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Institution: Oklahoma State University, Stillwater, Oklahoma

Title of Study: PLANNING FARM MECHANICS LABORATORIES FOR OKLAHOMA

Pages in Study: 61 Candidate for the Master of Science Degree

Major Field: Agricultural Education

Scope and Method of Study: The purposes of this study were (1) to secure information from experienced teachers concerning the building requirements for an adequate farm mechanics laboratory; and (2) to develop complete plans for buildings or laboratory rooms.

A questionnaire was formulated and distributed to each of the ninety-three vocational agriculture teachers in the Southwest district. Fifty teachers cooperated in this study.

Findings and Conclusions: In many cases buildings were very inadequate in all areas of study, although a few departments have adequate facilities to properly teach farm mechanics in vocational agriculture.

Areas where farm mechanics laboratories were inadequate are: (1) lack of adequate floor space; (2) ceiling heights were too low; (3) ceilings were constructed of materials which were not fire-proof; (4) many laboratories were in poor condition; (5) natural and artificial lighting were poor in many instances; (6) windows in a majority of laboratories were installed too low; (7) exhaust fans were definately lacking in most laboratories; (8) electric wiring was inadequate; (9) heating systems were inadequate (10) many laboratories do not have rest room and wash room facilities; (11) tool rooms and storage rooms were inadequate; (12) student lockers and outside work areas were inadequate.

The study revealed that most laboratories were adequate in the following areas: (1) service entrance doors; (2) location adjacent to classroom; and (3) desired type of work-benches.

The author's conclusions were that teachers of vocational agriculture should assume responsibility in planning an economical and useful laboratory.

ADVISER'S APPROVAL Ernest D. Edington

PLANNING FARM MECHANICS LABORATORIES FOR OKLAHOMA

By

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Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1962

Submitted to the faculty of the Graduate School of
the Oklahoma State University in partial
fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
August, 1962

PLANNING FARM MECHANICS LABORATORIES

FOR OKLAHOMA

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ACKNOWLEDGMENT

The author expresses appreciation to Dr. Robert Price for his inspiration and encouragement in this study. Appreciation is also expressed to Dr. Everett D. Edington, the author's major advisor, who so willingly provided inspiration and guidance, and to Mr. George Cook, Dr. Claxton Cook, and Professor Don Orr, for advise rendered in the preparation of this study.

The author also wishes to express gratitude to the teachers of vocational agriculture, and to the district supervisors of Oklahoma, without whose help this information could not have been assembled. Appreciation is also expressed to Mr. William N. Shafer, and the drafting department of the Altus High School for their preparation of floor plans used in this study.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

To establish a farm mechanics program is a challenge that has faced vocational agriculture teachers since the Smith-Hughes act of 1917. Many teachers of vocational agriculture will be faced with the same problem of expanding their farm mechanics program in meeting the ever increasing need for the training brought about by mechanization.

Since 1955 mechanization has constantly grown until today we have automation in many respects. It is the duty and responsibility of every teacher to instruct both all-day students and adult farmers in mechanical skills necessary to maintain modern farm equipment efficiently. To instruct this group of people properly, adequate facilities must be available.

Training received in farm mechanics by all-day and young and/or adult farmers affords them an opportunity to acquire ideas, knowledge, and the necessary skills to make a farm mechanics program meaningful and worthwhile.

Statement of Problem

The problem of concern in this study is to determine what facilities are needed by teachers to teach farm mechanics properly in vocational agriculture. Within the scope of this study the author wishes to develop a guide to be used in properly planning adequate and usable facilities to meet the need for beginning and making an advancement in farm mechanics for students in vocational agriculture.

Purpose of the Study

The purposes of this study are as follows:

1. To secure information from experienced teachers concerning the building requirements for an adequate farm mechanics program as a part of vocational education in agriculture.
2. To provide complete plans for buildings or rooms for teaching farm mechanics.

Method of Procedure

The district supervisor of vocational agriculture of the Southwest district was asked to furnish a list of the schools in that district.

A questionnaire based upon personal experience was formulated and approved by the staff at Oklahoma State University. This questionnaire was then distributed to each of the ninety-three teachers at their regular profess-

ional Improvement meetings.

The questionnaires used in this study were completed and returned by the vocational agriculture teachers in fifty or 53.7 percent of the schools in this district.

In obtaining farm mechanics laboratory plans and pictures, the assistant state supervisor furnished a list of six schools in each of the five districts with the most outstanding farm mechanics facilities.

A letter was mailed to each of the teachers asking for drawings and pictures of their farm mechanics laboratory. Laboratory drawings and pictures were received from twenty-one schools.

CHAPTER II

REVIEW OF LITERATURE

Mechanization is developing so rapidly that many teachers of vocational agriculture have suddenly become aware of the need for adequate facilities in training vocational agriculture students to meet this challenge.

Morford[1] lists objectives of farm mechanics training:

a. To help the student discover his farm mechanics aptitudes.
b. To develop dependable judgment in farm mechanics activities.
c. To develop basic skills in farm mechanics.
d. To develop self-confidence in performing mechanical operations.
e. To understand the underlying principles of mechanical processes.
f. To develop an appreciation for good workmanship.
g. To give interest and variety to the routine of daily classroom work.
h. To understand and determine what mechanical activities can be done more economically by someone else.
i. To provide opportunity for learning by doing.
j. To develop abilities necessary for doing the farm mechanics jobs that a farmer needs to be able to do.

Farm mechanics by necessity has become a very integral part of the course of vocational agriculture. Farm mechanization has continued to increase, until today farmers and all-day students must be qualified in the skills

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1. V. J. Morford, "Methods in Teaching Farm Mechanics," Burgess Publishing Co. p 2.

necessary to make necessary repairs and construct farm machinery and equipment. Cook[2] makes the following comment concerning tools and facilities.

> By being proficient in the use of tools and having suitable facilities to perform the needed jobs, which he is capable, the farmer can save considerable time, inconvenience, and money.

Pruitt[3] wrote a thesis entitled, "A Four Year Farm Mechanics Program in Vocational Agriculture for the Marshall High School Based Upon a Community Survey." Pruitt found that farmers in his study believed that students should be taught farm machinery maintenance and repair in the vocational agriculture farm mechanics classes as an integral part of their farming.

There is without question a definite need for farm mechanics training in vocational agriculture classes. Schmidt[4] makes the following remarks about the objective to be sought.

> An objective is anything at which one aims. It may be regarded as a goal sought or as an achievement of a definate purpose. Objectives are things set up to be accomplished. One cannot arrive at any desired destination until he first knows where he wants to go; neither can he accomplish anything until he first knows

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2. G. C. Cook, "Farm Mechanics Text and Handbook." Interstate p 47.

3. Walter E. Pruitt, "A Four Year Farm Mechanics Program in Vocational Agriculture for the Marshall High School Based Upon a Community Survey." (unpublished Masters Thesis, Oklahoma Agricultural and Mechanical College 1954)

4. G. A. Schmidt, "Teaching Farm Shop Work and Farm Mechanics." The Century Co. p 33.

> specifically what he wants to accomplish. To him who knoweth not the port whither he is bound, no wind can be favorable.

To train present and prospective workers for proficiency in their respective fields should be a challenge to every teacher of vocational agriculture. The lack of proper facilities appears to be the major factor in meeting this need in farm mechanics in agriculture. Lynch[5] makes the following comment.

> One of the things that is holding back improved instruction in farm mechanics is the lack of proper facilities. Mechanization of the many farms came rather fast due to many factors, including World War II, and the expansion and investment period after the war. The vocational agriculture program has not kept pace with the times. Many shops are just big rooms and some are not so big. These rooms have not been especially planned for the big equipment which we have on our farms today.

There are several factors which inhibit progress toward an adequate program in farm mechanics, and in many cases extensive planning must be executed. These could be influenced by (1) lack of interest on the part of both the school administration, and/or the teacher of vocational agriculture, (2) lack of enrollment in the school system, or (3) adequate funds to finance a department of farm mechanics. Fox[6] made the following observation:

> Student enrollment and finances naturally play a large

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5. Paul R. Lynch "Improved Instruction in Farm Mechanics." Agricultural Education Magazine, November 1958 p 110.

6. Howard F. Fox, "No Substitute for Planning." Agricultural Education Magazine, January 1957. p 156.

part in determining the floor space allotted for the vocational agriculture shop. The sooner the teacher can be invited to advise with the school administration, board members, and architect the better.

Convenience to the agriculture classroom, toilet facilities, access to utilities such as water, drains, gas, various voltages and/or phases of electricity needed, location in reference to driveways, and freedom from shop noises from other classrooms are all factors worthy of early planning. Size and location of doorways and windows, patio, height of ceiling, cupboard and storage space, utility outlet locations, built in lockers, room for painting, tools, etc., should next come in for consideration.

A baker would not attempt to bake a cake without a recipe and the necessary directions. This same principle is true for the planning and construction of a farm mechanics laboratory building. In planning the school farm mechanics laboratory, Schmidt[7] lists the following items which should be given special consideration.

1. Size - the school farm mechanics shop, whether it be a separate building or whether it be a part of the building devoted to vocational agriculture, should be large enough to permit the undertaking of all types of farm mechanics work. Most school shops are too small. The Department of Vocational Education of the State of Nebraska recommends that the school farm shop be not less than 28 x 50 feet in size.

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7. G. A. Schmidt, "Teaching Farm Shop Work and Farm Mechanics." The Century Co. p 187-192.

2. Doors - farm shops should be provided with large doors which make it possible to bring into the shop almost any kind of farm machinery or equipment. A width of eight feet, however, resists the machinery which can be brought in. The minimum width of farm shop doors should be ten feet.
3. Floors - two kinds of floors are found in most shops, the wood and the concrete. Both have their good points and have objectionable points. Wood floors of heavy lumber, well laid and well braced will serve the purpose and last for a long time. Where forges are used, however the wood floors are not practicable, unless proper protection is made against fire. Concrete floors are cold, very tiresome to the feet, and tools accidentally dropped upon them by the pupils are liable to breakage.
4. Light - there should always be provision for an abundance of light in any shop. Glass area equal to twenty percent of the floor space is desirable. Many mistakes are made by not having sufficient light; nevertheless, generally this is not as serious a mistake as not placing the windows well up from the floor. Shop windows with small panes are recommended; this style of windows does not materially affect the light and minimizes expense in replacing broken glass.

5. Providing ample floor space - there must be no obstructions to interfere with free access to the center of the farm shop floor. For this reason the roof of a shop building should be supported in such a way as to do away with posts and pillars in the center of the room. Also, practically all the benches should be placed against the walls of the building.
6. Allotting space for distinctive units of work - few farm shops are so well arranged as to get the maximum amount of work out of those who make use of them. The "unit" idea of shop arrangement is excellent. By this is meant having the wood working equipment in one part of the shop, the metal working equipment in another place, the farm motors work in another place, and so on.
7. A few general suggestions about arranging the details of the shop. Teachers should use judgment in locating the various enterprise units. No two farm mechanics shops are exactly alike and consequently no set rule can be followed exactly. Time, energy, and inconvenience are all saved when the school farm shop is well arranged. More efficient work can be done when every kind of work has its place. Teaching the boys competent shop arrangement is an important part of regular farm mechanics instruction.

In addition to these recommendations Siniard[8] lists the following recommendations:

1. Location - The most desirable location for a farm shop is adjacent to the vocational agriculture classroom.
2. Location must provide:
   a. A ground floor entrance easily accessible to the public.
   b. A wide service entrance and drive.
   c. An outside parking area.
   d. A large open area, either inside or outside, for demonstration work.
3. Space: The space needed in a farm shop will vary from school to school, depending upon the program offered. In general, the size of the shop may be determined by calculating the sum of the three following needs:
   a. Space for Pupil Work Area: Allow 75-100 square feet per boy in the largest shop class.
   b. Space for Farm Shop Equipment: The amount of space needed for the shop equipment depends entirely upon the kind and amount of equipment in the shop.
   c. Space for Storage: Allow from 80-120 square feet for a tool room, 120-150 square feet for a supply room, and 200 or more square feet for project and project materials storage.
4. Shape and Dimension: The shape of the shop should be rectangular. Under average conditions, the width should be not less than 32 feet. Thirty-six feet is the optimum width for the shop. The length will vary to give the necessary floor area. If less than optimum space is to be included in the original building plans, care should be taken to provide an adequate shop width in order than future expansion may be accomplished by extending the length.
5. Floor Materials: A concrete floor, 4 inches thick, is sufficient for all work areas except in the construction area near the large door where cars, trucks, tractors, and/or heavy farm machinery will be driven or placed.

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8. G. G. Siniard, et al, "Providing Facilities for Departments of Vocational Agriculture in Georgia." The University of Georgia, College of Education, Department of Agricultural Education, Athens, Georgia. p 56-62.

6. Walls: All walls must be of sufficient strength to carry the super-imposed loads. They should be at least 12 feet high and may be constructed of brick, concrete, concrete blocks, tile, steel, or wood. If masonry walls are used, they should be waterproofed.
7. Artificial Lighting: For general lighting, there should be at least twenty food-candles of light at work bench height (36 inches off the floor). For tedious and special work on tables and on machines, thirty to forty food-candles of local light should be provided. Where in-school, young farmer or adult classes meet for prolonged periods at night, the artificial illumination should be twenty foot-candles.
8. Windows: For ventilation and natural light, window glass area should be equal to twenty percent or more of the floor area.
9. Doors: There should be at least two outside doors in the shop. The large door should be 10 to 12 feet wide and 10 feet high. It is desirable to have a standard outside hinged door, 3 feet wide and 7 feet high.
10. Heating and Ventilation: Heating devices should be sufficient in number and size to keep the shop comfortable at all times. Unit heaters are usually installed.
11. Power: There should be one convenience outlet for each permanently placed piece of power equipment of less than one-half horsepower. Each motor driven piece of equipment of one-half horsepower or over should have a special purpose outlet in the floor. The caps of these floor outlets should always be flush with the floor surface.

Henderson[9] lists the following space requirements necessary for the different pieces of equipment. Space for simular tools not mentioned here can be calculated from this table.

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9. Harry D. Henderson, "Space Requirements in the Farm Mechanics Laboratory." Agricultural Education Magazine, January 1960. p 148-149.

Work Station	Minimum Inches side-side	Depth	Optimum Inches side-side	Depth
Arc Welder	60	30	72	36
Bench Vice	52	27	72	36
Drill press	48	24	60	27
Grinder-buffer	60	24	80	30
Oxacetylene welder	64	30	84	30
Radial saw	240	40	384	48
Soldering bench	60	30	72	36
Tool grinder	48	24	60	28

In a study made in Pennsylvania, Bristol[10] found the following information concerning tool rooms and shoproom storage.

> A survey was made of sixty-four school farm shops in Pennsylvania. Of the sixty-four farm mechanics shops included in the study, only four made use of toolroom storage exclusively. Thirteen of the school farm shops made use of both toolroom and shoproom storage. The remaining forty-seven schools used shoproom storage of tools exclusively.

10. Benton K. Bristol. "What Teachers say about Tool Storage." Agricultural Education Magazine, January 1957. p 158.

Literature concerning the establishing of farm mechanics facilities for use in vocational agriculture classes points to a dire need for more expansion in this program. Existing facilities do not meet the demand, buildings are inadequate, and apparently little planning has gone into existing facilities in many schools.

A great responsibility rests upon the teacher of vocational agriculture to enlighten his administration as to the need and value of a program of farm mechanics and to assume responsibility in planning an economical and useful program.

Since the primary aim in vocational education in agriculture is to train present and prospective farmers for proficiency in farming,[11] it behooves each teacher to evaluate his present situation and make adjustments to meet this need

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11. Federal Board of Vocational Education, Training Objectives in Vocational Education in Agriculture, Bul. 153, p. 1.

CHAPTER III

The data presented in this chapter were obtained by a questionnaire from fifty teachers of vocational agriculture in the Southwest district of Oklahoma. The purpose was to gain information about the farm mechanics laboratory buildings and facilities.

A substantial part of the data is presented in tabular form in order to facilitate comparison and analysis.

TABLE I

SIZES OF FARM MECHANICS LABORATORIES

Sizes in Square Feet	Schools Reporting	
	Number	Percent
400- 600	6	12
601- 800	5	10
801-1000	8	16
1001-1200	13	26
1201-1400	3	6
1401-1600	4	8
1601-1800	5	10
1801-2000	2	4
2001-2200	0	0
2201-2400	2	4
2401 and over	2	4
Total	50	100

Table I shows thirty-two or sixty-four percent of farm mechanics laboratories to be less than twelve-hundred square feet. Of significance is the fact that thirteen or twenty six percent of all laboratories fall into the average group, the mean size being 1264.04 square feet per laboratory.

Twenty-two or forty-four percent of vocational agriculture instructors voluntarily indicated that their laboratories were too small. The recommended size will be discussed on page 16.

TABLE II

NUMBER AND SIZES OF LABORATORIES IN RELATION TO NUMBER OF CROWDED CLASSES

Classes Crowded	Schools Reporting Number	Percent	Ave. Size
None	14	28	1526.8
One	21	42	1334.9
Two	9	18	831.3
Three	5	10	1138.8
Four	1	2	616.0
Total	50	100	

The average size of farm mechanics laboratory is 1264.04 square feet. Table III shows the average number of students to be 37.52 per school, providing each student with an average of 33.72 square feet of working space, or an area less than six feet square. Many projects that are constructed or repaired may consume as much as one-hundred square feet or more, not considering working area around them.

Schmidt[12] reports that the Department of Vocational Education in the state of Nebraska recommends that the school farm mechanics shop should be a minimum of 1400 square feet.

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12. G. A. Schmidt, "Teaching Farm Shop Work and Farm Mechanics." The Century Co. p 187-192

TABLE III

ENROLLMENT IN FARM MECHANICS CLASSES

Number of Students in Schools	Schools Reporting	
	Number	Percent
16-20	3	6
21-25	3	6
26-30	7	14
31-35	7	14
36-40	9	18
41-45	9	18
46-50	7	14
51-55	3	6
56-60	2	4
Total	50	100

Table III shows the distribution in sizes of enrollment in schools teaching farm mechanics. The average number of students per school is 37.52. Twenty schools or forty percent have an enrollment of between 16 and 35 students, twenty-five schools or fifty percent have an enrollment of between 36 and 50 students, and five schools or ten percent have an enrollment of between 51 and 60 students.

TABLE IV

LENGTH IN YEARS VOCATIONAL AGRICULTURE HAS BEEN OFFERED IN SCHOOLS AS COMPARED TO LENGTH IN YEARS FARM MECHANICS HAS BEEN OFFERED

Number of Years	Schools With Vocational Agriculture	Schools With Farm Mechanics Laboratories
1- 5	4	14
6-10	6	14
11-15	7	8
16-20	5	5
21-25	14	4
26-30	6	2
31-35	4	0
36-40	2	0
Total	50	50

There appears to be a trend toward providing farm mechanics training to students in vocational agriculture, since thirty-eight schools or seventy-six percent have offered vocational agriculture from six to thirty years, and forty-one or eighty-two percent of schools have offered farm mechanics training from one to twenty years, with twenty-eight or fifty-six percent of schools establishing farm mechanics laboratories during the past ten years.

TABLE V

HEIGHTS OF CEILINGS IN FARM MECHANICS LABORATORIES

Ceiling Heights	Schools Reporting	
	Number	Percent
8	1	2
9	4	8
10	14	28
11	2	4
12	11	22
13	1	2
14	4	8
15 and over	12	24
Total	50	100

The most noticeable point regarding ceiling heights, is that twenty-five or fifty percent of schools report heights of ten and twelve feet, and twelve schools or twenty-four percent report ceiling heights of fifteen feet or more. Ceiling heights of less than ten feet would be undesirable due to limiting the size of equipment that could be constructed or repaired.

Siniard[13] states that walls should be at least twelve feet high, which would in most cases provide a twelve foot ceiling.

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13. G. G. Siniard, et al, "Providing Facilities For Departments of Vocational Agriculture in Georgia," The University of Georgia, College of Education. Department of Agricultural Education, Athens, Georgia p 56-62.

TABLE VI

TYPES OF CEILINGS IN FARM MECHANICS LABORATORIES

Type Ceiling	Schools Reporting Number	Percent
Asbestos	1	2
Cellotex	7	14
Concrete	2	4
Metal	19	38
Sheetrock	2	4
Wood	12	24
Wood & Masonry	1	2
No Ceiling	3	6
Not Reporting	3	6
Total	50	100

Twenty-two or forty-four percent of all farm mechanics laboratories have ceilings constructed of fire-proof material. Nineteen or thirty-eight percent have metal roofs, which in most buildings of this type serve as both ceiling and the roof decking. This type roof and ceiling combination are used on the flat built-up roof type construction.

This table might indicate that some thought to fire prevention and economy were considered before these buildings were constructed.

TABLE VII

TYPES OF CONSTRUCTION AND CONDITION OF FARM MECHANICS LABORATORIES

Type of Construction	Schools Reporting					
	Number	Percent	Ex.	Good	Fair	Poor
Masonry	33	66	14	10	3	6
Masonry and Metal	1	2		1		
Masonry and Wood	8	16	1	4	1	2
Metal	1	2	1			
Metal and Wood	1	2			1	
Wood	6	12			3	3
Total	50	100	16	15	8	11

Thirty-one or sixty-two percent of buildings were rated as being in either excellent or good condition. Twenty-four of this group were of masonry construction. Apparently this would indicate that masonry construction is more desirable than other types of construction. There are also other advantages to masonry construction such as ease of heating, reduced insurance rates, a reduction of fire hazards, and the increased appearance.

Those buildings constructed of wood or metal and wood were rated only fair or poor.

TABLE VIII

SQUARE FEET OF WINDOWS IN FARM MECHANICS LABORATORIES AS COMPARED TO SQUARE FEET OF LABORATORY

Sq. Ft. of Windows	Schools Reporting		Square Feet of Laboratory
	Number	Percent	
0- 50	10	20	889.3
51-100	16	32	1112.4
101-150	6	12	1441.3
151-200	9	18	1469.6
201-250	3	6	1880.0
251-300	3	6	896.0
301 and over	5	10	1414.4
Total	50	100	

Table VIII points out the extremely poor lighting in farm mechanics laboratories. Twenty-six or fifty-two percent have one-hundred square feet or less of window space.

Schmidt[14] states that glass area should equal twenty percent of the floor space, the windows should be located well up from the floor, and should contain small panes.

Windows should be equally distributed on two sides of the laboratory, and if light is minimized, sky-lights may be added to supplement natural light.

Five schools reported an average of 78.4 square feet of sky-lights, and each reported lighting excellent or good.

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14. G. A. Schmidt, "Teaching Farm Shop Work and Farm Mechanics." The century Co. p 187-192.

TABLE IX

HEIGHT OF WINDOWS FROM FLOOR IN FARM MECHANICS LABORATORIES

Height from Floor in Inches	Schools Reporting Number	Percent
24-36	18	36
37-48	17	34
49-60	9	18
61-72	4	8
73-84	1	2
84-96	1	2
Total	50	100

Thirty-five or seventy percent of schools reported window heights of twenty-four to forty-eight inches from the floor. It appears that window breakage would be reduced if windows were placed above sixty inches.

TABLE X

RATINGS OF NATURAL LIGHT AS COMPARED TO AVERAGE SQUARE FEET OF WINDOWS AND AVERAGE SQUARE FEET OF LABORATORY

Light Rating	Schools Reporting	Sq. Ft. of Windows	Sq. Ft. of Lab.	Sq. Ft. of Lab. for each Sq. Ft. of Window
Excellent	11	250.4	1347.2	5.38
Good	18	132.6	1453.1	10.90
Fair	13	114.6	1054.6	9.2
Poor	8	60.0	1075.5	17.9
Total	50			

Eleven schools or twenty-two percent reported excellent natural lighting, and eighteen or thirty-six percent

reported good lighting. All laboratories having sky-lights were reported as either excellent or good.

Three of the departments reporting a good rating have sky-lights, and none of the departments with a fair rating have sky-lights. This could explain why laboratories in the fair group have a larger percentage of window area in proportion to floor area.

TABLE XI

RATINGS OF ELECTRIC LIGHTING IN FARM MECHANICS LABORATORIES

Rating	Schools Reporting	Ave. Watts per Lab.	Ave. Lights per Lab.	Ave. Sq. Ft. of Lab.
Excellent	13	1462.1	8.3	1401.9
Good	15	1366.6	7.3	1354.0
Fair	16	946.8	4.9	1123.1
Poor	6	1000.0	4.1	1106.0
Total	50			

The above table appears to be a natural norm. The larger laboratories have more watts and a larger number of lights than the smaller ones. This might indicate that proper lighting was considered in planning the laboratories.

TABLE XII

TYPES OF ROOFS OF FARM MECHANICS LABORATORIES

Roof Type	Schools Reporting	
	Number	Percent
Built-up	26	52
Composition shingles	7	14
Concrete	1	2
Metal	10	20
Tile	1	2
Wood shingles	5	10
Total	50	100

Twenty-six or fifty-two percent of all roofs on farm mechanics laboratories are the flat built-up type. This is the most common type roof on the newer buildings, although this type of construction has been used for many years.

TABLE XIII

SIZES OF EXHAUST FANS AS COMPARED TO AVERAGE SQUARE FEET OF FARM MECHANICS LABORATORY

Diameter of Fan in Inches	Schools Reporting	Average Sq. Ft. of Laboratory
18	1	1040.0
24	5	905.4
36	3	1283.3
42	1	1600.0
Total	10	

Only ten or twenty percent of the schools reported having exhaust fans. Fans are very effective in removal of fumes, and should be located near the Arc and Acetylene welding areas for best results.

TABLE XIV

CONDITION OF ELECTRIC WIRING IN FARM MECHANICS LABORATORIES

Rating	Schools Reporting		Average Number of Outlets		
	Number	Percent	115V	230V	Welder
Excellent	14	28	10.0	2.5	4.3
Good	20	40	6.6	3.0	3.6
Fair	10	20	8.8	3.7	4.1
Poor	6	12	3.0	2.0	2.0

Thirty-four or sixty-eight percent of schools rated their electric wiring as excellent or good, which might indicate that more electric equipment is being used than might have been used in past years.

Teachers apparently are not up to date on rating electrical wiring systems. The fair rating was above the good in all three types of outlets. This indicates a need for in-service training regarding electrical wiring.

TABLE XV

RATINGS OF HEATING SYSTEMS IN FARM MECHANICS LABORATORIES

Rating	Schools Reporting		Ave. BTU	Ave. Size Lab. in Sq. Ft.	Ave. BTU per Sq. Ft.
	Number	Percent			
Excellent	5	10	94,200	1402.2	67.1
Good	11	22	87,818	1388.9	63.3
Fair	4	8	48,750	1055.0	46.2
Poor	5	10	24,000	865.0	27.7
Total	25	50			

Fifty departments reported ratings of heating systems, but only twenty-five or fifty percent reported BTU. Of the twenty-five schools that did not report BTU, their ratings were: excellent, six or twelve percent; good, three or six percent; fair, eight or sixteen percent; and poor, eight or sixteen percent.

Sixteen schools reporting BTU and rating their heating systems as excellent and good had an average of 65.7 BTU per square foot of floor space.

Since the number of BTU was in proportion to size of laboratory and BTU per square foot of laboratory, teachers apparently have done a good job of rating heating systems, although heat was not considered on a practical basis when the buildings were erected.

TABLE XVI

TYPES OF HEATING SYSTEMS AND THEIR RATINGS IN FARM MECHANICS LABORATORIES

Type	Schools Reporting Number	Percent	Ex.	Good	Fair	Poor
Gas	33	66	4	8	11	10
Forced Air	15	30	7	6	1	1
Steam	1	2				1
No heat	1	2				1
Total	50	100	11	14	12	13

Forty-eight or ninety-six percent of all laboratories are heated with either gas or forced air. Since thirteen of the fifteen departments heated with forced air rated either excellent or good, the conclusion could be drawn that forced air is a very effective method of heating.

TABLE XVII

VALUE OF SERVICE DOORS IN FARM MECHANICS LABORATORIES

Rating	Schools Reporting Number	Percent
Essential	42	84
Very Important	2	4
Important	6	12
Not Important	0	0
Total	50	100

Eighty-four percent of teachers of vocational agriculture reported that large service doors were essential in the operation of a farm mechanics laboratory. Without this type door, much of the work must be done outside.

Table XVIII shows the various sizes and distribution of service doors. Ninety-eight percent of departments reported service doors, with one department reporting two service doors.

TABLE XVIII

SIZES OF SERVICE DOORS IN FARM MECHANICS LABORATORIES

Sq. Feet of Door	Schools Reporting Number	Percent
50- 75	7	14
76-100	25	50
101-125	8	16
126-150	5	10
151-175	2	4
176-200	2	4
No door	1	2
Total	50	100

Forty or eighty percent of departments reported doors varying from fifty to one-hundred and twenty-five square feet. The mean size was 85.2 square feet. The forty doors had the following widths: one was fourteen feet, six were twelve feet, two were eleven feet, twenty-one were ten feet, six were nine feet, and four were eight feet.

Siniard[15] reports that service doors should be at least 10 to 12 feet wide and 10 feet high.

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15. G. G. Siniard, et al, "Providing Facilities For Departments of Vocational Agriculture in Georgia," The University of Georgia, College of Education, Department of Agricultural Education, Athens, Georgia. p 56-62.

TABLE XIX

NECESSITY OF SMALL OUTSIDE DOOR IN FARM MECHANICS LABORATORY

Frequency	Number of Schools	Teachers feel Door is Necessary	Teachers feel Door not Necessary
With	31	37	13
Without	19		
Total	50		

Table XIX shows that thirty-seven or seventy-four percent of teachers feel that a small outside door to the laboratory is necessary.

When farm mechanics laboratories are being planned, some consideration should be given to the addition of this small outside door. This small door should be at least three by seven feet.

TABLE XX

NUMBER OF FARM MECHANICS LABORATORIES HAVING RESTROOM AND LAVATORY FACILITIES

	Schools Reporting	
	Number	Percent
Have Restroom in or near Laboratory	31	62
Have no Restroom Facilities	19	38
Total	50	100

The average number of lavatories in or near laboratory was 1.64, and the number of lavatories needed was 1.66. This would indicate that in the thirty-one departments reporting lavatories that they are almost adequate.

Since many students leave the laboratory with soiled hands, provisions should be made for facilities for students to wash before returning to other classes.

TABLE XXI

NUMBER AND SIZES OF TOOL ROOMS IN FARM MECHANICS LABATORIES

Sq. Ft. of Tool-room	Number of Schools	Number Adequate	Number Inadequate
26- 50	2	1	1
51- 75	5	4	1
76-100	7	6	1
Over 100	3	3	0
Total	17	14	3

Tool-rooms varying from fifty-one to seventy-five square feet are adequate for eighty percent of those reporting. This would indicate that a tool-room of this size would be satisfactory to the majority. Three tool-rooms had an average size of 273.3 square feet, bringing the mean square feet of all tool-rooms to 110.8.

TABLE XXII

NUMBER AND SIZES OF STORAGE ROOMS IN FARM MECHANICS LABORATORIES

Sq. Ft. of Storage	Number of Schools	Number Adequate	Number Inadequate
0- 50	1	1	
51-100	2	1	1
101-150	5	1	4
151-200	2	1	1
Over 200	2	2	
Total	12	6	6

Two storage rooms had an average of 402 square feet, bringing the mean square feet of storage rooms to 174.5 per laboratory.

Since four out of five storage rooms in the 101-150 square feet range were reported inadequate, this might indicate that this size is too small. Seven teachers reported a need for storage rooms.

Siniard[16] states that 200 or more square feet of storage is needed for project and project materials storage.

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16. G. G. Siniard, et al, "Providing Facilities For Departments of Vocational Agriculture in Georgia," The University of Georgia, College of Education, Department of Agricultural Education, Athens, Georgia. p 56-62.

TABLE XXIII

NUMBER OF FARM MECHANICS LABORATORIES EQUIPPED WITH STUDENT LOCKERS

	Schools Reporting	
	Number	Percent
Individual Student Lockers	2	4
Share Student Lockers	17	34
No Student Lockers	31	61
Total	50	100

The data in Table XXIII indicates a definite weakness in this phase of equipment in farm mechanic laboratories.

Since students must have proper laboratory clothing, provisions should be made for proper storage.

TABLE XXIV

SIZE AND NUMBER OF OUTSIDE WORK AREAS

Size of Work Area in Sq. Ft.	Number Reporting	Number Adequate	Number Inadequate
0- 500	7	4	3
501-1000	4	3	1
1001-1500	3	3	
1500 and over	5	5	
Total	19	15	4

A total of thirty-six or seventy-two percent of departments reported having outside work areas, but only nineteen reported their sizes. Five schools reported above fifteen hundred square feet, for an average of forty-eight hundred square feet.

Four schools reported work areas fenced, and three schools reported work areas covered or partially covered.

Table XXIV shows that work areas of less than 1000 square feet have a tendency to be inadequate.

TABLE XXV

TYPES AND TEACHER PREFERENCE OF WORK BENCHES IN FARM MECHANICS LABORATORIES

Type	Schools Reporting	Teacher Preference		
		Permanent	Movable	Both
Permanent	5	8		
Movable	44		31	
Both	1			11
Total	50	8	31	11

Forty-two or eighty-four percent of teachers prefer either movable or permanent and movable type work benches. Only eight teachers prefer the permanent type work benches.

This might indicate that the work bench that could be moved about in the shop would be more practical than those of a more permanent nature.

CHAPTER IV

SUMMARY AND CONCLUSIONS

In this chapter, is presented a summary of the findings and conclusions based upon the analysis of the data.

The purposes of this study are:

1. To secure information from experienced teachers concerning the building requirements for an adequate farm mechanics program as a part of vocational education in agriculture.
2. To provide complete plans for buildings or rooms for teaching farm mechanics.

SUMMARY

The problem in this study was to determine what facilities were needed by teachers to properly teach farm mechanics in vocational agriculture.

As was pointed out in the review of literature, the first thing to be considered in planning a farm mechanics laboratory is having proper facilities to meet the need.

Adequate size to allow each student at least 75-100 square feet of working area and lighting equal to twenty percent of the working area should be considered. Service doors should be a minimum of ten feet wide and ten feet high and a small entrance door should be three by seven feet.

Posts and pillars should be eliminated from the laboratory, and space should be allotted for distinctive units of work. Laboratories should be not less than thirty-two feet in width, have concrete floors a minimum of four inches thick and walls twelve feet in height. Heaters should be sufficient to keep the laboratory comfortable at all times.

It should be noted in this study that laboratories in the Southwest district in Oklahoma have a mean size of 1264.04 square feet, with an average of 33.72 square feet per student, which fails to meet the recommended size.

Only twenty-two percent of schools repored ceiling heights of the recommended twelve feet in height, and forty four percent of schools have ceilings of fire proof material. Thirty-one or sixty-two percent of departments reported laboratories in either excellent or good condition, and nineteen reported either fair or poor. Improper lighting of laboratories was evident in this study, with fifty two percent of departments reporting less than one-hundred square feet of window area. Of the five schools reporting natural lighting supplemented by sky-lights, all teachers rated the lighting as excellent or good. Height of windows were found to be lacking in this study, with seventy percent of windows reported from twenty-four to forty-eight inches off the floor.

Apparently teachers did a good job reporting electrical lighting in laboratories, since a natural norm was established.

Laboratories are decidedly lacking in the number of exhaust fans, since only ten departments reported having fans. Electrical wiring was improperly reported by teachers, which might indicate a need for in-service training of teachers. Only six departments rated their electrical wiring as poor.

Teachers reporting excellent heat had an average of 67.1 BTU per square foot, and those reporting good heat had an average of 63.3 BTU per square foot of laboratory. Of the twenty-five departments reporting BTU and rating their

heating systems, teachers apparently did an excellent job.

Forced air appears to excel for heating, since thirteen of the fifteen departments reporting had excellent or good heating systems.

Forty-two or eighty-four percent of teachers feel that large service doors are essential in the farm mechanics laboratory, although thirty-two schools reported doors with a size of one-hundred square feet or less. Seventy-four percent of teachers feel that small entrance doors to the laboratory are a necessity.

Lavatories averaged almost adequate, although there is a need for more uniform distribution, since thirty-eight percent of departments have no lavatory or restroom facilities.

Toolrooms and storage facilities are definitely a weak spot in facilities in farm mechanics labatories, since only seventeen reported having toolrooms, with only fourteen of those adequate. Storage rooms were reported available in twelve departments with only six of those adequate.

Student lockers are definitely insufficient in departments, since only four percent reported individual lockers, and thirty-four percent reported having lockers shared by students. Thirty-one departments reported no available student lockers.

In reporting extra features of their labatories forty eight percent have floor drains, fifty percent have a view of the laboratory from their office, but ninety-four percent

feel this view is important. Eighty percent of laboratories are adjacent to classroom, and sixty-two percent of laboratories are separate from the acedemic building.

Teachers indicated a preference for work-benches that were movable.

RECOMMENDATIONS AND CONCLUSIONS

This study covers fifty of the departments of vocational agriculture where farm mechanics is taught. The author has visited sixteen of the departments. From the information gathered and the personal observation, the following suggestions and recommendations seem appropriate.

The following requirements for farm mechanics laboratories are suggested.

1. Laboratories should be large enough to accomodate the largest class taught, taking into consideration types of projects that will be constructed or repaired, and space required for each. One-hundred square feet per student would seem advisable.
2. Ceiling heights should be sufficient to accomodate the larger projects constructed, and allow sufficient space for windows. A height of twelve feet is desireable.
3. Attention should be given to type of construction material, with masonry probably being the most durable, economical, and practical.
4. Window area should be in proportion to size of laboratory, and best results should be obtained when window area equals approximately twenty per cent of floor area. To prevent excess breakage, and to allow a more uniform distribution of light,

the bottom of the windows should be from five to six feet from the floor, and equally spaced on two sides of the laboratory.

5. Electric lighting should be so planned to eliminate any shadow in the laboratory. The number of lights and the wattage will depend upon height and color of ceiling and the type of light fixtures. A minimum of one watt per square foot is feasible.
6. Types of ceiling materials should be considered in the construction of a farm mechanics laboratory. Fire prevention, durability, and a reduction of insurance rates should be most important.
7. The building trend seems to be moving toward a flat type built-up roof, consisting of steel decking, fiberous insulation, felt paper, pitch, and gravel.
8. Exhaust fans should be located near the arc and acetylene welding areas, and should be large enough to give a fairly rapid exchange of air.
9. Electric outlets should be properly located about the laboratory to enable use of power tools at any location in the room, without an excessive use of extension cords. Consideration should be given to the amount of equipment needed for future use when planning electric wiring.
10. Type of construction, height of ceiling, and the amount of glass in windows should be considered in figuring heat loss for laboratory buildings.

Sixty-five BTU of heat per square foot appears sufficient.

11. The forced air heater appears to be more practical than other types.
12. Size of service entrance door should be planned to accomodate the largest piece of equipment to be repaired or constructed in the laboratory.
13. Toilet and lavatory facilities should be definitely considered, allowing enough space for students to wash in a minimum of time.
14. Adequate tool-room and storage facilities are a necessary part of the laboratory, and should definately be considered. Tool-rooms should contain from 50 to 75 square feet, and storage rooms should be 100 to 150 square feet.
15. Since students should wear special clothing in laboratory work, student lockers should be provided either on an individual or share basis.
16. For practical purposes farm mechanics laboratories should be located adjacent to the vocational agriculture classroom and provide a view of the laboratory from the instructor's office.
17. An outside work area either covered or partially covered, and having a concrete floor should be provided from projects repaired or constructed outside the laboratory.

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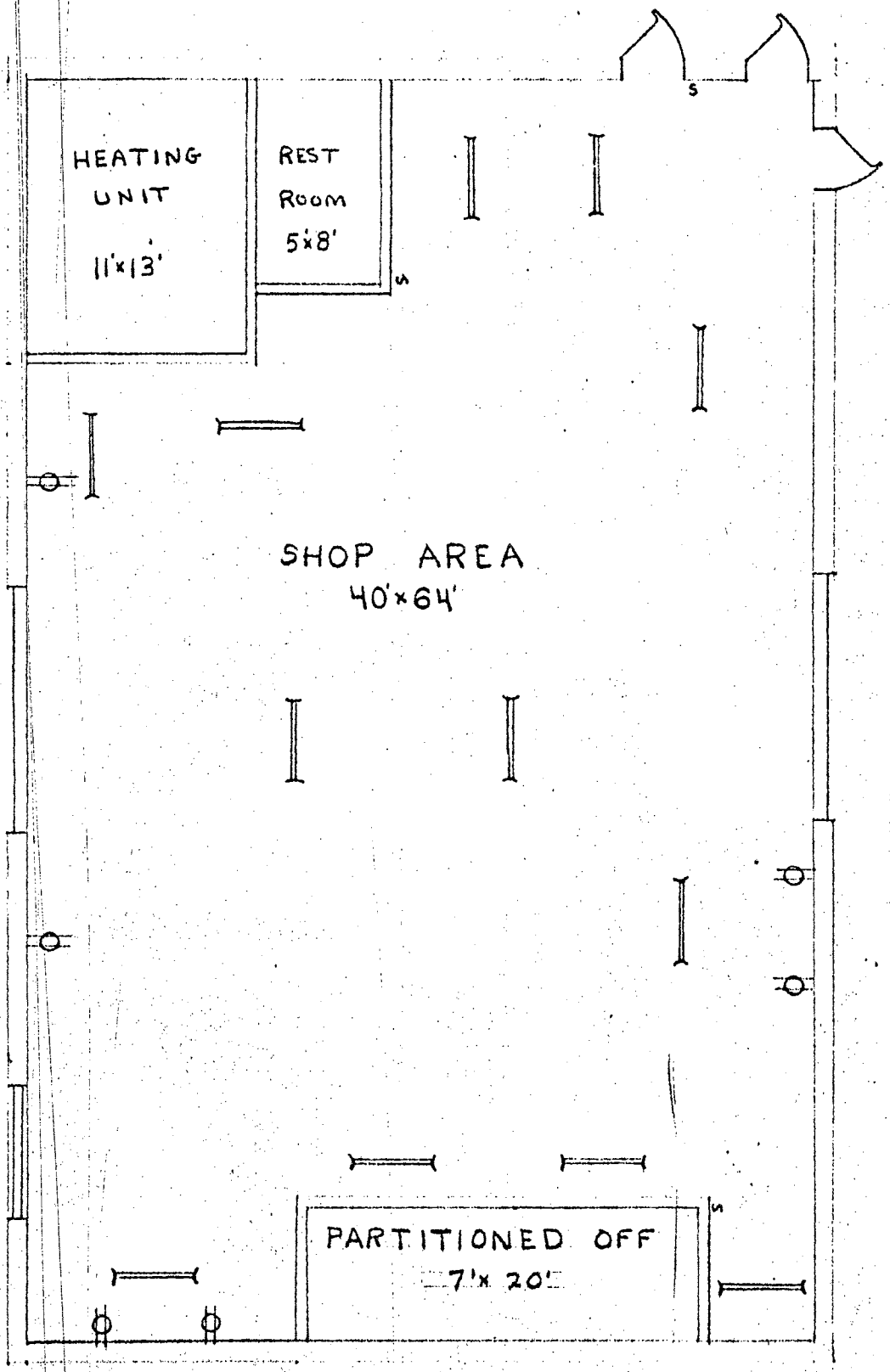
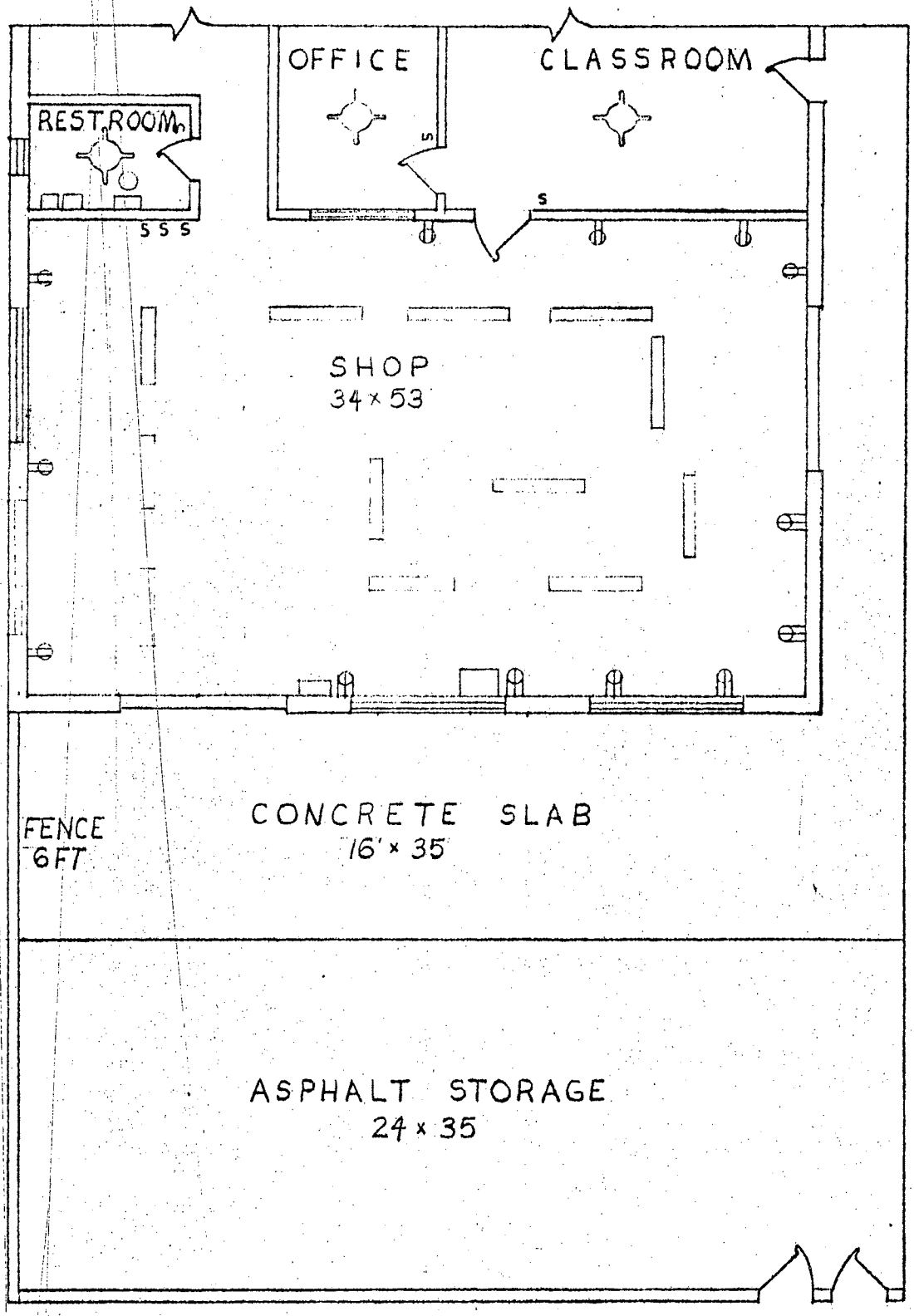
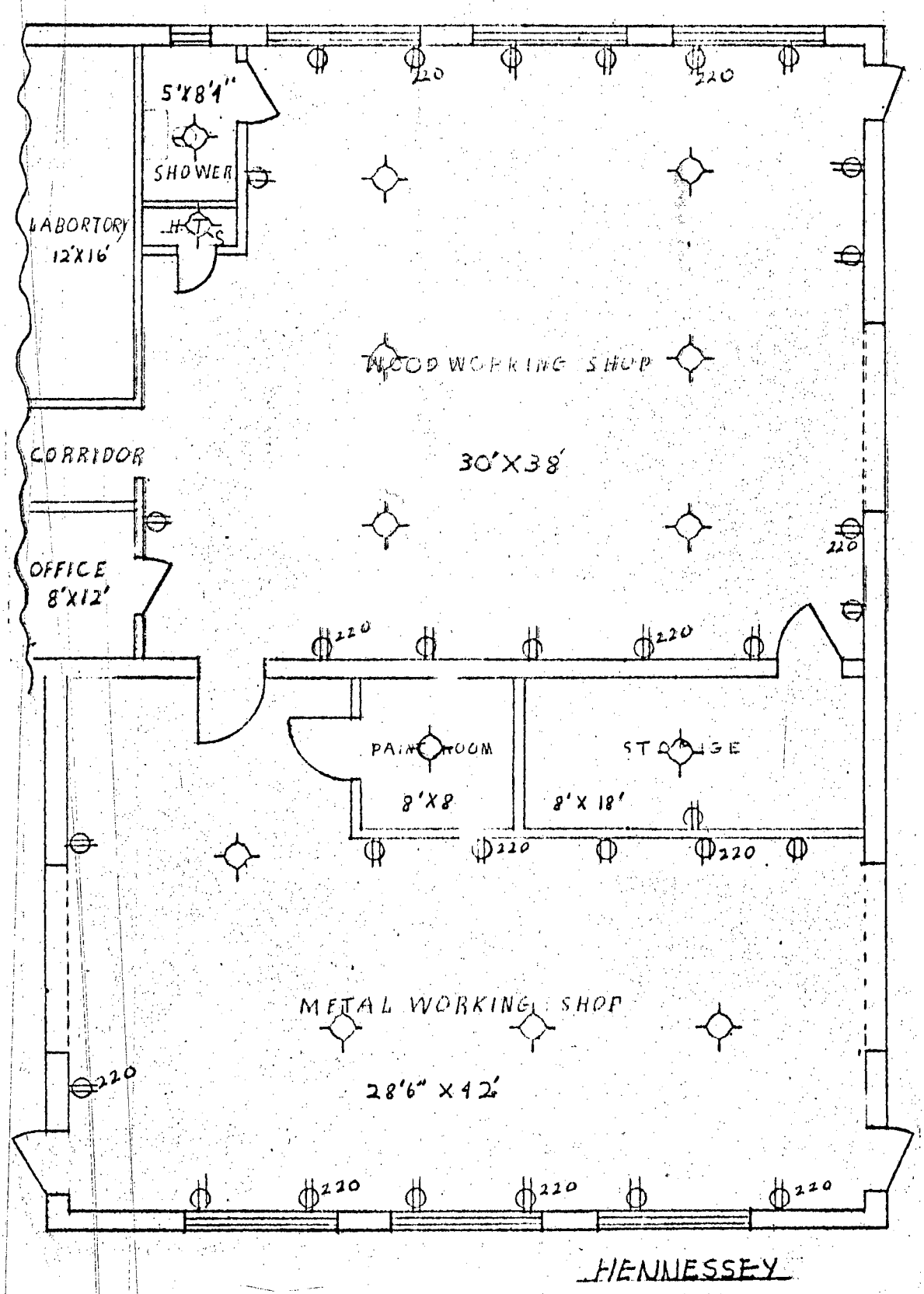
APPENDIX

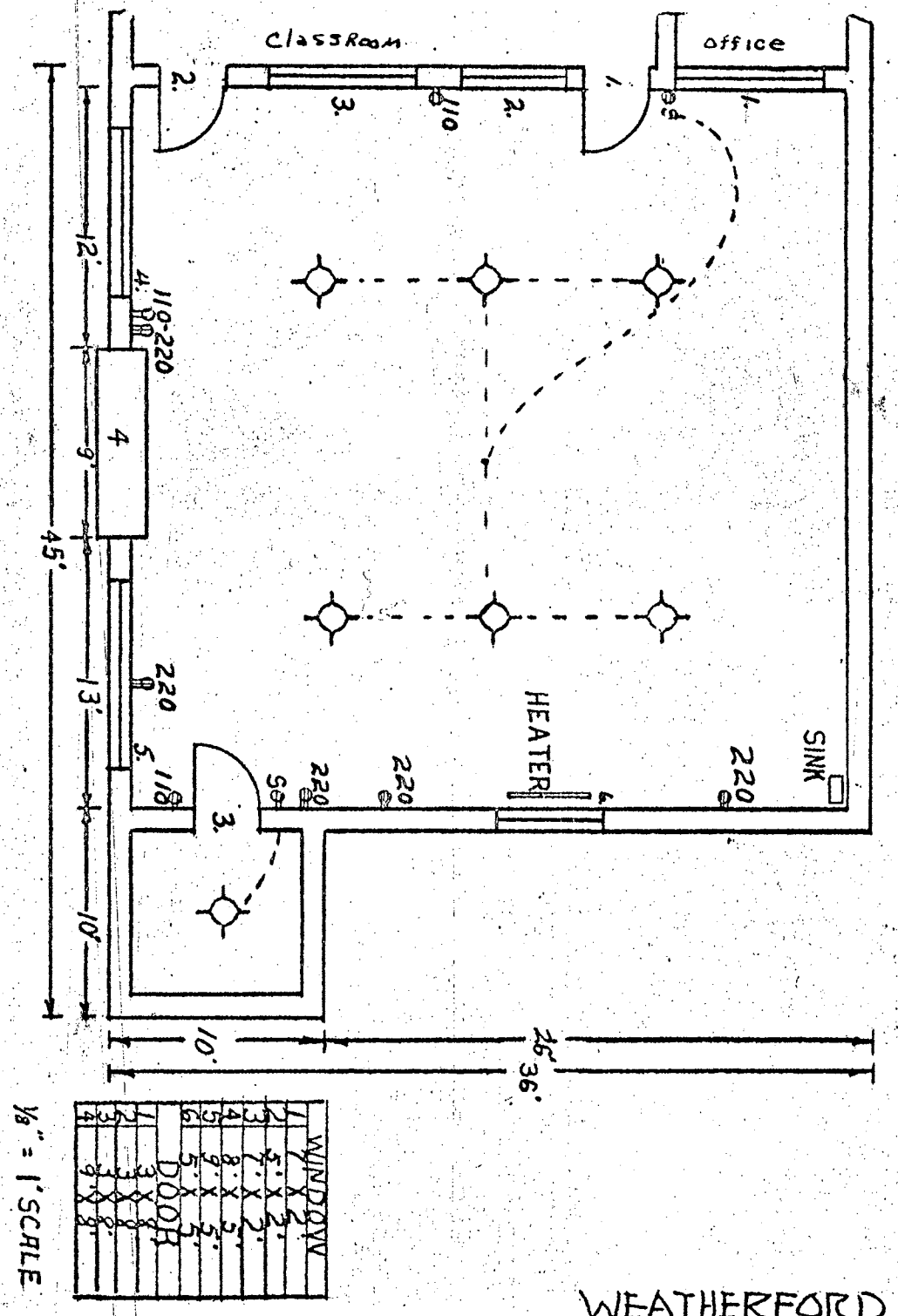

HEATING
UNIT
11'x13'
REST
Room
5'x8'
S
S
SHOP AREA
40'x64'
PARTITIONED OFF
7'x 20'
S

ALVA

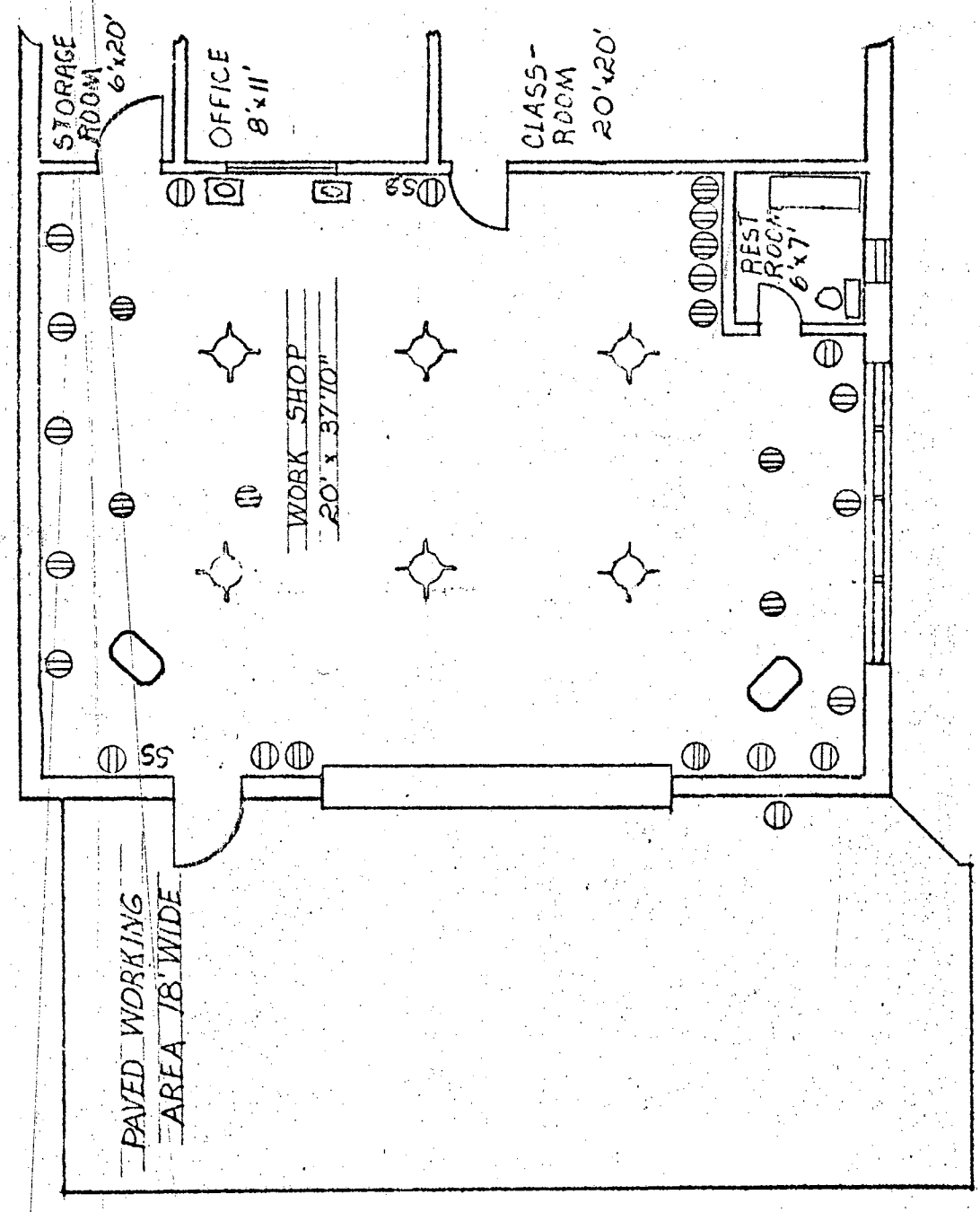

OFFICE
CLASSROOM
REST ROOM
S S S
S
S
SHOP
34 × 53
FENCE
6FT
CONCRETE SLAB
16' × 35
ASPHALT STORAGE
24 × 35

PURCELL

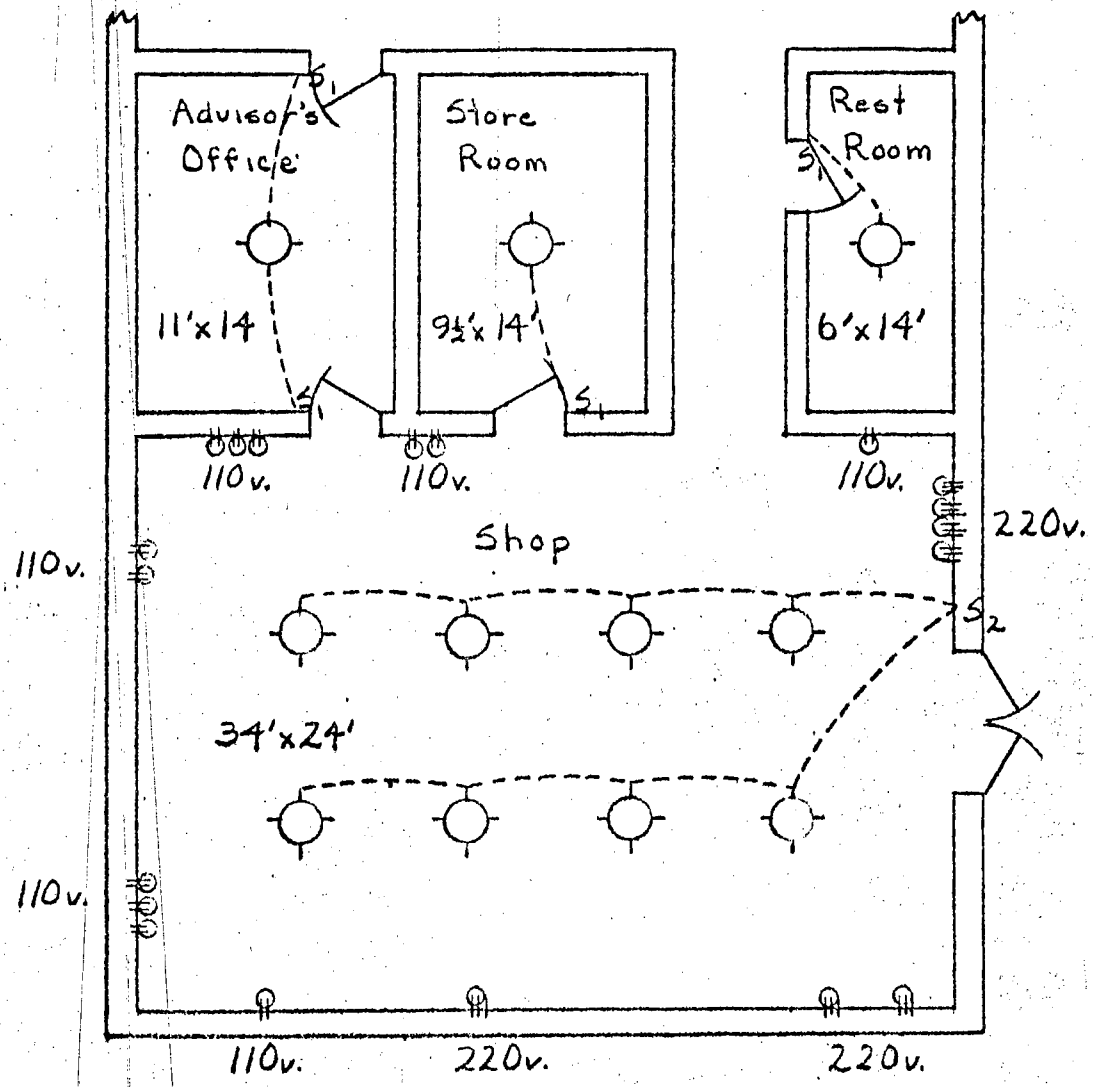

5'X8'1"
SHOWER
H
T
S
LABORTORY
12'X16'
WOOD WORKING SHOP
30'X38'
CORRIDOR
OFFICE
8'X12'
220
PAINT ROOM
8'X8
STORAGE
8'X 18'
METAL WORKING SHOP
28'6" X 42'
HENNESSEY



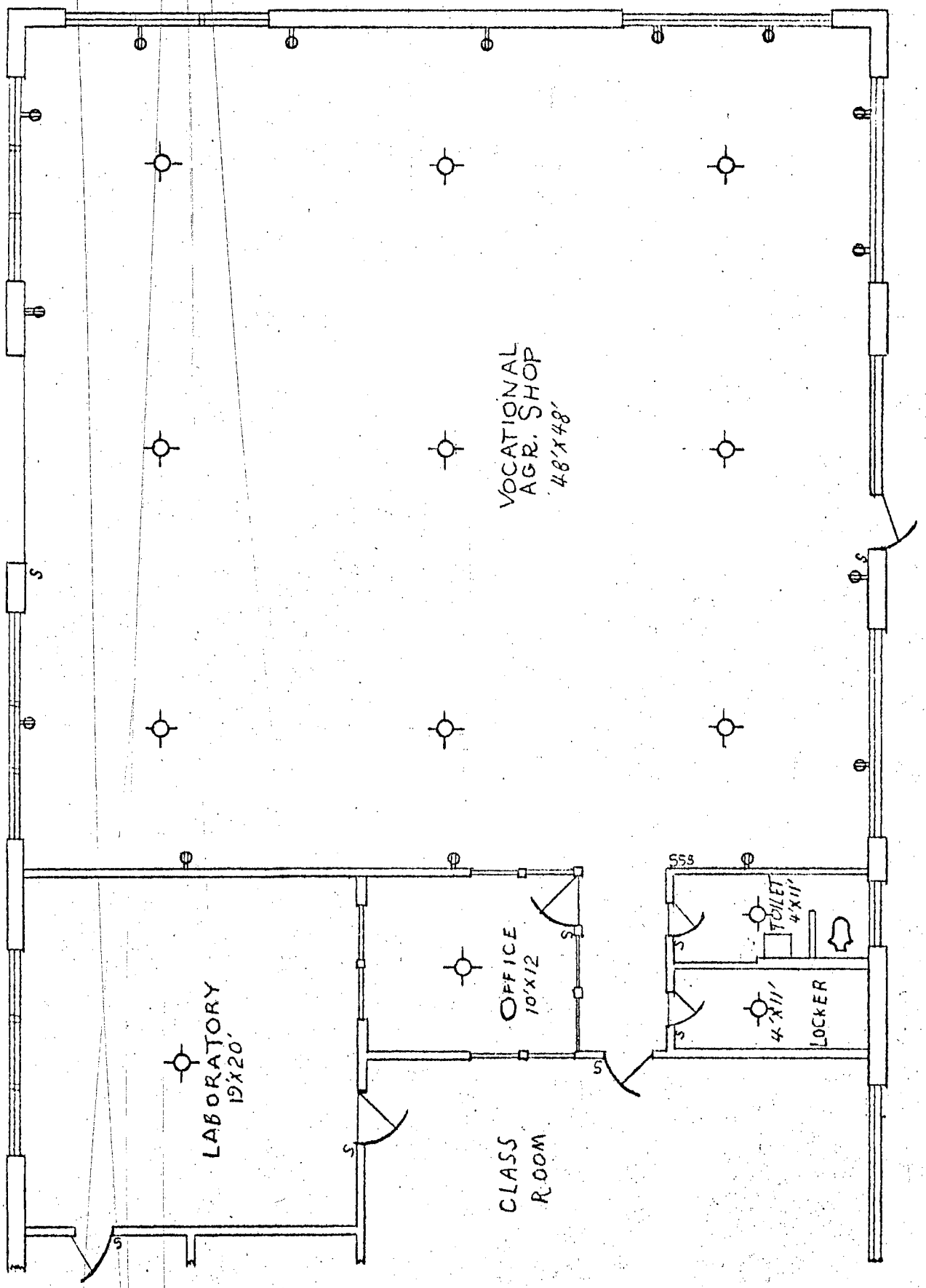
WEATHERFORD


STORAGE ROOM 6'x20'
OFFICE 8'x11'
CLASS-ROOM 20'x20'
REST ROOM 6'x7'
WORK SHOP 20' x 37'10"
PAVED WORKING AREA 18' WIDE

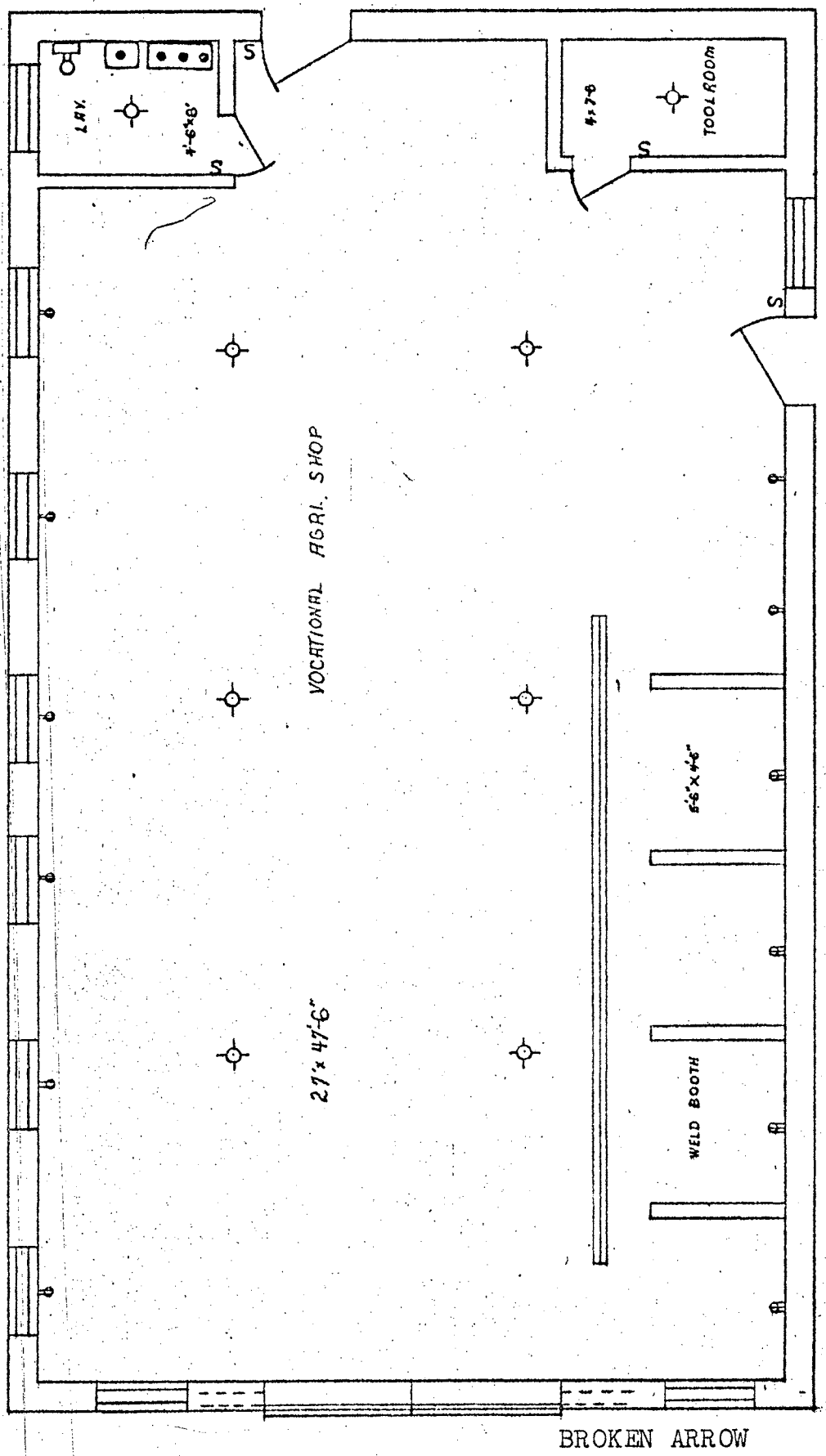
CUSTER CITY

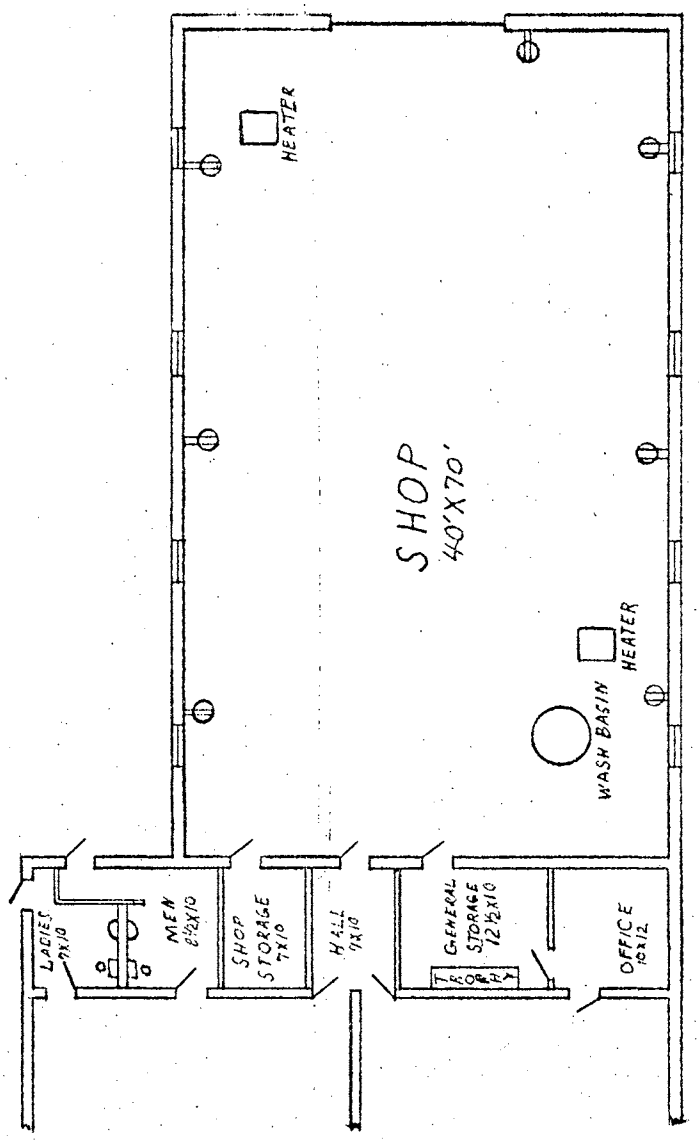


Maysville Agriculture Building
36'x 62'

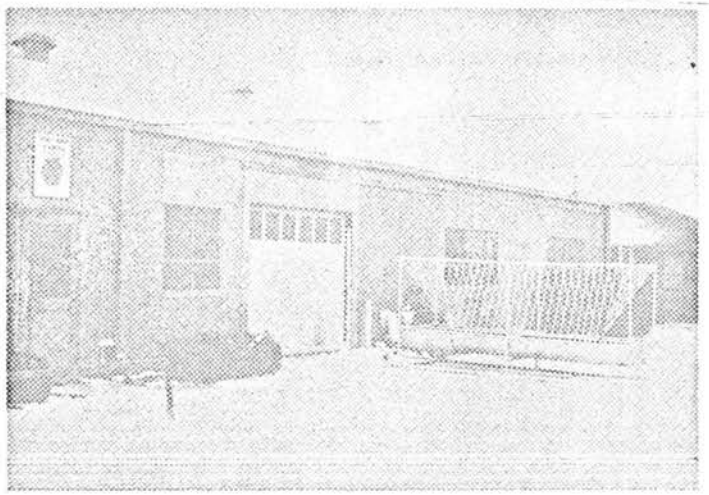

VOCATIONAL AGR. SHOP 48'X48'
LABORATORY 19'X20'
OFFICE 10'X12
CLASS ROOM
TOILET 4'X11'
4'X11'
LOCKER
S

KINGFISHER

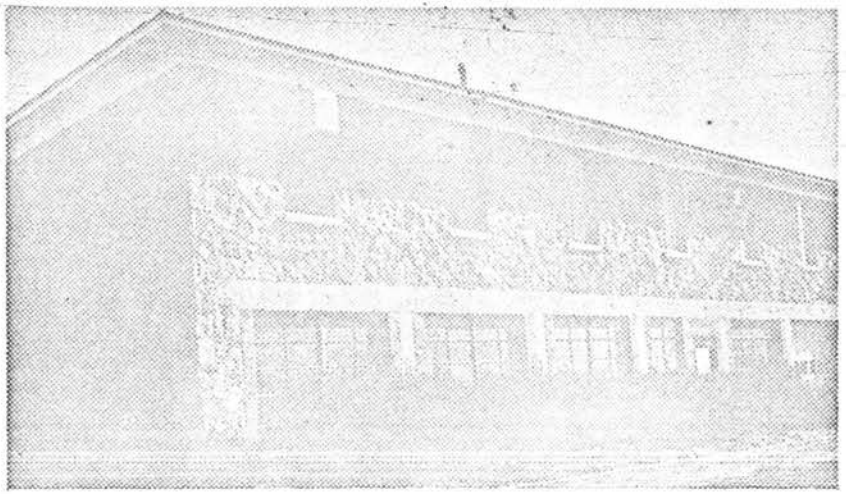

LAV.
4'-6"x8'
S
S
4'x7'-6"
TOOL ROOM
S
S
VOCATIONAL AGRI. SHOP
21'x 47'-6"
5'-6"x 4'-6"
WELD BOOTH
BROKEN ARROW


HEATER
SHOP
40'X70'
HEATER
WASH BASIN
LADIES
7X10
MEN
8½X10
SHOP
STORAGE
7X10
HALL
7X10
GENERAL
STORAGE
12½X10
TOILET
OFFICE
10X12

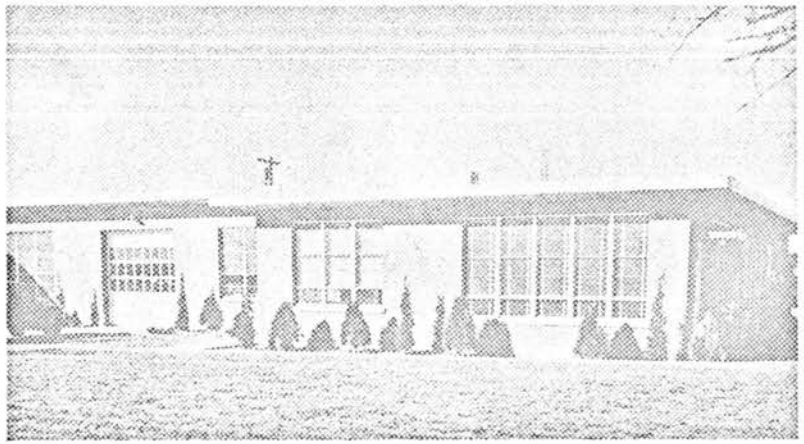
CHECOTAH



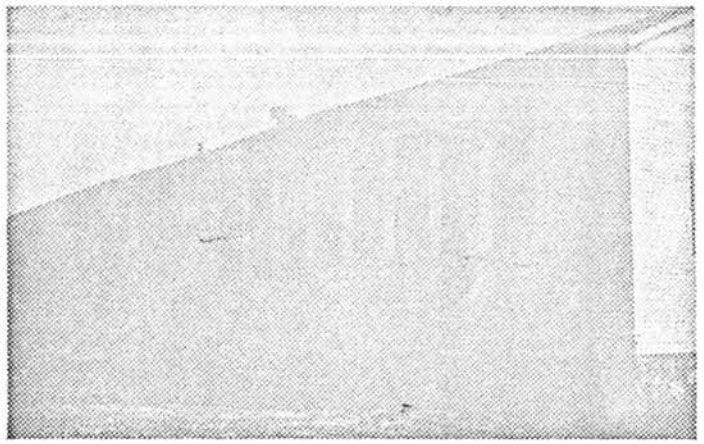
SHATTUCK



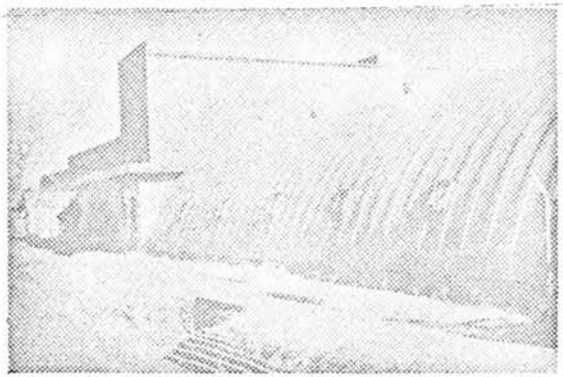
WEATHERFORD



ALVA



COLCORD

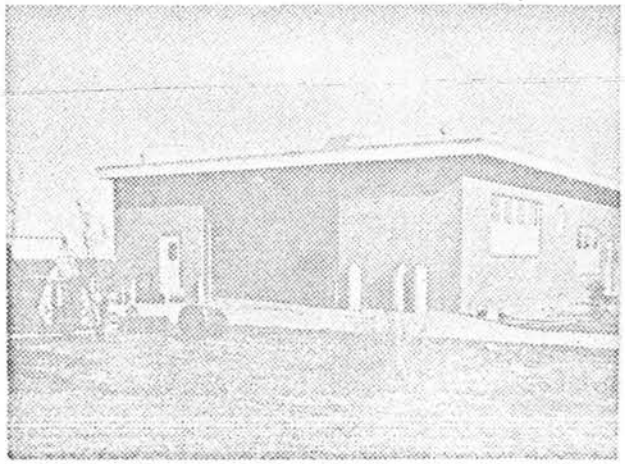


CHECOTAH

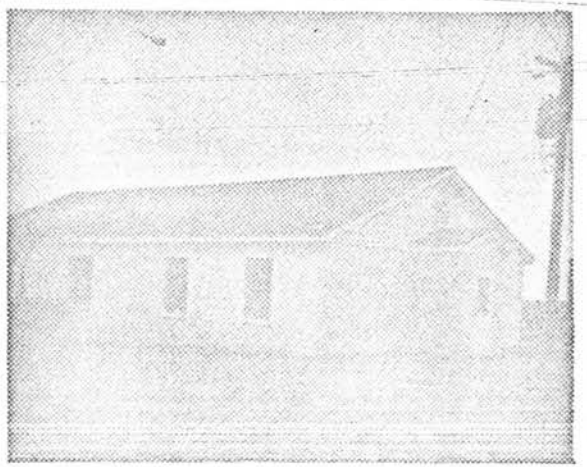
LAVERNE

PERRY

PURCELL



CUSTER CITY



BETHEL

CORDELL

Altus, Oklahoma
December 19, 1961

Dear Vocational Agriculture Teacher

I am doing my masters report on farm mechanics shops in high schools in Oklahoma. Your school was reported by the state department as having one of the top six shops in your district. My plans are to include an outside picture, or a good inside picture along with the floor plan of each of these thirty school shops.

Would you please send me one or more pictures along with a rough drawing of your shop, including the deminsions. The Drafting department here at our school has agreed to re-draw the plans.

Thank you very much for your cooperation.

Sincerely,

Orval Warren
1716 Hollywood Dr.
Altus, Oklahoma

These schools were listed as having the outstanding Farm shops in the five districts.

CENTRAL	NORTHWEST	NORTHEAST	SOUTHEAST	SOUTHWEST
Bethel	Alva	Checotah	Calvin	Duncan
Davenport	Laverne	Inola	Latta	Purcell
Lexington	Kingfisher	Skiatook	Calera	Cordell
Norman	Perry	Broken Arrow	Maysville	Roosevelt
Prague	Shattuck	Welch	Battiest	Custer City
Wellston	Hennessey	Colcord	Wetumka	Weatherford

QUESTIONNAIRE

1. Name of school _____.
2. Does your department have a Farm Shop: yes ____ no ____.
3. Number of students in the following classes: Agri. I _____, Agri. II _____, Agri. III _____, and Agri. IV_____
4. Which class or classes are overcrowded in your shop: Agri. I __, Agri. II __, Agri. III __, Agri. IV __ or none __.
5. Number of farm boys _____, number of town boys _____.
6. Number of years school has had a vocational agriculture department. _____.
7. Number of years school has had a farm shop _____.
8. Is your farm shop a separate building from the main academic building: yes ____ or no ____.
9. What is the size of your farm shop: Length _____ ft., width _____ ft., ceiling height _____ ft.
10 What type floor does your farm shop have _____.
11 What type construction is your farm shop: Wood, masonry, wood and masonry, or metal _____.
12 What is the present condition of your shop building: excellent, good, fair or poor _____.
13 What is the approximate square feet of windows in your shop. _____.
14 How high are these windows from the floor _____ ft.

15. Is natural lighting considered: excellent, good, fair, or poor _____.
16. Is your shop equipped with sky-lights: yes or no _____. If yes, how many _____, and what size _____.
17. What degree of effectiveness do you consider the electric lighting in your shop: excellent, good, fair or poor _____.
18. How many ceiling lights do you have _____, How many watts of lighting in all ceiling lights _____.
19. What type ceiling do you have: wood, metal, concrete or other: _____.
20. Do you have an exhaust system for the purpose of removing fumes: Yes or no _____, If yes, what is fan diameter _____ ft.
21. Would you consider electric wiring in your shop as: excellent, good fair, or poor _____. How many 115V outlets _____, 230V outlets _____, how many welder outlets _____.
22. Is the heating system in your shop considered: excellent good, fair, or poor _____.
23. What type heating system do you have: Forced air, coal, steam, oil, gas or other _____. How many BTU _____.
24. Do you have a large service entrance door in your shop: yes or no _____. If yes, what is the width in feet _____, height in feet _____. Do you consider

service entrance doors as essential, important, or not important _____.

25. Do you have a small outside door in your shop: yes or no _____. Do you think a small door is necessary: yes or no _____.
26. Do you have restroom facilities in your shop, or near your shop: yes or no _____.
27. Do you have lavatories in your shop: yes or no _____. How many lavatories do you have _____. How many is needed _____.
28. Do you have a separate tool-room: yes or no _____. What size is your tool-room: length _____, width _____. Is this size adequate or inadequate _____.
29. Do you have a storage room for student materials: yes or no _____. What size: length _____, width _____. Is this size adequate or inadequate _____.
30. Do you have an outside working area adjacent to building: yes or no _____. If yes, what is the size: width _____, length _____. Is this side adequate or inadequate _____.
31. Is outside working area fenced: yes or no _____.
32. Is outside working area covered or partially covered _____.
33. Are student lockers furnished for shop clothing: yes or no _____. Do students have a separate locker, or share lockers _____.

34. What type roof does your shop have: flat mopped-on, wood shingles, composition shingles, metal, tile or other _____.

35. Does your shop have a floor drain: yes or no _____.

36. Are work benches built in permanent location, or are they movable _____. Which do you prefer _____.

37. Do you have a view of the shop from your office: yes or no _____. Do you feel this is important: yes or no _____.

38. Is your shop adjacent to classroom: yes or no _____.

39. What are the most outstanding features of your shop.

    a. _____.

    b. _____.

    c. _____.

40. What are the major construction problems, such as size, arrangement etc.

    a. _____.

    b. _____.

    c. _____.

VITA

Orval Ray Warren

Candidate for the Degree of

Master of Science

Report: PLANNING FARM MECHANICS LABORATORIES FOR OKLAHOMA

Major Field: Agricultural Education

Biographical:

Personal Data: Born near Duke, Oklahoma, December 9, 1921, the son of Barney L. and Era Berniece Warren.

Education: Attended grade school at Prairie Hill and Duke, Oklahoma, graduated from Duke High School in 1940; received the Bachelor of Schience degree from the Oklahoma Agricultural and Mechanical College, with a degree of Agricultural Education, in May 1953. Graduate study, Oklahoma State University, Stillwater, Oklahoma, Oklahoma University, Norman, Oklahoma, and Midwestern University, Wichita Falls, Texas.

Professional experience: Entered United States Army 1942, and served for three and one half years with Military Intelligence. Teacher of vocational agriculture at Ryan, Oklahoma 1953-1957; teacher of vocational agriculture at Altus, Oklahoma from 1957 until present time.

Professional organizations: Phi Delta Kappa, Alpha Zata, Oklahoma Vocational Association, American Vocational Association, Oklahoma Education Association, National Education Association and Red Red Rose.