe any scholar completing the industrial course is better equipped to earn his living than any other high-school graduate.

STATISTICS.

The cooperative industrial course of Fitchburg, now so commonly known as "the Fitchburg plan," in the five years of its operation has graduated three classes, with a total of 49 boys. It has enrolled in the five years 134 pupils. The yearly classes, with their enrollment, have been as follows: 1908-9, 34; 1909-10, 15; 1910-11, 30; 1911-12, 25; 1912-13, 30; total, 134.

In September, 1913, approximately 56 boys are taking this course.

The graduates for the three years were as follows: In June, 1911, 20; 1912, 10; 1913, 19; total, 49.

The occupations to which the boys have been assigned during the five years were as follows: Drafting, 8; iron molding, 4; machinist, 86; office work, 6; pattern making, 6; printing, 2; saw making, 10; textile work, 8; tinsmithing, 4; total, 134.

Those who have received diplomas are now employed to a great extent in the occupation elected by them during their school period or have gone to higher institutions to fit for teaching. The following table indicates their present employment:

Occupations of graduates.

Engaged as—	Class of—		
	1911	1912	1913
Assistant to superintendent.....		1	
Draftsman.....	4	1	2
Elevator inspector.....	1		
Instructor of physical training.....	1		
Machinist.....	9	3	6
Office worker.....	1		1
Saw maker.....		3	2
Tinsmith.....			1
University student.....	4	2	7

The average wage of the graduates has not been determined, but no graduate is now working for less than \$2 a day, and one is employed at his trade at a salary of \$40 a week. They measure up well with their fellow workman, and from conversations with superintendents and foremen, the future of the boys now out in the world seems very promising.