A STUDY OF THE OBJECTIVES AND TRENDS OF GENERAL EDUCATION
AND THE NEEDS OF THE SHEET METAL INDUSTRIES OF DALLAS,
TEXAS IN ORDER TO DETERMINE WHAT TRENDS SHOULD BE
TAKEN FOR A COURSE OF SHEET METAL WORK AT
N. R. CROZIER TECHNICAL HIGH SCHOOL,
DALLAS, TEXAS

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DALLAS, TEXAS

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By

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CHAPTER I

INTRODUCTION

N. R. Crozier Technical High School is located in the heart of Dallas, one of Texas' most rapidly growing cities. Not only is it growing from a population standpoint, but also from an industrial standpoint. N. R. Crozier Technical High School acquired its students not only from its own district, but also from other high schools having students that desired special courses not offered in their respective schools. The boundaries of N. R. Crozier Technical High School include the following:

Between N. R. Crozier and North Dallas--Roseland, Haskell, Thomas, H. & T. C. R. R., Munger, Pearl, Cedar Springs, Maple Avenue, Hawes, Denton Drive; Between N. R. Crozier Technical and Woodrow Wilson--Peak Street between Roseland and Parry Avenue; H. & T. C. R. R., Eakins, Bopp, Canton, First Avenue, and Parry Avenue to Peak.1

Students attending N. R. Crozier Technical High School come from families with a wide range of incomes; however, most of them are from the lower income groups. This situation is generally found to exist in any city just outside its central business district. N. R. Crozier Technical

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High School is located just outside the central business district of Dallas. Another factor contributing to the low income situation lies in the fact that N. R. Crozier Technical High School has a high enrollment of children of Latin American descent.

Fathers in other school districts, who themselves are skilled tradesmen, often send their sons to N. R. Crozier Technical High School with the intention that the sons learn a trade in order to pursue the trade of the fathers.

Statement of Problem

The problem of this study is (1) to study the objectives and trends of general education, and (2) to study the needs of sheet metal industries in Dallas, Texas, in order to determine what the trends should be for a course of sheet metal work at N. R. Crozier Technical High School.

Purpose of the Study

Since education is an ever changing process, periodical evaluation of its trends should be observed; and since graduates of the sheet metal course at N. R. Crozier Technical High School look to the sheet metal industries for employment, it is for the good of the student as well as the school to take time at various intervals to examine the needs of both general education and the sheet metal industries. It is for this expressed purpose that this study is designed.
Delimitations of the Study

Since general education is so broad in its every aspect, this study is limited to that portion of general education concerned with the vocational development of the child. The survey of the sheet metal firms is limited to those sheet metal shops operating within the city limits of Dallas, Texas. The sheet metal firms studied in this survey include both those firms engaged in sheet metal repair work and those firms engaged in sheet metal fabrication. The names of firms studied in this survey were selected from listings found in Key to Buying in Dallas.\(^2\) Firms were selected from all parts of Dallas in order to get an overall picture of all the city.

Definitions of Terms

"Sheet metal" is referred to in this study as that phase of metal work employing the use of sheet metal plate of less than one-eighth inch in thickness. Metals included are black iron, galvanized iron, galvannealed iron, tin plate, copper plate, zinc plate, and aluminum plate.

"Sheet metal industries" and "sheet metal firms" are used interchangeably and refer to those industries or firms engaged in the repair and fabrication of all types of sheet metal work.

\(^2\)Key to Buying in Dallas, official buyers' guide of the Dallas Manufacturers and Wholesalers Association, Incorporated, 1949.
"General education" is referred to as that phase of education which tends toward the over-all development of the individual.

Source of Data

Data were gathered from books and periodicals in the field of general education, books and periodicals in the field of industrial education, and interviews with employers of sheet metal industries. For the chapter dealing with the offerings at N. R. Crozier Technical High School, the bulletin, N. R. Crozier Technical High School Handbook,\textsuperscript{3} and the bulletin, General Information Concerning Dallas Junior and Senior High Schools,\textsuperscript{4} were used.

Method of Presentation

The data are presented in such a manner that they might be used as a guide for designing a course of study for sheet metal work at N. R. Crozier Technical High School. The fact that the data might be used as a guide for a course of study at N. R. Crozier Technical High School does not necessarily mean that they might be used as a guide in any other situation because situations vary. Attention is given to the objectives of general education


and industrial education which is a necessary part of general education. Chapter I is designed to give an introduction, statement of problem, purpose of the study, delimitations of the study, definitions of terms, source of data, method of presentation, and recent and related studies. In Chapter II, a brief summary is given of the offerings at N. R. Crozier Technical High School. A general picture is given of the over-all offerings and then of the specific offerings for sheet metal work. Chapter III is designed to give the objectives of general education and industrial education which is a necessary part of general education. Objectives are then given including industrial arts, technical education, and vocational education, which are all parts of industrial education.

Chapter IV deals with actual interviews with employers. It was considered advisable before attempting to design an interview check list for this subject to first visit one of the sheet metal industries and discuss the problem with their owners or foremen. This was done with the intention of getting in mind some of the problems facing the local sheet metal industries.

An interview was arranged and conducted with one of the local firms, the problem was presented to the foreman and he was asked to give frank opinions as to the amount of time he thought a foreman might be able to devote to a study of
this type, possibility as to whether cooperation might be gained, what possible questions might be asked which would be of value, and anything else that might be used. Notes were taken as the discussion progressed, with nothing being omitted that might be of use. The foreman expressed a belief that cooperation could be obtained in most instances, and he further volunteered the opinion that a survey of this type would be of use to industry as well as the school because there was definitely a need for a richer background of instruction for beginners in the sheet metal field. This point was brought out time and time again when the actual interviews were begun.

A check list was drawn up based on the findings of the first interview; however, it was deemed advisable that a trial check list be used first with a few sample firms. This was performed with three selected firms, and several apparent defects in the original check list were noted. The second check list was drawn up, necessary questions that had been omitted from the first were added, and those considered irrelevant to the study were omitted.

All interviews were completed on a person to person basis. In all cases an attempt was made to talk directly to the owner of the business; however, in some cases it was necessary to contact the foreman instead of the owner. In a majority of cases owner and foreman were one and the same person. Fifty-two sheet metal firms were listed in Key to
Buying in Dallas.\textsuperscript{5} Since person to person interview type surveys consumed much more time and are more thorough in nature than the "mailed out" type of questionnaire, it was considered possibly half of the number listed would be enough to gather sufficient trends. A close check was kept as the interviews progressed to determine any apparent trends. It would have been possible to have completed this survey from fifteen interviews because trends at this time were no different from those at the completion of the survey; however, interviews were continued until twenty-one firms had been interviewed. An attempt was made to limit the interviews to no longer than forty-five minutes; however, this was impossible in most cases as employers were so vitally interested in the problem that some interviews lasted as long as two hours and more. Several employers even expressed desire for future visits in order to discuss possibilities for future graduates of N. R. Crozier Technical High School being hired in their firms. This has been done in some cases with the result of some graduates being hired.

It was impossible to record all points brought out by employers; however, an attempt was made to record as much as possible of the more important issues. It should be borne out that the check list was used only as a guide to interviews.

\textsuperscript{5}Key to Buying in Dallas, official buyers' guide of the Dallas Manufacturers and Wholesalers Association, Incorporated, 1949.
In a study of this type it probably would have been impossible to design a check list to fit all situations, as all firms have different problems and methods of procedure; consequently, this study relies heavily upon the recorded comments made by employers. These comments were recorded on a space provided at the end of each check list.

The last chapter deals with summary, conclusions, and recommended trends for a course of study at W. R. Crozier Technical High School.

Recent and Related Studies

Land, in his address before the Practical Arts and Vocational Education Section of the Pennsylvania State College Educational Association concerning his survey of "What Industry Expects of Vocational Education," brought out the following eight industry objectives:6

1. Reducing the time required to adapt workers on the job. In this it was found that an untrained worker takes 4.05 months to be of any use to the company, while the trained worker takes only 1.83 months.

2. Securing the maximum utilization of available manpower. No figures were given on this point.

3. Reducing the amount of time spent by foremen and superintendents in breaking in green workers on the job.

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On this point it was found that it takes 41.3 per cent of foremen's and superintendents' time with new personnel, whereas it takes only 14.3 per cent of their time when they have personnel that has had some training.

4. Reducing the use of plant production equipment for training purposes to a minimum. On this point it was found that 66.3 production man hours were saved on machines when trained personnel was used.

5. Reducing to a minimum the loss of materials and machines due to breakage brought about by poor workmanship. Breakage was found to be 9.5 per cent when untrained personnel was used, whereas there was only 2.0 per cent breakage found when trained personnel was used.

6. Reducing the accident rate to a minimum. The accident rate was found to be 8.2 per cent when all employees were considered, whereas it was found to be only 2.9 per cent when only trained personnel was considered.

7. Reduction of labor turnover. It was found that there was a turnover of all personnel of 32.91 per cent, whereas the turnover for trained personnel was only 16.75 per cent.

8. The reduction of absenteeism. It was found that the absentee rate for all personnel was 6.61 per cent, whereas for trained personnel it was only 4.91 per cent.

Hayes, in his study of N. R. Crozier Technical High School graduates, found that students were trained
adequately in all phases of technical training. In a follow-up study by Butler, it was found that the program was effective; but the following recommendations were given: that public speaking be added to the curriculum; that chemistry as related to industry be added; and that the general high school graduates do not realize at the time they are in high school what they actually should take; consequently, that the schools should strive not only to give them guidance but to help them in their choice of a vocation and give them related information dealing with the various vocations.

Smith made a study to determine a psychologically sound and democratically sound solution of what should be offered in the Dallas Schools. One of his recommendations was that from grades ten through high school industrial training and certain other technical fields be included.

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Fetterman made a study to determine the stenographer and secretarial employment requisites in business firms in Dallas, Texas.\textsuperscript{10} A comparison was made between the training given to the students and the requirements made by business firms in hiring stenographers and secretaries. In this study it was found and recommended that the schools should keep close contact with the business firms, and that they also keep well informed as to the needs of these business firms. A guidance program was also suggested in which the students might be kept informed as to the needs of the various business firms. It was also suggested that certain other related fields be studied. Included in these were arithmetic, spelling, English (as used in letter writing), office machines, and functional courses in office practice.

CHAPTER II

OFFERINGS AT N. R. CROZIER TECHNICAL HIGH SCHOOL

General Offerings

N. R. Crozier Technical High School must offer courses offered in all of the other Dallas High Schools in addition to its own special courses. Following is a list of courses offered:¹

College preparatory courses
  Engineering
  Commercial
  Academic
Technical courses (two-hour shops)
  Architectural drawing
  Mechanical drawing
  Metallurgy
  Industrial science and chemistry
  Photography
  Electricity
  Radio and television
  Heating, ventilation and air conditioning
  Printing
  Aircraft
  Textiles
Commercial courses
  Stenography
  Bookkeeping
  Clerical and sales
Industrial courses (three-hour shops)
  Machine
  Welding
  Cabinet and mill work
  Sheet metal

Automotive mechanics
Cafeteria management (girls only)
Cosmetology (girls only)

Homemaking course
Applied arts courses
Commercial art
Art pottery
Music

Special two-, three-, and four-year
certificate courses
Commercial
Industrial

General Shops

The general shops, or industrial arts shops as they are sometimes called, are designed to give exploratory work for the first two years of the high school program. A student may take one general shop each semester, or a total of four general shops in his first two years at N. R. Crozier Technical High School. Included in these general shops are the general machine shop, general auto shop, general sheet metal and forge shop. Students spend two fifty-minute class periods each day in the general shops.

Advanced Vocational Shops

The advanced vocational shops are designed to meet the needs of the student who has taken two years of general shop work and decided on the vocation he desires to enter. These shops include the advanced machine shop, advanced electric shop, advanced sheet metal shop, welding, the advanced auto shop, and the advanced wood shop. Each student spends a minimum of three hours per day in the advanced shops. In
addition to the regular one-half unit or credit, the student receives an additional half unit of credit for related science. This is given sometime during the three-hour class period. The advanced shops are arranged so as to provide two hours of shop work and one hour of related information each day.

Technical Shops

The technical shops are basically the same as the advanced vocational shops with the exception that related information is presented in a different manner. In the technical shops related information is presented at a period other than the shop period, whereas in the vocational shop it is presented in the same period. The technical shops are designed not to give specific skills but to give a broad background in some technical field. Examples of technical related subjects might include physics, chemistry, mechanical drawing and shop English.

Mechanical Drawing

All students taking shop work are required to take three semesters of general mechanical drawing. Programs are so designed that students may take more than the required three semesters if they so desire. Advanced architectural and machine drawing are provided for those students who desire to take more than their required three semesters of drawing.
Sheet Metal Offerings

Since sheet metal is the primary object of this study, the following explanation of sheet metal offerings is given: General sheet metal shop is designed for two distinct types of students; first, those students taking the college preparatory course who wish to take exploratory shop courses as electives in their program; and second, those students taking the industrial courses and desiring general sheet metal as one of their four general shop courses.

Both advanced vocational sheet metal and technical sheet metal work are designed for those students who have decided to go into either sheet metal work or the air conditioning field.

General Sheet Metal

In general sheet metal shop only those basic sheet metal procedures and practices are studied. These include the following: soldering, shearing, using brake and bar folder, making simple sheet metal seams such as hems, grooved seams, double bottoms, and others, forming metal, etching, simple pattern layouts and others. Related information include job opportunities in the sheet metal field such as types of solder, manufacture of sheet metal, types of sheet metal, sizing of sheet metal and other related information of a like nature. Students make projects for their own use such as tool boxes, sugar scoops, waste paper baskets, funnels and others.
Advanced Sheet Metal Work

In advance sheet metal work, air-conditioning duct work is stressed. This includes both the round and rectangular duct work. Students draw up various intersections in round and rectangular duct work first on drafting boards, and then lay them out on metal scrap and fabricate them to check for accuracy. In advanced work not as much emphasis is placed on personal projects, but useful exercises are stressed. Typical of those useful exercises would be a round, ninety-degree, four-piece elbow, or a round pipe intersecting a square one. This is known as a transition piece. Related information includes carrying capacities of round and square duct work and resistance to air pressure in this duct work. The purchase of tools and materials and employer and employee management relations are also stressed. Students spend approximately one-third of their time working out various layout problems by the use of mechanical drawing boards.

Necessarily, the above is a bare statement of the program as carried on at the N. R. Crozier Technical High School, Dallas, Texas. The reader will note three distinct types of industrial programs offered. These include industrial arts, advanced vocational, and technical. Before proceeding further with this study it is apparent that further insight must be gained as to the over-all picture of industrial education.
Since industrial education is only one of the necessary parts of the total over-all picture of general education, it is first necessary to examine the objectives of general education, and then to study the objectives of industrial education. Since this study is confronted with trends in education, an attempt will be made to study any trends that might be evident in any of the phases mentioned.
CHAPTER III

GENERAL EDUCATION

Objectives

General education is primarily concerned with knowledge, skills, and attitudes that are held to be useful for successful living, without reference or application to particular occupations or callings. It might also be said of general education that it is an over-all picture of public free education. Its objectives are simple in appearance, but broad and far reaching in nature. Wilber sums them up in the following manner:1

1. To transmit a "way of life," an important feature of our way of life lying in the fact that it is democratic;
2. To improve that way of life, the most feasible method being by training for effective critical thinking;
3. To meet the needs of individuals in the basic aspects of living.

It can be assumed from the above statement that a great responsibility rests upon the shoulders of modern educators. In fact, the continuation of the "American Way of Life" depends upon the trends taken by modern education.

1Gordon O. Wilber, Industrial Arts in General Education, Chapter I.
Trends

Up until recently, the prime objectives of education were to give isolated subject matter as prescribed by a fixed course of study. The more recent trends tend toward student interest or student goals; the theory in this case is that all the subject matter the student normally would have acquired from the subject matter curriculum will also be acquired in the new type of curriculum through exploration of his own interest. It is further theorized that he will gain further insights through his own interest and directed exploration than he normally would have from the subject matter type of curriculum.

Shattuck, Director of Vocational Education, High School, Ilion, New York, probably gave the most forward look along these lines when he said that the common emerging point of view begins and ends with the treatment of the pupil.²

1. It sees education as living, which implies growing.
2. It sees growth as coming through experiences.
3. It points out that education presupposes interest and that interest grows through activity.
4. It sets up the pupil into the planning of his program and evaluation of his progress.
5. It avoids the formal content administered in the traditional question-answer procedure.
6. It brings the pupil into the planning of his program and the evaluation of his progress.

Struck made the statement that, "At the secondary school level practical arts education in all its forms is a part of general education." After making the above statement, Struck went on to say that even that form of industrial education known as vocational education is a part of general education so long as it prepares that individual for life situations. Consequently, we might assume that all phases of industrial education are part of general education; therefore, it behooves the leaders of all phases of industrial education to meet the needs of general education. In order to do this, the objectives of industrial education as a part of general education must be clearly defined.

Industrial Education

Industrial education, or practical arts as it is sometimes called, may be termed as that phase of general education which directs the individual toward his life profession. At the present time three distinct phases of industrial education may be phrased in many different ways; however, for the purpose of this study they will be referred to as industrial arts, vocational education and technical education. Each of these are designed with a distinct purpose or objective in mind.

Industrial Arts

Definitions for industrial arts have been approached from many different ways; however, a study of each definition will show approximately the same interpretation. Probably the most clearly expressed definition could be found in the following: "Industrial arts is a phase of general education that concerns itself with the materials, processes, and products of manufacture, and with the contribution of those engaged in industry." 4

Probably the forerunner of our modern set of objectives for industrial arts were those of Otto Salomon, the man responsible for the development of Sweedish Sloyd system of education. 5 They are as follows:

1. To cause the child to acquire a general skill of hand.
2. To awaken in him the taste and love of labor.
3. To call forth spontaneity—the initiative.
4. To give him experience of the fact that order and correctness in labor are necessary elements of progress.
5. To develop the faculties of attention and perception.
6. To render the child earnest and persevering.
7. To inspire the esthetic sentiment without allowing it to become vague or exaggerated.
8. To neutralize the injurious effects produced upon the system by intellectual studies, and by the sitting position which the child must maintain during the ordinary lesson.


Objectives found in later works do not vary in content a great deal from those of Salomon. Wilber, Director, Division of Industrial Arts, Teacher Education State Teachers College, Oswego, New York, states them in this manner:6

1. To explore industry and American industrial civilization in terms of its organization, raw materials, processes and operations, products, and occupations.
2. To develop recreational and avocational activities in the area of constructive work.
3. To increase an appreciation for good craftsmanship and design, both in the products of modern industry and in artifacts from the material cultures of the past.
4. To increase consumer knowledges to a point where students can select, buy, use, and maintain the products of industry intelligently.
5. To provide information about, and in so far as possible experiences in, the basic processes of many industries, in order that this student may be more competent to choose a future vocation.
6. To encourage creative expression in terms of industrial materials.
7. To develop desirable social relationships, such as cooperation, tolerance, leadership and followership, and tact.
8. To develop a certain amount of skill in a number of basic industrial processes.

In addition to those objectives as set forth by Weber, Selvidge in an earlier work included the following: self-reliance in individual students; orderly method of procedure; the habit of self-discipline which requires one to do a thing when it should be done, whether it is pleasant or not; and development of each pupil in the knowledge of mechanical drawing.7

7Robert W. Selvidge and others, Industrial Arts in Modern Education, p. 33.
Newkirk gives eight objectives for industrial arts that are parallel to those brought out by Wilber.\(^8\) In addition to giving eight objectives, he points out that industrial arts though broad in nature should be limited to metalworking, woodworking, drafting, graphic arts, ceramics, electricity, plastics, transportation and textiles.

**Vocational Education**

Although volumes have been written about vocational education, only one specific objective seems to be prevalent, that objective being that vocational education prepares a student for a specific trade or vocation. Shattuck sums it up in the following manner:\(^9\)

The vocational-industrial courses offered in many high schools aim to impart specific trade skills, trade knowledge, related theory, and trade appreciations. This is terminal education. The student can, upon graduation, enter into his chosen occupation with confidence that he knows much about it.

Possibly vocational education might be approached with a clearer understanding from the standpoint of characteristics rather than objectives, since there is very little information on objectives. Struck gives the following

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\(^8\) Louis V. Newkirk, *Organizing and Teaching the General Shop*, p. 44.

characteristics found in vocational education:

1. It is a preparation for a given vocational proficiency.
2. Students must be above fourteen years of age—best results with boys sixteen to eighteen years and above.
3. A minimum of one-half of each school day or usually fifteen hours per week of shop work must be used.
4. A teacher must be an expert tradesman with at least six years of trade experience plus some professional training.
5. Trade skill is very important.
6. Equipment should measure up to actual trade requirements and size.
7. It is usually reimbursed by Federal funds, but this is not always the case.

Since it is not the aim of this study to determine a means of supporting education, but rather a means of presenting its content, no mention will be made of Federal aid for vocational education other than the fact that a large majority of schools do receive a partial reimbursement through a series of federally supported bills. These bills include the Smith Hughes Act of 1917 which was supplemented by the George Deen Act of 1936, and finally the Vocational Education Act of 1946 which superseded the other two.

Technical Education

"Technical education is intended to prepare a student to earn a living in an occupation in which success is

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dependent largely upon technical information and an understanding of the laws of science and technology as applied to modern design, production, distribution and service.\textsuperscript{11} The term "vocational technical education" seems to appear as much as the term "technical education"; however, upon close observance, both seem to have the same meaning and will be used interchangeably in this study. Although it is not known just how far it will advance, technical education seems to be the emerging trend in the larger schools. It is not only emerging in the larger high schools, but it is also taking the form of terminal or technical institutes. It is evidently becoming an educational movement and interest is increasing rapidly with many new programs being established.

Technical education on the high school level with which this study is concerned seems to have a two-fold purpose. Struck clearly sums up this purpose in the following manner:\textsuperscript{12}

\textit{It [technical education] has several rather distinct aims that differentiate it from a trade school or department. These may be summarized as follows: The chief purpose is to prepare students for positions of leadership in industry}


that require considerable technical knowledge, though less than that required of engineers, and some mechanical training and skill though not as much as is secured by skilled craftsmen during a four-year apprenticeship. The aim, in other words, is to train for the junior engineering field—for such occupations as drafting, designing, testing, inspecting, estimating, and supervising. Another aim of technical high schools is to give pre-engineering training in the same sense as the pre-medical school trains for entrance upon the college of medicine. Technical high schools and departments, then, have as a second aim preparation for entrance to higher technical schools or colleges of engineering.

It can be assumed that technical education is two-fold in nature; first, it prepares the students for the technical or sub-engineering fields, and second, it gives the student sub-engineering or college preparatory training.

Objectives for technical education seem to be best defined in the following report:14

1. To make clear to the pupil the opportunities that exist for junior workers in the various technical fields.

2. To give the pupil training in the more easily mastered fundamental theories and practices of the technical occupation which he desires to follow.

3. To give the pupil a thorough preparation in the pure and applied mathematics and sciences which a junior worker in a special technical field must obtain.

4. To give the pupil a good general knowledge of the tools, materials, processes and methods used in the practical operation, construction or production work to which the special technical service relates.

5. To give the pupil knowledge of modern technical methods in solving the problems in some one technical field.

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It can readily be seen that technical education does not necessarily require as much shop work as does vocational education. Struck brings this point out in the following statement:15

Instead of meeting the requirements of National Vocational Education Act that specify that half-time or more, and not less than fifteen hours per week is to be devoted to instruction in shopwork, as is the case with unit trade schools or departments run on a vocational basis, the curriculum of the technical high school may provide some number of hours of shop instruction less than fifteen; such as six, eight, or ten hours per week.

From a close observation of the two authorities quoted above, it becomes readily apparent that technical education like industrial arts is interested not so much with specific skills, but with general over-all development of the student. This line of thought is in keeping with the objectives of general education; however, it will be noted that vocational education does not meet this objective.

Trends

Harris gives a set of objectives for industrial arts that are definitely in line with the modern trends for general education.16 They are as follows:

1. To develop in each student the highest possible interest in the goals for which you wish him to strive in the future.


2. To establish the proper ideals and add these to the conviction developed as to worth of value of the proposed goal.

3. To develop interest in industrial education, and guide student thinking in that direction.

4. To stimulate that interest with a desire for knowledge.

5. To perpetuate that interest to the end, to which all knowledge is a means.

6. To provide participating experiences which will offer the opportunity to each student to become a leader and a follower.

7. To develop effective health-safety consciousness, as it relates to present industrial methods, and equipment.

8. To develop the ability to carry out a clearly defined plan of action.

9. To develop in the pupils a strong interest in the new ability which they are about to acquire, and the ideal of mastering it thoroughly.

10. To develop in each student a strong interest in the manipulative ability which they are about to acquire, and the ideal of becoming skillful in its performance.

It will be noted that the above set of objectives are directed toward the interest of the student. It will also be noted that in Chapter II the industrial arts courses were designed so as to use the student project method of teaching, while the advanced vocational course did not.

The student project method of teaching relies entirely upon the interest of the student in designing a project that will be useful to him.

It can then be assumed from the above information that the trends in industrial arts are parallel to the trends in general education, while the trends in vocational education are not. While the objectives of technical education do not point directly toward student interest, technical education does trend toward a wide general knowledge of the
subjects studied. This would indicate that technical education objectives partially fulfill the objectives as set forth by general education.

Summary

It has been shown that general education strives for the over-all development of the individual, and that in striving for this over-all development student interest is used to gain this objective. Industrial education, which includes industrial arts, vocational education, and technical education, is assumed to be a part of general education. Industrial arts and technical education are broad in nature, while vocational education is narrow and trains the student for one specific job.

To study only the objectives as set forth by educational leaders would not be enough to gain insight as to what should be the trend in a course of sheet metal work. Consequently, it is for this reason that industry is looked to for that other all important phase of this study.
CHAPTER IV

SURVEY OF SHEET METAL INDUSTRIES

It was clearly understood at the beginning of this study that the immediate problem was to consider the possible existence of jobs in the sheet metal field. This was considered necessary because the actual existence or absence of jobs determine, to a large extent, the attractiveness of a course of this type.

Job Opportunities

An attempt was first made to determine the actual over-all employment outlook. This was approached from several different directions. An attempt was made to determine differences in employment policies of union and non-union firms. Employees were grouped as either journeyman, apprentice, or helper. The check list was further divided as to those now employed, possible job openings, and those employed within the last twelve months. This was done in order that the assumption could be made that if a certain number were employed within the last twelve months, the chances were for a like number being hired in the future.
Eight union and thirteen non-union shops were included in this survey. One small non-union firm, employing only one man other than the owner, refused to cooperate in any way. Two union firms refused to answer the routine questions, but discussed the general problem freely with the interviewer.

Six union shops reported the total number of men employed at present as seventy journeymen, five apprentices and 108 helpers. No openings were reported in either of the three employment brackets. A total of eleven journeymen, eight apprentices, and 117 helpers were reported as hired within the last year. Two union shops refused to answer that part of the check list dealing with employment data.

Twelve non-union shops reported the total number of men employed at present as fifty journeymen, twenty-eight apprentices, and seventeen helpers. No openings were reported in the three employment brackets. A total of twenty-seven journeymen, nine apprentices, and eleven helpers were reported hired within the last year. One non-union shop refused to answer.

It was noted that union firms averaged 30.5 men per shop, while non-union shops averaged 7.9 men per shop. It will also be noted that the ratio for hiring new employees was found to be much higher in the union shops than was found in the non-union shops. This would possibly indicate that job security is not as great in union shops.
From a casual glance one would observe that a high school graduate would stand a better chance of securing a job in a union shop due to the fact that more men are hired yearly in union shops. However, the following facts should be noted: Of the 136 new employees hired by the union shops in the last year, 117 were helpers.

All union shops reported that they allowed their helpers no use of sheet metal tools whatsoever, but confined their work strictly to common labor type of work. However, the non-union shops all reported that they allowed all men the use of tools, and that they were progressed in wage scale from helper to apprentice and journeyman as they improved in their work. The union shops reported that if a man was hired as a helper he always continued with the firm as a helper because if the company considered him as being a journeyman possibility when he was first hired, he was immediately hired as an apprentice. It will be noted that only seven apprentices were reported hired within the last year in union shops, indicating that chances for advancement in union shops are very slim.

All union shops reported that they had a four year apprenticeship period before men were advanced to journeymen, while non-union shops reported an apprenticeship requirement of from two to four years. Seven non-union shops reported that employees were advanced as they were able to do journeyman work regardless of time employed.
It can readily be seen from the above information that there are more than enough jobs for graduates wishing to go into the sheet metal field, and it is also apparent that the greatest possibilities rest within the non-union shops. In fact, a union shop owner made the following statement: "If a boy wishes to learn the sheet metal trade he should go into a non-union shop where a wider selection of procedures are carried on rather than a union shop where more men are employed and work is specialized."

On the Job Training Program

It was thought that some insight might possibly be obtained as to what the trends should be in the sheet metal course at N. R. Crozier Technical High School by asking the firms what type of training program they offered or required their new employees to take. However, in all non-union firms, "what they receive as practice on the job" was the answer. One union shop required that their apprentices take a course in pattern development through International Correspondence Courses. Another reported a government on the job training program to be in effect; however, this was not elaborated upon. Two union shops reported that they required their apprentices go to night school at N. R. Crozier Technical High School. This course is approached strictly from the sheet metal drafting standpoint and no layout is performed on metal.
Machines Found in Industry

An attempt was made to determine what machines were used in the various sheet metal industries. This was done in order to make the assumption that, if a machine were found in a number of sheet metal firms, it would be reasonable to assume that a knowledge of that machine should be taught to high school students in a course of this type. It should be noted here that only seventeen check lists were filled out on this subject. In the other four cases the interviewer was not invited to visit the shop; consequently, he was not able to complete this part of the check list.

From three to six shops reported having power rotary, power squaring shears, box and pan brake, notching machine, setting down machine, ring and circle shears, and grooving machine. This seemed to indicate that these machines were used only in shops having specific jobs requiring their use.

It can then be assumed that the use, operation and maintenance of the first machines mentioned would be necessary in the sheet metal course at N. R. Crozier Technical High School. Furthermore, it would be desirable to teach the use, operation and maintenance of the other group if facilities and time permitted.

Operations Performed by the Firms

In preparing that portion of the check list dealing with operations performed in the shops, the assumption was
made that students should be familiar not only with things industry is doing but also with the method of procedure used by industry.

It was found that all firms do some type of brake work. Most firms do spot welding, louver work, skylights, and gutter work. A few firms do air duct work. However, a majority of employers were of the opinion that, since most air-conditioning duct work is on a mass production basis, it is not entirely necessary that a high school student be required to fabricate it. Nevertheless, practically all employers agree that a knowledge of layout should be considered essential.

Since all layout books begin with the development of an elbow, and most sheet metal instructors have their students actually lay out and fabricate an elbow, an attempt was made to see what industry thought of this practice. It was found that elbows are bought already fabricated in the smaller sizes. Since the larger sizes must be made in the shops, most employers agreed that students should be familiar with the layout, fabrication, and methods of joining elbows. These methods of joining included swedging, veeing, and soldering.

Soldering as performed in most sheet metal courses is by the gas furnace method. Since sheet metal shops cannot carry gas furnaces out on roofing jobs where it is required that gutter work be soldered, an attempt was made to determine
how soldering is performed under these circumstances. It was found that most firms used very simple charcoal pots. These pots have several advantages over the gas furnace. They are easier handled, more economical, irons are easier to keep tinned, and they can be made right in the shop.

Riveting, which for some time has been the principal method for fabricating sheet metal, was found to be replaced in a great majority of cases by either gas, arc, or spot welding. Gas and arc welding were found to be used on all non-galvanized metals, while spot welding was found to be used on galvanized metals. Welding seems to be cheaper and faster than the riveting process of joining metal.

As would be expected riveting has not been discarded in all cases. All shops have not purchased welding equipment, and then in some cases welding is not practical. It was found that making holes for the rivets may be done in three different ways. Drilling is used for making holes where neatness is desired. The Whitney punch is used in most other cases; however, if speed is necessary drawing is primarily used. Drawing consists of forcing the rivet through the metal by use of a hammer and rivet set.

Sheet metal stakes were found to be used very little in industry now; however, most employers were of the opinion that, since there are times when a sheet metal worker must have a knowledge of using them, a high school student should be familiar with them.
Most sheet metal books used in high school explain to a great extent the many different mixtures that may be prepared for soldering flux. It was found in this study that straight muriatic acid was used by all firms for the soldering of galvanized iron; and for all other soldering purposes zinc was added to the muriatic acid to make a solution known as cut acid.

An attempt was made to determine if job procedure sheets were used by industry. It was found that no shops use them. However, in the list of comments made by employers this statement was found: "I estimate that of the 300 journeymen union card holders only eighteen men can take a job from blueprints and think the job through to a successful conclusion." This would indicate that although job procedure sheets are not used in industry, high school students should be using them in order to develop a plan of thinking jobs through before beginning them. Job procedure sheets are designed so students may enumerate step by step how a job is to be completed.

**Essential Mathematics**

Since mathematics is the basis for all industrial work, without some knowledge of its practical use it would be impossible to carry on a skilled trade. Questions were asked as to what employers considered should be taught in the way of mathematics to high school students planning to enter the sheet metal trade. Practical mathematics was mentioned as
necessary in all cases but one. All but seven shops answering this question thought that geometry was necessary, but they made the statement that, in their opinion, geometry as it is now taught is impractical. Eight employers considered trigonometry to be of use to beginning sheet metal workers. Nine expressed a belief that a knowledge of algebra was useful. Eight thought that a knowledge of the use of the slide rule would possibly be of use.

General Comments

Although some definite trends were shown, as would be expected general comments seemed to be varied. As has been said before, more useful information was received from the comments than was gained from routine check lists.

Possibly one of the most significant statements found in comments by employers was the fact that high school sheet metal courses should be general in nature and not concentrate so much upon specific skills. Employers stated that when students get on the job, all employers will have specific ways they want jobs performed and anything students learned in high school in the way of skills will have to be relearned in the methods their employers desire a job performed. Although stated in different ways, this comment was repeated time and time again. It will be noted that this statement is in keeping with the objectives of general education, industrial arts and technical education.
All employers thought that an extensive course should be given in sheet metal lay out. Among the more direct comments on this matter were the following: "Long layout methods taught in high school help men to understand the shorter methods used in the shop"; "Old employees do not have the time to teach layout to the new employees"; and "There is not a shop in town that will pay a boy to learn pattern layout—they must first learn somewhere else."

Another employer volunteered the information that an employee could cut his apprenticeship time by one year if he had a good knowledge of pattern development. Naturally this was a non-union shop.

Other points discussed included the teaching of welding, procedure for doing jobs, braking, soldering and cleaning coppers, conservation of materials, confidence in themselves, a familiarity of tools, trade terms, gages of metal and bend allowances, and practical mathematics.

Almost every employer volunteered the comment that he considered a general course of this type should be taught in order to familiarize the boys with the trade to let them see if they actually liked this type of work.

Summary

Definite openings have been shown to exist in the sheet metal industry. However, the best opportunities seem to be in the non-union shops. Machines used by industry include
the cornice brake, spot welder, lock seamer, slip forming roller, squaring shear, and rotary machines. Some firms also have power rotary, power squaring shears, box and pan brake, notching machine and setting down machine, ring and circle shears, and grooving machines. Air duct work should be taught from the layout standpoint rather than the fabrication standpoint. Welding is replacing riveting. Charcoal pots are used in soldering on all outside jobs. Stakes are used very little but a knowledge of them is necessary. Practical mathematics should be emphasized, while a knowledge of algebra, geometry, and trigonometry is also useful in sheet metal work. Knowledge of the slide rule might also be helpful. An extensive program should be offered in sheet metal layout. The sheet metal course should be general in nature.

It is not the purpose of this study to make a comparison of the objectives of general education and the desires of sheet metal firms; consequently, no comparison will be made of Chapters III and IV. However, it is the purpose of this study to take the contributions made by the objectives of general education and the needs of industry and use them both in determining trends for a course in sheet metal work at N. R. Crozier Technical High School. Points brought out in both chapters will be used to draw conclusions and recommendations. The last chapter will deal with summary, conclusions and recommended trends for a sheet metal course at N. R. Crozier Technical High School.
CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDED TRENDS FOR A COURSE OF STUDY AT N. R. CROZIER TECHNICAL HIGH SCHOOL, DALLAS, TEXAS

Summary

It was shown by this study that the objectives of general education tend toward the over-all development of the individual. Furthermore, industrial education is a necessary part of general education. Industrial education is composed of industrial arts, technical education and vocational education. Industrial arts and technical education are broad in nature. In addition to being broad in nature, technical education prepares students for technical jobs and engineering schools. Vocational education is narrow because it prepares a student for only one specific job.

Job opportunities were seen to exist in the sheet metal field in Dallas for graduates desiring this type of work. The greatest number of openings existed in the non-union shops. Although some definite job procedures for teaching sheet metal work were found in this survey, employers considered a general course in sheet metal work to be of more value than teaching specific skills. Most
employers agreed that an extensive course should be offered in sheet metal pattern layout. The objectives for general education and the desires of employers seemed to be parallel in nature due to the fact that both specified a course that would be general in nature.

Conclusions

1. There is definitely a need for a richer background of instruction for beginners in the sheet metal field.

2. Industry is vitally interested in the instruction given high school industrial education courses.

3. Jobs do exist for graduates desiring to go into the sheet metal field.

4. Non-union shops provide the greatest opportunities for beginning workers.

5. High school courses do not necessarily always follow trade practices, but this is not necessary as the trade practices will soon be learned when the student reaches industry.

6. Practical mathematics is necessary in sheet metal work.

7. Although they are not entirely essential, algebra, geometry, trigonometry and a knowledge of the use of the slide rule are an asset to a sheet metal worker.

8. Long layout procedures help a beginning worker when he is introduced to the shorter layout method.
9. Industrial arts and technical education meet the objectives as set forth by general education, but vocational education does not meet these objectives due to the fact that it is narrow in nature.

Recommended Trends for a Sheet Metal Course at N. R. Crozier Technical High School, Dallas, Texas

1. All shop work should be based on student interest. This should be accomplished by individual student projects.

2. All related information should be given as the student needs it in completing his individual project.

3. Only the courses of general sheet metal shop and technical sheet metal shop should be taught.

4. The course in general sheet metal should be concerned with only basic skills, knowledge of tools, job opportunities in the field and only that related information which is necessary to the completion of student projects.

5. The technical sheet metal course should be primarily concerned with air conditioning and pattern layout. It is assumed that if a student is taking technical sheet metal shop his prime interest is in this type of work.

6. The information found in this survey should be used to provide a richer background for a course of sheet metal work at N. R. Crozier Technical High School.

Since so much interest was shown by firms included in this survey, it would seem worthwhile to make other surveys of this type at least once a year for the good of the school,
student, instructor and the sheet metal firms of Dallas, Texas. Furthermore, it stands to reason that a like interest might also be found to exist in other fields as well as in sheet metal work. Consequently, it is suggested that studies of this nature be carried on periodically at N. R. Crozier Technical High School.
APPENDIX

INTERVIEW CHECK LIST

Name of firm ________________________________ Address ________________________________

Type of business engaged in
Air conditioning ________________________________
Gen. sheet met. ________________________________
Others ________________________________

Union _______ Non-union _______

<table>
<thead>
<tr>
<th></th>
<th>Number now employed</th>
<th>Openings</th>
<th>Employed last year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journeyman</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apprentice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Helpers are allowed use of tools ________
Helpers are not allowed use of tools ________
Required apprenticeship period ________
Requirement as a helper before entering apprenticeship ________
List journeymen requirements here ________

High school graduate would be started as helper ________
Apprentice ________

Original patterns are made by:
Working out by mechanical drawing ________
Actually laid out on metal on spot ________
Other means (name) ________

Pattern developments necessary in the business
Circular ________
Square ________
Transitions ________
Others ________

Who is responsible for original pattern developments
Draftsmen ________
Journeymen ________
Apprentices ________
Others ________

List of provisions made for training of apprentice workers if any ________
Helpers are included in this program

Helpers are not included in this program

<table>
<thead>
<tr>
<th>Welding used in the business</th>
<th>Not used</th>
</tr>
</thead>
<tbody>
<tr>
<td>If used what type? Gas</td>
<td>Arc</td>
</tr>
<tr>
<td>For what purpose</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of math considered necessary in the business</th>
<th>Practical math</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>Trigonometry</td>
</tr>
<tr>
<td>Do</td>
<td>Do not consider use of slide rule helpful in sheet metal work.</td>
</tr>
</tbody>
</table>

| Do | Do not use job procedure sheets |
| Do | Do not work from blueprints |

To what extent is work done from blueprints

List any other way jobs are conveyed to journeyman other than from blueprints

<table>
<thead>
<tr>
<th>Machines used in the business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cornice brake</td>
</tr>
<tr>
<td>Box and pan brake</td>
</tr>
<tr>
<td>Spot welder</td>
</tr>
<tr>
<td>Pittsburg seamer</td>
</tr>
<tr>
<td>Grooving machine</td>
</tr>
<tr>
<td>Ring and circle shear</td>
</tr>
<tr>
<td>Notching machine</td>
</tr>
<tr>
<td>Slip forming rolls</td>
</tr>
<tr>
<td>Throatless shear</td>
</tr>
<tr>
<td>Slitting shear</td>
</tr>
<tr>
<td>Double seaming</td>
</tr>
<tr>
<td>Setting down</td>
</tr>
<tr>
<td>Rotary with turning rolls</td>
</tr>
<tr>
<td>Burring rolls</td>
</tr>
<tr>
<td>Wiring rolls</td>
</tr>
<tr>
<td>Vee rolls</td>
</tr>
<tr>
<td>Beading rolls</td>
</tr>
<tr>
<td>Crimping rolls</td>
</tr>
<tr>
<td>Squaring shear</td>
</tr>
<tr>
<td>Power rotary</td>
</tr>
<tr>
<td>Power squaring</td>
</tr>
<tr>
<td>Others</td>
</tr>
<tr>
<td>Specific operations necessary to business</td>
</tr>
<tr>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Braking</td>
</tr>
<tr>
<td>Spot welding</td>
</tr>
<tr>
<td>Air duct work</td>
</tr>
<tr>
<td>Louver work</td>
</tr>
<tr>
<td>Sky lights</td>
</tr>
<tr>
<td>Gutter work</td>
</tr>
<tr>
<td>90° elbow swedged</td>
</tr>
<tr>
<td>soldered</td>
</tr>
<tr>
<td>veed</td>
</tr>
<tr>
<td>Solder with furnace</td>
</tr>
<tr>
<td>Blow torch</td>
</tr>
<tr>
<td>Other ways</td>
</tr>
<tr>
<td>Riveting with gun</td>
</tr>
<tr>
<td>Riveting by hand</td>
</tr>
<tr>
<td>Using explosive rivets</td>
</tr>
<tr>
<td>Forming with stakes</td>
</tr>
<tr>
<td>Stakes used most</td>
</tr>
<tr>
<td>Preparing fluxes</td>
</tr>
<tr>
<td>Burr edges</td>
</tr>
<tr>
<td>Wire edges</td>
</tr>
<tr>
<td>Punch holes</td>
</tr>
<tr>
<td>Drill holes</td>
</tr>
<tr>
<td>Draw rivets</td>
</tr>
</tbody>
</table>

Which of the above three are used most and under what conditions are each used:

Weld duct work

List general comments as to what you would desire taught to high school students planning to entering the sheet metal trade.
BIBLIOGRAPHY

Books


Magazines


Reports


Unpublished Material


Local Bulletins

