A SURVEY OF PRESENT PRACTICES IN SHOP PLANNING, WITH RECOMMENDATIONS FOR ORGANIZING SMALL SECONDARY SCHOOL SHOPS

by

ELMER MAYNARD LEAF

A THESIS

submitted to the

OREGON STATE COLLEGE

in partial fulfillment of
the requirements for the
degree of

MASTER OF SCIENCE

July 1939

APPROVED:

Redacted for privacy

Guest Professor Of Industrial Arts

In Charge of Major

Redacted for privacy

Head of Industrial Arts Department

Redacted for privacy

Chairman of School Graduate Committee

Redacted for privacy

Chairman of State College Graduate Council

ACKNOWLEDGEMENT

To Clifford K. Lush, Supervisor of Industrial Arts, Minneapolis Public Schools, Guest Professor, Oregon State College, and main advisor, for his encouragement and direction; to Professor George B. Cox, Head of the Industrial Arts Department, Oregon State College, for his kind assistance; to state educational officials, particularly Roy G. Fales, Supervisor of Industrial Arts, State of New York; Lane C. Ash, Advisor of Industrial Education, State of Pennsylvania; J. W. Kelder, Director, Division of School Plant, State of Michigan; and Frank V. Powell, Assistant State Superintendent, State of Wisconsin; to superintendents, principals, and shop instructors for their cooperation; the writer wishes to express his sincere appreciation.

TABLE OF CONTENTS

LIST OF TABLES AND CHARTS

TABLES

CHARTS

A SURVEY OF PRESENT PRACTICES IN SHOP PLANNING, WITH RECOMMENDATIONS FOR ORGANIZING SMALL SECONDARY SCHOOL SHOPS

CHAPTER I

INTRODUCTION

Intelligent planning of school shops, particularly of new departments in small schools, has become increasingly difficult because of the gradual increase in the scope of industrial arts education. The solution of the problem of providing a wide range of experiences in new one-teacher shops may be acquired by a study of the present practices in shop planning. This study on small shop planning concerns itself with present opinions and practices and with recommendations for new one-teacher shops in small secondary schools. Briefly, the planning problems confronting the small schools are reviewed from the available literature.

The physical plant or shop facilities during the manual training and manual arts eras were conducive to but one and sometimes two or three types of activities. Woodworking, drawing, and some metalworking were the only practical courses that were taught in the schools. School shops were patterned largely after shops found in the trades or in industry. According to a tabulation by C. K. Lush, there are today approximately seventy different industrial arts courses taught in general shops at the present time.

Of the 16,598 population groups classified in cities and in incorporated places in rural territory (41), 15,616 (94.3%) are in places of 10,000 population or less. Where industrial courses are

offered, the department will consist mainly of a one- or two-teacher department. Aside from this, there are the consolidated schools in strictly rural sections, which may have departments of this type. It is recognized that 94.3 per cent of the places account for only 16.1 per cent of the total population of the United States, but the figures do show the scatter of department possibilities and the tremendous number of varied problems involved in small shop planning for such heterogeneous conditions.

The influences of American industries brought about different concepts of practical training in the schools. The industrial arts programs were broadened to include a variety of activities for exploration and consumer literacy values. In order to administer this newer type of training, it was necessary to put more emphasis on planning of school shops. The larger cities, with specialized supervisory assistants, have sensed the situation more rapidly than the smaller communities. In the larger schools, the industrial life of the community is being interpreted to the pupils in well-planned laboratories of industries. Some of the smaller schools also are meeting the needs of the pupils in general shops. However, in the past, the majority of the small secondary schools have been rather reluctant to provide a diversified program of shop activities.

Important factors in shop planning are: The preliminary school and community surveyes; the type of shop organization needed; the financial situation of the school; and the age, intelligence, and grade levels of the pupils. Superintendents, principals, and industrial arts teachers are becoming more and more concerned with the

philosophy underlying industrial arts, that of placing more emphasis on guidance exploration in various fields of practical and industrial activities. It is being recognized that the development of the pupil for successful participation in life situations may be made one of the principle outcomes of industrial arts.

The shop facilities in the small school must be planned for pupil orientation in a wide range of experiences and for developing a broad basic mechanical versatility which may later serve as a basis for vocational specialization. "As society becomes more complex, industrial arts and general work experiences will need to be increased if the individual is to be prepared to understand what is going on about him and to participate successfully in the varied occupational life around him."(42)

Industrial arts becomes more useful to all who come in contact with it. It has steadily broken away from the narrow isolated subject field characteristic of the manual training era. Today industrial arts has become a curriculum area rather than a subject, somewhat comparable to the language arts. Arthur B. Mays (23) points to the fact that "It is barely 55 years old as a recognized division of the school, yet it is rapidly coming to be seen as the most typical and in many respects the most significant aspect of modern education...it is becoming the most easily defended subject in the curriculum."

The functions of industrial arts education are based on sound educational philosophy. Learning by doing is not a catch phrase, for it serves as the basis for gaining understandings, attitudes,

and appreciations that are so essential in our ever-changing social and economic democracy.

According to C. K. Lush (21), the functional aspects of industrial arts may be considered in two categories: namely, the contributions to social living and the relationships of instruction to areas of industrial life. The functions as set forth by Lush are as follows:

1. Development of personality, character, and desirable attitudes
2. The fostering of democratic principles and social ideals
3. The interpretation of industrial processes for a general understanding of the material surroundings and for guidance purposes, both vocational and avocational
4. The development of hand and machine skills
5. The fulfilment of the natural desire for self expression through creative effort
6. The contribution of information and experiences of value to future conxumers and to those who enjoy maintaining and improving the home
7. The accumulation of respect for the aesthetic, for craftsmanship, and for the problems of all related occupations
8. The attainment of a consciousness of conservation and safety

The question of how the small school will adequately meet the new educational, social, and economic demands will rest upon the community and school officials who interpret the needs of the community.

Statement of the Problem

It is generally concluded that the general shop is the most feasible shop organization for the one-teacher shop department. At the present time opinions differ as to the type of general shop that should be put into practice. On the one side, there are those who believe in the comprehensive general shop or laboratory of industries, and on the other side those who favor the multiple-unit type. The planning of the physical plant for new shop departments depends entirely upon the type of general shop desired.

The writer recognizes the need of guiding principles in planning new shops in small schools. In the larger cities, supervisors of industrial arts with the assistance of school architects, draft shop plans to meet their requirements. The case is quite different in the small schools. There is no supervisor to make plans, so that the problem is left entirely to the industrial arts instructor and the superintendent, with possible suggestions from state supervisors where these men are available.

Briefly, the reason for making this study is to formulate guiding principles in planning new one-teacher shop departments.

The method of attacking this problem resolves itself into several branches, namely:

1. To secure a list of schools (in communities of approximately 1,000 to 5,000 population) in the various states in which new quarters have been provided for industrial arts within the past five years.

2. To make a questionnaire study of the representative new school shops over the country from the lists supplied by the state educational officials

3. To compile recommendations, including shop floor plans that may be helpful to school administrators or teachers anticipating the construction of new quarters for industrial arts activities

Terminology

In descriptions of a general shop we read and hear of such terms as: Laboratory of Industries, Industrial Arts Laboratory, Industrial Arts Shop, General Shop, Practical Arts Laboratory, and Arts and Industries Laboratory. All of these terms have the same meaning, namely, a shop where diversified or multiple industrial activities are carried on for the purpose of providing broad industrial training. The two most common classifications of the general shop are Laboratory of Industries and Multiple-Unit Shop. In a laboratory of industries organization, the industrial life is interpreted to the pupils by rotating groups of pupils (in all grades) through various areas or units of work simultaneously. The whole class does not perform the same activity at the same time. Many types of equipment are found in this type of shop, but not many of one kind. Usually each area is equipped to accommodate from four to twelve pupils, with one teacher supervising all of the various activities.

A major and a minor division of the units of work is characteristic of the multiple-unit shop. The shop is equipped for major units so that the whole class is taught the same courses at the same time. Typical major units are wood, drawing, electricity, or bench

metal. The minor activities may be wood turning, ceramics, printing, leathercraft, or machine lathe. The multiple-unit shop organization makes it possible for an entire junior high school shop class to work at the same activity simultaneously; whereas in senior high school classes, individuals may specialize in any unit or activity.

Procedure and Source of Data

In this type of study a survey of new one-teacher departments to determine existing conditions seemed necessary. A letter of transmittal and a questionnaire (Form I) were sent to various educational officials (43) in all forty-eight states. The results of Table I show the various state officials who cooperated in this study. Over sixty per cent of the questionnaires were sent to Superintendents of Public Instruction.

This letter requested a list of schools in communities of approximately 1,000 to 5,000 population where new facilities for industrial arts had been provided within the past five years. From this list of 117 secondary schools, a second letter of transmittal and Department Request Sheet (Form II) was sent to the principal or shop instructor as indicated on Form I, the purpose of which was to gather pertinent information relative to their shop facilities, course of study, and size of classes. Many items dealing with the physical features of shops, such as lighting, ceiling height, or floor materials, were purposely omitted from the questionnaire

because of the information already published by industrial arts leaders and other authorities.

TABLE I

Officials Who Supplied Department Locations

	Per cent*
Supervisor of Trade & Ind. Ed.	28.2
Director of Vocational Education	17.2
Supervisor of Industrial Arts	15.3
Supervisor of Schoolhouse Planning	12.8
State Superintendents of Public Instruction	9.4
Supervisor of Secondary Education	9.4
Teacher Trainer	4.3
Supervisor of Home Making	3.4
Total	100.0

*Read: 28.2% of the questionnaires were returned by Supervisors of Trade & Industrial Education.

TABLE II

Returns of Questionnaire
(117 Schools)

	No.	Per cent
Schools that supplied the information concerning their shop	56	48
Schools that did not respond to Questionnaire	55	47
Schools reported information not available	6	5
Total	117	100

The results of Table II show that information was received concerning 56 (48%) new shop departments. The sheets containing information about the various shops were segregated according to type of school and grade level.

TABLE III

Grade Level Classification
Of Schools Surveyed

Type of Shop	No.	Per cent
Junior-Senior High School (Grades 7-12)	37	66.0
Junior High School (Grades 7-10)	11	20.0
Senior High School (Grades 9-12)	8	14.0
Total	56	100.0

For the purpose of classification, the questionnaires that were returned were divided into three groups according to grade levels. Table III indicates that two-thirds (66%) of the new shops surveyed include junior and senior high school classes (Grades 7-12).

Limitations

This study is somewhat limited because of the relatively small per cent of state officials who returned names of secondary schools. The results show that a list of schools was obtained from twenty states (41.8%). State officials from nine states (18.7%) reported that the information was not available.

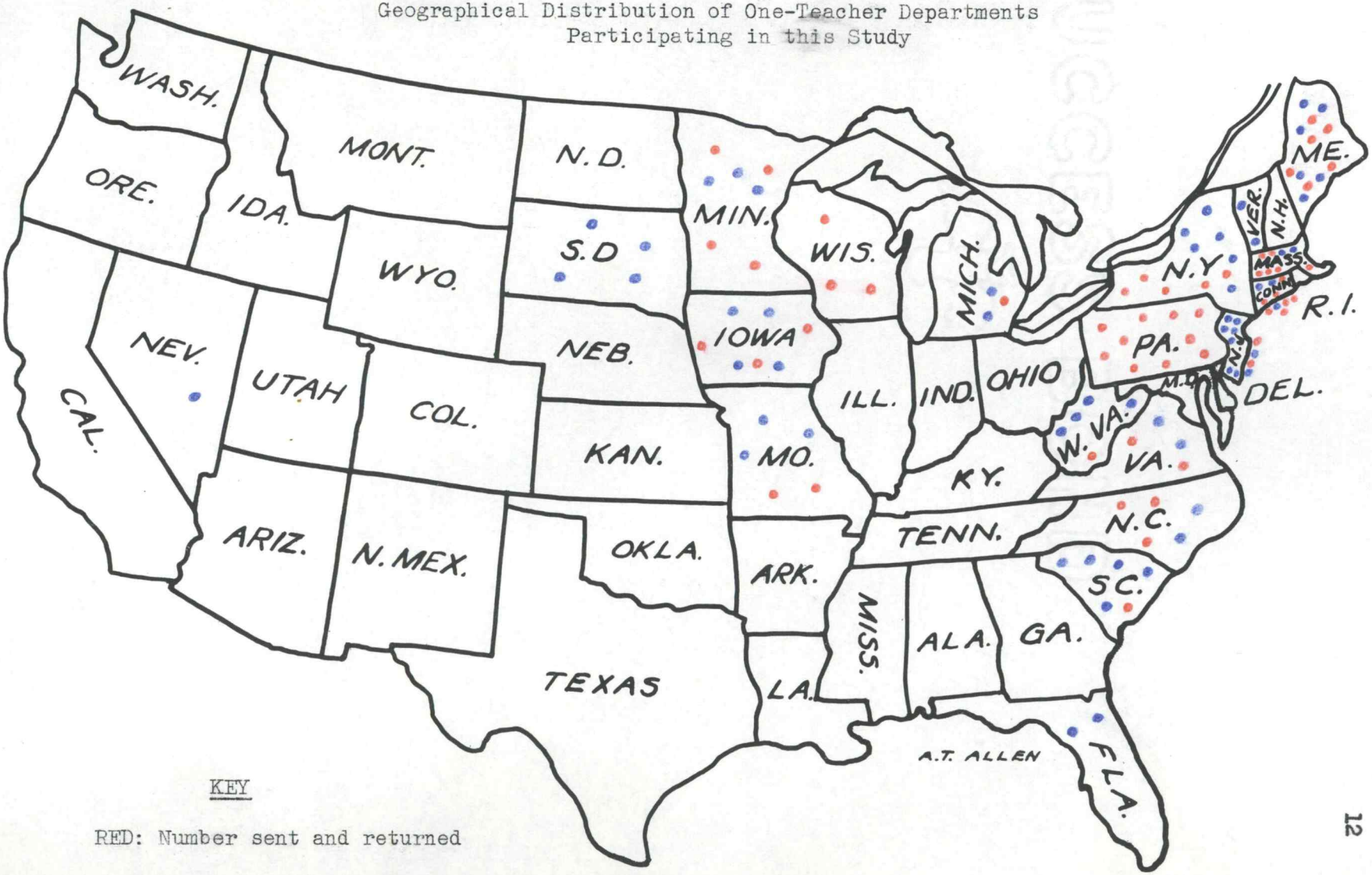
Mr. George B. Cox, Head of Industrial Education Department, Oregon State College, remarked when this problem was selected that it would be difficult to obtain information from the schools for this type of study. Therefore, the writer felt that the information requested on the questionnaire to the secondary schools must be

brief and yet adequate in order to draw the necessary conclusions. The writer hoped to obtain a wider sampling of all the United States rather than to restrict the study to the area east of the Mississippi River, as has finally been done. However, the shops in small secondary schools east of the Mississippi River and the Middle West can be generally considered as representative of those found over the entire United States.

Reference is here made to Chart No. I (spot map) which illustrates the number of new shop departments supplying information and the number who failed to return the first questionnaire.

CHART I

Geographical Distribution of One-Teacher Departments
Participating in this Study



KEY

RED: Number sent and returned

BLUE: Number sent and not returned

CHAPTER II

PRACTICES AND OPINIONS REGARDING THE PLANNING FOR INDUSTRIAL ARTS

Development of Shop Planning

School shop planning is not something new. It is as old as shop work itself. The advancement of educational philosophy has likewise brought newer developments in this phase of education. With the newer concepts of industrial arts, there has developed an entirely different viewpoint in regard to the physical planning of industrial arts shops or departments.

A survey of related literature on shop planning shows various conflicting opinions concerning many factors, especially in regard to the type of general shop. All agree that the shop should be of the diversified multi-activity type for general training, but the controversy arises over the amount of each type of equipment and the subsequent methods of instruction.

Many articles on shop planning, or phases of it, have appeared in the periodicals relating to this field of education. Bruce's Shop Annuals are important sources of information on phases of shop planning. These articles have been written by leaders in the field of industrial arts education and have been based chiefly on present practices. With regard to scientific research in school shop planning, much has been done at Ohio State University under the personal direction of Dr. William E. Warner. Another contributor to this field was the late William L. Hunter of Iowa State College. Other industrial arts leaders have from time to time made studies which

are helpful to those planning school shops. In this study, frequent references will be made to Warner's (46) article, Studies in School Shop Planning and Hunter's (19) Industrial Arts Laboratory Planning Series I, II, III, IV.

According to prominent industrial arts authorities, there still remain many problems to be solved scientifically. L. F. Ashley (2) says, "The industrial arts laboratory in any of its aspects is still a virgin field. While considerable work has already been done relative to the administration of industrial arts laboratories such efforts are but stepping stones which show the need for continuing studies in order that the work of the school can keep pace with trends in the social order."

Hunter (19:232) says, "In nearly all of these matters, even in the field of lighting, much research is yet needed before we can begin to think of calling ourselves scientific educators."

In making an historical review of what has been done, it seemed advisable to divide the general subject of school shop planning into its various aspects. Opinions and present practices on shop planning concerning these various aspects will be given in the following pages.

Standards for Departments

There are conflicting opinions among state educational officials as to the desirability of setting up standards for industrial arts departments. This fact is shown by the following statements:

Roy G. Fales (13) has this to say,

> The industrial arts shops which have been set up in the schools throughout the state have been planned in many different ways. Local conditions and individual needs necessarily prevent a single standard being followed. Nevertheless, there are many elements which are common to all shops, and a standardization of these elements should greatly aid in eliminating waste space, in removing hazardous working conditions, and in utilizing the available floor space to the greatest advantage.

In the state of Ohio, new high school standards governing the planning of industrial arts departments were put into effect in 1938. Willis A. Whitehead (47) lists these standards in his article.

Concerning standardization of shop planning, John J. Seidel[1] writes as follows: "We have no standards for the lay-out of industrial arts shops. In fact, we find it extremely unwise to do so. If one sets up a minimum requirement, too often the minimum becomes the maximum. In my opinion it is extremely unwise to standardize equipment too much."

To assist their instructors in one-teacher departments, Pennsylvania (30) and Michigan (24) administrators have formulated standards or suggestive shop floor plans and equipment lists for small general shops.

---

[1]Director of Vocational Education, State of Maryland. Letter, June 1, 1939

Efficiency in Planning

There is evidence that either overplanning or underplanning the industrial department may result in instructional difficulties and inefficiencies. William W. Willis (48) says: "The industrial arts as an integral part of public instruction must take aggressive action in the elimination of potential extravagance peculiar to its field." This extravagance in departmental planning is illustrated in his survey of 35 shop departments in South Dakota (1933-34). Willis found that these shops were open for class use on the average of but 59.9 per cent of the school day. The resulting loss in the use of shop space and equipment for the year was 40.1 per cent. To quote further, "A classroom, as an investment, pays dividends in direct proportion to the constancy of its use. Unused shops appear to outsiders as departmental dry-rot, indicating a lazity in organization and a possible failure to realize upon the wide possibilities of industrial arts education."

Procedures in Planning Shops

In the small secondary school the task of making a preliminary survey falls on the superintendent and the industrial arts teacher according to H. L. Stiles (37). Whitehead (47) presents points of procedure in shop planning as follows:

1. A clearly defined and consistent philosophy of education, with its implications for all phases of the educational program
2. The school and community survey, involving studies dealing with

the character and growth of the community; character, size, and probable growth of the school population; attitude of the community toward education; economic status of the community; nature of the existing school program; policies of the board of education; the ultimate school plant; channels of organization within the community; and the like

3. A survey and application of related technical researches and state and local building requirements, dealing with such problems as noise, building details, and lighting
4. A tentative plan of the physical plant showing principle areas and facilities, equipment placement, and service features
5. The final plan of the laboratory
6. Design of special features and equipment
7. Architectural and professional specifications
8. Equipment specifications
9. Presentation of the complete program to the board of education

H. J. Van Westrienen (45) presents his scientific technique for preliminary planning procedure. A summary follows:

1. A philosophy of education as related to the type of school
2. Curricula and course of study: a survey of local, social and industrial conditions
3. School membership survey: of past and present enrolment, the general character, and the growth of town

4. A schedule of classes; analysis of the curriculum courses, and anticipated enrolment providing a basis for determining the number of rooms needed in shop departments
5. Machines, tools, and other required equipment, kind, size, and shape of the machines, and approximate number of tools
6. Adequate storage space: Tool storage, project storage, pupil locker space, supply storage
7. Preliminary rough sketches: Width of the room as determined by the ceiling height which limits the window lighting area, main shop and auxiliary rooms such as tool room, lumber storage, unfinished project storage
8. Preliminary scale drawings: General arrangement, showing partitions if any ; location of shop equipment with the necessary working area required around each machine; relation of the items of equipment to each other; and safety factors--all this done by paper templates representing the scale size of the machine, cabinet or benches. Templates can be moved about until the most economical and practical arrangement is determined, the equipment to be drawn in after tentative decision
9. Detailed working drawings of building plans including all cabinet details for storage, supplies, bookcases, project storage, tool storage
10. Specifications are the responsibility of the architect: Responsibility of school officials to advise the architect on such items as power control of machines, special floors,

sinks and drinking fountain, acoustical wall and ceiling treatment, bulletin boards, blackboard space, gas and electric service for equipment, ventilation, dust collector, display case, door locks, exhaust fan for soldering bench, forge, and woodworking machines.

Types of Shop Organization

From the economic standpoint, the general shop organization seems to be the ideal shop for the small community, according to F. T. Struck (38). R. L. Hamon and H. E. Standish (17) say, "The general shop is the only plan which can be justified in the small rural school as it lends itself to the varied interests and needs of the rural community better than the Unit shop." In speaking about the general shop, Louis V. Newkirk and George D. Stoddard (27) say,

1. It makes possible an adequate industrial program for the small school.
2. It offers an economical way to gain experiences in many activities.
3. It enables a student to discover his abilities and aptitudes through manipulation of a wide range of materials, tools, and processes.

Roy G. Fales (13) expresses his opinion in regard to shop organization as follows:

> Small junior-senior high schools and small senior high schools, employing only one industrial arts instructor, are best served by installing a general shop. This will not differ greatly from the general shop in the junior high school. It should, however, contain some machines,

> in order that more difficult projects, appropriate for high school pupils, might be constructed.
>
> In the comprehensive general shop, it is desirable to make each section stand out as a typical unit, such as foundry work, sheet metal work, machine shop practice, etc., and to develop each section to accommodate from two to five pupils. This results in the class being distributed throughout all sections of the shop, and working upon projects involving a variety of tools and materials simultaneously.
>
> The comprehensive general shop is usually laid out in several small units. General woodworking, general metal, automobile mechanics, and general electricity are the subjects commonly taught. Printing and textile work are rapidly being given a place in this type of shop.

John J. Seidel[1] writes as follows:

> You will be interested to note that all schools having one teacher have their industrial arts shop organized on a general shop basis and that when two teachers are used, it usually breaks down into a general metal and electric shop in one space and woodworking and drawing in the other.

Earl S. Miller (26) says, "The flexible program of a general shop meets the needs of the adolescent boy very satisfactorily. A general shop depends greatly on the community, on the instructor, on shop facilities, and on the principal."

From a recent study by W. A. Baldwin (5), the data shows that the larger the junior high school enrolment, the fewer the number of general shops and the greater percentage of specific unit shops.

---

[1]Director of Vocational Education, State of Maryland. Letter, April 28, 1939

General Shop Units

In the state of Michigan (24) the activities for general shops in rural high schools must be selected from the following list: Woodworking, drawing, electricity, concrete, general metal, maintenance and repair including gas engine, and plumbing and pipe fitting. The minimum number of activities required each year is four.

Homer C. Rose (34) in expressing his belief, writes as follows:

> Instead of placing the diversified type of general shop in the lower grades, it has been reversed for the last year of the work at Augusta. Much of the literature written on the general shop seems to indicate that it is offered as one of the first courses at the junior high school level. Judging by the objectives, however, the writer believes that the general shop course where the boy is expected to use a variety of tools and materials, and to work in a number of fields with a minimum of class instruction should come after he has passed through a series of individual shops. (The term "individual shop" as used here refers to the individual fields of work even though the content covered may be as general in nature.)

Quoting again from Rose (34), he says,

> In the junior high school where almost 100 per cent of the boys take shop or drawing courses, six one-semester courses offering a good range of basic industrial "knowing and doing units" are listed...the work should not be spread over too large and varied a list of experiences, since the aim is to develop an understanding and appreciation of good workmanship and design, and the ability to plan and carry through a project to its completion.

The summary of a study made by Davis (11) shows the units that are usually included:

> The number of different industrial arts subjects reported as taught in general shops is 24. Woodwork is reported in 81 per cent of the combinations; mechanical drawing in 60 per cent; electricity in 55 per cent,...the following subjects were reported: General metal, foundry, machine shop, forging, cement and concrete, art metal, auto mechanics, home mechanics, welding, wood turning, printing, bookbinding,

plumbing, photography, weaving, upholstering.

A laboratory course developed by Merrit Pease (29) consists of the following units: Planning and drawing, general woodworking, electricity, general metal, consumer mechanics, ceramics, leather, photography, and printing.

Roy G. Fales[1] makes the following recommendation: "I am now recommending that all industrial arts departments be equipped and arranged to teach these six different activities: General woodwork, general metalwork, general electricity, general printing, general ceramics, and general textiles, regardless of whether they employ one teacher or forty teachers of industrial arts work."

The following is a list of industrial arts subjects that are taught in general shop courses over the United States. This list has been prepared by C. K. Lush, Supervisor of Industrial Arts, Minneapolis Public Schools:

INDUSTRIAL ARTS COURSES

WOOD	POWER MECHANICS
Hand Woodworking	Auto
Machine Woodworking	Wind
Cabinet Making	Steam
Patternmaking	Diesel
Carpentry	Tractor
Whittling	Aviation
Wood Carving	
Caning	
Art Fibre	

[1]Supervisor of Industrial Arts, State of New York. Letter, July 5, 1939

DRAWING

Readings of Drawings
General Drawing
Mechanical Drawing
Engineering Drawing
Architectural Drawing
Building Construction Drawing
General Construction Design
Lettering
Showcard Writing
Silk Screen Process

METAL

General Metalwork
Sheetmetal
Copper and Nonferrous Metalwork
Metal Spinning
Ornamental Iron
Bench Metal
Jewelry
Tool Making
Metal Patternmaking
Foundry
Forge
Machineshop
Welding
Plumbing
Metal Finishing

ELECTRICAL

Elementary Electricity
Experimental Electricity
Automotive Electricity
Communicative Electricity

GRAPHIC ARTS

Printing
Machine Composition
Lithography
Commercial Duplication
Paper Making
Bookbinding
Bindery Practices

CERAMICS

Cement
Keene Cement
Alabaster
Plastics
Clay

HANDCRAFTS (MISC.)

Shoe Repair
Leather (ornamental)
Harness
String Weaving
Brush Making
Basketry
Archery
Reed
Rope
Glazing

FARM SHOP

Harness
Machinery
Housing (etc.)

Course Requirements in Shop Work

A digest of a study made by Jules Bertin (8) showing the requirements and amount of time devoted to industrial arts is given as follows:

	7th Grade Column		8th Grade Column		9th Grade Column	
	I	II	I	II	I	II
Pennsylvania	100%	157	100%	150	66%	157
All other schools	85%	153	76%	134	10%	136

Column I: Shows per cent requiring industrial arts

Column II: Shows average number of minutes per week

Data based on 68 cities in 36 states

Other results of this study are: In Pennsylvania, 9th grade shop is elective in 34% of the schools; in all other schools 90%. The average amount of time for 9th grade elective for Pennsylvania, 265 minutes per week; for all other schools, 288 minutes per week.

As a result of his study of 60 schools, Ed Davis (11) concludes the following: "That industrial arts is a required subject in the 7th and 8th grades in approximately two-thirds of the schools, in the 7th, 8th, and 9th grades in one-fourth of the schools."

Physical Plant

Regarding the location of the shop, Warner (46) gives a list of shop locations in the order of preference:

1. Wing of building (most desirable)
2. Center of building (Ground floor under an auditorium)
3. Separate building attached to the main building
4. Entirely separate building
5. Portable structure (considered least desirable)

Other considerations in planning the shop proper are: place, floor level, accessibility and orientation. With respect to these features, Warner (46) says,

1. As to the floor level, preference is given to the first floor or street level by placing the shop floor one step above grade level.
2. Outside doors should be double doors and open on to a driveway if possible.
3. The main shop exit to the main building should open on to a principle corridor.
4. The orientation of the shop or the direction it faces does not make any difference as long as the artificial lighting installation is correct. It would seem to be an advantage in having more wall space in the general shop which could not be had if the wall space was given over to window space. A corner room is to be preferred.

O. A. Tearney's (40) study showed that 32.62 per cent of the shops are located on southeast rooms and 24.11 per cent in northeast rooms, thus giving 56.73 per cent of the shops east sunlight. From this study we also find that 53.1 per cent of the shops are

located on the first floor.

Warner (46) contends that there should be an interdepartment relationship. The art and home economics department should be adjacent to the industrial arts department, and the commercial work adjacent to the printing department.

Shop Size and Shape

Warner (46) states several general rules to follow in planning the shape and size of a school shop or laboratory:

1. The general rule followed is to keep shops within a ratio of 1:1 up to 1:2 as regards width to length.
2. There seems to be little excuse for anything other than an oblong shape unless the irregularities are used for auxiliary purposes.
3. More than 75 square feet of floor area per pupil would seem to be unnecessary and less than 40 would make for overcrowding.
4. It is concluded that the ceiling heights of 12 to 15 feet for shops are most desirable.

Hunter (19) states that "With smaller laboratories one must allow more space than in a larger one where many more pupils are accommodated. For most work, industrial arts teachers should do their best to get along with not more than sixty square feet per pupil."

R. A. Campbell[1] says, "We require that a shop should range from 50 to 100 feet in length and 22 to 24 feet in width."

---

[1]Supervisor of Industrial Education, State of New Jersey Letter, May 31, 1939

The results of the study of 141 shops made by Tearney (40) in 1932 showed that the average floor space per pupil was 64.9 square feet.

In the state of Pennsylvania (30) criteria for establishing industrial arts departments have been formulated, in addition to suggestive floor plans which may be obtained from the Department of Public Instruction. The criteria are as follows:

1. The minimum size of industrial arts shops in junior and senior high schools of more than 300 enrolment should be 22 x 60 feet. Preferably the shop should be 30 x 60 feet.

2. In small junior or senior high schools under 300 enrolment, shops may be approved with a minimum size of 22 x 60 feet or 22 x 45 feet.

3. In addition to the space required for shop work it is desirable to provide storage space either in a separate room or with additional length to the shop room, with the latter preferable.

4. Where necessary because of enrolment, a room should be provided for industrial arts drawing. The minimum size for the drawing room should be 22 x 30 feet. Preferably the room should be 22 x 45 feet.

G. O. Voss[1] makes the following recommendation concerning small shops for the state of Minnesota:

> Recommendation: Three rooms, consisting of a shop (two ordinary classrooms in size); a drawing room; and a room for project storage, finishing, and supply storage should be provided. To afford opportunities for general industrial training in a small school where the number of boys enrolled in each of the years, seven, eight, and nine will not exceed sixteen, a one-room department may be approved. Separate project storage and finishing facilities, however, should be provided.

[1]State Supervisor of Trade & Industrial Education, State of Minnesota. Letter, May 31, 1939

Fales (13) suggests the following shop sizes:

> The average floor area of the industrial arts shops in New York State, at the present time, is 1500 square feet. Such a shop will accommodate a class of 24 boys. A floor area of 1800 square feet might be considered a large shop, and anything in excess of that amount will result in a waste of space. Twelve hundred (1200) square feet of floor space should be the minimum amount for accommodating 24 boys. Any amount below this figure is inadequate for the type of courses commonly offered.

In describing the floor area for a general shop, Struck (38) says:

> In area or floor space these shops vary from about a standard classroom size, or approximately 900 to 1000 square feet, to three or four times that size. The minimum size ought to be equal to at least two, and preferably three classrooms. Current practice allows about 25 square feet of floor space per pupil for classroom instruction. For shop instruction the allowance should be between 50 and 100 square feet per pupil.
>
> One shop, the minimum size of which should be 1320 square feet, will be needed for every 750 pupil periods per week. This is based on a class size of 25 pupils and 30 sixty-minute periods of instruction per week.
>
> For ample space let us imagine a shop 24 to 28 feet wide and 75 feet long, with a shop library and planning center added to the side or at one end and a project and material storage room added on the other end or adjoining one side.

In respect to the shop, Ashley (2) says, "Rooms of any size and shape, and located in odd parts of the building or basement will no longer suffice."

Location of Units of Work

Three factors dominate the design and layout of shops according to O. B. Badger (3) which are: "(1) safety of the students; (2) economy of space; (3) efficiency from the standpoint of

necessary movement to and from various parts of the shop."

In respect to the usable floor and wall space in a shop, Newkirk and Stoddard (27) classify it into three divisions as follows:

> Section A may be located in any corner of the shop. Its major uses are, (1) class demonstrations; (2) reading; (3) storage for books; (4) drawing; (5) finishing room; (6) storage of supplies; (7) storage of unfinished projects which are too long to go into the lockers.
>
> Section B comprises the space on or near the walls and has many possible uses, providing for: (1) machines; (2) wall benches; (3) tool cabinets; (4) lockers; (5) supplies; (6) wiring panels; (7) and wash basins.
>
> Section C, the central portion of the shop, has many possibilities in a comprehensive general shop...It must afford room for the installation of many machines and benches, and a good share of the central floor space...is needed for assembly work. Section C should have a double door opening to the outside so that an automobile may be brought in readily.

In relation to the instructional areas Newkirk and Stoddard (27) recommend the following:

1. Since auto mechanics, forging, sheet metal, and plumbing divisions go well together, they can be arranged in one end of the shop.
2. Units such as woodworking, electricity, printing, and finishing may occupy the other end of the room.
3. Glass partitions may be used for separating areas such as woodworking, finishing, printing, and drawing.

Warner (46) states that photography and blue printing units are usually conveniently located near washing and lighting facilities; and that a planning room should be placed near both the main exit and the instructor's office. Other units, such as ceramics or foundry should be farthest away in a laboratory of industries setting.

According to Hunter (19:183) a shop including units of work which are naturally dirty, such as foundry work, ceramics, and forge work, should be placed farthest from the entrance to the laboratory.

Warner (46) believes that provisions for automotive instruction would be quite different if approached from the angle of automotive repair rather than from the angle of the consumer and general education.

Miller (26) says, in regards to locating the areas of work:

> The floor plan for the shop, which should be about 30 x 50 feet, will vary greatly with conditions. Divide the shop into four departments, allowing more space for metal and wood, than for the other subjects. Instead of building partitions or other obstructions, paint a bright red line on the floor about three inches wide. One line should run straight down the length of the shop, another across the shop.

Lighting

Another factor in planning for industrial arts is that of adequate lighting for the prevention of eyestrain and for facilitating efficient manipulation. After compiling recommendations of the Nela Park Laboratories, Cleveland Ohio, and the Franklin Specifications for Good Lighting, E. W. Bollinger (9) and Walter Sturrock (39) recommend that 12-15 foot-candles of illumination should be provided for general shop and 25 foot-candles for drafting.

Bollinger (9) states: "For school shops and drawing rooms, lighting data usually recommend that all ceilings should be white, creamy white, or ivory, not to exceed a semi-gloss finish. The

walls above the eye level should be of a light color, such as cream, ivory, light tan, warm light gray, light green, etc. Below the eye level, somewhat darker shades of the same color as used for the upper part of the wall."

Sturrock (39) says, "For school shops, in general, the open-type unit which shows an R. L. M. Standard Dome enameled steel reflector is quite satisfactory if equipped with a white bowl lamp. For best conditions, luminaires of a high quality such as the Glassteel Diffuser would be recommended."

For mechanical drawing or in the drafting room, Sturrock (39) recommends the indirect and semi-direct types of luminaires as best fulfilling the requirements. With reference to natural daylight, Sturrock continues that the greatest amount of daylight practicable should be provided. Reference is here made to the Ohio (28) school building code which reads as follows:

> There shall be provided not less than one square foot of glass area to each five square feet of floor area in each class, study, recitation, schoolroom and laboratory and not less than one square foot of glass area to each eight square feet of floor area in each domestic-science, manual-training room or shop. Tops of windows shall be placed above the finished floor line at a height equal to not less than half the average width of the room minus eight inches. The width of the room shall in every case be measured at right angles to the source of light.

Concerning glass area, Hunter (20) says, "Natural lighting should be at least one-fourth of the floor area of the shop."

Warner (46) is advocating the use of venetian blinds as a type of shade to provide daylight control.

Regarding natural and artificial lighting, Hunter (19:101) gives some suggestions, briefly summarized below:

1. In order to get light back into the room, the windows should be extended to the ceiling.
2. The bottom of the windows should be at least four feet from the floor so that the brightness outdoors will not come directly in the line of normal vision.
3. Steel sash is preferable to wooden sash and mullions.
4. The width of the shop should not exceed twice the maximum window height.
5. Twelve feet should be the minimum ceiling height, and for a wide shop fifteen or sixteen feet would be preferable.
6. Flat paint will reflect more light (in all directions) than a gloss paint.
7. Concrete beam ceilings, such as those sometimes found in shops, should not be left open. They should be plastered with an acoustical plaster or painted a light color.
8. If at all possible the lighting system in a shop should be of the indirect type, of sufficiently high wattage so that supplementary lighting will not be necessary.
9. Where two rows of luminaires are used to light a room, the inside row should be separately controlled. The lights in the inside row should be more powerful than those in the outside row.
10. Separate light circuits should be separately fused.
11. If possible, measure the light intensities of rooms with a light meter.

Lyla D. Flagler (14) summarizes an experiment in artificial lighting conducted at State Teachers College, Eau Claire, Wisconsin:

1. The direct type of fixture provided the most foot-candles with the least wattage; the semi-indirect ranked second in this respect. The indirect type gave the least illumination.

2. The glare from the direct was irritating and fatiguing. There was a slight glare from the semi-indirect type. There was practically no glare from the indirect type.

3. The psychological effect of the semi-indirect type of fixture was most pleasing. The addition of metal baffles eliminated practically all of the glare and provided an even distribution of illumination equal to that of the indirect type.

4. The illumination from the lights near the blackboards was less than in other parts of the room, showing that the blackboards absorb light.

5. It is recommended that the ceiling be painted a flat white to increase reflection.

6. A photo-electric eye should be installed if the room is to be an example of efficient school illumination.

Ventilation and Sanitation

Authorities also find that proper ventilation and sanitation should be considered in the construction of the industrial department. Reference is here made to the Ohio (28) building code, which reads as follows: "The ventilating system shall be capable of supplying not less than six (6) complete changes of air per hour in each room used for instruction purposes, including the shop or laboratory."

According to W. R. Williams Jr. (49), the Oberlin Arts and Industries Laboratory, built in a community approximating 5000

population, is equipped with air-conditioning, a strictly modern system.

The present conditions as found in school shops are described by Hunter (19:138) as follows: "At the present time, pupils are frequently in drafts, near cold windows, and the air in the schoolrooms is very impure, dusty and actually dangerous to human health."

Hunter (19:129) in his stimulating article gives the reader some ideas on shop sanitation.

1. ...The time will come when pedestals and under parts of benches will be so designed that they may be much more easily cleaned than at present.

2. Very few states have laws requiring exhaust systems for woodworking and all other machines that produce dust. Dust exhaust systems have been installed under the floors in some shops and they have been successful.

3. There is every reason to think that a vacuum cleaning system will be available in the newer schools of the future.

4. Concrete floors are not at all easy to clean. A concrete floor should be finished by letting the concrete partially set so that the free water has disappeared. A wooden float should be used first. The concrete should be allowed to set further and then it should be given a final finish with a metal trowel. In this way a concrete floor is obtained which is smooth and easily cleaned.

5. Cabinets and cases of all sorts should, whenever possible, be built in the wall and arranged flush so that there are no empty pockets and corners to collect dirt and rubbish.

6. Just as far as possible, all window ledges and other natural areas which collect dust should be eliminated.

Regarding equipment causing smoke or fumes, the Ohio (28) building code states that a hood of sufficient size shall be placed

over each bench or piece of equipment to receive and carry off all obnoxious odors, fumes, or gases. An exhaust fan shall also be placed in the ducts or flues to cause sufficient draft to carry away all smoke, fumes, or offensive odors.

In providing proper ventilation in other areas Hamon & Standish (17) say, "Special attention should be given to ventilating auto-mechanics and gas-engine units."

Elmer W. Christy (10) says:

> The removal of shavings and dust from woodworking machines by means of an exhaust system, not only provides a more pleasant and more healthful shop in which to work, but contributes materially to the safety of operators, and also improves the quality of work produced.
>
> The use of machines without a collector system results in an accumulation of shavings on the floor, and fills the air and covers everything in the shop with fine dust. Both of these conditions create a sanitary as well as a fire hazard which in a properly equipped shop need not exist.

In referring to a collector system, Christy (10) says, "In Cincinnati we have used automatic control so long and it has proved so satisfactory that it is now considered standard equipment in our junior and senior school woodworking shops."

Acoustics

Noise disturbance in a school, throughout the building as well as in the shop, is also a phase of consideration. Hunter (19:137) states what should be done to obtain better sound control within the shop.

1. As far as possible all existing noises should be absorbed at the point of origin.

2. From an economical and acoustical standpoint, machines purchased for school shops should be no larger than absolutely required.

3. As far as possible the industrial arts department should be located adjacent to other school activities which produce some noise.

4. From the standpoint of noise, it probably would be well to have at least 60 square feet of floor space per pupil in practically all industrial arts subjects except drawing.

5. ...Fairly hard material for walls up to a height of about 5 feet above this wainscoting and for the ceilings, acoustical plaster may well be used.

6. For the ceilings, where one wishes to use the very best kind of sound absorbent material, something like celotex or other acoustical board may be secured from dealers and manufacturers who specialize in this kind of material.

7. Whistling and rattling windows may be eliminated by using weather strips.

8. All doors...should be equipped with automatic closers, and they should open outward.

9. Shop floors should be insulated from the walls and foundation which support them.

10. Just as far as possible, the placing of motors, shafts, and other noise creating machinery on walls, ceilings, or other sound amplifying areas should be avoided. If this rule cannot be observed, they should be insulated.

Warner (46) gives the results of a study on school shop noises which was carried out at Ohio State University in 1933. He states that the ceiling material used should have a .30-.50 absorption coefficient to have satisfactory sound control. According to George F. Hall (16), power machines, if not properly insulated,

may be very annoying not only in the shop but throughout the entire building. Quoting from Hall (16):

> Steel, concrete and even wood are better transmitters of sound than air. If machines are not properly isolated from steel beams or concrete foundations upon which they are mounted, the vibrations transmitted will soon reach the walls and ceiling in the room in which they are located and may be transmitted to other rooms where they will be amplified.
>
> To eliminate vibratory noises from motors mounted on the floor, it is necessary to use sound insulating material interposed between the base of the motor and floor or foundation.

Henry G. Perring (31) has this to say regarding the use of acoustical materials:

> It is possible to take advantage of the fact that many acoustical materials have a high heat insulating value... so that the cost of the insulation is paid for in a few years by saving in the heat system and coal pile. It is believed that the application of acoustical materials in our schools will pay equally high dividends in the education of youth.

Warner (46) says, "There is a definite need for acoustical treatment of walls, ceilings, and floors; and for a color scheme which will provide adequate lighting as well as a pleasing environment.

Williams (49) points out that the walls and ceiling in the new Oberlin shop are acoustically treated by using cream-colored acoustical plaster.

Floors

Whitehead (47) points out that floors are an important detail of any laboratory. The wearing surface must be designed to endure, repairs must be kept at a minimum; floors must be sufficiently insulated to be quiet and prevent transmission of noise to other parts of the building. The floor must not be so hard as to cause tools that are dropped to break. A shop floor should be such as to facilitate cleaning and must not be so non-resilient as to be detrimental to health.

For flooring materials, Whitehead (47) recommends: end-grain blocks, wood-blocktile, and 5/4 maple flooring in the order named for use in woodworking, printing, electricity, and similar areas. In the drawing, art, and office areas he recommends cork tile, rubber tile, mastic tile, and cork carpet as the most suitable.

In the hot-metal areas, such as foundry, forge, welding, and auto mechanics, he recommends finished concrete.

Whitehead (47) says, "These variations in flooring materials can be easily provided in the same laboratory if they are planned in advance."

Fales (13) recommends matched maple for flooring, and if metal work or automobile mechanics is taught in part of the shop, a concrete floor is recommended for that section only.

In describing the floors in their new building, L. H. Petit (32) says, "With the exception of the woodworking shops, the floors of the department units were laid with asphalt tile in contrasting

color design. To prevent breakage of delicate tools, the woodworking shop floor is pine. All surfaces rest on concrete. The auto mechanics shop and the machine shop have plain concrete floors."

Teaching Facilities

Evidently, the seating problem is still another phase of planning a shop. A great deal of emphasis, as evidenced from the literature, is being placed upon information and "what is to be known" in industrial instruction. This requires seats for efficiency.

J. F. Friese (15) presents the results of an investigation which show that approximately 50 per cent of the shop time should be devoted to social and economic studies, acquisition of technical information, and problem solving acitivties.

Newkirk and Stoddard (27) say, "It is very convenient to have a demonstration room in which to seat the class...under controlled conditions."

In regard to seating facilities, H. A. Bailey (4) writes as follows:

> ...A rising tier of students' arm chair seats, each row being 10 inches higher than the one immediately in front of it. From these seats, students have an unobstructed view of the work being demonstrated, and the instructor may put most of his attention to the presentation of such demonstrations in a careful and logical manner.

Respecting teaching facilities in the small department, Fales (13) says:

> A unit of from two to six large benches, together with stools or boards laid across the benches, will provide

a teaching unit that is necessary in all school shops. Inasmuch as shop classes usually do not spend in excess of 25 per cent of the total shop time in discussion work, the arrangement of 20 to 24 seats, sometimes used, is being superseded by more temporary seating arrangements, such as benches or folding chairs. It is conceded to be wasteful of valuable floor space to have a permanent seating arrangement which will only be used one-quarter of the time.

A bulletin board should be provided near the entrance to the shop, or near the teacher's office. If this is done, the bulletin board should be not less than three feet square.

A blackboard is located as near as possible to the benches, in order that the boys may have a place to sit during brief instruction periods.

The shop library should be the center of all shop activities. Ideas which pupils bring to school, as proposals for individual projects, should be developed here. From this center also should emanate many stimulating ideas which the pupil should execute under the guidance of the shop instructor.

The library and planning center should contain a table, three or four chairs, a card file, a letter file, a display of books, and magazines, and the equipment necessary for making mechanical drawings.

When planning for the teacher's desk, Hunter (19:183) says: "It is a good thing not to get it too far away from the entrance to the laboratory. The principal and others who want to see the teacher can do so with the least amount of travel...when classes pass the teacher can be near the door to note those who come in and those who go out."

The following quotation, also from Hunter (19:183) is given in respect to glazed partitions as a teaching facility: "Just as far as possible all parts of the laboratory should be visible to the

teacher from any point in the laboratory. If there are auxiliary rooms, such as blueprinting or wood finishing rooms, it is desirable to have a part of the partition in glass."

Safety Precautions

Attention is given to providing a safe place in which pupils may work. A summary of Hunter's article (19:182) on Safety in laboratory planning follows:

1. Safety zones around machines should be marked by a painted line.
2. Machines should be separately fused, separately switched, machines individually and collectively locked where possible.
3. Machines should be operated at the speed recommended by the manufacturer.
4. Floors around machines should be nonskid.
5. Where goggles are needed they should be conveniently placed.
6. Fire extinguishers should be near doors as well as in far corners of rooms.
7. A first aid cabinet should be available and placed near an exit.
8. All switches to machines should be shock proof.
9. All power tools should be grounded to avoid static electricity.
10. Inflammable materials should be stored safely and conveniently.
11. All main doors to the laboratory should swing toward the nearest exit.
12. Equipment should not be located near entrances.
13. Machines should be arranged for maximum safety.

14. Main entrance to a shop should be from a corridor or from outside the building.

15. So far as possible, all corners and projections should be avoided.

16. Fire-resistant wire mesh glass should be used in all laboratory exits.

Auxiliary Facilities

Warner (46) says that it is not necessary to provide toilet facilities in the smaller shops. "The rule followed, however, is to place toilets within fifty paces from a shop exit."

Hunter (19:104) says of washing facilities: "Just as far as possible, one should equip the room so that the pupils have least cause to leave the room while the class is in session. Drinking fountains and wash basins should be available without leaving the laboratory."

Schmidt (35) says, "Hand-washing facilities are quite often very insufficient. It has been noted that where hand-washing opportunity is offered in the different shops that more use is made of them than when lavatories in the toilets are relied upon for this purpose. Ample provisions for slop sinks also should be made."

The following is recommended by Fales (13):

> A deep sink, preferably with a drain board on one side, should be provided in every school shop. Both hot and cold water should be piped to the sink. Where the shop is large enough to permit the installation of a deep porcelain-covered sink, adequate to accommodate five or

six boys, this provision should be made.

A large trap should be provided under each sink in order to prevent wax, grease, paint, plaster of Paris, cement, and other injurious materials from being washed into the drain pipe.

If automobiles are to be driven into the shop for repairs, a drain should be provided in the middle of the concrete floor which will carry off dirt, water, and grease.

A gas pipe should be brought into the shop through the floor, or above bench height, if it comes through the wall. The gas pipe placed in the wall, or near the wall, is more convenient than one in the middle of the room. It should be brought in at the place where the forging and foundry work is to be done. Where gas is not available either a gasoline torch or a coal forge may be used. Waste gases and fumes should be carried away by a flue when a coal forge is used, or by a hood, when a gas furnace is used.

In shops where heavy duty machinery is to be installed, or where light machinery drawing 220 volt current is to be used, the floor plan should be laid out previous to the installation of the conduit. For small comprehensive general shops, a 110 volt supply from the side wall, the floor or the ceiling, usually meets all needs for the operation of machinery. Shops which are being newly constructed should contain 110 volt outlets at approximately 15 foot intervals around the entire shop. These outlets should be located 42" from the floor.

When building a shop, the electrical contractor should be required to install a red pilot light at, or near, the switch controlling all electric circuits. This is a safeguard against leaving an appliance in the circuit after the close of school, as this is liable to start a fire. It also enables the teacher to tell at a glance whether or not the power lines operating the machines have been disconnected.

Storage Provisions

Tool Storage

In setting forth the requirements for tool storage, G. M. Brace (6) writes: "All general tool racks have certain uniform requirements: (1) They must be located conveniently to the majority of workers; (2) They must be securely locked when not in use."

Hunter (19:184) says, "Tools and tool panels should be so placed in the laboratory that a minimum of travel is required by the pupil. If so much as two minutes of time can be saved for each pupil in beginning and in putting it away, there will result quite a worthwhile saving."

Merrit Pease (29) writes about the tool room in his shop:

> The tool room is to be furnished with two long tool cabinets which may be opened to form panels on which all tools will be visible. A work bench is provided so the toolkeeper may repair tools during his spare time. Because the tool room is at one end of the laboratory, portable tool panels are provided on which may be kept the tools of a particular unit. These may be wheeled to any part of the laboratory during the day, and locked in the tool room at night.

Hamon & Standish (17) make the following statement: "In the small general shop, only one conveniently arranged tool supply case is needed."

Fales (13) opinion in respect to tool storage is as follows:

> Provision for tool storage may consist of a wall panel or case, approximately six feet square. If a wall panel is used, a wire cage, a foot or a foot-and-a-half deep, may be built over the entire panel. If the front of the cage is mounted on a sash which can be raised or

lowered, there will be adequate protection when the instructor is absent.

A tool crib is not recommended. The space that it occupies is not available for work, and the pupil does not have the same desire to use the tools as he does when they are on open display.

The significance of a study on tool storage made by L. A. Hill (18) is as follows:

1. The tools must be easily accessible to save the students time so that he can spend a maximum of each shop period in constructive work.

2. The teacher must have an accurate check to prevent the loss of tools.

For the trips that were made to secure or return tools in laboratories using tool panels the average time per trip was 14 seconds. In laboratories using a tool room, the average time per trip was 34.8 seconds.

It was found that in laboratories using the tool panel, the class took one minute less to return tools and put away work than was taken in the laboratories using tool rooms.

From the study it was consluded that the most efficient system was the one with tool kits at the benches supplemented with tools from two or more properly located tool panels. The study also brought out the importance of two or more tool panels to reduce the walking distance and therefore the walking time.

The second most efficient system was the one with all tools on three or more tool panels...it might be the most practical as it requires a smaller investment in tools, than to equip each bench with a kit of tools...tool kits at the benches add to the problem of making an accurate check of the tools at the end of the period.

In the general shop with areas for each unit of work, a tool system with a panel for each area is a good arrangement.

Relative to this same feature, Miller (26) says:

> The tools for each department are kept in their respective departments and painted different colors to avoid misplacement. Thus the rack and all the tools for electricity may be painted red with a black outline under the tools, green for metal, yellow for wood, and blue for general.
>
> One rack will be sufficient for the shop if it can be placed on the intersection of red lines. Half an A frame may be built in each department if wall space is available, but tools are not checked as easily at the end of each period.

Supply Storage

Hunter (19:184) says, "When making provisions for storing supplies, remember to provide space large enough to accommodate standard sized materials...large amounts of lumber, supplies and materials should not be openly accessible to pupils."

Williams (49) writes that "The general storage room provides space for metals and lumber. A large metal top bench in the center of the room serves as glue table with shelves underneath for the storage of an assortment of clamps. Large metal lockers are located on each side of the entrance and are used for storing small supplies."

In reference to lumber storage, Badger (3) writes as follows:

> The lumber rack attached to the wall is made of short lengths of pipe inserted into pieces of 4 x 4 inch pieces. It's location inside the shop...greatly increases the efficiency of the instruction. A careful study was made of the problem...and it was found that the instructor spent too much time in trips to and from the lumber storage room. The location of the lumber rack in the shop makes it possible for the instructor to supervise the cutting of stock from any part of the room.

Fales (13) says, "The type of lumber rack which is found most satisfactory in an industrial arts shop consists of about four up-rights, fastened to the wall. At about 15" intervals, pipes are inserted in them at a very small angle. Lumber is then laid on the pipes in a horizontal position, or placed vertically between the up-rights."

John J. Donovan (12) points out some features of the lumber room as follows:

1. The lumber room should be accessible to outside delivery of materials, lumber, and other supplies.
2. The size of a lumber room should be 8 x 12 feet or 10 x 15 feet.
3. There should be a double door at least 5 feet wide (double doors 2'-6") opening into the shop.
4. The lumber rack should be 1¼" galvanized pipe placed 12" o. c., 18" deep, braces to wall 3'-0" o. c. vertically. This will provide for stacking long and short pieces of lumber vertically. The floor of the rack should slope one to 1½ inches.

Project Storage

The provision of space for unfinished projects made by boys in industrial departments has been given only recent consideration. Only a few solutions to this problem of keeping the shop orderly have been found. D. M. Schweickhard (36) shows a detailed drawing of an economical series of shelves which allow storage for the heavy and light articles of various sizes.

Hunter (19:184) believes that in a laboratory where several types of activities are taken up at different times of the year, one really needs a separate room with many shelves and cases. He also says that this room should be adjacent to the laboratory and on the same floor level.

Badger (3) describes project storage as follows:

> The cabinets for unfinished work are so designed and constructed that material up to 31 inches in length can be placed in the shelves, with two students assigned to each shelf. The doors are all paneled with metal grills, and all locks are master-keyed. The grilled panels enables the instructor to check the contents of the lockers at all times without having to unlock the doors.

Large lockers, built to accommodate wood and metal projects in the finishing stage, are provided in some school shops. The doors of the cabinets are made of heavy wire mesh screen, and the sides are slats to provide plenty of air circulation. Each locker is equipped with a lock and key. This type of locker is described by Radtke (33) in his article.

Schmidt (35) suggests this when providing space for storage, "Equip for plenty of storage space for both supplies and work." In this connection, Badger (3) says, "Experience has shown that it is easier to get $500 of built-in features at the time a building is constructed than it is to get $100 in supplimentary equipment later on."

According to Fales (13), "Adequate storage may be obtained by providing drawers under the bench tops for unfinished projects. Other space may be provided from built-in storage cabinets, steel

cabinets, or a storage room if the latter can be afforded."

Pupil Material Lockers

In working with various media and personal tools, there is a recognized need for a safe place in which each student may keep such materials while he is not in the shop. Hunter (19:183) says, "Whenever possible the lockers for the pupils' work should be located in the shop."

A large metal-base bench with four woodworking vises equipped with twelve pupil lockers below, has been recently developed. A similar metal wall bench with lockers is available. Williams (49) says, "The space in the center of the laboratory is occupied by three work benches. These, together with the wall benches, have metal unit lockers equipped with self-closing locker doors. Each student locker is 12 by 15 by 24 inches."

Display Space

The need for display facilities for the completed projects of industrial arts students is recognized. According to Warner (46) the show case should be built in the principle corridor walls rather than in the shop room itself. The show case should be equipped with vertical rows instead of horizontal rows of light. The case should be equipped with plate glass shelves supported with movable brackets.

Certainly a shop department should not be without the necessary blackboard and bulletin board space for displaying the visual aid

material pertaining to industrial arts work. Hunter (19:183) believes that "Blackboards and bulletin boards should be placed so that the pupil can see them without glare. If possible bulletin boards should be artificially lighted." He also describes a show case that is electrically lighted, and in which the lights are controlled by an "electric eye."

Schmidt (35) says, "Blackboards and full-width bulletin boards are considered quite essential in most shops; in practice, comparatively little space is devoted to them and frequently makeshift devices are relied upon."

In respect to display space, Fales (13) says:

> Slightly above the blackboard should be placed a shelf approximately 10" or 12" in width, on which may be displayed small projects made either by the instructor or the pupils. These serve to make the shop wall interesting, attractive and educational. Probably the greatest asset of this display lies in the stimulation which is offered to the casual pupil observer.

Assembly Space

Occasionally large projects, such as boats, chest of drawers, or tables are constructed in the school shop. Provisions for ample space in which to assemble these will facilitate this type of work. In respect to this item, Hamon and Standish (17) say, "Ample space must be provided for the assembly of projects of various sizes without overcrowding or interfering with adjoining activities."

Shop Equipment Problems

Even with the well-known Bruce's Shop Annual, and assistance from state departments, there occur many instances of poor judgment in the selection of equipment for industrial arts. Schmidt (35) says,

> In many instances, especially in the small school systems, the purchase of shop equipment and planning the layout is left to the local teachers...Observation shows that much equipment is planned for and purchased with little thought of its fitness to serve the needs and objectives of the work...In case there is not enough money on hand to equip all of the shops completely, it is a good plan to carefully study the situation and provide the most needed and useful equipment first.

In conclusion Schmidt (35) lists several rules that should be observed:

1. Do not overequip, neither should there be stinting.
2. Equip for essentials and immediate needs first. Embellishments and extensions may come later.
3. Before equipping be sure there are firmly established objectives; equip for their fulfillment.
4. Do not crowd the equipment. Allow for plenty of work space so that machines may be used to capacity.
5. Do not spend money for equipment just because there are funds. Equip for defensible purposes.
6. Make the specifications for equipment specific and clear-cut.
7. Do not purchase on the spur of the moment, even if the money that is being spent belongs to other people; they are entitled to some thought and consideration.

Warner (46) says, "The tendency seems to be toward smaller, better designed equipment, which allows the school to use its more limited funds to spread over a wider range of installation."

Earl L. Bedell (7) writes:

> An activity or job analysis must precede any intelligent request to set up equipment and supply lists. Then tools, materials, and machines can be purchased intelligently for the course under consideration.
>
> One observation has been that a machine must be sturdy enough to resist misuse by young and careless learners.
>
> School shop equipments are limited, in most cases, by the amount of money that is available. For purposes of discussion, therefore, it might be well to consider the number and type of power machines to be provided from that point of view. Machines are built in price ranges very much as are automobiles. Irrespective of the price paid, one can be assured that the manufacturer has placed into the machine all the accuracy and fineness of construction that he possibly can at that price. Competition guarantees that. The decision rests with the school to decide just what quality of workmanship and finish are required for the instructional program.

According to Struck (38) the general shop should be equipped as follows:

> The shop should have equipment for four to eight major types of activities. Those most commonly found are general mechanical drawing, general woodwork, general metalwork, sheetmetal, general electric work, and sometimes elementary automobile mechanics, concrete work, printing, home mechanics, general crafts, photography, hobby activities, and the like. In any event, there ought to be facilities for shop sketching and drawing in an adjoining planning center as mentioned, or else in the main part of the shop.
>
> The equipment can be arranged in units--wood here, electricity there, molding and the other activities elsewhere.
>
> The work can be planned so that each pupil will have contact with all types of work for which provision has been made.

Naturally, they cannot all start with the same activity because the equipment is planned so that there will be enough for only a few students in each activity. Otherwise some of the equipment would stand idle a part of the time. This situation presents the first serious teaching problem.

Roy R. Van Duzee (44) presents a list of criteria that have been found helpful in determining the kind and amount of equipment for a shop, as follows:

A. Concerning what the shop is to be equipped for:

1. Purpose or objectives of the work
   a. Introductory, finding, acquaintance
   b. Prevocational
   c. Technical
   d. Trade
   e. Hobby, Recreational

2. Activity or activities to be taught
   a. Specific operations to be taught
   b. Degree of skill to be expected
   c. Rate of work or amount of work to be done
   d. Size of work
   e. Material to be worked

3. Grade where taught
   a. Age of student
   b. Size of student

4. Time allotment
   a. Length of periods
   b. Time per semester

B. Number of students to be handled

1. In a class

2. Total number of classes to be provided for

C. Method of teaching, class organization

1. Unit Shop

2. General shop equipment
   a. One unit at a time
   b. Several activities taught simultaneously

3. Amount of equipment assigned to individual students

4. Storage of individual equipment and unfinished work
   a. Bench space
   b. Cabinet space
   c. Combination bench and cabinet

D. Shop space available or planned

1. Size and number of rooms

2. Shape of rooms

3. Built-in cabinets and accessories

4. Separate lecture-demonstration space

E. Amount of money to spend

1. Immediately

2. Ultimately

In arranging shop equipment Hamon and Standish (17) say, "Equipment should be so arranged as to facilitate the work of the pupil and to relieve congestion or needless passing from one section of the room to another. Tools and supplies should be centrally located so that they are easily accessible to the entire shop."

Hunter (19:183) has this to say:

> In all laboratories, we should think of the sequential order in which machines and certain pieces of equipment are going to be used.
>
> Machines requiring a similar type of instruction should be grouped together. Also, machines requiring similar types of accessories could well be grouped in adjacent areas. This enables the teacher to be available to a group of similarly interested pupils with the least amount of confusion to the rest of the class.

Work Stations

When providing individual bench space or work stations for each pupil, Fales (13) recommends the following:

> A portion of the shop should be set aside for a formal arrangement of single, double or four-pupil benches. In the extremely small shops, four-pupil benches, with a vise on each corner, will be found to be most economical. Benches which have 8 individual drawers, built into the space underneath the top, provide a locker for almost every boy taking industrial arts work in any given shop. If the space is not utilized in this manner, it is usually completely wasted.
>
> In selecting benches for a shop, it is never well to purchase the same type of bench for, let us say, 24 pupils. Four or six double benches and 10 or 12 single ones provide adequate working positions for boys in the majority of industrial arts shop classes. If more double benches are desired, single ones may be placed back to back, thus obtaining economy in floor space and requiring little sacrifice in other ways. These same single benches may be placed end to end around the wall, thereby providing a different grouping from that ordinarily found in a woodworking shop.
>
> The minimum distance between benches in the center of the floor is 30 inches.

Lush (22) says, "A room with woodworking benches wired with outlets, and with a metalworking vise on every fourth bench; with stools, drawing boards, a soldering bench, facilities for wood finishing, appropriate tools, recitation seats: This may be ideally used for a home mechanics situation.

For making an attractive looking laboratory, Warner (46) recommends a steel-body bench which houses 12 lockers one foot wide, 15 inches high and two feet deep. Each bench is equipped with four rapid-acting woodworking vises.

Concerning the location of work benches, L. R. Abbott (1) writes as follows: "...Benches placed nearer than three feet apart would not provide sufficient working space for a student...if double benches are used, five feet will be necessary. To provide for adequate circulation...four feet are required for the main aisles."

CHAPTER III

PHASES OF INSTRUCTION RELATED TO PLANNING

In this study it was necessary to ascertain the type of shop, class organizations and related characteristics of the new one-teacher departments. Two sections of the Department Request Sheet (See Appendix Form II) were directed toward securing information concerning courses of study, shop requirements, general shop units, and time allotments, which are considered determining factors in shop planning. It will be noticed that two-thirds of these new one-teacher departments are located in junior-senior high schools (Table III).

General Shop Courses

The general shop type of organization seems to be much more common in the one-teacher department than the unit style.

According to Table IV 82.2 per cent of all the one-teacher departments surveyed offer general shop courses.

TABLE IV

General Shop Courses
(56 School Shops)

Type of Shop Organization	General Shop Course		Per cent having General Shop
	Yes	No	
Jr.-Sr. High School (Grades 7-12)	31	6	55.3
Junior High School (Grades 7-10)	9	2	16.0
Senior High School (Grades 9-12)	6	2	10.7
Total	46	10	82.2*

*Read: 82.2 per cent of 56 shops offer General Shop courses.

Industrial Arts Offerings

Industrial arts courses are combines in several ways resulting in a wide scatter of shop work experiences in the field. There is a total of 25 different industrial arts courses taught in general shops in the forty-six one-teacher departments studied (See Table V).

Woodworking and wood finishing appear in all (100%) of the general shop courses, while bench metal and mechanical drawing are units of work in 93.4 per cent of the shops.

Electricity is taught in four-fifths (80.4%) of the general shop courses. Art metalcraft is taught in approximately three-fourths (73.9%) of the courses. Carpentry, home mechanics, machine shop, and forge work are taught in one-half (50%) of the general shop courses. In one-third (32.6%) of the general shop courses, a unit

of work in foundry is included.

Farm mechanics, auto mechanics, architectural drafting, and printing are activities in practically one-fourth of the general shop courses.

Craft subjects, such as leathercraft, art fibre, plastics, and photography, are less frequent activities in the shops surveyed.

Plumbing, tire repairing, shoe repairing, and general repair are each reported in only one instance.

TABLE V

Industrial Arts Offerings

(46 Departments)

Units	Frequency	Per cent
Woodworking	46	100.0*
Wood Finishing	46	100.0
Bench Metalworking	43	93.4
Mechanical Drawing	43	93.4
Electricity	37	80.4
Art Metalcraft	34	73.9
Carpentry	25	54.3
Home Mechanics	25	54.3
Machine Shop	25	54.3
Forge	22	47.8
Foundry	15	32.6
Farm Mechanics	11	23.9
Printing	11	23.9
Auto Mechanics	10	21.7
Architectural Drafting	9	21.4
Leathercraft	6	13.0
Ceramics	5	10.8
Art Fibre	4	8.7
Plastics	2	4.3
Art and Design	2	4.3
General Repair	1	2.1
Shoe Repairing	1	2.1
Photography	1	2.1
Tire Repairing	1	2.1
Plumbing	1	2.1

*Read: 100.0 per cent of the shops include woodworking in their general shop course.

Required Courses in Industrial Arts

Industrial arts courses are required in one or two grades so that all pupils receive some practical art experiences. From the findings in Table VI it is evident that there is a lack of uniformity in shop work requirements as to grade level.

Practically one-half (48.5%) of these small schools require shop work in the seventh and eighth grade. Approximately one-fourth (26.8%) of the schools surveyed require no industrial arts work, but all offer it. Eight schools (14.3%) out of the fifty-six require shop work in all three grades (7, 8, and 9). Three (5.3%) schools have a requirement in four grades (7, 8, 9, and 10). As indicated, one school requires seventh grade shop work; one requires eighth grade shop work, and one requires ninth grade shop work.

When considering the requirements by separate grades, approximately three-fourths (71.2%) of the schools require shop work in the seventh and eighth grades. Further study shows that approximately one-fourth (21.3%) of the schools surveyed require shop work in the ninth grade. A tenth grade shop course is required in three (5.3%) of the schools surveyed.

TABLE VI

Required Courses in Industrial Arts

Grade Levels and Combinations	No. of schools	Per cent
7	1	1.7*
8	1	1.7
7 and 8	27	48.5
7, 8, and 9	8	14.3
9	1	1.7
7, 8, 9, and 10	3	5.3
Not Required	15	26.8

*Read: 1.7% of the schools require shop work in the 7th grade.

Free Election of Courses

In addition to required industrial arts courses, all schools offer pupils the opportunity of electing them. The results of the survey in respect to free election is shown in Table VII. The average number of eligible boys in the Grade 7-10 type of school is 140. Of this number, three-fourths (76.3%) elect shop work. In the Grade 9-12 type of school the results show that 189 boys are eligible, of which approximately one-half (52%) elect industrial arts. In the Grade 7-12 type of school, there are 205 boys, with two-fifths electing shop work.

TABLE VII

Free Election of Industrial Arts
(56 Schools)

Type of School	Eligible*	Elections**
Grades 7-10	140	76.3%
Grades 9-12	189	52.0%
Grades 7-12	205	41.7%

*Average number of boys in the various schools eligible for shop work.

**Percentage of the boys who elect shop work where it is not required.

Time Allotment for Industrial Arts

The time allotment for industrial arts work varies from school to school because of difference in requirements, length of period, and emphasis placed upon this phase of education.

The results of the time allotted shop work in the one-teacher departments surveyed are tabulated in Table VIII. The time allotment per week gradually increases from 148.5 minutes in the seventh grade to 323.5 minutes in the twelfth grade.

Combining the seventh, eighth and ninth grades (junior high school levels), the average time allotted to shop work is 193 minutes per week.

In grades seven and eight, where approximately one-half (48.5%* of the schools require shop work in both grades, it is found that the time allotment is 157.5 minutes per week. In grade nine, where nearly one-fourth (21.3%) of the schools require shop work, the time allotment if found to be 264 minutes per week.

When combining the tenth, eleventh, and twelfth grades the results show that 311.7 minutes are devoted to shop work weekly. In the twelfth grade where specialization may be evidenced, the time allotment (323.5 minutes per week) is the greatest.

TABLE VIII

Time Allotment for Industrial Arts
(56 School Shops)

Type of Shop	Grade Levels 7	8	9	10	11	12
Junior High School Shop	150	173	237	286		
Senior High School Shop			309	356	328	348
Jr.-Sr. High School Shop	147	160	246	272	286	299
Total	297	333	792	914	614	647
Average	148.5	166.5	264	304.6	307	323.5*

*Read: In the 12th Grade, 323.5 minutes per week are devoted to shop work.

Size of Classes

The size of industrial arts classes in the schools surveyed show a wide variance. Table IX shows that the shop classes in grades seven to nine range from 10 to 39 pupils per class. The average size in these grades is 22.93 pupils.

The average size class in grades ten to twelve is 22.18 pupils, with classes ranging from 6 to 35 pupils.

TABLE IX

Size of Classes

Grade Level	Number	Range
Grades 7-9*	22.93	10-39
Grades 10-12	22.18	6-35

*Read: The average size shop class in the junior high school (7-9) is 22.93 pupils, with a range of from 10 to 39 pupils.

Industrial Arts for Girls

Small secondary schools reviewed in this study are offering the girls the same opportunities to take industrial arts courses as the boys. The results show (Table X) that 10 (19.2%) schools have made provision for girls in industrial arts.

From Table XI facts pertaining to time allotment, number of meetings per week, and average class size for girls in industrial arts may be ascertained. The time allotment for girls' work at the

junior high school level is greater (1.4 times) than for senior high school girls. Girls classes meet on the average of 3.5 times per week. Twenty pupils per class is the average size for girls industrial arts.

TABLE X

Industrial Arts Provisions for Girls

Grade Level	No. of Schools	Per cent
10, 11, and 12	5	9.6
7, 8, and 9	5	9.6
Total	10	19.2*

*Read: 19.2 per cent of the schools offer regular shop classes for girls.

TABLE XI

Average Time Allotment and Class Size
For Girls Industrial Arts

School	Time per week	Meetings per week	Class size
Junior High School*	234 min.	3.75	20.2 pupils
Senior High School	167 min.	3.5	19,8 pupils

*Read: In the junior high school girls' take industrial arts on an average of 234 minutes per week in 3.75 meetings per week. The average size of class is 20.2 girls.

CHAPTER IV

PHYSICAL PLANNING PRACTICES

The information requested on the Department Request Sheet (Form II) relative to the physical plant and equipment was only general in nature. The scope of this problem is such that each phase of the respective parts might be made a subject for a complete study.

The study of the physical plant in new one-teacher departments involves these phases; location of industrial arts departments within the building, shape of shops, floor space, auxiliary rooms, the ratio between area of the main shop and auxiliary rooms, storage provisions, work stations, blackboard and display space, special features, and partitions. The detailed analysis of these physical aspects will follow.

Location of Industrial Arts Departments

The results of Table XII indicate that new school shops are located on the first floor or ground floor in nearly three-fourths (71.3%) of the cases. One-fifth (20%) of the departments are located in basements. Shop departments are located on more than one floor in four (7.1%) of the schools surveyed. A shop department as a separate building was found in only one instance, as indicated in the same table.

TABLE XII

Location of Industrial Arts Departments

(56 Shops)

Floor Level	No.	Per cent
First or Ground Floor	40	71.3*
Basement	11	20.0
First and Basement	3	5.3
First and Second Floors	1	1.7
Separate Building	1	1.7

*Read: 71.3 per cent of the shops are located on the first or ground floor.

Shape of Shops

From the floor plans received (Table XIV), the shape of the various shops was determined.

As indicated in Table XIII, the ratio of width to length of twenty shop floor plans ranges from 1:1 to 1:3.5. The average ratio (width to length) of new one-teacher departments is 1:2.3. In other words, the length is practically two and one-third times the width. A room twenty-four feet wide would thus be forty-six feet long or approximately 1300 square feet of area.

TABLE XIII

Shape of Shops

Size		
Width	Length	Ratio
21	73	1:3.5*
22	70	1:3.2
22	60	1:2.7
20	60	1:2.7
22	58	1:2.7
25	66	1:2.7
26	66	1:2.7
23	56	1:2.5
32	76	1:2.5
21	56	1:2.4
22	52	1:2.4
30	60	1:2
30	60	1:2
23	48	1:2
37	72	1:1.9
37	72	1:1.9
39	72	1:1.8
30	50	1:1.7
35	50	1:1.5
30	30	1:1

*Read: The ratio of width to length is 1:3.5. Average ratio is 1:2.3.

It will be noticed on the questionnaire (Form II) that a request was made of the secondary school officials for a floor plan of their shop (or shops). The result of this request is shown in Table XIV. Practically one-half (45.7%) of the officials sent floor plans of their departments.

TABLE XIV

Floor Plans Received

	Number	Per cent
Shop Plans Received	26	45.7*
Shop Plans Not Received	30	54.3

*Read: 45.7 per cent of 56 school officials sent a sketch of the shop floor plan

Floor Space

The floor space devoted to shop work is indicated in Table XV. The results show that the main shop room in the fifty-six schools contains 1600 square feet of floor space. With the average class size of twenty-two pupils, as found in the data, there would be approximately 70 square feet of floor space per pupil. In about one-half (50%) of the shop departments, the main shop includes auxiliary areas such as finishing, planning, supply storage, or project storage.

The average area of all additional (auxiliary) rooms was found

to be 287.7 square feet. With an average size class of twenty-two pupils there would be approximately 13.2 square feet of additional space (exclusive of main shop) per pupil for each class period. This additional floor space is used for auxiliary rooms as described in the next section.

TABLE XV

Floor Space for Industrial Arts

Space	Number of Departments	Floor Space (Sq. Ft.)
Main Shop	56	1600.0*
All Additional Rooms	41	289.7

*Read: 1600 square feet is the average size of the main shop in 56 shop departments.

Auxiliary Rooms

In addition to the main shop, many of the shop departments surveyed have auxiliary rooms as indicated in Table XVI. The findings show that over one-half (59%) of the departments have a finishing room. Over one-half (55.3%) of the shop departments have a room for project storage.

Table XVI indicates that over one-third (39.3%) of the shop departments have a room for storing supplies in general. Over one-third (39.3%) of the fifty-six shops have a lumber room for lumber storage purposes. A separate tool room is evident in less than one-

third (30.3%) of the shops. Slightly over one-fourth (28.5%) of the departments have an auxiliary room for mechanical drawing. As indicated, some departments (12.5%) have a library and planning center where pupils may draw as a part of their planning procedure.

Some provisions are made for lecture and demonstration facilities. Four shops (7.1%) have a room for this purpose. One-fifth (17.9%) of the departments have an office and conference room where clerical work or counseling may be done.

Two shops (3.5%) are equipped with a dark room for photography or duplicating purposes. A room for printing activities is reported in 12.5 per cent of the one-teacher departments.

Other rooms less frequently provided for instructional purposes are: Machine room, general crafts, farm shop, graphic arts, and locker room, as found in Table XVI.

TABLE XVI

Auxiliary Rooms for Industrial Arts

Room	Number*	Per cent**
Finishing	33	59.0
Project Storage	31	55.3
Supplies in General	22	39.3
Lumber	22	39.3
Tool Room	17	30.3
Mechanical Drawing	16	28.5
Office and Conference	10	17.9
Printing	7	12.5
Library and Planning	7	12.5
Recitation and Demonstration	4	7.1
Wash Room	3	5.3
Finishing and Storage	2	3.5
Lumber and Gluing	2	3.5
Dark Room	2	3.5
Machine Room	1	1.7
General Crafts	1	1.7
Farm Shop	1	1.7
Graphic Arts	1	1.7
Locker Room	1	1.7

*Number of shops with these rooms (floor space) in addition to the main shop. Read: 33 school shopshave a finishing room in addition to the main shop.

**Per cent of school shops with these rooms. Read: 59 per cent of the school shops have a finishing room in addition to the main shop.

Area of Auxiliary Rooms

The area of the various auxiliary rooms and the per-pupil area for these rooms is shown in Table XVII. The floor area of the room for graphic arts or mechanical drawing was found to be approximately 700 square feet (32 square feet per pupil). The area of the library-planning room is 321.2 square feet (14.6 square feet per pupil). The

per-pupil area in the printing room was found to be 7.2 square feet. It was found that the general supply room contains 10.4 square feet per pupil. The area of the lumber room is 193.3 square feet (8.7 square feet per pupil).

The area of the project storage room is 121.7 square feet (5.5 square feet per pupil). A room 10 x 10 feet is the average size of the tool room, as indicated in Table XVII.

The storage room for finishing materials have an average of 221 square feet (10 square feet per pupil) of floor area. The area for the lumber-project storage room averages 369 square feet.

The recitation-demonstration room has an average area of 471 square feet. As also revealed, the office-conference room contains an average of 67.5 square feet of floor space.

The finishing room, a common auxiliary room in a general shop, as found, contains an average of 106 square feet (4.8 square feet per pupil) of floor area.

As indicated, the additional rooms, such as: General crafts, dark room, locker room, and wash room have approximately 100 square feet of floor area (4 or 5 square feet per pupil).

TABLE XVII

Area of Auxiliary Room

Room	Area	Pupil Area
Farm Shop	900.0*	40.9**
Graphic Arts	768.0	34.9
Mechanical Drawing	687.8	31.3
Recitation-Demonstration	471.0	21.4
Lumber-Project	369.0	16.8
Machine Room	324.0	14.7
Library-Planning	321.2	14.6
Lumber-Gluing	300.0	13.6
Supplies in General	228.3	10.4
Finishing-Project	221.0	10.0
Lumber	193.3	8.7
Printing	159.0	7.2
Project Storage	121.7	5.5
Dark Room	121.0	5.5
General Crafts	112.0	5.0
Locker Room	110.0	5.0
Tool Room	109.6	4.9
Finishing (only)	106.0	4.8
Wash Room	104.0	4.7
Office and Conference	67.5	3.06

*Average size of auxiliary rooms. Read: The average size of the farm shop is 900 square feet.

**Read: The average sized room for farm shop is 40.9 square feet per pupil (based on average class of 22 pupils, data found in this study).

Ratios Between Area of Main Shop and Auxiliary Rooms

Figure II shows a relationship in area (square feet) between the main general shop and the other rooms as found in the fifty-six one-teacher departments. Not all these auxiliary rooms exist in any one shop but where one or more of them do exist, the average size in floor

area is as shown.

A comparison of the relative areas (ratio) between the main general shop and the additional rooms is given in Table XVIII.

TABLE XVIII

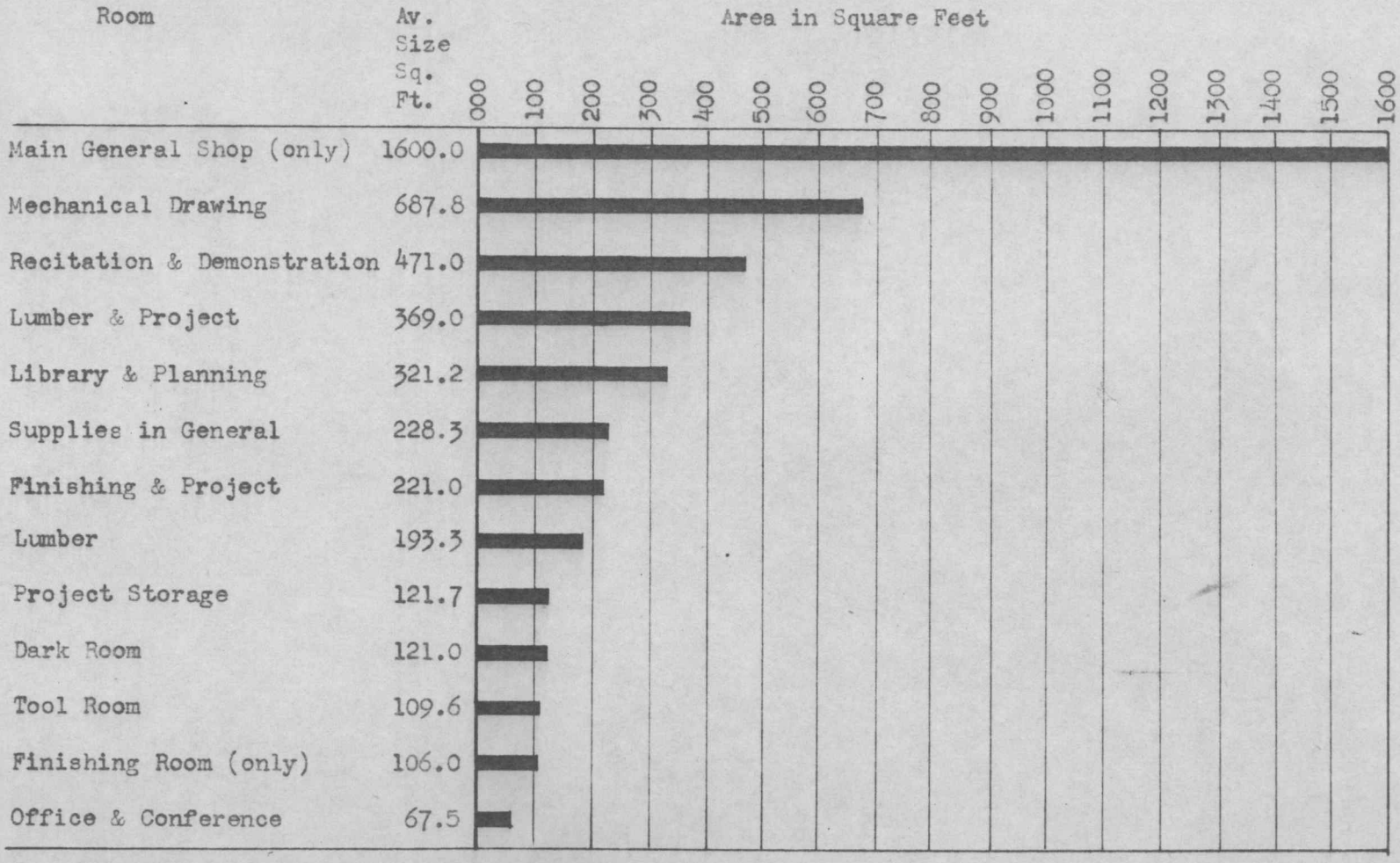
Ratio of Main Shop to Other Rooms

Room	Ratio
Mechanical Drawing	1:0.43*
Recitation-Demonstration	1:0.30
Lumber-Project	1:0.23
Library-Planning	1:0.20
Supplies in General	1:0.14
Finishing-Project	1:0.14
Lumber	1:0.13
Project Storage	1:0.08
Dark Room	1:0.08
Tool Room	1:0.07
Finishing (only)	1:0.07
Office-Conference	1:0.042

*Read: The ratio of the main shop to the mechanical drawing room where these exist is 1 to 0.43. A shop with an area of 1000 square feet has a drawing room of 430 square feet.

CHART II

Relationship between the Main Shop and the Auxiliary Rooms
(56 Industrial Arts Departments)



Storage Provisions

The findings respecting the storage provisions in the fifty-six new one-teacher departments appear in Table XIX. In approximately one-half (51.8%) of the shops, lumber is stored in a separate supply room. Lumber is stored in other ways, namely: A rack in the main shop (44.6%), mezzanine floor (93.5%), and tool room (1.7%) of the shops.

The results show that hardware is stored in the following places: Cabinet in the main shop in 85.7 per cent of the departments; in a supply room in 21.4 per cent of the shops; and in tool rooms in 5.4 per cent of the departments.

General supplies are stored in the following ways: Cabinets in the main shop (53.6%); supply room (41.1%); and finishing room (1.7%).

Finishing supplies are stored in cabinets in a finishing room in approximately one-half (48.2%) of the departments. A cabinet for finishing supplies in the main shop appears in about one-third (35.7%) of the shops surveyed.

In a majority of the departments (44.6%) lockers are provided in the main shop. Metal supplies such as sheet stock, bars, and rods, are stored in a supply room in 28.5 per cent of the shops. Sheet metal supplies, however, are stored under the metal bench, with bars and rods in racks in the main shop, in 23.3 per cent of the shops.

Referring to Table XIX, a wall cabinet in the main shop is the most common method of storing tools. There were two-thirds (66%) of the shops using wall cabinets. One-third (39.3%) of the shops

have a tool room.

The three most common places for storing unfinished projects are: Storage room, large cabinets, and finish room in the order named. Less frequent places for storing projects are: mezzanine floor, supply room, or on the floor in the main shop.

In twelve shops (21.4%) surveyed, bookcases were provided. Bookcases, containing books on related studies and projects, were found where a library and planning area had been provided. Machine accessory cabinets, type stands, and mechanical drawing cabinets were other types of cabinets reported.

TABLE XIX

The Storage Provisions
(56 Departments)

Type	Number of Shops	Per cent
Lumber Storage:		
Supply Room	29	51.8
Rack in Main Shop	25	44.6
Tool Room	1	1.7
Mezzanine Floor	2	3.5
Nails, Screws, Hardware:		
Cabinet in Main Shop	48	85.7
Supply Room	12	21.4
Tool Room	3	5.4
General Supplies:		
Cabinet in Main Shop	30	53.6
Supply Room	23	41.1
Finishing Room	1	1.7
Finishing Supplies:		
Cabinet in Finishing Room	27	48.2
Cabinet in Main Shop	20	35.7
Under Finish Bench	1	1.7
Cabinet in Lumber Room	2	3.5

Table XIX - Continued

Type	Number of Shops	Per cent
Pupil Lockers:		
Lockers in Main Shop	25	44.6*
Lockers in Corridor	3	5.4
Metal Sheets:		
Supply Room	16	28.5
Under Metal Bench	13	23.3
Rack in Main Shop	10	17.9
Tool Room	1	1.7
Metal Bars, Rods:		
Supply Room	16	28.5
Rack in Main Shop	15	26.5
Under Metal Bench	7	12.5
Tool Room	1	1.7
Tool Storage:		
Wall Cabinet in Shop	37	66.0
Tool Room	22	39.3
Supply Room	3	5.4
Individual Benches	1	1.7
Unfinished Projects:		
Storage Room	15	26.8
Large Cabinet	11	20.0
Finish Room	10	17.9
Lockers	5	9.0
Lumber Room	4	7.1
Mezzanine Floor	3	5.4
Shop Floor Space	2	3.5
Main Shop	2	3.5
Supply Room	1	1.7
Miscellaneous:		
Bookcase	12	21.4
Machine Accessories Cabinet	7	12.5
Type Stands	7	12.5
Mechanical Drawing	1	1.7
Drawing Board Cabinet	1	1.7

*Read: In 44.6% of the shops, pupil lockers are in the main shop.

Work Stations

Table XX shows the type and extend of work stations and miscellaneous bench space as found in fifty-six new one-teacher shops. Over one-half (57.1%) of the departments are equipped with double benches, while one-third are equipped with single benches. The four-place bench appears in four (7.1%) shops.

Practically all (92.9%) of the shops are equipped for drawing, thus providing instructional planning facilities. One-fifth (20%) of the departments provide work stations for printing. One shop is equipped with fifteen combination wood, metal, and electrical benches, and so provides a work station for more than one activity.

Four-fifths (83.9%) of the shops provide work stations for metal-working, while practically one-half (48.2%) have electrical bench space.

Miscellaneous benches for other general shop activities are also indicated in Table XI. Wood finishing benches are most common, appearing in more than four-fifths of the shops. Benches for soldering, ceramics, automotive, machine equipment, foundry, lay-out, glue, library, leather, display, bookbinding, and welding are other bench provisions.

At this point, reference is made to Part II of Table XX. This table shows the results of the average number of the various types of work stations and benches that are found in one-teacher departments. Where single benches are used, approximately eighteen benches are provided in the average shop.

TABLE XX (Part I)

Word Stations and Miscellaneous Bench Space

(56 School Shops)

Type of Bench	No. of Shops	Per cent
Work Stations:		
Woodworking Benches		
Double Bench	32	57.1*
Single Bench	20	35.7
4-Place Bench	4	7.1
3-Place Bench	1	1.7
Drawing Bench	52	92.9
Metalworking Bench	47	83.9
Combination Wood, Metal, and Electrical	1	1.7
Miscellaneous Benches:		
Wood Finishing Bench	49	87.5
Electrical Bench	27	48.7
Printing Bench	11	20.0
Soldering Bench	10	17.9
Ceramics Bench	8	14.3
Automotive Bench	6	10.7
Machine Equipment Bench	6	10.7
Foundry Bench	6	10.7
Lay-out Bench	5	9.0
Glue Bench	4	7.1
Library Table	3	5.4
Leather Bench	1	1.7
Display Bench	1	1.7
Bookbinding	1	1.7
Welding Bench	1	1.7

*Read: 57.1% of the shops have double woodworking benches.

TABLE XX (Part II)

Type of Bench	Number
Work Stations	
Woodworking Benches	
Single Bench	17.36*
Double Bench	7.53
4-Place Bench	3.25
3-Place Bench	1.0
Combination Wood, Metal, Electrical	15.0
Drawing Bench	12.25
Metalworking Bench	2.65
Miscellaneous Benches	
Printing	2.5
Electrical or Wiring Bench	2.0
Lay-out Bench	2.0
Power Equipment Bench	1.3
Wood Finishing Bench	1.27
Automotive Bench	1.16
Ceramics Bench	1.0
Soldering Bench	1.0
Glue Bench	1.0
Display Bench	1.0
Leather Bench	1.0
Library Table	1.0
Foundry Bench	1.0
Bookbinding Bench	1.0
Welding Bench	1.0

*Read: 17.36 is the average number of single woodworking benches provided in the average shop.

Blackboard and Display Wall Space

Table XXI shows that provisions have been made for bulletin or display space in 37 (75%) of the shop departments. The average space allotted for this purpose was found to be 75 square feet or approximately 3.4 square feet per pupil, where the average class size is 22.6 pupils.

Blackboards have been provided in over three-fourths of the shops. The average blackboard area is 58 square feet or approximately 2.6 square feet per pupil.

TABLE XXI

Blackboard and Display Wall Space

Space	Number	Average Area in Square Feet
Bulletin or Display Space	37	75*
Blackboard	41	58

*Read: 75 square feet is the average amount of bulletin or display space.

Special Features

Table XXII shows that practically three-fourths (71.3%) of the departments have a wash basin. Over one-half (57%) of the shop teachers have a personal filing cabinet. A private wardrobe is a part of the teachers facilities in approximately one-half (48.2%) of the departments.

Some of the other special characteristics of these shops are: Insulation in or on the ceilings, insulation in or on the walls, a display case, and wiring booths for electrical work. These features were found in approximately one-fourth of the departments, as the results indicate.

TABLE XXII

Special Features of New Departments

Special Features	Total Number	Per cent
Wash Basin	40	71.3*
Personal Filing Cabinet	32	57.0
Private Wardrobe	27	48.2
Insulation in or on Ceiling (acoustical)	14	25.0
Display Case, Projects	13	23.2
Wiring Booth, Electrical Work	13	23.2
Glazed Partitions	12	21.4
Insulation in or on walls against noise	9	16.0
Dust Exhaust System	4	7.1
Lavatories	3	5.4
Exhaust Bag on Power Saw	1	1.7
Automatic Ventilating and Heating Fan	1	1.7
Mezzanine Floor	1	1.7
Cement Floor	1	1.7

*Read: In 71.3 per cent of the school shops there is a wash basin.

Glazed Partitions

New one-teacher shop departments have glazed partitions between the main shop and certain auxiliary rooms as indicated in Table XXIII. Over one-third (37.5%) of the shop departments have glazed partitions. This type of partition is provided in 14.3 per cent of the departments between the general shop and the finishing room.

As shown, areas separated by glazed partitions are: main shop and tool room, printing and planning room, general shop and office, finishing and drawing rooms, general shop and drawing rooms, and the general shop and library.

TABLE XXIII

Glazed Partitions

Rooms	No.	Per cent
General Shop and Finishing	8	14.3*
General Wood and General Metal	3	5.4
General Shop and Office	2	3.6
Finishing and Drawing	2	3.6
General Shop and Library	2	3.6
Main Shop and Tool Room	1	1.7
Printing and Planning	1	1.7
Total	21	37.5

*Read: 14.3 per cent of the school shops have glazed partitions between the general shop and finishing room

Machine and Hand Equipment

Information concerning the extent of equipment for woodworking, metalworking, electricity, auto mechanics, ceramics, graphic arts, drawing, and finishing was reported relative to the fifty-six new one-teacher shops. Table XXIV shows the frequency where various machines are found in the different shops surveyed. The wood lathe is the most common machine, there being eighty-one lathes in the fifty-six new one-teacher shops or two lathes per shop occur as often

as one.

Practically all (96.4%) of the departments have a table saw. Three-fourths of the shops have a jointer. The jig saw was reported in two-thirds (62.5%) of the shops. A tool grinder for woodworking purposes is found in four-fifths of the shops. Over two-thirds (68%) of the departments have a drill press for woodworking purposes. Attachments for shaping, mortising, and sanding are popular accessories of this machine, as indicated in the table.

A sander of some type is a part of the equipment of certain shops. The small belt sander is reported in 42.9 per cent of the shops, while the disk sander is found in 10.7 per cent of the shops.

The extent of the metalworking equipment as shown in Table XXIV signifies that an anvil, screw cutting machine lathe, and a gas or electric furnace are found in more than fifty per cent of the school shops. Equipment for doing all types of general metal work operations is also shown. Burring, wiring, crimping, and beading operations are done on a combination machine in a majority of the cases, as indicated. A special metal spinning lathe is not very common in the shops. In majority of the cases the wood lathes are equipped with metal spinning accessories.

Table XXIV shows that one-fifth (20%) of the departments have a car motor for auto mechanics. The extent of the ceramics equipment is somewhat limited. Platen presses are reported by 19.6 per cent of the shops. It will be noticed that this printing equipment occurs only in the junior-senior type of shop, probably indicating that it may be used by senior high school boys only.

The school shops studied have only limited fixed drawing equipment. Three schools reported that they have a blue print machine and one school reported an azalid machine for duplicating purposes. However, one-fourth (23.2%) of the shops reported a blue print frame for sun printing.

Finishing equipment, such as spray booths and fans, air compressors and spray guns, is also limited in the fifty-six school shops. Five schools (9%) reported they have air compressors and spray guns.

TABLE XXIV

Machine and Hand Equipment
(56 School Shops)

Equipment	Jr. High Shop (7-10)	Sr. High Shop (9-12)	Jr. & Sr. Shop (7-12)	Total	Per Cent
Wood Lathe	13	13	55	81	144.6*
Table Saw	11	7	36	54	96.4
Grinder, Tool	10	8	31	49	87.5
Band Saw	6	8	30	44	78.5
Jointer	9	4	30	43	76.8
Drill Press	9	6	23	38	68.0
Jig Saw	9	5	21	35	62.5
Sander, Belt	4	2	18	24	42.9
Shaper	4	4	7	15	26.8
Mortiser	2	6	6	14	25.0
Mortising Attachments			13	13	23.2
Surfacer	1	1	6	8	14.3
Sander, Disk		1	5	6	10.7
Shaper Attachments			5	5	9.0
Router	2		2	4	7.13
Steamer (Bending Wood)			2	2	3.57
Belt-Disk Sander	1			1	1.7
Sander Attachments			1	1	1.7
Trimmer			1	1	1.7

*Read: 144.6 per cent of the school shops have a wood lathe.

Table XXIV - Continued

Metalworking and Electrical Equipment

Equipment	Jr. High Shop (7-10)	Sr. High Shop (9-12)	Jr. & Sr. Shop (7-12)	Total	Per Cent
Anvil	8	8	26	42	75.0*
Furnace, Gas or Electric	11	7	24	42	75.0
Engine Lathe	11	4	26	41	73.2
Grinder	6	4	13	23	41.07
Forge	4	2	14	20	35.7
Drill Press	6	1	11	18	32.1
Squaring Shears	3	3	10	16	28.5
Bar Folder	4	1	6	11	20.0
Metal Spinning Attachment For Wood Lathe			11	11	20.0
Buffer Attachment			9	9	16.0
Forming Rolls	2	2	5	9	16.0
Buffer	3	2	3	8	14.3
Combination Wiring, Burring, Crimping and Beading	2	2	6	8	14.3
Welding Outfit, Gas or Elec.	2		4	6	10.7
Shaper	2		3	5	9.0
Power Hack Saw	2		2	4	7.13
Brake	2		2	4	7.13
Metal Spinning Lathe	1		3	4	7.13
Bench Stakes	2			2	3.57
Large Gas Metal Furnace	1			1	1.7
Coal Furnace	1			1	1.7
Wiring Machine			1	1	1.7
Turning Machine			1	1	1.7
Beading Machine			1	1	1.7
Burring Machine			1	1	1.7
Bench Lever Shears			1	1	1.7
Milling Attachment for Lathe			1	1	1.7

*Read: 75 per cent of the schools have anvils.

Table XXIV - Continued

Auto Mechanics Equipment	Jr. High Shop (7-10)	Sr. High Shop (9-12)	Jr. & Sr. Shop (7-12)	Total	Per Cent
Car Motors	1		10	11	20.0*
Chassis			4	4	7.13
Air Compressor		1	3	4	7.13
Hydraulic Lift	1		2	3	5.35
Unit Parts, Differential, Transmission and Gears			1	1	1.7
Delco Generator and Gas Engines			1	1	1.7
Ceramics Equipment					
Furnace (molding)			2	2	3.57
Kiln	1			1	1.7
Kiln (electric)			1	1	1.7
Potter's Wheel					
Graphic Arts Equipment					
Platen Presses			11	11	19.6
Paper Cutter			4	4	7.1
Drawing Equipment					
Blue Print Frame		4	9	15	23.2
Blue Print Machine			3	3	5.3
Ozalid Machine	1			1	1.7
Finishing Equipment					
Air Compressor and Spray Gun		1	4	5	9.0
Spray Booth with Exhaust Fan			3	3	5.35
Spray Booth		1		1	1.7

*Read: 20 per cent of the shops have car motors for auto mechanics.

Machines in Order of Frequency

The entire list of the various machine and hand equipment for the several shop activities has been tabulated according to rank or importance. Table XXV illustrates this composite grouping of equipment.

The ten machines most commonly purchased for small shops are: wood lathe, grinder, drill press, table saw, band saw, jointer, furnace, anvil, machine lathe, and jig saw.

The ten next common are: belt sander, forge, squaring shears, wood shaper, bar folder, car motor, printing press, forming rolls, combination sheetmetal machine, and wood surfacer.

Other equipment in less than 12.7 per cent of the shops are as follows: mortising attachments, buffer, welding outfit, disk sander, air compressor and spray gun, wood shaper attachments, metal spinning attachments, metal spinning lathe, router, brake, metal shaper, power hack saw, air compressor, chassis, hydraulic lift, ceramics kiln, blue print machine and spray booth with exhaust fan.

Additional equipment in this group is as follows: trimmer, sander attachment, large gas metal furnace, wiring machine, turning machine, beading machine, burring machine, bench lever shears, milling attachment for lathe, ozalid machine, spray booth, Delco generator and gas engine, and unit parts such as differential, transmission and gears.

TABLE XXV

Machines in New Departments
Listed in Order of Frequency

Equipment	Number	Per cent.
Wood Lathe	81	144.6
Grinder	72	128.5
Drill Press	56	100.0
Table Saw	54	96.4
Band Saw	44	78.5
Jointer	43	76.8
Furnace (Gas or Electric)	42	75.0
Anvil	42	75.0
Machine Lathe	37	73.2
Jig Saw	35	62.5
Belt Sander	24	42.9
Forge	20	35.7
Squaring Shears	16	28.5
Wood Shaper	15	26.8
Bar Folder	11	19.6
Car Motor	11	19.6
Platen Press	11	19.6
Forming Rolls	9	16.0
Combination Sheetmetal Machine	8	14.3
Wood Surfacer	8	14.3

TABLE XXVI

Cost of Equipment

Machine	Cost
Wood Lathe	$ 84.00*
Grinder	54.00
Drill Press	74.00
Table Saw	144.00
Band Saw	115.00
Jointer	94.00
Furnace	20.00
Anvil	15.00
Machine Lathe	240.00
Jig Saw	43.00
Belt Sander	94.00
Forge	25.00
Squaring Shears	108.00
Wood Shaper	63.00
Bar Folder	75.00
Forming Rolls	75.00
Combination Sheetmetal Machine	40.00
Total	$1363.00**

*Read: The average cost of the wood lathe is $84.00.

**Read: The average total cost of the seventeen most frequent machines is $1363.00.

The values of the seventeen most frequent machines found in the new one-teacher departments are shown in Table XXVI. Every shop is not equipped with all of these machines. The total cost of these machines is approximately $1363.00.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

The scope of industrial arts education has grown from two or three to more than seventy activities during the past fifty years. Much controversy has arisen regarding the choice of physical facilities, methods of presentation, and subject offerings in small six- or four-year secondary schools in order that a representative area of this phase of instruction may be covered.

This study is concerned with the courses and the shop planning in one-teacher departments less than five years old to determine the present practices. A brief summary of the review of current literature on shop planning is as follows:

Authorities do not agree as to the advisibility of formulating shop planning standards. However, the following states, Pennsylvania, Michigan, New York, and others have standards and suggestions for planning one-teacher departments. The writer suggests that anyone contemplating a new shop should write to these states for this information.

There is evidence to show that limited floor space and under equipment may result in instructional difficulties and inefficiences. Extravagances such as excessive floor space and over equipment may have the same results.

Efficient planning for a one-teacher department must be based on the following: A sound modern philosophy of education; the type of school and community; the courses to be offered; the methods of

instruction; the building space; and money available to meet the requirements.

The shop in a small high school where one instructor is employed should be of the diversified multi-activity type. Some favor the comprehensive general shop and others believe the multiple-unit general shop to be superior.

In respect to general shop offerings, the existing literature shows that there are approximately seventy different industrial arts courses taught in general shops over the United States.

A recent survey shows the following: Three-fourths of the schools require industrial arts in the seventh and eighth grades with one-fifth requiring it in the ninth grade, the time allotment being 141 minutes per week. All other shop work is elective, with 288 minutes per week devoted to shop work.

Evidence shows that preference is given to the first floor level in a wing of the main building as the ideal location of a shop department.

In respect to shop size and shape, authorities agree that the shape (width to length) of the shop should be approximately 1:2, with a floor area of 50-75 square feet per pupil.

Forging, foundry, metalwork, and ceramics should be grouped together in one end of the shop is the consensus of opinion. Authorities also say that activities such as woodworking, electricity and drawing should be placed in the opposite end, with the office and planning center near the main entrance.

Authorities on lighting recommend 12-15 foot-candles of illumination for general shop activities and 25 foot-candles for the drafting portion. Even 100 foot-candles are recommended for very fine work. The R. L. M. Standard Dome reflector and the Glassteel Diffuser luminaires are both satisfactory, while the latter is recommended. Many leaders favor the indirect lighting system for the entire shop.

Walls should be painted a flat white or ivory to get the maximum efficiency from the lighting system. The walls four or five feet up from the floor should be of a darker shade than the upper wall or ceiling.

The building as designed by the architect determines the window or glass area. Industrial arts authorities say that the glass area should be approximately one-fifth of the floor area. Other recommendations are that the windows extend to the ceiling beginning four feet from the floor. Steel sash should be provided and the ceiling height should be at least twelve feet.

Ventilation is the problem of the ventilating engineer; however, present literature indicates that the system shall be capable of supplying not less than six complete changes of air per hour. Present practices in shop planning point toward air-conditioning for efficiency.

Sanitary measures as recommended by authorities are: Dust exhaust system, built-in cabinets, elimination of all dust collectors, a smooth finish on concrete floors where they are essential, and a hood over that equipment which causes smoke, odors, or gases. Exhaust

fans in ducts or flues should be provided.

For sound control, industrial arts leaders recommend acoustical wall and ceiling treatment, either the acoustical board or plaster. Acoustical board is economical from the heating standpoint. Transmitted noises may be isolated by proper floor insulation and by the use of insulating materials at the base of noise-making equipment.

Floors are one of the most important considerations in planning a new department. Materials recommended for the school shop are: End-grain blocks, wood-block tile, and 5/4 inch maple flooring. Cork tile, rubber tile, and mastic tile are recommended for the drawing and office areas. Smooth finished concrete is recommended for the foundry, forge, welding, and auto mechanics areas.

For teaching efficiency school shop authorities recommend the following: Class seating facilities, a library and planning center, and a desk for the instructor.

Industrial arts leaders recommend certain safety precautions in planning a new department. Machines should be arranged for maximum safety; fire extinguishers should be placed near doors; inflammables should be safely stored; and all power machines should be grounded.

Present practices indicate that the following facilities are provided for in planning new one-teacher departments: wash basin with trap, floor drain and a drinking fountain. Additional facilities recommended are: Gas outlet near the forging and foundry, floor outlets for power machines, and a red pilot light at or near the switch, controlling all electric circuits.

Present practices also show that the wall tool cabinet is the most efficient system of storing tools. It is also the most practical from the investment standpoint.

Various methods are used for supply storage. The general storage room is recommended by a majority of the leaders. Where the floor space is limited, supply racks are provided in the main shop.

For storing unfinished projects, the following is recommended: Shelves in the finishing room, a separate room with shelves and cases, or large lockers with grilled panel doors.

Pupil material lockers are provided under work benches, in built-in wood cabinets, steel cabinets, or in a separate or auxiliary room.

A display case should be built in the corridor of the main building in order to bring the practical arts program before the students and public. Ample wall display space is considered essential for exhibiting visual aid materials relative to industrial arts activities. Space for assembling large woodworking projects should be provided.

A job or activity analysis of the work to be performed is quite essential before equipment can be purchased intelligently. The present literature and practices are indicative of a trend toward smaller and better designed equipment. Where limited shop funds are available, they are used for a greater diversity of smaller, less expensive machines, rather than for a few expensive machines.

Machines must be centrally located if used in more than one area, and machines requiring a similar type of instruction should be grouped together.

Authorities recommend the following types of work stations:

A four-place steel-body bench, equipped with four wood vises which house twelve pupil lockers, and a combination single bench equipped for drawing, woodworking, electricity, and bench metal.

Summary of Findings

The results of the questionnaire data concerning the present practices in planning new one-teacher departments in the eastern and central states are summarized:

Four-fifths (82.2%) of the schools surveyed offer general shop courses. The specific unit shop is common in the remainder of the departments.

It was found that there are twenty-five different industrial arts courses taught in the forty-six general shops. The first six courses are: woodworking, wood finishing, bench metalworking, mechanical drawing, electricity, and art metalcraft.

Approximately three-fourths of the schools require shop work in grades seven and eight, while one-fourth have a requirement in the ninth grade. A small per cent (5%) require tenth grade shop. All other courses offered are elective.

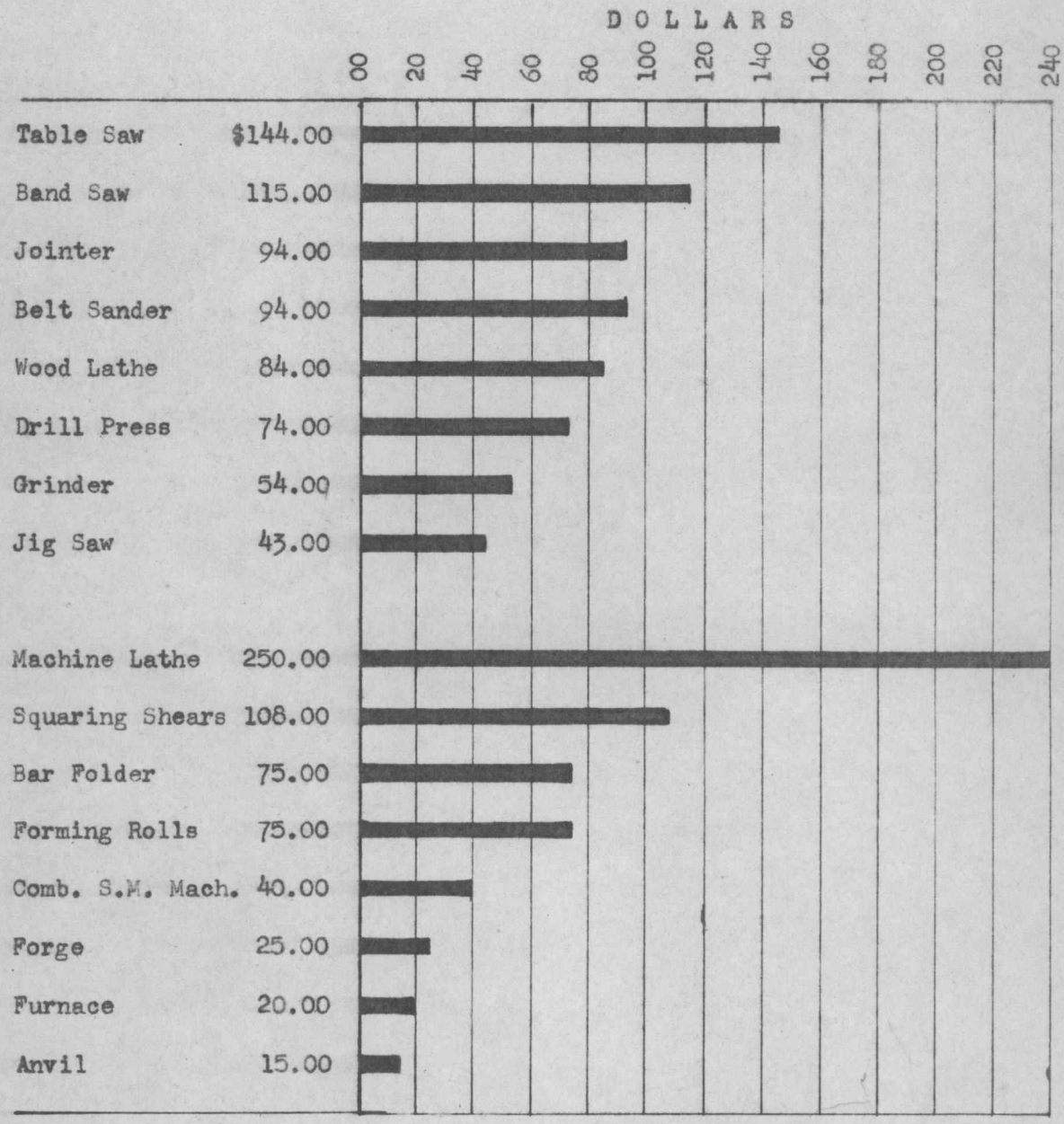
Forty-one per cent of the boys in the grade 7-12 type of school elect industrial arts where it is not required.

The following weekly time allotment was found in the fifty-six schools: Seventh and eighth grades, 157 minutes; ninth grade, 264 minutes; and the senior high school grades, 311 minutes.

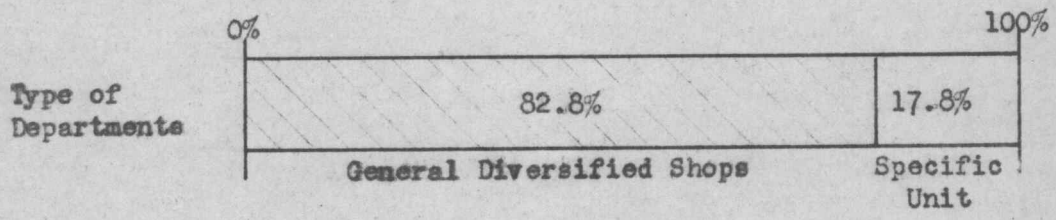
It was found that the average size class was twenty-two pupils,

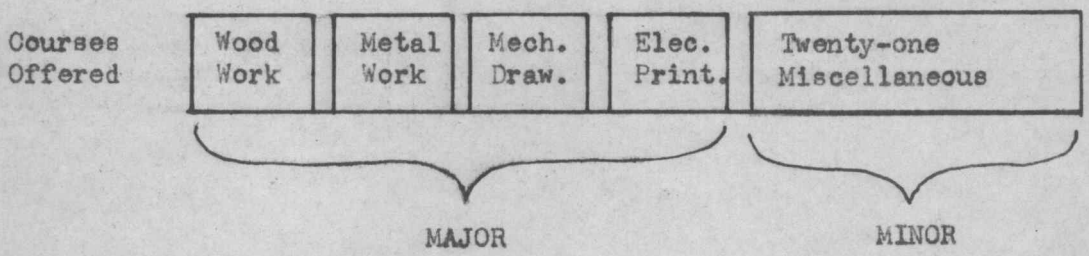
CHART III

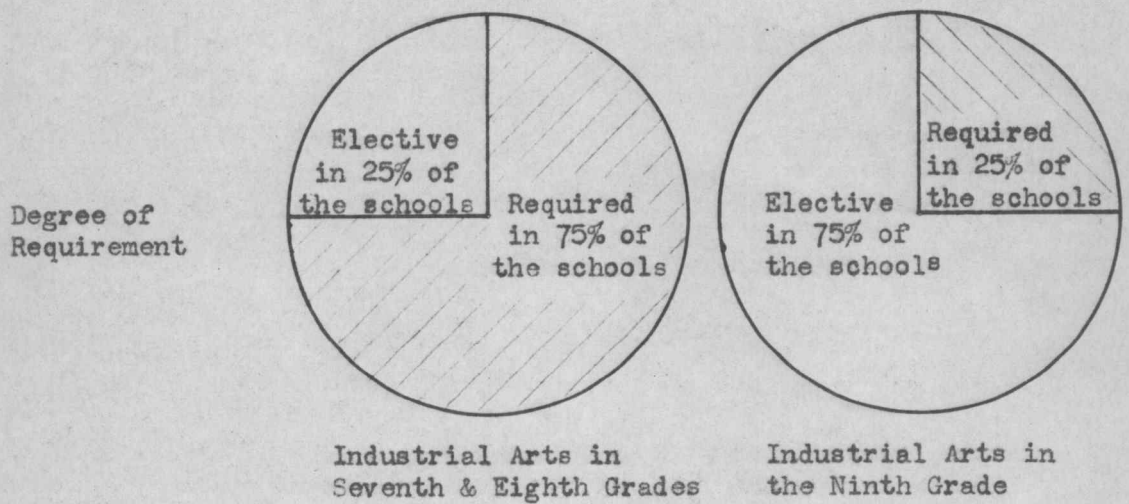
Comparison of Cost of Equipment



Typical Instructional Features in New One-Teacher Departments







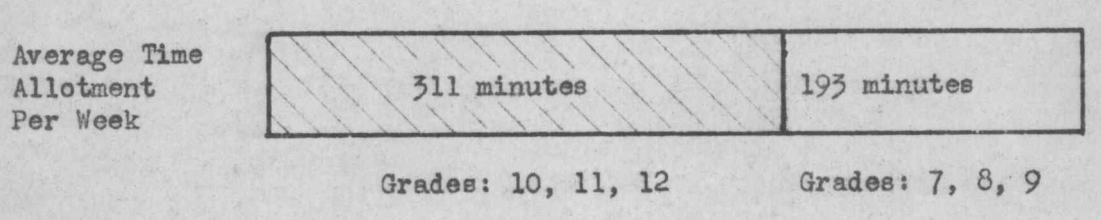
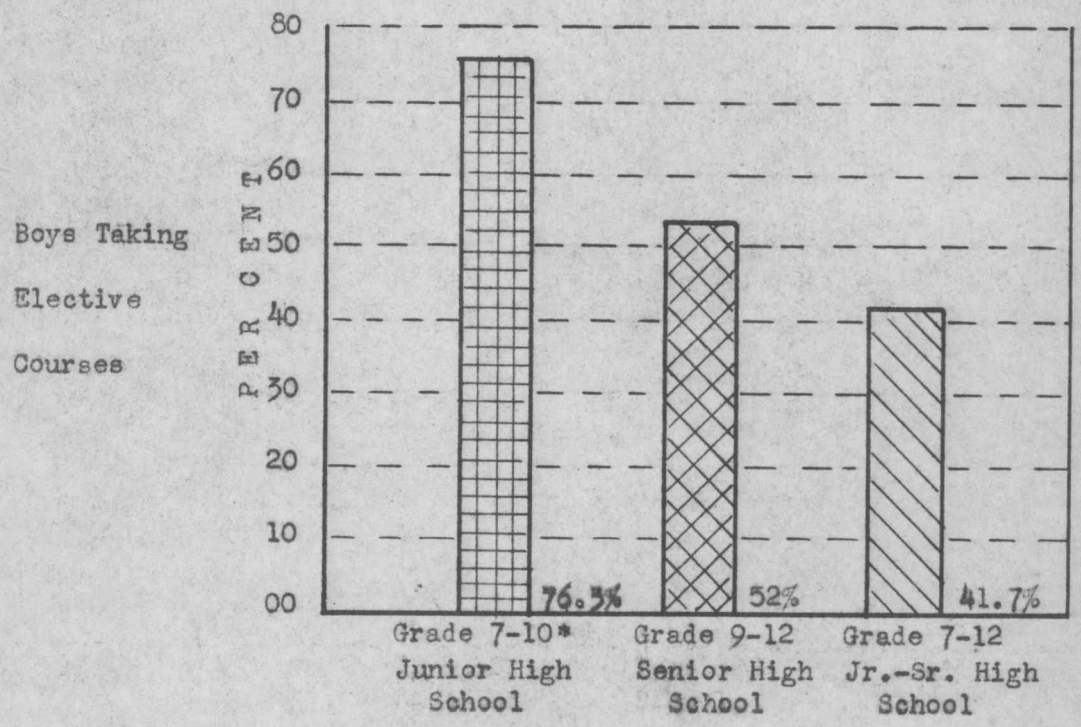
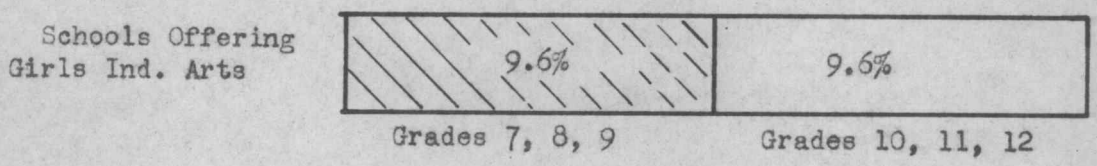
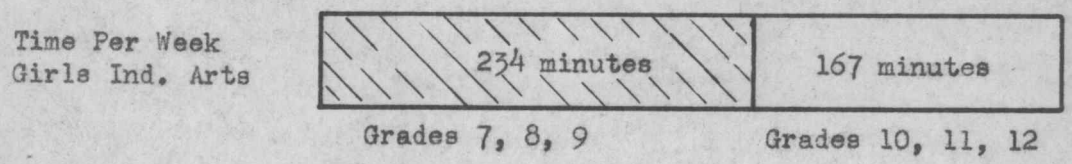


CHART IV



Read: Where Industrial Arts is elective, 76.3% of the Junior High School boys enroll.





with classes ranging from six to thirty-nine.

Nineteen per cent of the one-teacher departments offer girls the same opportunity to take industrial arts as boys.

These new shop departments are located on the first floor in nearly three-fourths of the cases.

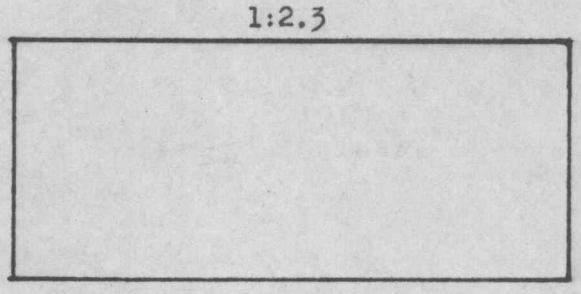
Regarding the shape of the shops, it was found that the ratio of width to length ranges from 1:1 to 1:3.5 with an average of 1:2.3. These ratios were calculated from twenty-six floor plans which were sent by school officials.

The main shop room in fifty-six schools contains 1600 square feet of floor space. Most of the departments include one or more additional rooms, such as: finishing room, tool room, supply storage, drawing room, library-planning center, recitation-demonstration room, lumber room, and office and conference room. The average floor area of these additional rooms is 289.7 square feet. The ratio of the main shop to the mechanical drawing room, where these latter exist, is 1 to 0.43. A shop with an area of 1000 square feet would have a drawing room of 430 square feet.

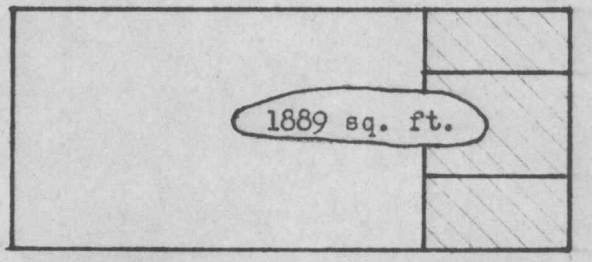
Concerning storage provisions in the fifty-six shops, it was found that in fifty per cent of the shops, lumber is stored in a supply room, and in sixty-six per cent of the shops, tools are stored in wall cabinets in the main shop. The most common methods of storing unfinished projects are in storage rooms, in large cabinets, and in the finishing room.

More than fifty per cent of the shops have double benches for woodworking. The single woodworking bench was found in over one-third

Ratio of Width to Length of the Shop Room



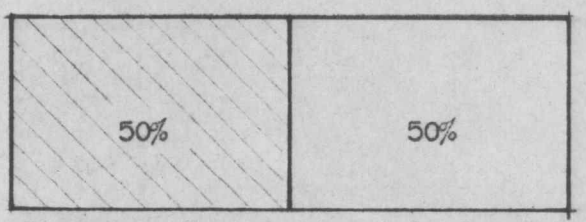
Entire Area of Average Department



1600 sq. ft. for Main Shop

289 sq. ft. for Drawing, Recitation, Storage, and Finishing

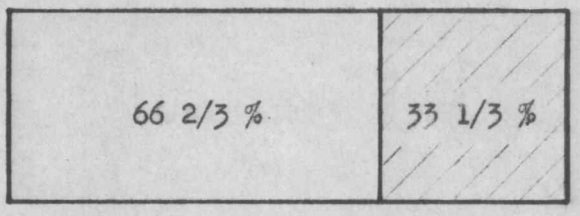
Lumber Storage



Stored on Rack in Main Shop

Stored in Special Lumber Room

Hand Tools



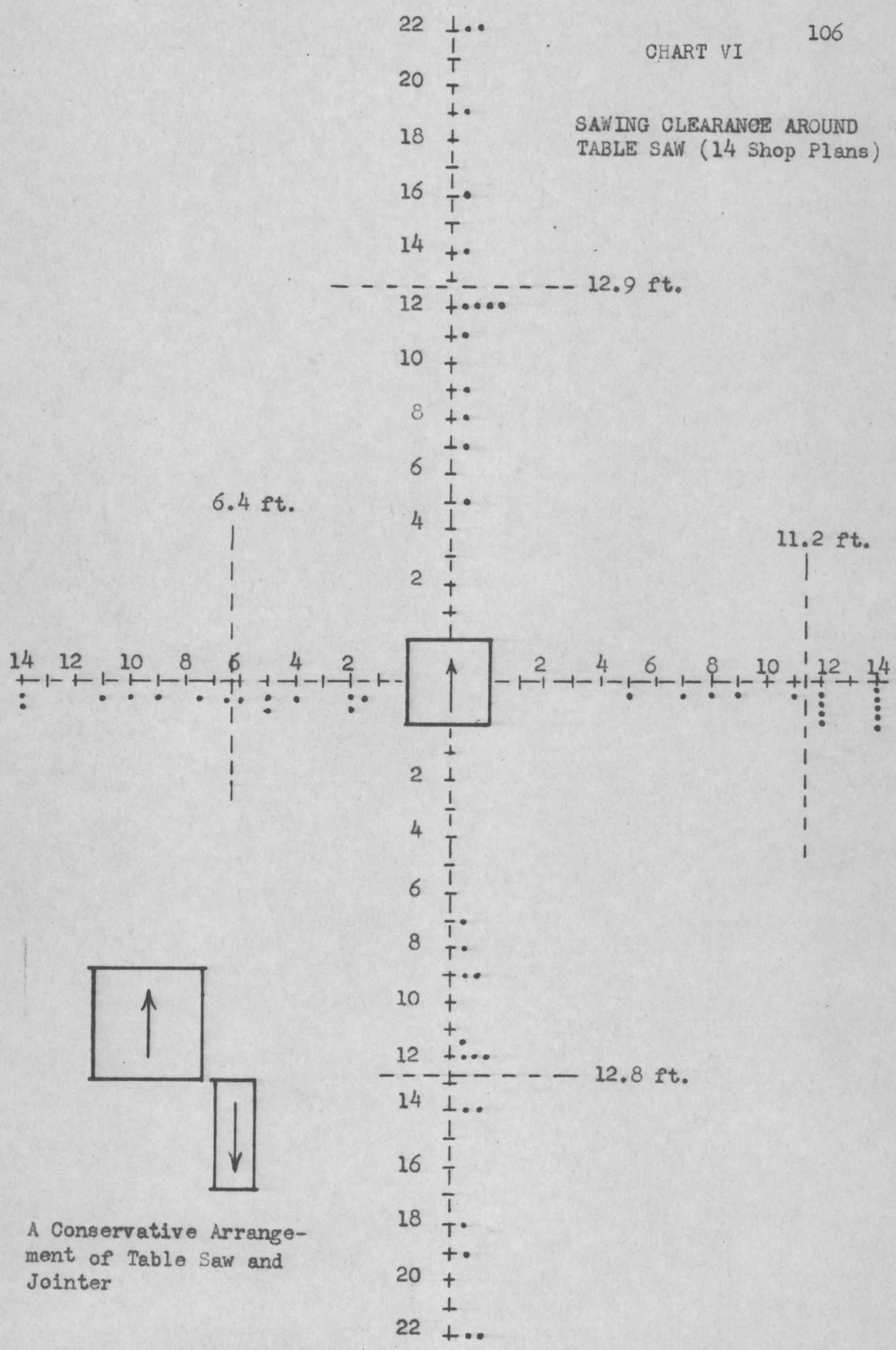
Wall Cabinet in the Main Shop

Special Tool Room

CHART V

CHART VI

SAWING CLEARANCE AROUND TABLE SAW (14 Shop Plans)



A Conservative Arrangement of Table Saw and Jointer

of the shops. Fifteen combination wood, metal, and electrical work stations were in one of the shops surveyed. In most of the schools bench space is provided for woodworking, drawing, metalworking, and electricity. The most common activities for which additional bench space is provided are: wood finishing, printing, soldering, ceramics, auto mechanics, foundry, lay-out, and planning or reading.

Fifty-eight square feet is the average area of blackboard space, while seventy-five square feet is devoted to bulletin or display space.

The most common special features in the fifty-six departments are: wash basin, instructor's filing cabinet and wardrobe, acoustical treatment of walls or ceiling, display case, and glazed partitions. Over one-third of the shops have glazed partitions to increase teaching efficiency.

In respect to machine and hand equipment, the ten most common machines in the departments are: wood lathe, grinder, drill press, table saw, band saw, jointer, furnace, anvil, machine lathe, and jig saw.

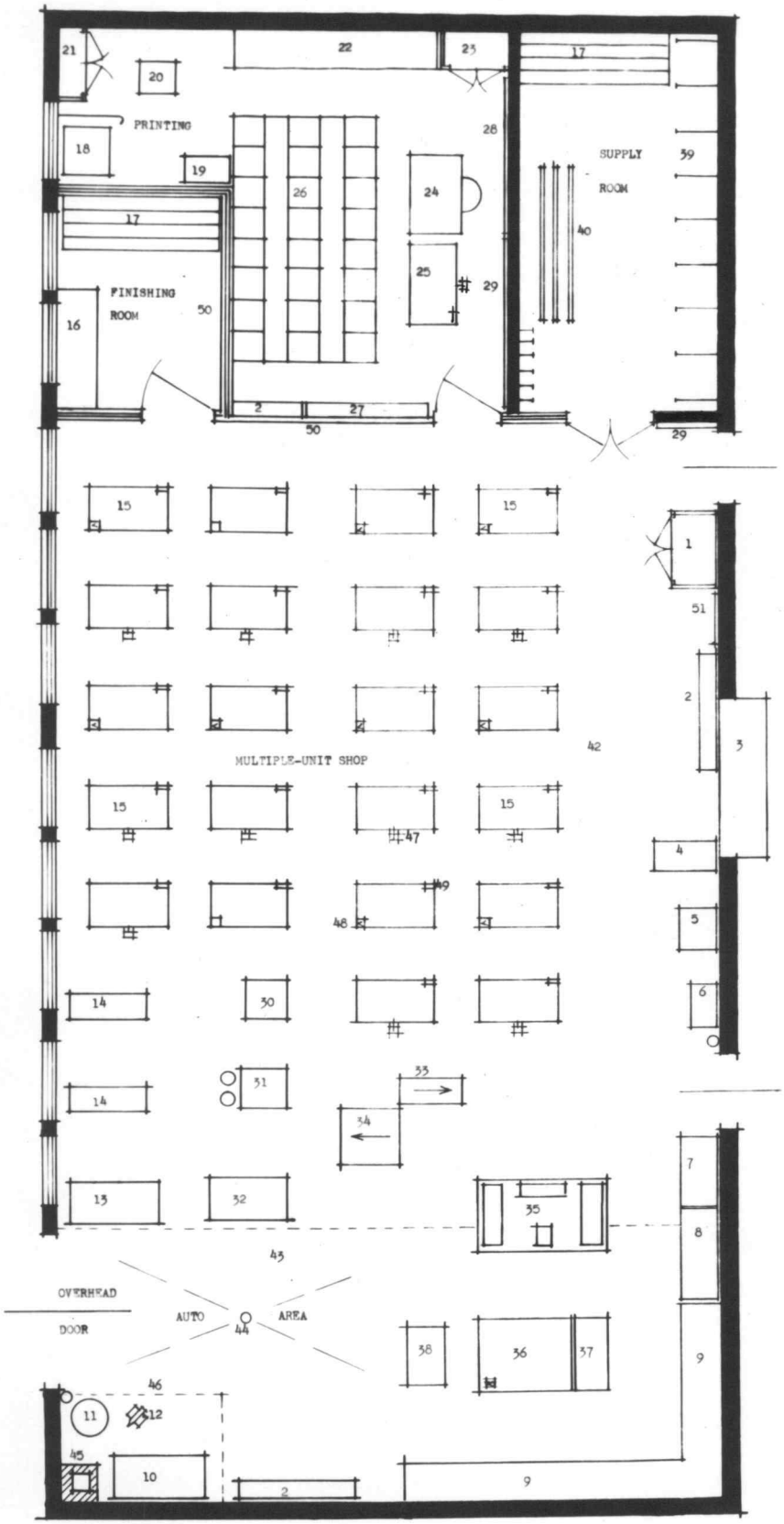
The study shows that these small shops are equipped for offering a wide range of practical and useful experiences in the twenty-five different industrial arts subjects.

Recommendations

A suggested one-teacher shop department (Chart VII) is presented here to illustrate the possibilities for a multi-activity shop. It is recognized that each school has its own particular problems.

The recommendations are briefly summarized as follows:

1. Type of shop: Multiple-unit shop
2. Instructional units: Drawing, woodworking, bench metalworking, and electricity as major units; wood turning, forging, foundry, ceramics, printing, and machine shop as minor units
3. Floor space: Entire shop department approximately 2000 square feet, with the main general shop about 1400 square feet or 60 square feet per pupil (24 pupils maximum size class)
4. A work station for each pupil: Combination work station (C. K. Lush design) equipped for major units of work
5. Teaching facilities: Provisions for class seating facilities for class control; library planning center for problem-solving activities related to manipulative work
6. Storage room for lumber and supplies
7. Glazed partition separating main shop from the recitation-planning room
8. Finishing facilities to be provided separately from the main shop, in the recitation room or in a separate partitioned space



1. SUPPLY CABINET
2. TOOL CABINET
3. DISPLAY CASE
4. JIG SAW
5. DRILL PRESS
6. GRINDER
7. SINK & FOUNTAIN
8. CERAMICS BENCH
9. PUPIL MATERIAL LOCKERS
10. FOUNDRY BENCH
11. FORGE
12. ANVIL
13. MACHINE LATHE
14. WOOD LATHE
15. COMB. WOOD, DRAWING, METAL & ELEC. BENCHES
16. FINISHING & SUPPLY BENCH
17. SHELVES
18. PRESS
19. PILOT PRESS
20. IMP. STONE
21. CABINET
22. COMBINATION TYPE STAND AND PLANNING CENTER
23. WARDROBE
24. DESK
25. DEMONSTRATION BENCH
26. TAB ARM OPERA SEATS
27. BOOKCASE
28. BLACKBOARD
29. DISPLAY SPACE
30. BAND SAW
31. WELDING BENCH
32. SOLDERING BENCH
33. JOINTER
34. TABLE SAW
35. METAL BENCH
36. LAY-OUT BENCH
37. BOX BRAKE
38. PORTABLE MOTOR
39. LUMBER RACK
40. SHEET METAL RACK
41. METAL BAR RACK
42. 5/4 MAPLE FLOORING
43. SMOOTH FINISH CONCRETE FLOOR
44. FLOOR DRAIN
45. FLUE AND FAN
46. METAL HOOD
47. ELECTRICAL OUTLET
48. METALWORKING VISE
49. WOODWORKING VISE
50. GLAZED PARTITIONS
51. ELEC. SWITCH PANEL

CHART VII

One-Teacher Industrial Arts Department

Multiple-Unit Shop
Scale 1/8"=1'-0"

Implications for Further Study

This study of the present practices and opinions in one-teacher departments for small secondary schools shows possibilities for further research on related subjects necessarily excluded from the present work. A partial list of such problems follows:

1. A comparison of the laboratory of industries type of shop with the multiple-unit type to weigh the effectiveness of instruction in each
2. Scientific arrangement of power equipment in a general shop
3. A study of the location of working areas with respect to each other for the most effective method of handling materials and supplies
4. A study of built-in features, wall cabinets, storage cabinets, and pupil material lockers
5. A study of dust and smoke conditions in school shops with recommendations
6. A study of types of work stations which contribute toward more effective teaching
7. A study of class seating facilities from the standpoint of type of seats, arrangement and floor space required

BIBLIOGRAPHY

1. Abbott, L. R. Space Around Woodworking Benches. Industrial Education Magazine, 27:341, April 1926.

2. Ashley, L. F. Research Possibilities in The Laboratory Organization III. Industrial Arts and Vocational Education Magazine, 26:235-236, August 1937.

3. Badger, O. B. Planning a Shop Building for a Junior High School. Industrial Education Magazine, 31:381-385, April 1930.

4. Bailey, H. A. A Wood Bench Shop From Two Classrooms. Industrial Education Magazine, 27:341-342, April 1926.

5. Baldwin, W. A. Present Statis of Industrial Arts in the Junior High Schools of California. Unpublished Thesis. Oregon State College, Corvallis, 1939.

6. Brace, George M. Wall Racks for General Tools. Industrial Education Magazine, 31:376-377, April 1930.

7. Bedell, Earl L. Budgeting School-Shop Departments. Industrial Arts and Vocational Education Magazine, 28-3:87-89, March 1939.

8. Bertin, Jules. Time Devoted to Industrial Arts in Grades Seven, Eight, and Nine. Unpublished Thesis. Pennsylvania State College, 1938.

9. Bollinger, Elroy W. Securing the Right Kind of Light. Industrial Arts and Vocational Education Magazine, 22:135-141, March 1933.

10. Christy, Elmer W. Automatically Controlled Shaving Collecting System. Bruce Shop Annual. Milwaukee, Bruce Publishing Co., 1932.

11. Davis, Ed. Trends in Methods, Organization, and Selection of Subject Matter for the General Shop. Industrial Education Magazine, 39:25-30, January 1937.

12. Donovan, John J. A Method of Procedure and Checking Schedule for Planning School Buildings. Milwaukee, Bruce Publishing Co., 1932.

13. Fales, Roy G. Suggestions for Shop Floor Plans. Monograph. The State Education Department. Albany, 1935.

14. Flagler, Lyla D. An Experiment in Classroom Illumination. American School Board Journal, 96:81-82, January 1938.

15. Friese, John F. Establishment of Aims in Industrial Arts. Industrial Education Magazine, 32:10-11, July 1930.

16. Hall, George H. Quiet Operation, the Result of Proper Motor Installation. Electric World, 103:335-338, March 1934.

17. Hamon, R. L., and Standish, H. E. General Shop for Rural Schools. Industrial Arts and Vocational Education Magazine, 24:49-54, February 1935.

18. Hill, L. A. That Tool Problem Again. Industrial Arts and Vocational Education Magazine, 26:96-99, March 1937.

19. Hunter, William L. Industrial Arts Laboratory Planning Series. Industrial Arts and Vocational Education Magazine, Vol. 27, 3:101-104, March 1938; 4:137-139, April 1938; 5:182-184, May 1938; 6:232-235, June 1938.

20. Hunter, William L. Principles of Shop Planning. Industrial Arts and Vocational Education Magazine, 23:38-39, February 1934.

21. Lush, C. K. Functions in Industrial Arts. Mimeographed. Minneapolis Public Schools, 1939.

22. Lush, C. K. Technique for Selection of the Course Content in Home Mechanics. Industrial Education Magazine, 41:71-75, March 1939.

23. Mays, Arthur B. Significant Trends in Industrial Education. Industrial Education Magazine, 38:98-99, March 1936.

24. Michigan, State Board of Control for Vocational Education. Shopwork for Rural High Schools. Lansing. Bulletin No. 233, 1938.

25. Micheels, William J. Industrial Arts in the Smaller School. Industrial Arts and Vocational Education Magazine, 25:182-184, June 1936.

26. Miller, E. S. A Practical General Shop Plan. Industrial Arts and Vocational Education Magazine, 24:54-58, February 1935.

27. Newkirk, Louis V., and Stoddard, George D. The General Shop. Peoria, The Manual Arts Press, 1929.

28. Ohio State Department of Industrial Relations. State Building Code for School Buildings. Columbus. Bulletin No. 103, 1938.

29. Pease, Merrit. General Industrial Arts Laboratory. Industrial Arts and Vocational Education Magazine, 27-3:124-127, March 1938.

30. Pennsylvania State Department of Public Instruction. Criteria for the Establishment of Industrial Arts Education. Monograph. Harrisburg, 1938.

31. Perring, Henry G. Acoustics in the School. The American School and University. New York, American School Publishing Corporation, 1937.

32. Petit, L. H. The Senior Trade School Building, Chanute, Kansas. American School Board Journal, 96:61-62, January 1938.

33. Radtke, Roy. Industrial Arts Education in Milwaukee. Industrial Arts and Vocational Education Magazine, 27-4:139-142, April 1938.

34. Rose, Homer C. Industrial Arts at Augusta, Wisconsin. Industrial Arts and Vocational Education Magazine, 26:80-82, March 1937.

35. Schmidt, H. W. Some Principles Underlying Shop Equipment and Planning from a Supervisors Viewpoint. Bruce Shop Annual. Milwaukee, Bruce Publishing Company, 1932.

36. Schweickhard, D. M. Education in the Industrial Arts. Industrial Arts and Vocational Education Magazine, 28-5:182-184, May 1939.

37. Stiles, H. L. A Study of Industrial Arts Supervision in Schools not Employing Special Supervisors. Oregon State College, Corvallis, M. S. 1938.

38. Struck, F. T. Creative Teaching. New York, John Wiley and Sons, Inc., 1938.

39. Sturrock, Walter. The School Shop Lighting Problem. Industrial Arts and Vocational Education Magazine, 22:45-50, February 1933.

40. Tearney, O. A. A Study of School Shops for the Junior High School. Industrial Arts and Vocational Education Magazine, 22:73-75, March 1932.

41. United States Census Bureau. Population--U. S. Summary, First Series. Washington D. C., 1931.

42. United States Office of Education. Industrial Arts, Its Interpretation in American Schools. Superintendent of Documents, Washington D. C. Bulletin No. 34, 1937.

43. United States Office of Education. Educational Directory. Superintendent of Documents, Washington D. C., Bulletin No. 1, 1938.

44. Van Duzee, Roy R. Industrial Arts Departmental Supplies, Maintenance, and Equipment Planning and Accounting. Industrial Arts and Vocational Education Magazine, 21:143-149, May 1932.

45. Van Westrienen, H. J. Planning a School Building Program. Industrial Arts and Vocational Education Magazine, 20-5: 159-165, May 1931.

46. Warner, William E. Studies in School Shop Planning. Industrial Arts and Vocational Education Magazine, 23:31-38, February 1934.

47. Whitehead, Willis A. Planning and Equipping Industrial Arts Laboratories. The American School and University. New York, American School Publishing Corporation, 1939.

48. Willis, William W. Idle Industrial Arts Classrooms. Industrial Arts and Vocational Education Magazine, 25:306-307, October 1936.

49. Williams, W. R. Jr. The Oberlin Arts and Industries Development. Industrial Arts and Vocational Education Magazine, 27-3:85-88, March 1938.

APPENDIX A

Letter and Questionnaire

to

State Officials

OREGON STATE COLLEGE
SCHOOL OF ENGINEERING AND INDUSTRIAL ARTS
CORVALLIS, OREGON

DEPARTMENT OF
INDUSTRIAL ARTS
AND ENGINEERING SHOPS

In keeping with the current curriculum revision movement, industrial arts departments in small schools have been passing through a stage of tremendous development during the past ten years. The so-called "child centered" curriculum and emphasis upon the unit-activity program has resulted in different objectives and in improved facilities to provide greater diversity of industrial experiences.

It is the purpose of the present study to determine the extent of change in the small schools, particularly those with a one- or two-teacher industrial arts department above the 6th grade; to learn how these schools may have subsequently altered the planning of shop facilities and new buildings -- all in an effort to discover certain related specifications and to compile recommendations that may be helpful to school administrators anticipating the construction of new quarters for industrial arts departments.

It will be helpful if you will kindly send us a list of schools in your state in which new quarters have been provided for industrial arts. Our interest is in communities of approximately 1,000 to 5,000 population, where new facilities for industrial arts have been provided within the past five years, and in which the industrial arts work is conducted by one or two teachers. It will be appreciated if you can also furnish the names of the persons in charge of the industrial arts work at these several schools, or the principals of the schools concerned.

A response form is enclosed for your convenience. Your help will be appreciated and a summary of the results of this study will be made available to all who cooperate.

Very truly yours,

_____

Coordinator

Form I

Information furnished by _____

Official position _____ State _____

Please list below the names and location of the small schools of your state in which new quarters have been provided for industrial arts, within the past five years. The present study is concerned with the improvement of physical facilities for industrial arts work above the 6th grade, in one- or two-teacher shops, in the schools of small communities of 1000 to 5000 population. Please give names of the teachers where known; otherwise the principal's name.

	School	Address	Name of I.A. Teacher or Principal
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Please return to:

Elmer M. Leaf
Industrial Arts Department
Oregon State College
Corvallis, Oregon

APPENDIX B

Letter and Questionnaire

to

School Officials

OREGON STATE COLLEGE
SCHOOL OF ENGINEERING AND INDUSTRIAL ARTS
CORVALLIS, OREGON

DEPARTMENT OF
INDUSTRIAL ARTS
AND ENGINEERING SHOPS

The industrial arts department in your school has been referred to us by your State Department of Education as one designed for the interpretation of the modern philosophy of education. We are, therefore, seeking your cooperation in a study of the physical plant necessary to meet modern objectives in industrial arts.

As you know, there has been a tremendous development in the industrial arts departments of small secondary schools during the past ten years. The so-called "child centered" curriculum and emphasis upon the unit-activity program have resulted in different objectives and in improved facilities to provide greater diversity of industrial experiences.

It is the purpose of the present study to determine the extent of change in the industrial arts departments of small schools, above the 6th grade; to learn how these schools may have subsequently altered the planning of shop facilities and new buildings--all in an effort to discover certain related specifications and to compile recommendations, including floor plans of representative industrial arts departments, that may be helpful to school administrators anticipating the construction of new quarters for industrial activities.

A response form is provided for your convenience. Your help will be appreciated and a summary of the results of this study will be made available to all who cooperate.

Very truly yours,

Coordinator.

EML/T
Enc.

Form II

Name: _____ Address: _____

School: _____ Grades in Building: _____

Number of Stories (floors): _____ On which floor is the shop? ____

Please check or enumerate the pieces of equipment or the special features which are a part of your shop facilities. It would aid greatly if you can include a floor plan of your shop (or shops). This may be either a copy of the blue print prepared by the architect when the building was erected, or a drawing prepared by one of your pupils. Please show the location of all fixed equipment as well as the architectural plan.

	Number Of	Describe if necessary
BENCH SPACE:		
Woodworking Benches		
Metalworking Benches		
Electrical or Wiring Benches		
Drawing Benches		
Printing Benches		
Ceramics Benches		
Automotive Benches		
Wood Finishing Bench		
Others		

Form II (cont.)

STORAGE PROVISIONS:	Number Of	Describe if necessary
Pupil lockers		
Lumber Storage		
Nails, Screws, Hardware		
Metal, Sheets		
Metal, Bars & Rods		
General Supplies		
Tool Storage		
Unfinished Projects		
Finishing Supplies		
Others		

FIXED EQUIPMENT:	Number Of	Type or Approximate Cost
Woodworking:		
Table Saw		
Wood Lathe		
Jig Saw		
Surfacer		
Jointer		
Sander, Belt		
Sander, Disk		
Band Saw		
Grinder, Tool		
Shaper		
Mortiser		
Drill Press		
Others		

	Number Of	Type or Approximate Cost
Metalworking & Electricity:		
Engine Lathe (screw cutting)		
Metal Spinning Lathe		
Grinder		
Forge		
Furnace, Gas or Electric		
Drill Press		
Anvil		
Buffer		
Power Hack Saw		
Shaper		
Squaring Shears		
Others		
Auto Mechanics:		
Air Compressor		
Hydraulic Lift		
Chassis		
Car Motors		
Others		
Ceramics:		
Kiln		
Potter's Wheel		
Furnace		
Others		
Graphic Arts:		
Pilot Press		
Lever Press		
Others		
Drawing:		
Blue Print Machine		
Others		
Finishing:		
Spray Booth with Exhaust Fan		
Others		

Check the rooms in addition to your main shop of which you have complete charge in relation to the shop work.

Rooms	Approximate Size	Special Features
Supplies in General		
Finishing		
Gluing		
Lumber		
Tool Room		
Mechanical Drawing		
Printing		
Office		
Wash Room		
Recitation & Demonstration		
Library & Planning		
Others		

What is the approximate area of:	Number of Sq. Ft.
Main Shop	
All Additional Rooms-total	
Bulletin or Display Space	
Black Board	

Special Features: YES NO

Private Wardrobe
Personal Filing Cabinet
Lavatories - wash basin
Display Case-projects
Dust Exhaust System
Wiring Booth-electrical work
Insulation in Walls-against noise disturbance
Insulation in Ceiling-acoustical
Glass Partitions
Others

If you have a dust exhaust system, what machines are connected with it? _____

If you have glass partitions, which rooms are so separated?

_____

What Industrial Arts Courses do you offer? (Mark special classes for girls)

Courses	Grade Level of Pupils	No. Pupils	Meetings per week	Length of period
. . . . .				
. . . . .				
. . . . .				
. . . . .				
. . . . .				
. . . . .				
. . . . .				

General Shop course includes what Units?

Units	YES	NO	Units	YES	NO
Woodworking			Art Fibre		
Bench Metalwork			Auto Mechanics		
Art Metalcraft			Machine Shop		
Foundry			Carpentry		
Forge			Printing		
Electricity			Mechanical Drawing		
Leathercraft			Home Mechanics		
Ceramics			Architectural Drafting		
Farm Mechanics			Others		

How many boys are there in school eligible for shop work? _____

In which grades is shop work required? _____

Of the boys not required to take shop work, what per cent elect it at the present time? _____%

Would you care to have a copy of the summary of this study? _____

Is a floor plan included? _____

Note: Please return to -- Elmer M. Leaf, Coordinator
Industrial Arts Department
Oregon State College
Corvallis, Oregon

APPENDIX C

State and School Officials

Who Returned the Questionnaire

STATE OFFICIALS WHO RETURNED THE QUESTIONAIRE (FORM I)

Connecticut: John E. Nichols, Supervisor of Buildings & Plans

Florida: J. L. Graham, State School Supervisor

Iowa: Agnes Samuelson, Superintendent of Public Instruction

Maine: S. E. Patrick, Director of Vocational Education

Massachusetts: Robert O. Small, Director of Vocational Education

Michigan: F. W. Dalton, Chief, Trade & Industrial Education

Minnesota: Gordon O. Voss, Supervisor of Trade and Vocational Ed.

Missouri: N. E. Viles, Director of School Building Service

Nevada: Donald C. Cameron, Supervisor of Trade & Ind. Education

New Jersey: Robert A. Campbell, Supervisor of Industrial Education

New York: Roy G. Fales, Supervisor of Industrial Arts

North Carolina: J. Warren Smith, North Carolina State College

Pennsylvania: Lane C. Ash, Advisor, Industrial Education

Rhode Island: Dr. James F. Rockett, State Director of Education

South Carolina: B. R. Turner, Supervisor of Trade & Ind. Education

South Dakota: Nora V. Hasle, Supervisor of Home-making Education

Vermont: J. E. Nelson, Supervisor of Trade & Industrial Education

Virginia: George J. Oliver, Supervisor of Secondary Education

West Virginia: A. J. Gibson, State Supervisor of High Schools

Wisconsin: Frank V. Powell, Assistant State Superintendent

STATE OFFICIALS WHO REPORTED THE INFORMATION WAS UNAVAILABLE

Arkansas: W. J. Breit, Supervisor of Trade & Industrial Education

California: Charles Bursch, Supervisor of Schoolhouse Planning

Colorado: W. H. Cooper, Director of Vocational Education

Illinois: Carl H. King, Ass't. Supervisor of Vocational Education

Kansas: E. R. Sheldon, State High School Supervisor

Kentucky: J. W. Brooker, Director School Buildings & Grounds

Maryland: John J. Seidel, Director of Vocational Education

New Mexico: Marie M. Holland, Ass't. State Sup't. Public Education

Oklahoma: C. R. Wood: Oklahoma Agric. and Mech. College, Stillwater

SECONDARY SCHOOLS WHO RETURNED THE QUESTIONAIRE (FORM II)

Connecticut:

C. E. Matson, Instructor, Somersville
C. A. Magnuson, Principal, South Windsor
Eugene W. Ellis, Superintendent, Unionville
Walter E. Wilson, Instructor, Newington
Robert F. Edmunds, Instructor, Portland
R. D. McAllister, Superintendent, Suffield
Adelbert Cox, Instructor, Guilford

Iowa:

A. C. Martens, Instructor, Tipton
Elmer S. Hansen, Instructor
O. H. Schaefer, Instructor, Sac City

Maine:

Ellery L. Huff, Instructor, Pittsfield
Kervin C. Ellis, Instructor, Thomaston
Stanwood C. Gilman, Instructor, Auburn
Charles S. Allen, Instructor, Saco
R. G. King, Instructor, Lisbon Falls
Charles Landerkin, Instructor, Greenville

Massachusetts:

Stephen G. Bean, Superintendent, Tewksbury
Ralph C. Whipple, Instructor, Ipswich
Frank L. Mansur, Superintendent, Swampscott
John M. Jeffrey, Instructor, Littleton
Donald W. Dunnan, Superintendent, Burlington
E. Ellery Norton, Instructor, Vineyard Haven

Michigan:

Reuben R. Green, Instructor, Grand Rapids

Minnesota:

Oscar Lindstrom, Instructor, Hutchinson
C. W. Selden, Instructor, Hopkins
Walter Rupp, Instructor, Excelsior
C. P. Wegner, Instructor, Two Harbors

Missouri:

Raymond Palm, Instructor, Sikeston
E. R. Shackelford, Instructor, Webb City

New Jersey:
James F. Foley, Principal, Woodbine
Walter H. Dudley, Instructor, Matawan

New York:
Leon Hult, Principal, Hoosick Falls
Michael F. Blawat, Instructor, Silver Creek
N. C. Wood, Principal, Spencerport
William E. Huss, Instructor, Cobleskill
F. W. Howe, Instructor, Wadesboro

North Carolina:
Charles G. Lampley, Instructor, Dunn
C. C. Clinger, Instructor, Mt. Airy
Gerald Hicks, Instructor, Wadesboro

Pennsylvania:
Ralph A. Sharrocks, Instructor, Elizabeth
William H. Stotz, Instructor, Hollidaysburg
Elvin K. Troutman, Instructor, Camp Hill
W. R. Ballantine, Instructor, Grove City
G. E. Engstrom, Superintendent, Johnsonburg
Frank G. Beck, Instructor, Wilmerding
M. L. Dixon, Instructor, Somerset
Edward R. Rice, Instructor, Conway
Ralph L. Cope, Instructor, Phillipsburg
Ralph M. Tucker, Instructor, Albion

South Carolina:
L. E. Carothers, Instructor, Fort Mill

Virginia:
Samuel A. Cravatta, Instructor, Waynesboro
Everett A. Teal, Instructor, Williamsburg

West Virginia:
J. A. McClung, Instructor, Kenova

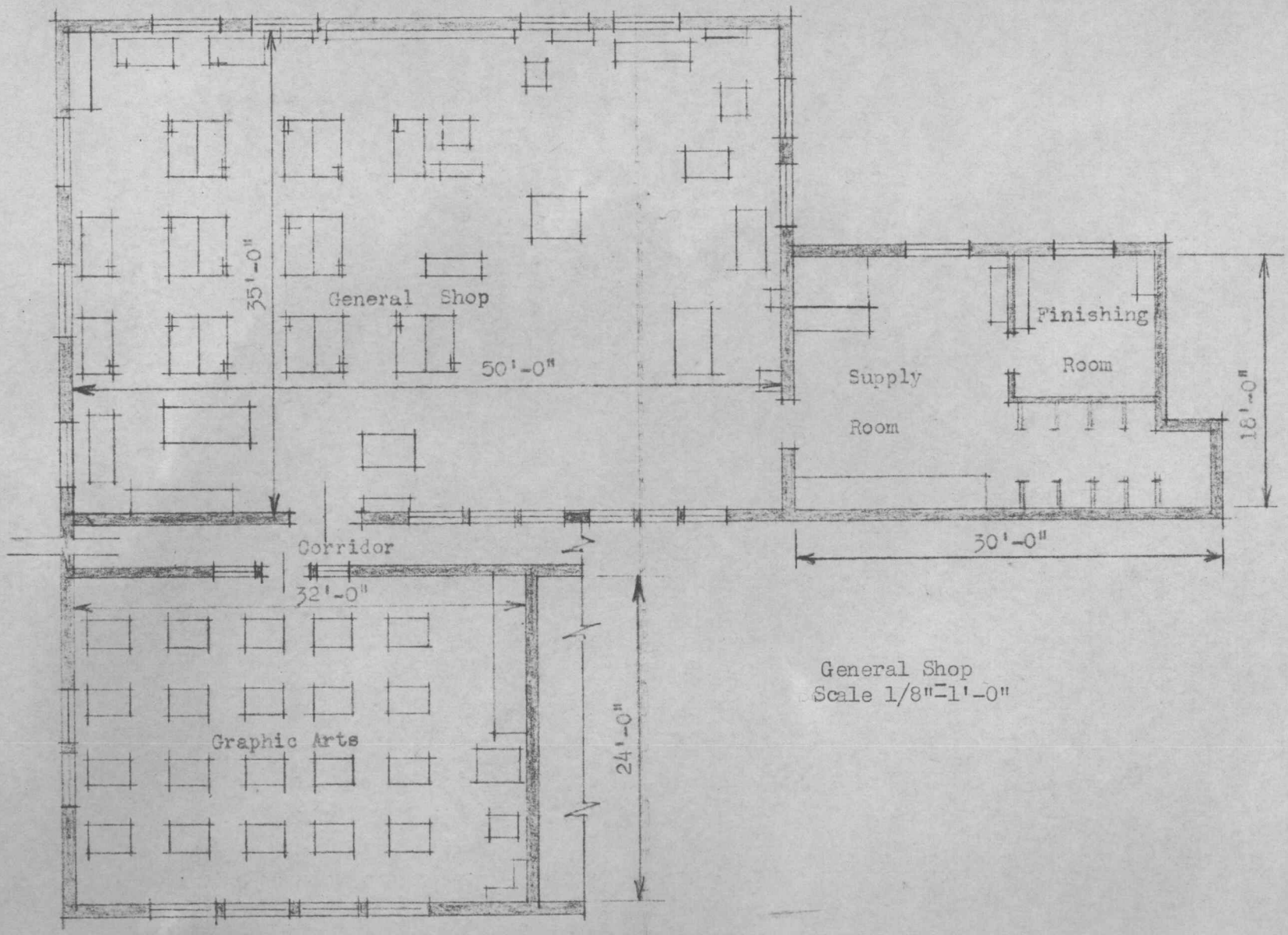
Wisconsin:
J. R. Gerritts, Instructor, Kimberly
C. J. Hagen, Instructor, Jefferson
Leo R. Ebben, Instructor, Kohler

APPENDIX D

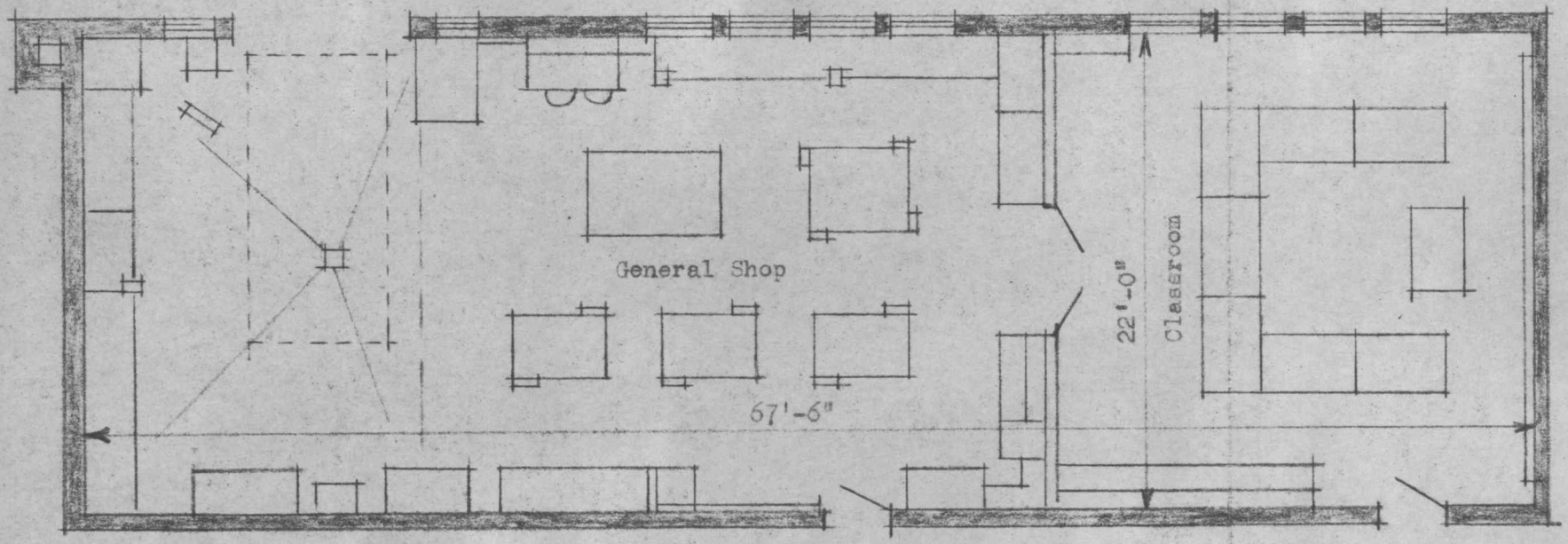
Typical Floor Plans

of

Shops Surveyed

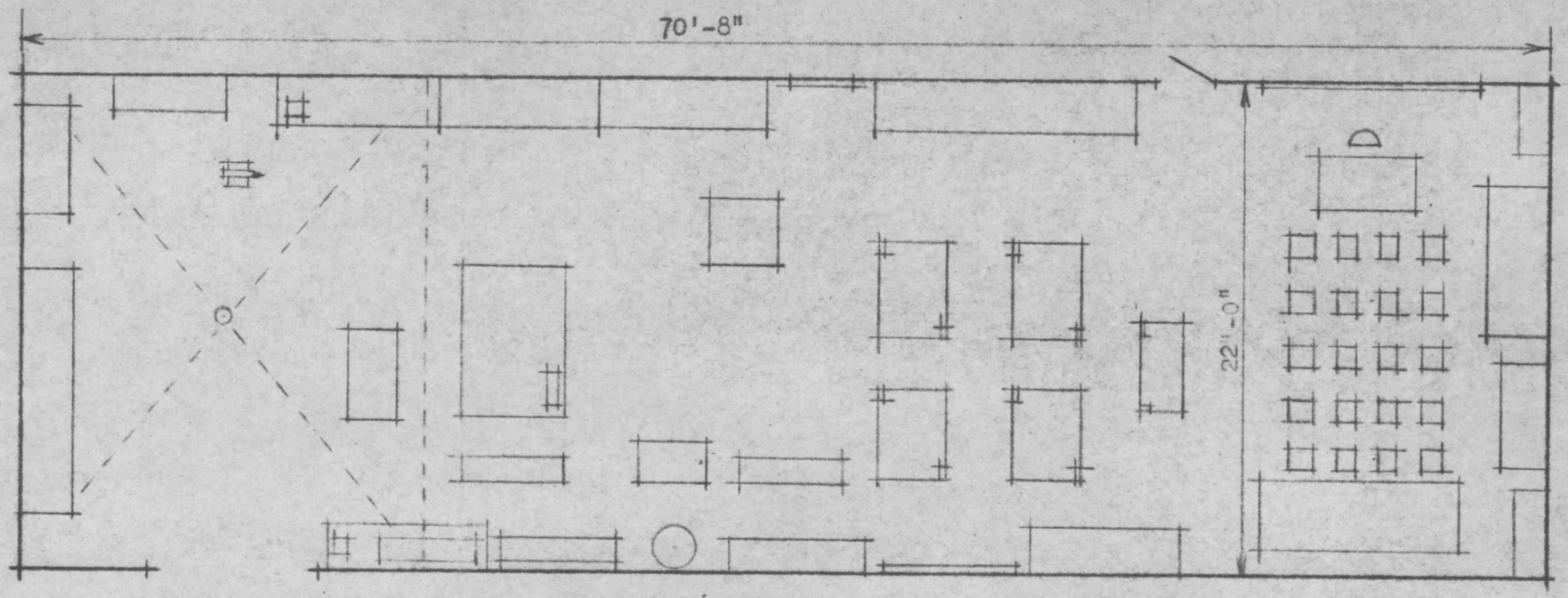


General Shop
Scale 1/8"=1'-0"

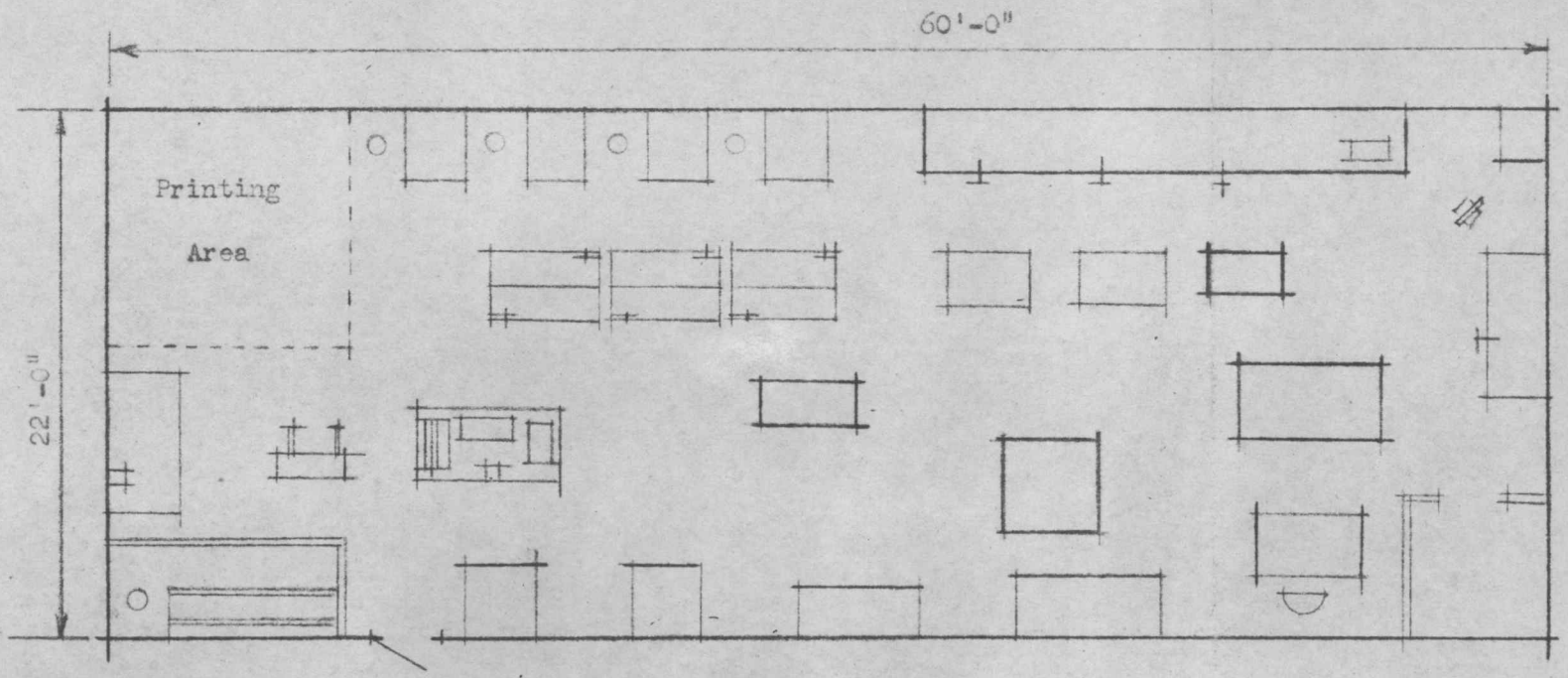


COMPREHENSIVE GENERAL SHOP

Scale 1/8" = 1'



COMPREHENSIVE GENERAL SHOP
Scale 1/8"=1'-0"



GENERAL SHOP

Scale 1/8" = 1'