A STUDY OF THE UTILIZATION OF NATIVE WOODS FOR FARM BUILDING CONSTRUCTION IN THE CUT-OVER AREA OF MICHIGAN WITH PARTICULAR REFERENCE TO ASPEN

Thesis for the Degree of M. S.
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Cecil H. Jefferson

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THESIS

This is to certify that the

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A STUDY OF THE UTILIZATION OF NATIVE WOODS FOR FARM BUILDING CONSTRUCTION IN THE CUT-OVER AREA OF MICHIGAN, WITH PARTICULAR REFERENCE TO ASPEN

By

Cecil H. Jefferson

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INTRODUCTION

At the time this study was undertaken the entire nation was gradually recovering from its worst financial depression. The farmers in the northern part of the lower peninsula of Michigan or the area commonly referred to as the "cut-over" area of Michigan (Figure 1) were particularly distressed.

For various reasons agriculture in this area has never attained the degree of stability found in southern Michigan. Many of the farmers are forced to rely upon factory jobs in adjacent industrial cities for supplemental income and others eke out a bare subsistence from poorly equipped and ill managed marginal or sub-marginal land.

The cut-over area of Michigan has approximately 40,000 families. The history of this area indicates that most of them intend to stay even though it might be to their advantage to relocate. Regardless of the purely social aspects of agricultural development in the cut-over area, there are immediate and more practical aspects.

One of the most pressing problems confronting the farmers in this area is that of adequate housing, including dwellings as well as livestock and storage structures. Although farm buildings throughout Michigan are in a critical state of depreciation and obsolescence, the buildings in the cut-over area are even more seriously depleted.

Numerous requests for assistance in obtaining more

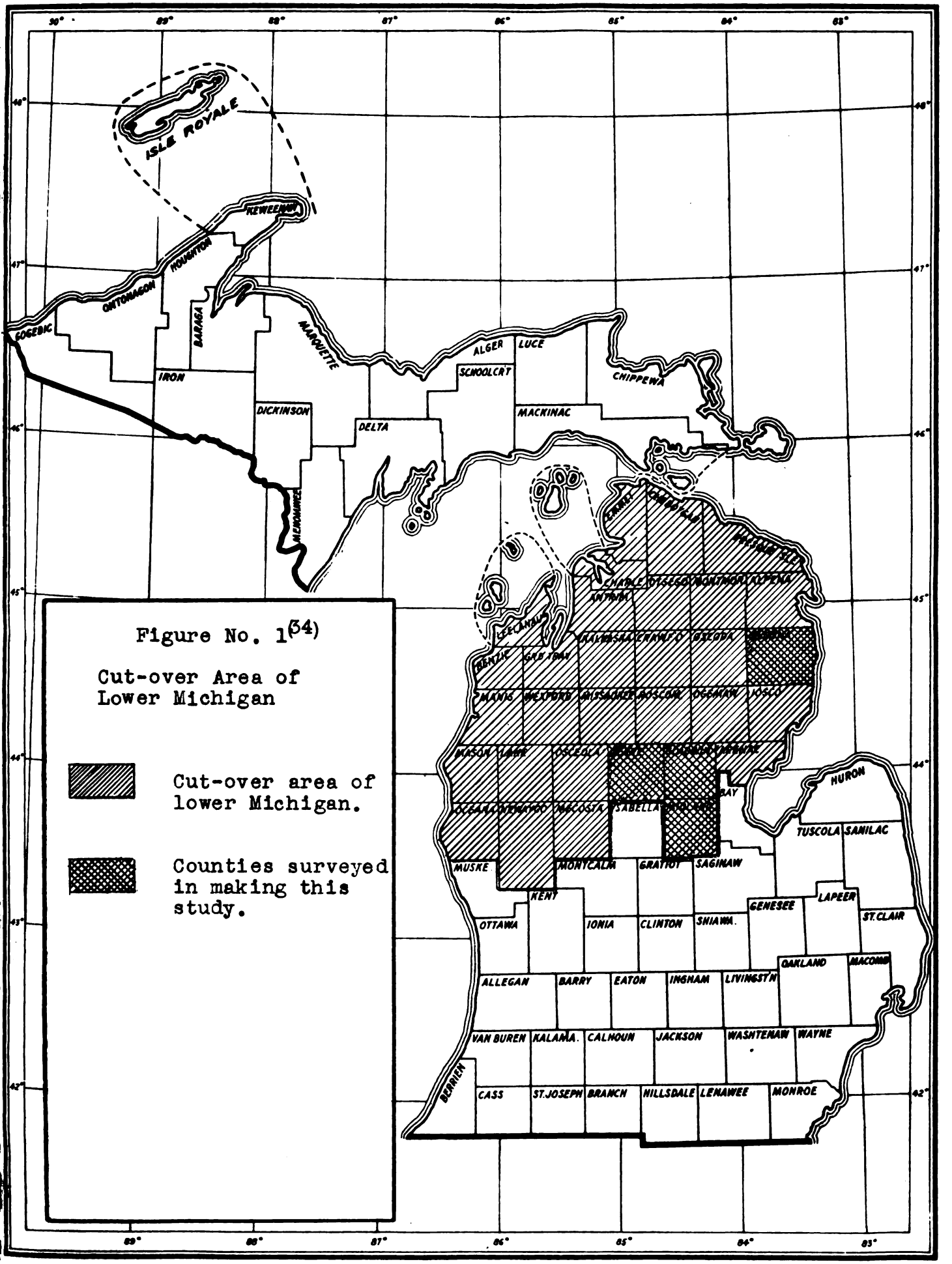


Figure No. 1(34)

Cut-over Area of Lower Michigan

Cut-over area of lower Michigan.

Counties surveyed in making this study.

adequate farm buildings are received from individual farmers and from county agricultural agents. Some interest is shown in using readily available native woods such as jack-pine, aspen, balsam, poplar, etc., but the majority of lumbermen, local builders, and even farmers, are prejudiced against using such "inferior" woods. It may be of interest to note that at a meeting called by the County agricultural agent in one of the cut-over counties to discuss this problem the suggestion that these so-called inferior woods be used in farm construction was received with evident disfavor. One farmer even stated that he would go without buildings before he would be guilty of using such worthless lumber. The appearance of the buildings in this county would seem to indicate that other farmers felt the same way.

In 1935 the Farm Security Administration was set up to help deserving farmers rehabilitate themselves. One of the first requests from this agency was for plans of farm buildings that could be constructed entirely from farm woodlot timber without the necessity of buying any article, except possibly nails and other hardware. Since most of these farmers did not have available cash for the purchase of standard lumber from their local dealer, the utilization of local lumber seemed like a practical approach to the problem of obtaining more adequate buildings for the farmers in the cut-over area of Michigan.

In this cut-over area there are approximately 7,000,000 acres of timber land with a potential supply of lumber that

provide adequate housing for the farm families and all their livestock, crops, and equipment. Much of this timber is on individual farms and could be converted into usable lumber at a cost of only a few dollars per thousand board feet for sawing, plus some farm labor for cutting and hauling the logs to a local mill.

Additional timber is available on thousands of acres of state and national forest land and can be purchased from the proper authorities for a very low stumpage fee (Figure 2). At the time this project was started, this fee for some species of timber was as low as one dollar per thousand board feet.

There is evidence that the supply of aspen and jack-pine is increasing so fast that the problem of clearing it from state lands is becoming a serious problem. The Michigan State Department of Conservation would welcome an opportunity to cooperate with farmers in making this timber available for farm construction.(32)

One wonders why more of this timber has not been used. This project was undertaken in an attempt to answer this question by:

1. Ascertaining the need for farm building construction in the cut-over area of Michigan.
2. Determining the extent to which native lumber, particularly aspen, might be used to supplement commercial lumber.
3. Determining the availability of aspen.

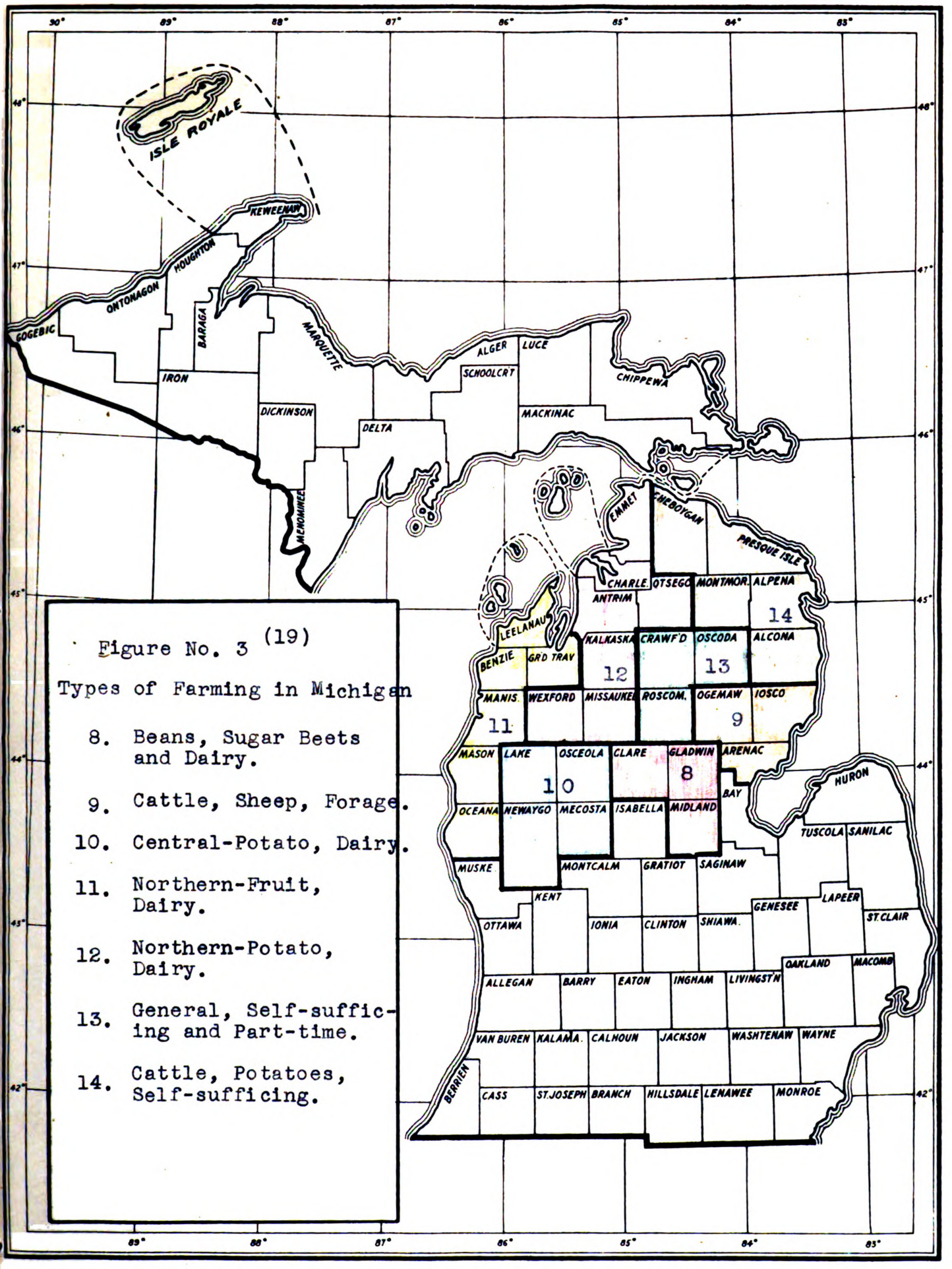


Figure No. 3 (19)

Types of Farming in Michigan

8. Beans, Sugar Beets and Dairy.
9. Cattle, Sheep, Forage.
10. Central-Potato, Dairy.
11. Northern-Fruit, Dairy.
12. Northern-Potato, Dairy.
13. General, Self-sufficing and Part-time.
14. Cattle, Potatoes, Self-sufficing.

4. Determining the adaptability of aspen to farm construction.
5. Studying the characteristics of native lumber with the idea of improving its quality.
6. Developing plans adapted to native lumber or adapting it to present plans.

It was the original intention to make these studies in a representative county in each of the "Type of Farming" areas in this region as classified by the Farm Management Department of Michigan State College (Figure 3). Owing to tire and gasoline restrictions, most of the field studies were made in Midland, Clare, Gladwin, and Alcona Counties. Since these counties are typical of the larger part of northern Michigan where farm improvements are needed and where the type of building material available is similar, if not identical, the findings reported here may be applied to the entire northern half of the Lower Peninsula and the whole of the Upper Peninsula of Michigan.

REVIEW OF LITERATURE

Numerous general statements have been made concerning the desirability of using native lumber for farm building construction but definite recommendations have usually been omitted regarding specific uses of the species of lumber most readily available to Michigan farmers at the present time.

The practicability of using native lumber for farm construction is indicated by the following statement from

a federal publication:

> "The importance of the home forest as a reserve for 'pinch' times cannot be overestimated. In the midst of the lumber shortage and high prices during the fall of 1919 and the spring of 1920, for example, communities and individual farmers having local supplies of standing timber are reported to have suffered the least from the widespread deterioration of farm buildings and deferment of necessary new construction. The effect has been not only smaller losses of crops and livestock but better farm conditions and more contented farm labor.
>
> "Lack of knowledge of the proper use of timber is one form of farm mismanagement. It is a mistake to saw up choice logs of white oak, ash, cherry, and yellow poplar for rough uses at home or to use clear black walnut for gate boards or split up white oak butts for fence posts. Many valuable logs go into crossties which would bring the owner much more if sold as saw logs." (28)

This bulletin was prepared for national distribution but most of the woods mentioned are native to Michigan. When this statement was made, most of the "choice woods" had been disposed of through various wood using industries in the state and were no longer available. However, attention was called rather forcefully to the practicability of using native woods for farm lumber and to the lack of knowledge if all woods were not used to best advantage. No information was given on what woods could be used for farm lumber, how they should be handled or where they should be used to best advantage.

This author also comments on the importance of the farm woodlot as a source of firewood when he says that in 1920 enough firewood was cut from the farm woodlots of this country to reach four times around the world. However, there was no word of caution about using for firewood timber that

might better have been used for rough lumber. This would also seem to be a factor contributing toward mismanagement of the farm woodlot.

A publication released by Michigan State College includes the following:

> "The farm woodlot is capable of producing much of the rough construction and repair lumber, fence posts, part or all of the fuel wood needed on the farm, and may also produce periodically an excess of timber suitable for sale." (12)

No mention is made of what woods to use for firewood, what ones would be most suitable for farm construction or those which would be most in demand as commercial timber.

An experience of a Michigan farmer in using native lumber follows:

> "Glenn Ingram, a farmer living near Hastings, Michigan, reports very satisfactory returns from 10 acres of woodland. During a period of eighteen years, from 1910 to 1928, Mr. Ingram cut 53,000 feet of timber, part of which was sold and part used on the farm for building purposes. The complete record of returns, uses made of timber, and years of cutting follows:
>
> 1910 - cut 14,000 feet; built a farm home.
> 1913 - cut 13,000 feet; sold and cash put into improvements.
> 1918 - cut 7,000 feet; used for shed, henhouse, and flooring.
> 1927 - cut 17,000 feet; built a barn.
> 1928 - cut 2,000 feet; used for repairs.
>
> "In addition to these returns, the woods have produced an average of 100 gallons of maple sirup a year, besides furnishing fence posts, whippletrees, and other products as needed on the farm.
>
> "Mr. Ingram has followed a simple cutting plan, taking out the larger ripe trees and leaving the younger ones to grow another crop of timber. Special care was taken in cutting operations to protect all young promising poles and sapling trees. This system kept the woods in good timber- producing condition. The woods were

> pastured at first but after studying the problem, the owner decided that his stock damaged the timber, so he has fenced it off.
>
> "'This 10-acre woodland is just as valuable as any other field on the farm,' Mr. Ingram says. A recent offer of $2,500 for the 10 acres was no inducement to Mr. Ingram to sell. He has decided that his woodland holds a very necessary place in his farm-management program."(45)

A more recent reference to the use of home grown timber for farm construction in a state where conditions are almost identical to those in Michigan still calls attention to the use of hardwoods that are scarce and rapidly becoming more so.

Little effort has been made to encourage the use of jack-pine and aspen although in most of the cut-over areas of Michigan, where economical farm buildings are primarily needed, these woods represent the most readily available source of lumber. In much of the earlier cut-over region, trees of the above species are from thirty to fifty years old and are ready to be harvested. Yet farmers in this area are going without adequate buildings because they can't afford to buy the out-of-state lumber usually handled by local dealers, but they still hesitate to use such so-called inferior wood for building purposes.

AGRICULTURAL HISTORY OF CUT-OVER AREA OF MICHIGAN

The amount of lumber used on any farm or in any farming community will vary with social and economic conditions prevailing in that area, and upon the decree of development or stability of its agriculture. The lumber required will be used for the following purposes:

1. Repair and maintenance of present buildings.
2. Replacement of existing obsolete and wholly inadequate buildings.
3. Construction of new buildings for:
   a. Expansion on present farm units.
   b. Anticipated increases in farm units.

Although there seems to be some tendency in the more highly developed agricultural communities to replace lumber with more permanent building materials, it is estimated that at the present time more than ninety per cent of all farm buildings in the United States are constructed of lumber. (17)

The cut-over area of Michigan would certainly be no exception unless the percentage of wood buildings be even greater than in typical agricultural regions.

In most farming communities, agricultural development has reached its peak. Therefore, future lumber consumption in these communities can be quite accurately estimated because lumber will be needed primarily for maintaining the present farm buildings by repair and replacement.

Social and economic conditions in the cut-over area of Michigan are somewhat uncertain and perhaps a brief history of the agricultural developments of this area will be helpful in analyzing the lumber consumption based upon farm building requirements for this area.

The development in the northern part of the lower peninsula of Michigan has lagged far behind the development of agriculture in the southern part. Variation in soil and climate are not the only reasons for this difference.

In southern Michigan the timber was cut primarily to prepare the land for farming and most of the lumber was

used either on the farms or was sold to local wood using industries and the money so obtained used to further develop the farms.

In the northern part of lower Michigan, the pine forest was cut primarily for the lumber and not to clear farm land as it was needed. As long as the timber remained, local communities prospered but from the very beginning it was the gold rush type of prosperity. The environment of the lumber camps provided little inducement to farmers who were seeking the security of a more permanent agricultural community. Most of the camp followers came north in the winter to earn cash wages which they either spent at the end of the season or took south to live on while developing farms in southern Michigan, Ohio, or Indiana.

A few clearings close to lumber camps and villages were converted into farms which helped to supply the demand for large quantities of food and forage. A more permanent type of agriculture was discouraged by the large lumber companies who feared that brush fires incidental to land clearing would endanger their mills and timber holdings and also because they wished to avoid the higher taxes required for schools, roads, and other improvements in permanent agricultural communities.(39)

In such an atmosphere of insecurity it is not surprising that few permanent farm buildings were constructed. In fact, very few were needed. In most cases even the part-time farmers lived in the lumber camps. The crops were consumed almost as soon as they were harvested. The few head of livestock roamed the range in the summer and in the winter were stabled with the camp horses.

In the short span of about twenty years the land had been cleared with a thoroughness that left little doubt as to the future of lumbering or of agriculture in this cut-over area. With the disappearance of the lumber industry, the only enterprise that could have sustained agriculture until it became self-sufficient, went the hopes of agriculture. As the lumber mills moved westward, land in northern Michigan was left to become tax delinquent and many of the inhabitants were left in a wilderness of brush and stumps without funds, without employment, and without markets for their products (Figure 4). Even though they might have had capital to sustain themselves during the five to ten year period required for the development of self-sufficient farms, they could not survive without markets. One author gives the following summary of this critical period:

> "In the northern part of the state, agriculture was more or less incidental until after lumbering had passed its zenith. All of the timber that could be disposed of was cut, and most of the rest was destroyed in logging or by fires. The land did not remain timbered until it was wanted for farming, as in the southern counties, but was practically stripped of merchantable material before it was made available to settlers. When the settlers came, they found little standing timber to supply their needs for building material, posts, or even fuel, except for scattered patches in the swamps. Without enough capital to buy such material, they were compelled to get along with crude, makeshift buildings, and poor fences or none. The pine stumps and roots supplied firewood for many years, and in some localities are still the principal source of fuel and fencing, but where the stumps have been consumed many farmers have no wood except small birch and aspen, hardly large enough for bean poles. In many instances, even the farmers who have timber cannot sell it because the sawmills and wood using industries have gone, taking their railroads with them." (41)

Figure No. 4A

"A wilderness of brush and stumps."

This was the settlers' heritage.

Figure No. 4B

Ground cover suitable for grazing, the first step in converting this land to agriculture.

Figure No. 4C

Grazing was followed by cultivation between stumps, but time-consuming and costly land clearing operations were necessary for even subsistent farming.

Although conditions may have seemed almost hopeless to some individuals, the opportunities in the cut-over area were grossly exaggerated by others who stood to profit by rapid settlement.

The large lumber companies wished to dispose of their holdings to avoid the burdensome tax and the railroads to bolster their diminishing traffic. Either directly or through colonization agencies, they organized intensive advertising campaigns to dispose of their holdings.

A development bureau is quoted as follows:

> "Thousands of settlers have come during the past few years, other thousands have bought land for investment or for future settlement. Everywhere there are new farms, new clearings, new buildings, good roads, schools, and churches. The country has passed from a lumbering to a farming community." (40)

The success of these land selling schemes is indicated by the growth of farms shown in Table No. 1.

TABLE NO. I

NUMBER OF FARMS FROM 1900 TO 1940 (7)

	1900	1910	1920	1930	1940
State	203,261	206,011	195,714	168,811	186,828
Alcona County	701	808	840	783	771
Clare County	852	1,302	1,248	893	899
Gladwin County	769	1,395	1,452	1,102	1,271
Midland County	2,153	2,246	2,163	1,730	2,061

As early as 1900, barely twenty years after the peak of lumbering, there were 203,261 farms in Michigan and by 1910 the number of farms had reached the high mark of 206,011. The demand for farm products at relatively high prices during and after World War I gave added impetus to the colonization movement although the number of farms continued to decline after 1910. Many of the partially developed and abandoned farms of pre-war settlers were resold to these new farmers.

The type of agriculture prevalent in the cut-over area during this period is indicated in Tables No. II and No. III.

TABLE NO. II

PERCENTAGE OF CROP AREA DEVOTED TO EACH CROP (30)

CROP	ACRES	PER CENT
Corn	7.0	14.6
Potatoes	4.3	8.9
Wheat	1.5	3.2
Rye	2.1	4.4
Oats	9.7	20.2
Barley	.5	1.0
Buckwheat	.6	1.2
Hay	19.2	39.9
Peas	.6	1.2
Beans	1.1	2.3
Roots	.1	.2
Fruit	1.2	2.5
Truck	.2	.4
Total	48.1	100.0

TABLE NO. III

NUMBER AND PERCENTAGE OF ANIMAL UNITS OF EACH CLASS (31)

KIND OF ANIMAL	Animal Units NUMBER	PER CENT
Dairy cows	5.8	41.1
Young cattle	2.9	20.6
Bulls	.3	2.1
Steers	.6	4.2
Work horses	2.7	19.1
Colts	.2	1.4
Sheep	.3	2.1
Hogs	.8	5.8
Poultry	.5	3.6
Total	14.1	100.0

A summary of the agriculture of this period is also given in part as follows:

> "It is possible, but not easy, to start farming here with very little capital. The total capital of the average farm studied is $6,856 and the average family income only $559. This is little enough on which to live; even when none of it has to be used to pay interest." (31)

In spite of low farm income, these farmers invested heavily in land clearing operations and in other improvements such as buildings out of all proportion to the productive capacity of the land. The increase in building investment is shown in Table No. IV.

Some idea as to the source of capital that was used to make these investments in shown in Figure 5.

As prices began to decline at the end of the war, the fate of many farmers, particularly those who had settled on the poorer type of soil, is shown by the large number of

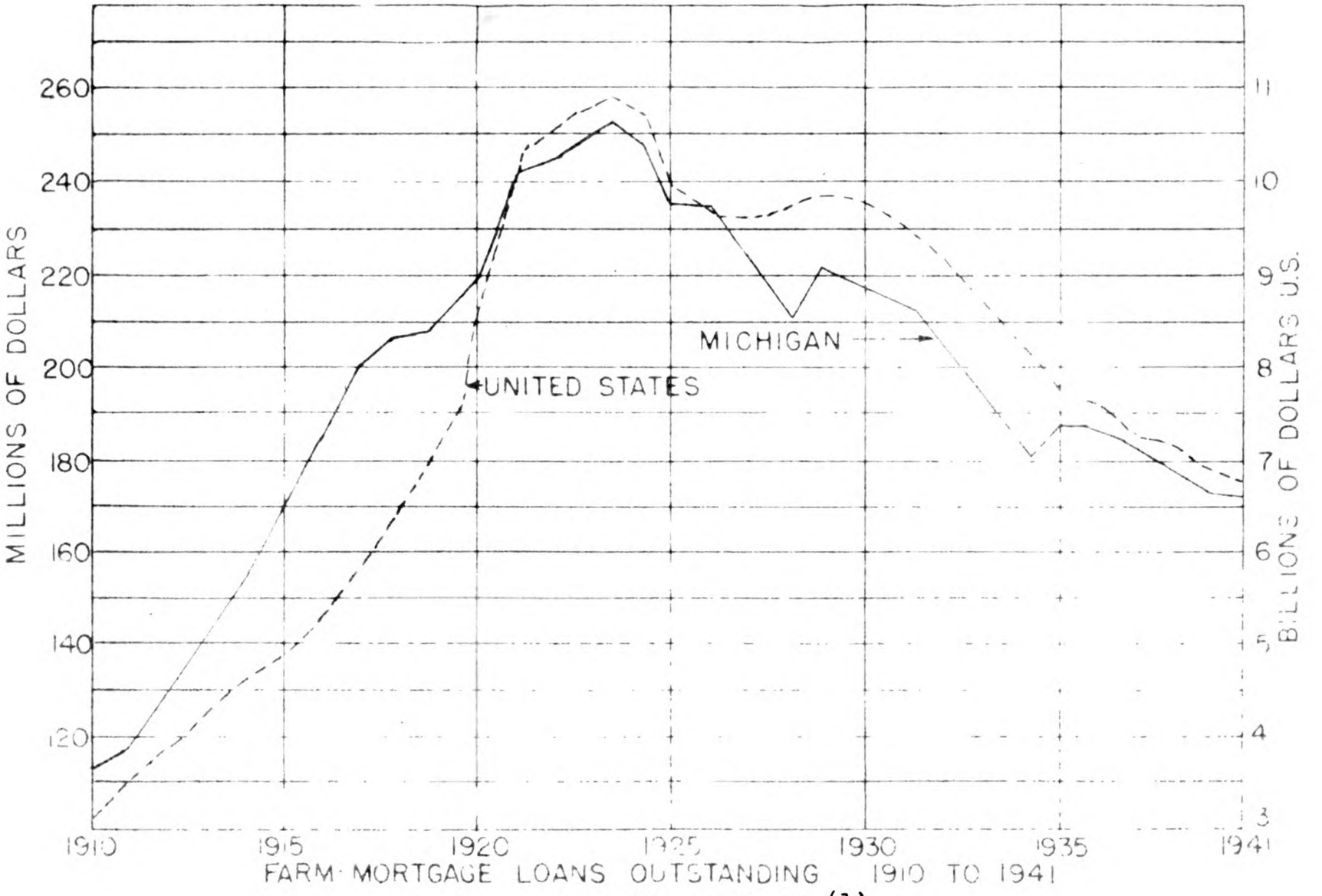
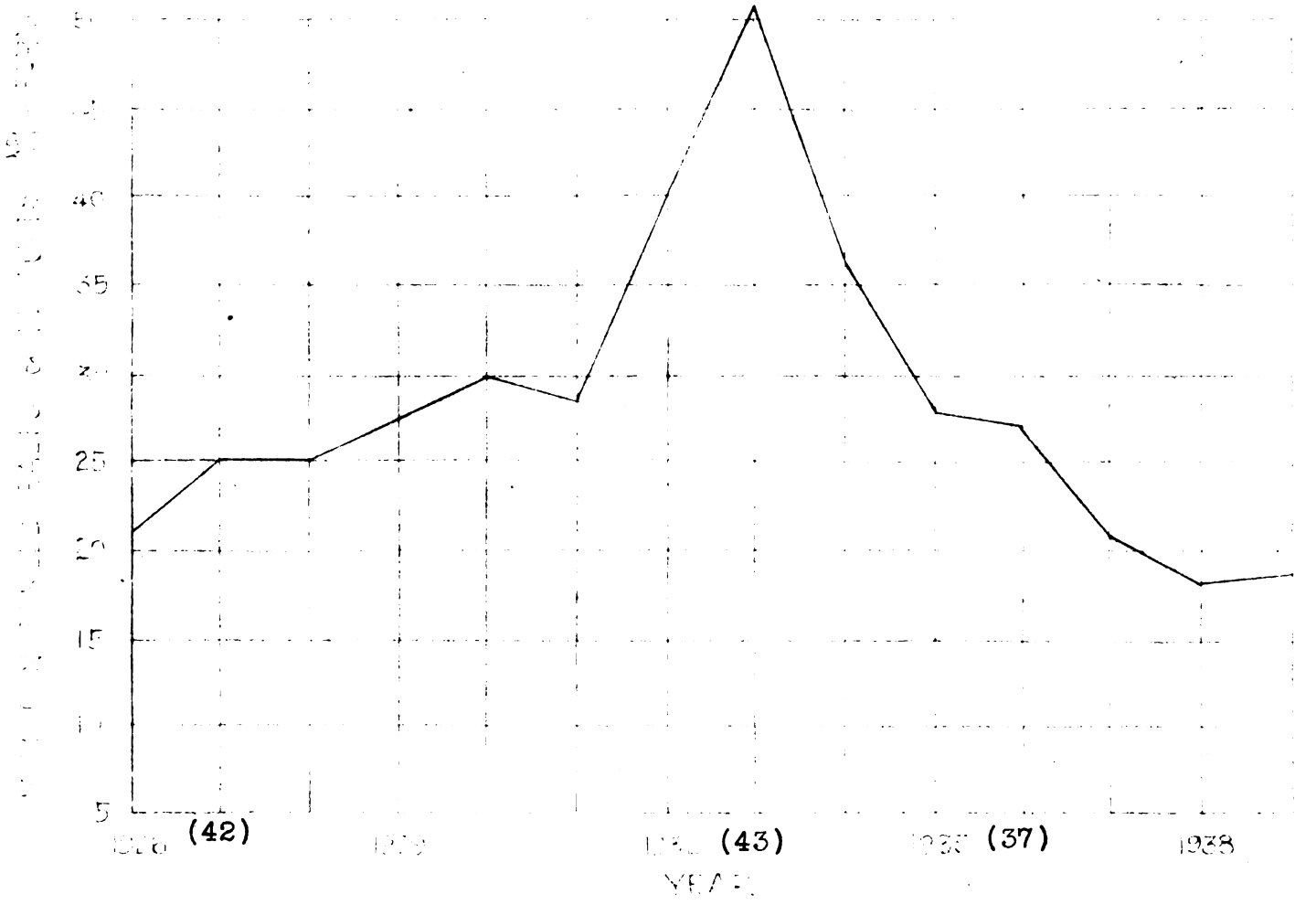


Figure No. 5 (1)

MICHIGAN FARM MORTGAGE DEBT

Figure No. 6

Michigan Forced Sales and Defaults Per Thousand Farms



foreclosures. (Figure 6). Other farmers, perhaps because they had no place to go, were forced to remain and seek part time employment in the nearby shops to maintain a standard of living that was a mere subsistence. (Figure 7.)

Fortunately for these farmers as well as for those on better developed farms, part time employment and greatly expanded markets were created by the tremendous growth of the automobile and allied industries in Michigan and by the increased volume of tourist trade. Had it not been for these sources of additional income, the number of foreclosures and abandoned farms would undoubtedly have been larger during the prolonged period of depressed farm prices of the 1920's.

Regardless of accumulating evidence that much of the cut-over area was not suited to permanent agriculture and that the apparent prosperity of the region was built upon borrowed capital and nourished by markets of a highly variable nature, those interested in the region continued to exploit its resources.

> "It would be easy to cite by title and page the overt encouragement given by state and federal agencies to the land development schemes of private operators. They too were blinded by the emotional appeal of the movement to the practical and long time problems incident to a judicious use of natural resources." (20)

In the May, 1939, report of the National Resources Committee may be found the following statement:

> "This booming of wild land for farms is not ancient history. It was only two decades ago that government agencies in each of the three Lake States, in common with other states, put out booster literature encouraging the selling of cut-over lands for farms and promising the settler that he could grow rich in these regions." (33)

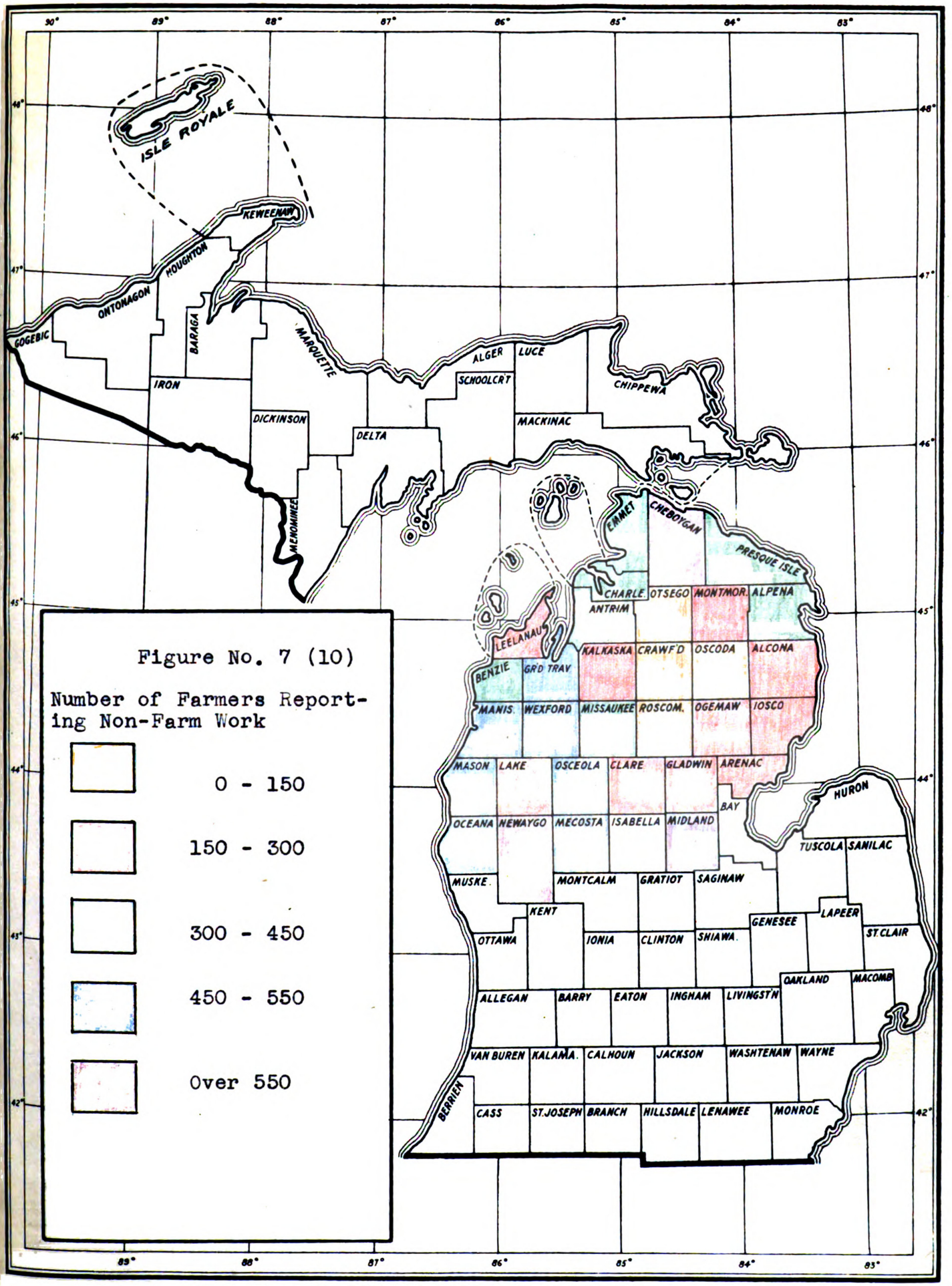


Figure No. 7 (10)

Number of Farmers Reporting Non-Farm Work

- 0 - 150
- 150 - 300
- 300 - 450
- 450 - 550
- Over 550

TABLE NO. IV.(5)

NUMBER OF FARMS AND VALUE OF BUILDINGS FOR STATE AND SELECTED COUNTIES

	1900	1910	1920	1930	1940
STATE OF MICHIGAN					
Number of Farms	203,261	206,011	195,714	168,811	186,828
Per Cent Change		1.35%	-5%	-13.7%	9.7%
Value of Buildings	158,947,760	285,230,601	476,594,379	521,677,319	453,490,622
Value of Buildings Per Farm	770	1,384	2,430	3,100	2,425
Per Cent Change		80%	75%	28%	-22%
ALCONA COUNTY					
Number of Farms	701	808	840	783	771
Value of Buildings	194,120	586,846	1,351,790	1,537,315	1,188,216
CLARE COUNTY					
Number of Farms	852	1,302	1,248	893	899
Value of Buildings	227,360	352,700	1,906,557	1,712,909	1,430,655
GLADWIN COUNTY					
Number of Farms	769	1,395	1,452	1,102	1,271
Value of Buildings	206,360	352,700	2,551,317	1,874,821	1,856,017
MIDLAND COUNTY					
Number of Farms	2,153	2,246	2,163	1,730	2,061
Value of Buildings	800,970	1,709,325	3,579,048	3,805,375	4,214,621

Yet census reports showed a decided drop in the rate of increase in farms in the cut-over area of the three Lake States by 1920, and in Michigan, which had been cut over earlier, the rate of increase in some counties reached its peak about 1910.

Even during the first World War some people began to realize that abnormal war production had clouded the real issue of proper land utilization and management. In the early 1920's, this was said: "Most of the land not now in farms is worth more for forests or grazing." (33) In 1923. Dr. L. C. Gray, in discussing the problems of land economics and land utilization, indicated that there was little need for the development of new lands, particularly wild lands of doubtful value, and that continued unlimited production as urged upon farmers as a war measure would lead to troublesome agricultural reverses. (35)

In spite of these warnings farming conditions in the cut-over area of Michigan remained about the same until the agricultural depression which began in 1921 and continued through the 1920's, with only minor indications of recovery, finally culminated in the total depression of 1929.

Omitting reactions to the second World War, farming in the cut-over region since 1929 needs little elaboration. It was a period of curtailed income, high taxes, increased debts, moratoriums on foreclosures, jobless thousands returning to farms and finally direct government relief for approximately 8,000 rural families in Michigan.

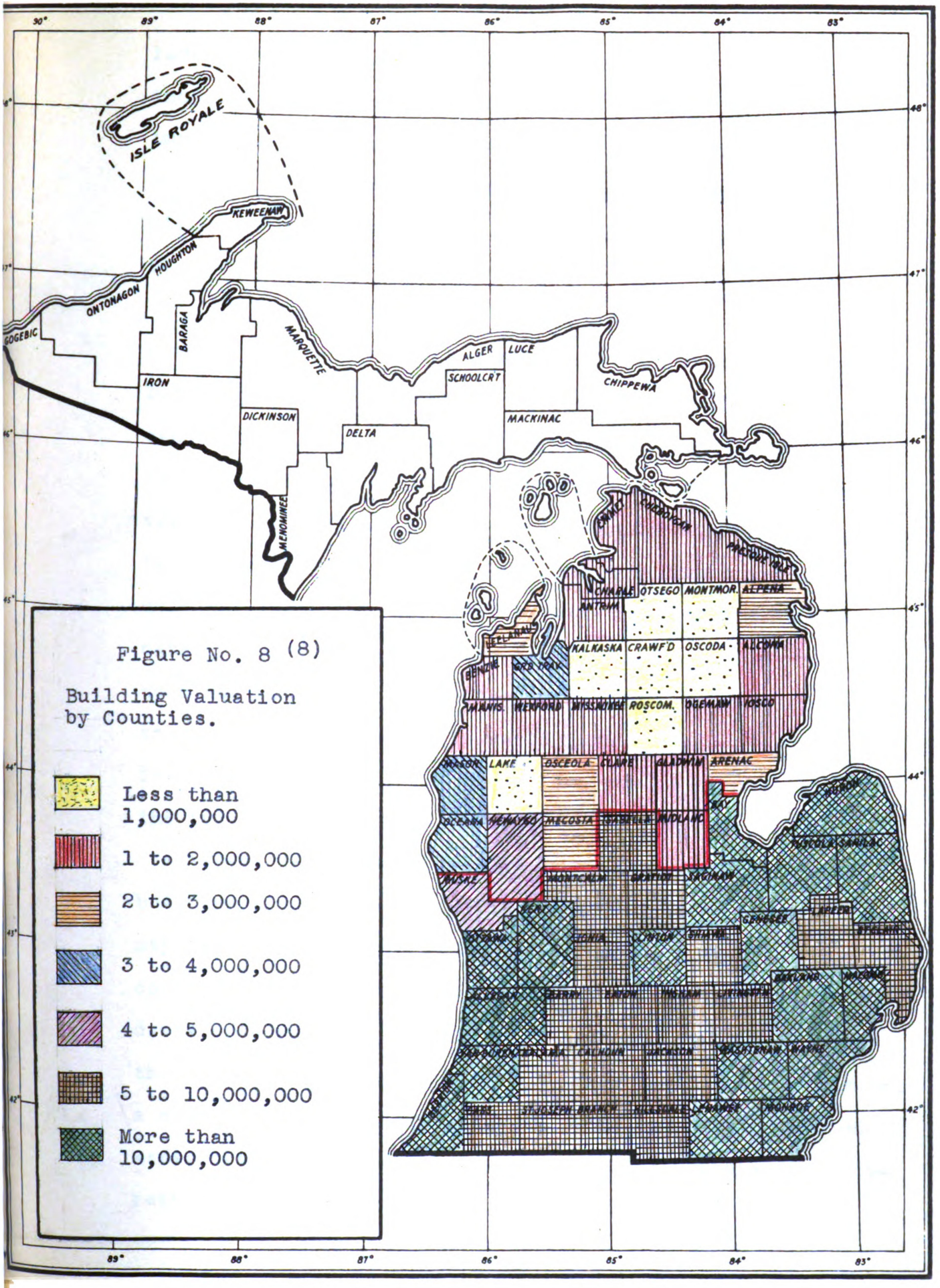
This review of the history of the cut-over area has

been given to acquaint the reader with the social, economic, and agricultural background of conditions that prevailed when this study was undertaken.

ECONOMIC IMPORTANCE OF ADEQUATE FARM BUILDINGS

It hardly seems necessary to justify the need for adequate farm buildings. The fact that the farm building investment in Michigan is approximately 500,000,000 dollars would seem to indicate the importance of farm buildings to any agricultural enterprise. The investment in buildings is almost as large as the investment in land and nearly four times as large as the investment in machinery. (9)

The investment in buildings by counties of the lower peninsula of Michigan is shown in Figure 8. The relationship between buildings and farm income is shown in Table No. V. A study of this table reveals that on farms of eighty acres or less with an average of sixty-six tillable acres there were 3 2/5 tillable acres per animal unit for the third highest labor income group and 4 1/2 tillable acres per animal unit for the third lowest labor income group. This shows a greater concentration of livestock on the farms having higher labor incomes. The value of crops per tillable acre for the third highest labor income group was $13.44 and for the lowest labor income group was $12.33. This may reflect the value of fertilizer in the form of farm manure returned to the land which would not be available without livestock. On these same farms the livestock income per tillable acre was $28.12 for the third highest


ISLE ROYALE
KEWEENAW
HOUGHTON
ONTONAGON
GOGEBIC
BARAGA
MARQUETTE
ALGER
LUCE
SCHOOLCRT
CHIPPEWA
IRON
DICKINSON
DELTA
MACKINAC
MENOMINEE
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLE VOIX
ANTRIM
OTSEGO
MONTMOR.
ALPENA
LELANAU
BENZIE
GRD TRAV.
KALKASKA
CRAWF'D
OSCODA
ALCONA
MANIS.
WEXFORD
MISSAUKEE
ROSCOM.
OGEMAW
IOSCO
OSCEOLA
CLARE
GLADWIN
ARENAC
LAKE
MASON
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
BAY
HURON
TUSCOLA
SANILAC
MUSKE
MONTCALM
GRATIOT
SAGINAW
KENT
IONIA
CLINTON
SHIAWA
GENESEE
LAPEER
ST CLAIR
BERRIEN
CASS
VAN BUREN
CALHOUN
JACKSON
WASHTENAW
WAYNE
ST JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
Figure No. 8 (8)
Building Valuation by Counties.
Less than 1,000,000
1 to 2,000,000
2 to 3,000,000
3 to 4,000,000
4 to 5,000,000
5 to 10,000,000
More than 10,000,000

labor income group and $16.15 for the third lowest labor income group. The number of livestock seems to be a most important factor and livestock require buildings. The building investment per tillable acre was $44.89 for the highest labor income group and $38.80 for the lowest labor income group.

Although buildings seem to be necessary for a successful farm program, it may be possible to have a larger building investment than the most practical farm program can justify. It is interesting to note that in two of the farm classifications, according to size, the building investment per tillable acre was higher for the third highest labor income group but the building investment per animal unit was lower for the third highest labor group in every case. Perhaps the buildings for the lower income group were not utilized to capacity. Certainly an increase in the number of animal units would have lowered the building investment per unit, but there is also the possibility that the building investment was abnormally high.

There is a growing realization on the part of farm building specialists that the investment in farm buildings may be disproportionally high. A proper concept of low cost farm buildings does not presume a lowering of standards or a reversion to outmoded methods. On the contrary the problem of designing low cost farm buildings constitutes a challenge in the adaptation of plans and utilization of available materials that will reflect greater utility value rather than the wealth put into their construction.

As an example, the Doane Agricultural Service of St. Louis, Missouri, in establishing allowable building costs for their clients have adopted a capital investment of $22 per unit of livestock for a beef animal including all buildings and accessory equipment such as yard fences, feed bunks, and water tanks.(14) Actual experiences show that costs of $60 to $70 per unit of livestock are not unusual for buildings of this type exclusive of the above mentioned equipment. As a means of lowering building costs, the Doane Service suggests a careful study of building plans with the idea of adapting them to the use of native materials.

In discussing the problem of how to obtain adequate farm buildings with limited income, Deane G. Carter suggests that there are almost inexhaustible supplies of native materials such as stone, logs, poles and low grade lumber that can be used in the construction of satisfactory farm buildings. (11)

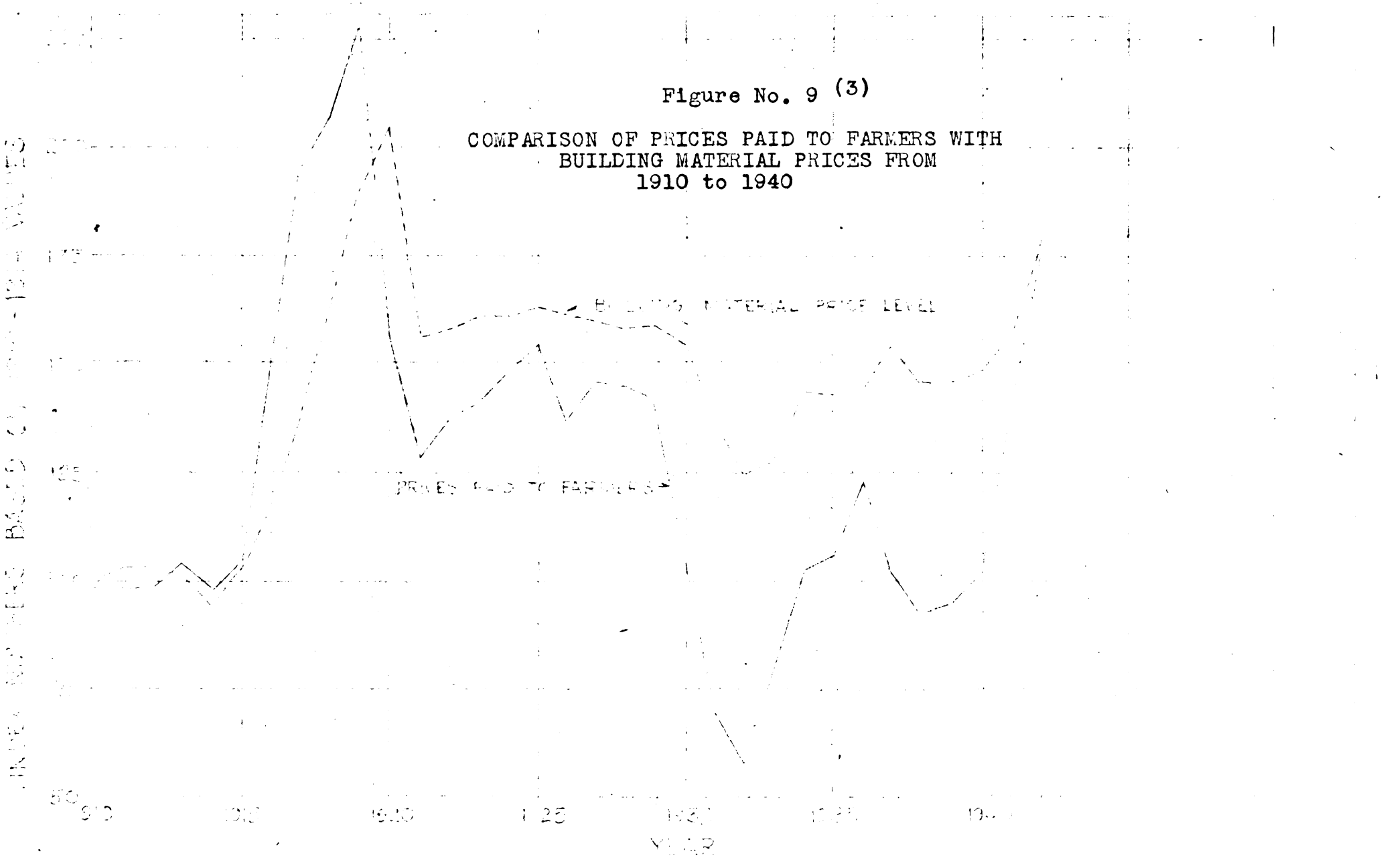
This would seem to be particularly applicable in farming areas of low income such as the cut-over area of Michigan. A project on the utilization of jack-pine and aspen for farm buildings in areas where it is readily available is therefore in line with current opinion on the use of building materials for farm construction.

LUMBER REQUIREMENTS FOR REPAIR AND REPLACEMENT OF PRESENT BUILDINGS

Lumber for farm construction will be required to repair and maintain existing buildings, to replace obsolete or inadequate buildings and to build new ones.

Figure No. 9 (3)

COMPARISON OF PRICES PAID TO FARMERS WITH
BUILDING MATERIAL PRICES FROM
1910 to 1940



Some indication of the lumber requirements for repair and maintenance in some of the typical cut-over counties of Michigan was indicated by the accumulated depreciation of buildings shown in Table No. IV.

Table No. IV also shows the number of farms and the value of farm buildings for the state and for four typical cut-over counties from 1900 to 1940. It is interesting to compare the per cent change in number of farms with the per cent change in the value of farm buildings. From 1900 to 1910 the number of farms increased only 1.35% while the value of buildings increased 80%. From 1910 to 1920 the number of farms decreased 5% although the value of buildings increased 75%. This increase in building valuation resulted in part from additions and improvements on individual farms during this period of agricultural prosperity as previously mentioned.

It was also influenced by the general upward trend of basic price indices. The graph in Figure 9 shows the relationship between prices paid to farmers and the price of building materials during the period from 1910 to 1915. This price differential was favorable for the construction of new farm buildings.

By following these curves through the years from 1929 to 1940, it is not difficult to understand why the building valuation on many farms declined and why improvements and repairs were neglected.

From 1920 to 1930 the number of farms decreased 13.7% but the value of buildings increased 28%. Agricultural

prosperity for this region had apparently reached its peak. The period from 1930 to 1940 needs no explanation, and the increase in number of farms while the building value decreased tells the story of the back to the land movement and depressed farm incomes. It is apparent that most of these farm buildings were constructed prior to 1920. Therefore the majority of them are from 20 to 30 years old and many of them much older. If the average life of a farm building may be assumed to be 40 years, it is obvious that those buildings constructed from 1910 are 100% depreciated. Many of those that have been maintained and are still usuable are obsolete and wholly inadequate for present production methods.

But if these buildings are to be maintained, an annual expenditure of $13,041,932 will be required to provide for an annual depreciation of 2½% on a building valuation of $521,677,319. No sum approaching this figure has been spent.

What actually happened is shown in Tables No. VI and No. VII. Beginning in 1931 and continuing through 1935, the money spent for buildings on some of the better farms of Michigan failed to cover the cost of depreciation. This accumulated depreciation over the past ten to twenty-year period must be faced eventually either by making needed repairs or by replacement. Enormous expenditures will be required during the next few years to make up for past neglect and to care for current depreciation, repair and replacement.

In addition to these data showing the need for lumber, it has been estimated that approximately 850 board feet of lumber will be required annually on each farm in Michigan to meet the requirements for repair and replacement of existing buildings and an additional 150 board feet per farm per year to provide for new construction based on the 1920 to 1930 distribution of new farms.(18)

These estimates are average for all farms in the state and probably are too low to meet the requirements in the cut-over area where many of the original pioneer buildings are still being used and where repairs and improvements to more modern buildings have consistently been neglected.

Additional data showing the need for repairs are reported in the Sixteenth Census of United States for 1940. Table No. VIII was taken from this census.

Various other surveys in recent years have provided conclusive evidence of the need for farm building improvement by giving statistics on specific structural requirements for lumber, by showing financial loss owing to unchecked depreciation and by showing a photographic record of existing buildings.

Because of the difficulty of further adequate description on this subject, a photographic record of typical farm buildings in the cut-over area is given on the following pages.

TABLE NO. V (4)

SOME FACTORS AFFECTING FARM INCOMES ON DIFFERENT SIZE FARMS

	Labor Income	Gross Income Per Farm	Tillable Acres	Value of Crops Per Til. Acre	Til. Acres Per Animal Unit	Livestock Income Per Til. Acre	Number of Cows	Dairy Products Sold Per Cow	Number of Hens	Building Investment Per Acre	Building Investment Per Animal Unit
LESS THAN 80 TILLABLE ACRES - AVERAGE TILLABLE ACRES - 66											
1/3 Highest Labor Income	$ 769	$2301	66	$13.44	3.4	$28.12	9.7	$107	108	$44.89	$131
All Farms - 45	341	1818	66	13.50	3.9	21.75	8.2	91	100	43.93	150
1/3 Lowest Labor Income	-136	1314	67	12.33	4.5	16.12	7.4	73	78	38.80	148
81 to 140 TILLABLE ACRES - AVERAGE TILLABLE ACRES - 108											
1/3 Highest Labor Income	$1250	$3451	114	$16.31	4.8	$20.07	9.0	$101	115	$33.08	$142
All Farms - 73	518	2536	108	13.87	4.9	16.57	8.2	90	112	33.52	146
1/3 Lowest Labor Income	116	1923	109	12.12	5.2	12.91	8.2	81	86	34.43	159
141 AND OVER TILLABLE ACRES - AVERAGE TILLABLE ACRES - 191											
1/3 Highest Labor Income	$1788	$5806	201	$16.19	4.1	$20.04	13.5	$111	141	$33.31	$129
All Farms - 73	810	4218	191	13.68	4.8	15.34	12.2	98	100	32.00	141
1/3 Lowest Labor Income	-141	2827	185	11.26	5.1	11.55	9.1	74	94	32.12	148

TABLE NO. VI(46)

AVERAGE INVENTORY OF 40 FARMS IN TYPE OF FARMING AREA NO. 9

	1931	1932	1933	1934	1935	1936	1937	1938
Building Investment	$2850	$2733	$2647	$2582	$2484	$2030	$2378	$2236
Building Improvement	106	92	102	92	98	181	167	135
Change in Building Inventory		-13	-14	-16	-5	92	70	39
Cash Receipts		1129	1151	1317	1674	1944	2117	1932
Cash Expenses		679	623	638	837	1082	1248	1146
Net Income		450	528	679	837	862	869	786

TABLE NO. VII (46)

AVERAGE INVENTORY OF 40 FARMS IN TYPE OF FARMING AREA NO. 5

	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
Service Building Investment	$5546	$5025	$4970	$4909	$4366	$4393	$4454	$4454	$4407	$4405
Change in Building Inventory	36	24	-62	-95	-60	-41	7	59	86	35
Cash Receipts	4396	3259	2295	1852	1950	2745	3319	4094	3995	3397
Cash Expenses	2840	2046	1463	1132	1062	1536	2088	2340	2353	2146
Cash Net Income	1555	1213	832	720	888	1209	1231	1759	1641	1251

TABLE NO. VIII(6)

ESTIMATED VALUE, STATE OF REPAIR AND SANITARY FACILITIES FOR FARM DWELLINGS IN SELECTED COUNTIES OF MICHIGAN

	Alcona	Clare	Gladwin	Midland
Value under $500	160	97	307	235
$500 to $1,000	236	238	354	389
$1,000 to $1,500	139	171	215	350
$1,500 to $2,000	79	94	89	231
$2,000 to $3,000	54	100	120	323
$3,000 to $4,000	29	15	31	103
Over $4,000	22	6	16	76
Owner-occupied dwellings	1,135	1,660	1,704	4,804
Needing major repairs	464	200	363	1,243
With private bath and private flush toilet	17	7	19	90
With private flush toilet no private bath	-	1	1	30
With running water no private flush toilet	25	20	30	295
No running water in dwelling unit	422	172	313	1,256
Not reporting repair or plumbing	79	102	50	289
Tenant-occupied dwelling	277	791	693	2,126
Needing major repairs	140	146	175	569
With private bath and private flush toilet	6	5	9	42
With private flush toilet no private bath	2	-	1	19

TABLE NO. VIII (continued)

	Alcona	Clare	Gladwin	Midland
With running water no private flush toilet	10	25	8	39
No running water in dwelling unit	122	116	157	469
Not reporting repair or plumbing	14	49	19	173
Number of owner-occupied dwellings	760	885	1,213	1,934

Figure No. 10A

A farmstead on a typical cut-over farm in Gladwin County, Michigan.

Figure No. 10B

This was "home" to some farm family in Cheboygan County, Michigan.

Figure No. 10C

A farmstead on a typical cut-over farm in Midland County, Michigan

Figure No. 11A

Milk for human consumption was being produced in this wholly inadequate barn in Presque Isle County, Michigan.

Figure No. 11B

This combined corn crib, granary and implement shed has depreciated almost beyond repair.

Figure No. 11C

This old barn is still being used while the new barn in the background is being finished on a farm in Iosco County, Mich.

Figure No. 12A

This house in Alpena County, Michigan is constructed of native logs and is an improvement over many farm dwellings in the cut-over area.

Figure No. 12B

This farm in Gladwin County, Michigan lies idle because of inadequate buildings.

Figure No. 12C

A small saw mill in Harrison County, Michigan sawing aspen logs for local use in farm construction.

LUMBER REQUIREMENTS FOR NEW CONSTRUCTION ON PRESENT FARM UNITS

Lumber requirements for new construction to replace present obsolete or totally depreciated structures will depend largely upon these factors:

1. A better appreciation among farmers in general as to the actual value of adequate but inexpensive farm buildings.
2. The development of a government subsidized post-war rural housing project.
3. The degree of improvement in rural living standards.

In addition to the need for repairing and remodeling old buildings, there is a need for additional new buildings to accomodate the increased livestock and feed, if the present small farms in the cut-over areas are supplemented from outside labor in nearby factories.

In the event that factory employment wanes and the farmers are obliged to depend more and more upon farming, they will have to increase very materially the average area under cultivation, if they are to continue in the business. This can be done by clearing more land where feasible or by consolidating existing units and reducing the number of farms. If the present number of units remains, it will be necessary to add 500,000 acres of improved land in the upper peninsula and 950,000 acres in northern lower Michigan just to bring them up to the 70 to 90 acre farms of the better developed southern counties.

This is more land than has been cleared in the whole state during the last quarter century, and for the upper peninsula it would mean more than doubling the present

improved area. But as it is, settlers have already cleared the better lands in the cut-over districts and many of them have cleared about all the contiguous land that the topography and soils will permit. In many places the surface is so broken or the good soils are so spotted in distribution that it is physically impossible for a settler to increase his area of cultivable land except by acquiring that of some other settler.

An increase in improved acreage is by no means all that is needed to insure the future of farming in the north. Much labor and money must also be expended to provide more adequate farm buildings and other equipment, and to build more attractive farm homes, or the more desirable elements of the next generation will gradually pull up stakes and leave the region.

Many of the farms in northern Michigan are still in the frontier stage with lands only partially cleared, fences lacking or temporary makeshifts, barns usually crude and inadequate and rarely painted, and dwellings largely tarpaper shacks of one or two rooms or even log cabins, chinked with clay. Such conditions are perhaps to be expected in a frontier settlement, but hardly in the homes of a permanent, prosperous agricultural community.

National attention was focused on better rural housing as an aid in the solution of unemployment previous to the present war emergency and it is evident that new measures will be used to stimulate farm construction when the time comes. This problem ranks high on the list of post-war projects and some rural housing program is almost a certainty.

The effect of this program upon lumber requirements will depend upon the number of houses constructed, which in turn will depend upon what the farmers accept as a minimum desirable standard. It is difficult to set a minimum standard for any group or class of people. No definite information exists as to what farmers in the low income group will adopt as a minimum dwelling for themselves or how many are now living in dwellings below their proclaimed standards.

PRESENT SOURCE OF MICHIGAN LUMBER

It is estimated that less than half of the nearly 400 billion board feet of Michigan's original stand of timber was actually converted into lumber and very little of this was used for the construction of farm buildings in Michigan.

As early as 1920 nearly 60% of the wood used in Michigan was shipped in from outside sources primarily from the southern hard pine region and from the west coast douglas fir region. The transportation charges alone on this lumber amounted to $16,000,000 in 1920 or 30% of the total cost. The dependence upon outside sources for lumber steadily increased and the price of imported lumber also continued to advance. The following tables show the source of lumber consumed in Michigan in 1938 and the price by years.

TABLE NO. IX (38)

TOTAL APPARENT CONSUMPTION OF ALL WOODS IN MICHIGAN IN 1938 IN M FEET B. M.

Derived within the state	Derived from other states	Imported	Apparent total	Consumption* per capita
180,274	566,319	28,674	775,267	159

TABLE NO. X (38)

TOTAL APPARENT CONSUMPTION OF SOFTWOODS IN MICHIGAN IN 1938 IN M FEET B. M.

Derived within the state	Derived from other states	Imported	Apparent total	Consumption per capita
59,847	500,781	22,577	583,205	120

* The term "apparent consumption" is used because these figures are compiled from estimates showing the quantities of domestic lumber retained within each state for consumption, plus the domestic lumber received by distribution from other states, plus the foreign lumber which apparently enters the state.

TABLE NO. XI (2)

AVERAGE VALUE AT THE MILL, PER 1,000 FEET, BOARD MEASURE, IN SPECIFIED YEARS

Kind of Wood	1899	1909	1919	1924	1929	1934	1939	1940	1941	1942
SOFTWOOD										
Balsam fir	no data	$13.90	$32.23	$27.66	$25.49	$20.27	$19.43	$20.92	$24.93	$28.93
Cedar	$10.91	19.95	33.80	38.74	34.83	27.94	40.68	39.56	44.69	46.97
Cypress	13.32	20.46	38.38	42.08	35.29	30.73	35.50	36.07	40.64	45.39
Douglas fir	8.67	12.44	24.62	22.08	20.05	16.14	17.91	19.49	25.45	30.51
Hemlock	9.98	13.95	29.16	23.35	18.90	17.70	19.39	22.19	27.33	31.36
Larch (tamarack)	8.73	12.68	23.29	20.82	18.35	16.07	16.80	16.03	19.47	23.89
Lodgepole pine	no data	16.25	29.98	21.07	17.97	16.54	17.76	19.01	19.71	23.41
Ponderosa pine	9.70	15.39	27.75	27.73	26.47	20.51	22.75	24.29	28.65	32.52
Redwood	10.12	14.80	30.04	35.90	31.00	30.03	34.56	40.35	46.20	50.47
Spruce	11.27	16.91	30.76	30.18	28.64	21.75	26.68	26.85	31.71	35.79
Sugar pine	12.30	18.14	35.99	40.54	43.08	27.64	30.10	30.28	38.75	41.66
White fir	no data	13.10	25.66	21.69	20.63	15.15	17.34	18.05	23.36	27.64
White pine	12.69	18.16	32.83	32.66	29.87	23.75	25.90	27.87	30.32	33.17
Yellow pine	8.46	12.69	28.71	26.55	25.66	21.64	19.70	21.35	25.50	27.80
Average	10.27	14.08	28.39	26.52	24.31	20.05	20.97	22.48	27.26	30.73

TABLE NO. XI (continued)

Kind of Wood	1899	1909	1919	1924	1929	1934	1939	1940	1941	1942
HARDWOOD										
Alder	no data	$12.57	$34.67	no data	$27.18	$19.16	$24.63	$27.11	$28.10	$32.57
Ash	$15.84	24.44	52.69	$49.54	43.14	39.26	34.33	35.18	42.10	44.03
Basswood	12.84	19.50	40.03	41.94	39.88	30.78	31.94	32.98	37.85	42.63
Beech	no data	13.25	29.98	29.95	28.39	22.93	22.03	24.24	26.49	30.11
Birch	12.50	16.95	35.79	43.83	39.35	30.58	33.11	34.63	41.78	47.68
Chestnut	13.37	16.12	32.30	25.07	29.51	23.53	21.94	20.89	24.93	30.43
Cottonwood	10.37	18.05	32.24	29.43	29.70	20.68	21.41	22.40	26.87	28.77
Elm	11.47	17.52	36.39	38.63	35.28	24.09	24.54	26.11	29.64	33.14
Gum, red and sap	9.63	13.20	32.68	30.24	34.42	24.70	23.28	25.67	31.15	30.88
Hickory	18.78	30.80	44.37	52.24	40.33	27.92	26.75	29.99	29.70	35.31
Magnolia	no data	17.04	28.01	no data	38.11	27.60	27.26	29.20	39.49	no data
Maple	11.83	15.77	35.56	40.36	36.93	30.84	32.51	34.54	38.29	43.56
Oak	13.78	20.50	37.87	36.13	38.43	27.54	26.32	26.20	29.74	32.96
Sycamore	11.04	14.87	30.32	29.31	30.07	21.52	22.26	22.93	26.82	26.81
Tupelo	no data	11.87	28.42	25.86	25.39	22.70	22.09	24.01	28.86	30.68
Walnut	36.49	43.79	72.13	103.66	119.15	86.60	63.18	71.43	77.20	81.13
Yellow Poplar	14.03	25.39	41.65	44.38	41.66	30.01	26.98	26.04	30.70	32.31
Average	13.53	19.52	37.32	37.84	38.04	28.01	27.66	28.47	32.34	34.87
All Kinds	11.13	15.38	30.21	28.57	26.94	21.47	21.97	23.32	28.09	31.50

TABLE NO. XII (38)

PERCENTAGE OF SOFTWOOD SPECIES CONSUMED IN MICHIGAN

	West Coast	South Pine	Other Softwood
1922	9.0%	54.3%	36.7%
1928	13.9	49.5	36.6
1934	14.8	51.3	33.9
1936	19.2	41.9	38.9
1938	14.8	52.8	32.4

It is obvious from Table No. XII that approximately 90% of the lumber consumed in Michigan is imported.

Figures are not available to show what part of the lumber consumed in Michigan is consumed on the farm nor the per cent of consumption by species, but experience would indicate that at least 90% of all lumber used on the farms of Michigan, at the time the study was made, was also imported. However, as previously mentioned, the small amount of this lumber used on the farms of the cut-over area was insufficient to provide adequate buildings. If these assumptions are correct and this study indicates that they are, the supply of native timber certainly should be given more consideration as a source of lumber for farm construction.

AVAILABILITY OF ASPEN

Aspen occupies more area of forest land in Michigan than any other tree species. Together with other poplar species it occupies nearly one-third of the forest cover in the cut-over area (see Figure 13.).

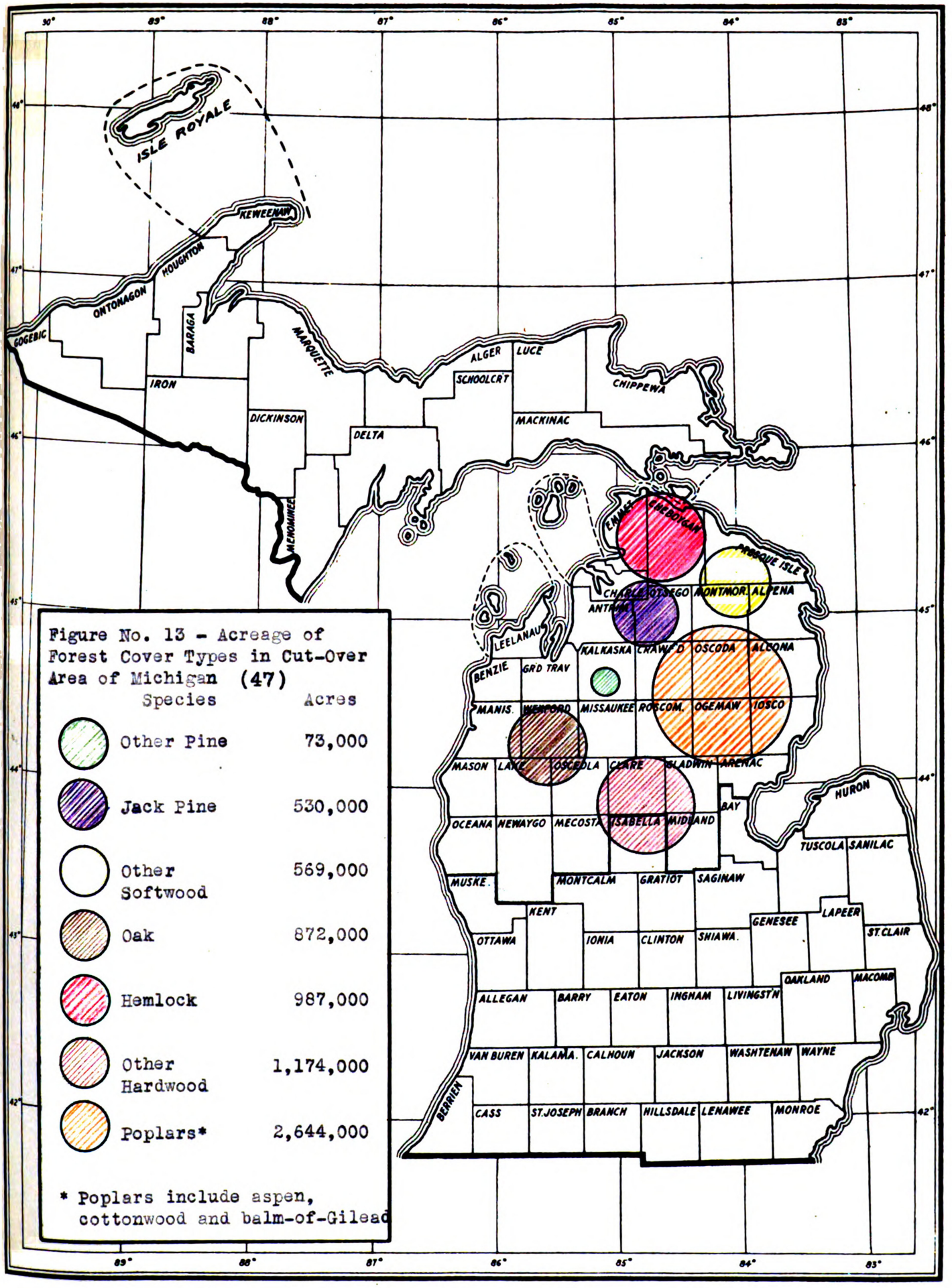


Figure No. 13 - Acreage of Forest Cover Types in Cut-Over Area of Michigan (47)

Species	Acres
Other Pine	73,000
Jack Pine	530,000
Other Softwood	569,000
Oak	872,000
Hemlock	987,000
Other Hardwood	1,174,000
Poplars*	2,644,000

* Poplars include aspen, cottonwood and balm-of-Gilead

Information regarding the amount of aspen cut and its uses are difficult to obtain owing to the practice of statistical agencies of combining it with cottonwood and related species. However, an estimated volume of saw timber is given in Figure 14. The relatively small volume of saw timber from such a large area is explained by the fact that the majority of aspen trees are small diameter stock, measuring less than six inches in diameter. See Table No. XIII and Figure 14.

TABLE NO. XIII (15)

ACREAGE OF ASPEN BY SIZE OF TREE FOR TYPICAL COUNTIES IN MICHIGAN

County	Size of Tree			Total Acres of Forest Land
	0"-3"Dia.	3"-6"Dia.	6"-9"Dia.	
	Acres	Acres	Acres	Acres
Alpena	93,776	35,282	385	159,917
Roscommon	70,331	9,141	53	102,308
Kalkaska	5,452	5,474	653	57,263
Menominee	112,296	37,488	7,456	184,259

It has been estimated that in the entire Lake States cut-over area, there are 29,000,000 cords of aspen in trees four inches and more in diameter, of which there are not more than 12,000,000 cords over six inches in diameter, which is the minimum diameter recognized for merchantable timber. On this basis it is predicted that within 25 years 15 to 40 per cent of this stand will become merchantable and in 25 to 50 years 60 to 85 per cent will become merchantable. (21)

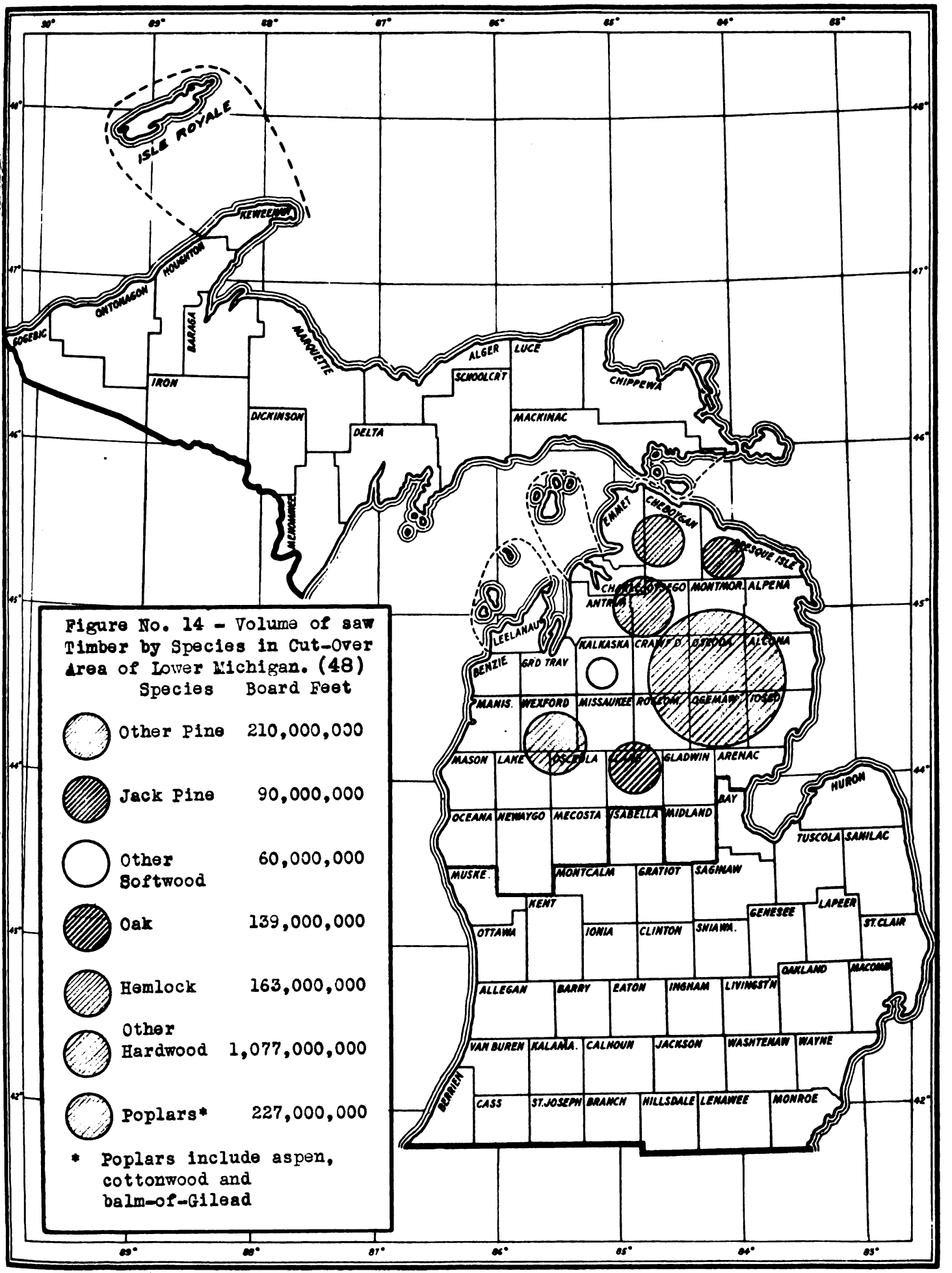


Figure No. 14 - Volume of saw Timber by Species in Cut-Over Area of Lower Michigan. (48)

Species	Board Feet
Other Pine	210,000,000
Jack Pine	90,000,000
Other Softwood	60,000,000
Oak	139,000,000
Hemlock	163,000,000
Other Hardwood	1,077,000,000
Poplars*	227,000,000

* Poplars include aspen, cottonwood and balm-of-Gilead

It is also estimated that on medium soils the growth rate of aspen at 30 years of age is about 4/10 or a cord per acre annually for well-stacked stands and at 50 years of age almost 9/10 of a cord. (22)

If the figures in Table No. XII are assumed to be average for the entire area of aspen forest in the cut-over area and it is further assumed that this forest cover is soil of medium fertility, then the volume of aspen on the $2\frac{1}{2}$ million acres of cut-over land is increasing at the approximate rate of 250,000 cords per year only on the stands 25 years of age and over.

This volume of wood can be converted into equivalent board feet of lumber per cord by using the conversion factors from Table No. XIV. By using the conversion factor of 265 for aspen bolts of six inch top diameter, this 250,000 cords of aspen would be equivalent to 66,250,000 board feet of lumber. The fact that this increase in the volume of aspen wood cannot all be converted into lumber should be emphasized. These estimates, however, do indicate the rapid increase in the total volume of aspen wood, and it seems reasonable to assume that the increase in the supply of potential aspen lumber is proportional.

In concluding their study of aspen, Johnson, Kittridge, and Schmitz say, "The large area of land occupied by aspen forests in the Lake States makes it essential that the species be utilized more extensively. The wood is growing faster than it is being used and the short life of the tree requires that consumption be more nearly balanced with growth, otherwise a large portion of the crop will be wasted." (24)

PROPERTIES AND UTILIZATION OF ASPEN

Available information on the properties and utilization of aspen generally has been limited to the large commercial users of this wood. There has been little incentive to make this information available to small local builders, since aspen has been so little used for building construction. However, those industries, particularly the paper and excelsior manufacturers, which are the largest users of aspen, have known of its desirable properties for these specific uses.

Wood distributors and users in the aspen area have always been prejudiced against the use of aspen. This attitude is due chiefly to the relatively small size of the mature tree and the generally poor appearance of the tree and the finished lumber.

Other species such as cottonwood, eastern hemlock, jack pine and red gum have passed through a similar stage. A comparison of the properties of aspen with those of other, better known, woods should remove some of the prejudice against aspen and aid in the more extensive utilization of the species.

A comparison of the properties of aspen with those of other woods for which it might be substituted is made in Table No. XV.

In discussing the use of aspen for structural lumber, Johnson, Kittridge, and Schmitz, have this to say:

> "That aspen can be used for lumber and that such lumber will give good service under certain conditions has been amply demonstrated. Time alone can tell how successfully it can compete in the market with other woods.

"Considerable quantities of aspen have been and are being cut into lumber by portable sawmills in Minnesota. This lumber is used by settlers for practically all ordinary purposes. Unless it has received a preservative treatment however, it should not be used in contact with the soil or in damp places which are favorable to decay."(23)

A LIST OF REPORTED USES OF ASPEN

Lumber
Boxes and Crates
Excelsior
Crossties
Fuel Wood
Posts
Mine timbers
Slack cooperage
Tight cooperage
Matches
Core Stock
Novelties
Boxes, piano
Boxes, pill
Boxes, shoe peg
Boxes, tackle
Boxes, veneer
Brooms
Brushes
Buckets
Cabinets
Carrier, potato
Carriers, root
Cases, shipping
Casing
Casing, house
Caskets and outside boxes
Ceiling
Clapboards
Cooperage
Crates
Crating
Doors
Dowels and skewers
Dressers
Driers, clothes
Fillers, shoe
Finish, interior, house
Fixtures
Flooring
Forms, hosiery
Baskets, fruit and vegetable packages
Beams and frames for railroad cars
Blocks, brush
Boards, hosiery
Boats, stone
Bodies, vehicle
Bottoms, basket
Boxes, bluing
Boxes, butter
Boxes, candy
Boxes, cheese
Box, lock-corned
Forms, shoe
Frames, door
Lining, interior, refrigerator
Matches
Novelties
Newels, stair
Organs
Pails, candy
Pails, cooky
Parts, body, vehicle, machinery
Parts, organ
Parts, potato machinery
Poles
Products, planing mill
Pulp, paper
Racks, clothes
Refrigerators
Sash, doors and blinds
Scows, sand
Sheathing
Sheeting
Shingles
Shooks
Shuttles, spools and bobbins
Siding
Sleds, bob

List of Reported Uses of Aspen (continued)

Spools
Stringers, clothes rack
Supplies, dispensary
Sweepers, carpet
Tenders, baby
Timbers, mine
Toothpicks
Frames, window
Furniture
Furniture, work, hidden
Games
Handles, brush
Handles, cutlery
Handles, dipper
Handles, knives
Handles, paint and sweeping
Heads, spool
Hoops, basket
Implements, agricultural
Kegs, putty
Kegs, spice
Kits, fish
Ladders
Lasts, show
Toys, bottom, cart
Toys, bottom, sled
Toys, bottom, wagon
Toys, game
Toys, wheelbarrow
Toys, yard, play, baby
Trees, shoe
Tubs, food, poultry
Tubs, jelly
Tubs, lard
Tubs, powder
Tubs, sugar
Vehicle parts
Woodenware
Wool, wood
Work, interior furniture
Venetian blind slats

TABLE NO. XIV(16)

VOLUME EQUIVALENTS FOR ASPEN

Aspen Box Bolts [1]
(100" lengths unpeeled)

Top Diameter of Average Bolt	Bolts Per Cord	Board Feet Per Cord		Cubic Feet Per Cord		Weight Per Cord[2]	
		Scribner Decimal C	Lumber Scale	Wood	Bark	Green	Dry
Inches	Number	Board Measure				Pounds	Pounds
6	43	210	265	70	8	3,770	2,210
8	26	330	413	76	9	4,110	2,420
10	18	400	479	77	9	4,150	2,440
12	13	450	510	78	10	4,260	2,500
14	10	485	530	79	10	4,300	2,530
16	7	500	540	80	10	4,350	2,550
18	6	505	530	80	10	4,350	2,550
20	5	510	520	80	10	4,350	2,550

1. Based on truck-load lots and a standard cord of 128 cubic feet. To convert to wood piling (loose) deduct 10 per cent; (average) 7 per cent; (close) 3 per cent. For railroad car lots at loading point, add 5 per cent, at delivery point, 8 per cent.

2. Based on Western Weighing and Inspection Bureau weight of 3,000 pounds for peeled, dry wood. Rough wood, weight of 4,700 pounds suggested by same source.

TABLE NO. XV (27)

STRENGTH AND RELATED PROPERTIES OF WOODS GROWN IN THE UNITED STATES

Species	Specific Gravity, Oven Dry, Based on Volume	Weight Per Cubic Foot Pounds	Shrinkage from Green to Oven-Dry Condition Based on Dimensions When Green Volumetric Per Cent	Static Bending Modulus of Rupture Pounds per Sq. Inch	Compression Parallel to Grain - Maximum Crushing Strength - Pounds per Sq. Inch	Hardness; Load Required to Embed a 0.444-Inch Ball to 1/2 Its Diameter. Side-Lbs.	Shear Parallel to Grain Maximum Shearing Strength. Lbs.per Sq.In.	Cleavage; Load to Cause Splitting. Pounds per Inch of Width	Tension Perpendicular to Grain; Maximum Tensile Strength Lbs. Per Sq. Inch
Aspen	.40	26	11.5	8,400	4,250	350	850	210	260
Aspen, Largetooth	.41	27	11.8	9,100	5,300	420	1,080	220	390
Basswood	.40	26	15.8	8,700	4,730	520	990	230	350
Cottonwood, Eastern	.43	28	14.1	8,500	4,910	430	930	270	580
Elm, American	.55	35	14.6	11,800	5,520	830	1,510		660
Oak, Red	.66	44	13.5	14,300	6,760	1,290	1,780	410	800
Oak, White	.71	48	15.8	15,200	7,440	1,360	2,000	450	800
Poplar, Balsam	.35	23	10.5	6,800	4,020	300	790	200	350
Poplar, Yellow	.43	28	12.3	9,200	5,290	450	1,100	280	520
Cedar, Northern White	.32	22	7.0	6,500	3,960	320	850	150	240
Fir, Balsam	.41	25	10.8	7,600	4,530	400	710		180
Hemlock, Eastern	.43	28	9.7	8,900	5,410	500	1,060	150	
Pine, Jack	.46	30	10.4	7,900	5,400	580	1,120	200	390
Pine, Longleaf	.62	41	12.2	14,700	8,440	870	1,500	270	470
Pine, Northern White	.37	25	8.2	8,800	4,840	400	860	160	300

ORIGINAL INVESTIGATIONS AND EXPERIMENTAL CONSTRUCTION

The value of an extended study of experimental construction in the utilization of aspen is well recognized. Although such construction was undertaken during this study, it is questionable whether the time alloted will be sufficient to draw any definite conclusions upon which design recommendations can be made. However some preliminary data have been obtained which are discussed later.

To obtain data which could be applied immediately to recommendations on the utilization of native lumber, particularly aspen, in farm building construction, a survey was made in previously identified areas where such construction is most urgently needed.

No definite survey procedure was followed in making this study. The primary objective was to contact individuals who had used native lumber and by inspecting the buildings and studying the building requirements of these individuals determine:

1. The need for native lumber.
2. How native lumber was being used.
3. The durability of native lumber under actual service conditions.
4. The user's reaction to the desirability of using native lumber.
5. What improvements in the manufacture, distribution and utilization of native lumber would increase its use.

The users of native lumber visited in this survey were located through contacts with county agents, local saw mill

operators, and by inquiries from those interviewed in the course of this survey. The data collected are recorded on the following pages.

The first eight reports are on farm buildings and the remainder are reports on miscellaneous types of construction.

Figure No. 15

Farm - No. 1

Location - Gladwin County

Size of Farm - 80 Acres

Woodlot - None

Type of Farming - Dairy

Type of Soil - Class 1 Sandy Loam

Buildings Required for Adequate Farm Operations -

Poultry House
Granary
Machine Shed
Remodeled House

Lumber Requirements - 20 M Board Feet

The new barn constructed in 1940 will replace the adjacent one which is to be torn down. The owner of this farm had intended to use local aspen for the new barn and

says that he would have used it in preference to local yard lumber at the current price. Instead, he used Norway pine purchased for $36/M board feet which was being salvaged from down timber as a result of a severe storm in the Roscommon area. The completed barn, which is 36' x 66', cost $2500 as compared to an estimated $3500 if local yard lumber had been used.

Other buildings needed on this farm and which will be constructed are: a new poultry house for 200 hens, a granary for 2500 bushel of grain, a machine shed, and the house, which was not photographed at the request of the owner, will be remodeled.

It is estimated that at least 20 M board feet of lumber will be required for these proposed buildings. If the supply of Norway pine lasts until these proposed buildings can be constructed, it will be used. Otherwise, the owner says he will use jack pine or aspen.

Figure No. 16

Farm - No. 2

Location - Gladwin County

Size of Farm - 120 Acres

Woodlot - 60 Acres of Timber

Type of Farming - General, Livestock and Dairy

Type of Soil - Class 1 Sandy Loam

Buildings Needed - Barn
Poultry House
Granary
House Remodeled

Lumber Requirements - Estimated 40 M Board Feet

Type of Lumber Likely to be Used - Mostly Aspen, Other Hardwoods

The young couple who had moved from the city onto this farm left to them by aging parents were considerably depressed over the probable cost for new buildings which they considered essential. They were interested in using native lumber, perhaps from trees cut from their own wood lot and talked enthusiastically about the old barn which had been constructed about 40 years ago from aspen lumber. The aspen siding on this old barn, although it had never been painted, appeared to be in reasonably good condition.

Figure No. 17

Farm - No. 3

Location - Gladwin County

Size of Farm - 80 Acres

Woodlot - 6 Acres of Hardwood

Type of Farming - General Livestock and Dairy

Type of Soil - Class 1 Sandy Loam

Buildings Needed - New House
Granary
Poultry House
Machine Shed

Estimated Lumber Requirements - 50 M Board Feet

Type of Lumber likely to be Used - Elm and Other Hardwood from Woodlot

The twenty-five year old farmer who recently purchased this rundown farm hopes to make it pay. A new barn 36' x 60' has just been completed at a cost of $1200. All of the dimension lumber and roof boards, which are mostly elm, were obtained from the farm woodlot. The siding was purchased for $60/M board feet, from the local lumber yard, and this farmer admits that he could never have built the barn if he had been required to buy all his lumber at comparable prices.

Figure No. 18

Farm - No. 4

Location - Alcona County

Size of Farm - 120 Acres

Woodlot - None

Type of Farming - Dairy

Type of Soil - Class 1 Sandy Loam

A new barn with laminated rafters constructed almost entirely from short length aspen, balsam fir and balm-of-Gilead was erected on this farm in 1936 at a cost of $1500. The lumber used for the rafters was 1" x 3" strips cut from 8-foot pulp wood bolts. The pulp wood was cut from adjacent national forest land at a cost of $1/M board feet.

Figure No. 19

Farm - No. 5

Location - Gladwin County

Size of Farm - 40 Acres

Woodlot - None

Type of Farming - Hay and Grain (Land now cash rental)

Type of Soil - Class 1 Sandy Loam

Buildings required for adequate Farm Operation:

Barn for 8 to 10 Cows, 50 Sheep
Poultry House for 100 Hens
Granary for 500 Bushels Grain
Machine Shed

Estimated Lumber Requirements - 30 M Board Feet

The owner of this farm is now working in a factory in an adjacent city but would prefer to return to the farm with his family. The only reason he is not now on the farm is because the buildings are inadequate and the photograph would seem to substantiate this opinion.

The owner's father has a woodlot containing mostly aspen and some logs will be cut as time permits that will provide lumber for the needed buildings.

Figure No. 20

Farm - No. 6

Location - Clare County

Size of Farm - 300 Acres

Woodlot - 200 Acres of Woodland Pasture

Type of Farming - Dairy

Type of Soil - 100 Acres of Class 1 Sandy Loam

Buildings Required for Adequate Farm Operation -
House Remodeled
Granary for 2000 Bushel
Machine Shed

Estimated Lumber Requirements - 30 M Board Feet

A new barn was constructed for $1200 on this farm in 1940 using elm and aspen for framing; aspen and basswood for siding and sheathing; and cedar shingles. It was estimated that a similar barn constructed from local yard lumber would have cost at least $3000.

The owner has had some experience in lumbering and feels that aspen is entirely satisfactory for farm construction. Aspen logs are being sawed into lumber at a local mill for the new buildings that are soon to be constructed on this farm.

Figure No. 21

Farm - No. 7

Location - Alcona County

Size of Farm - 120 Acres

Woodlot - Some Wooded Pasture - Has Access to 400 Acres of Timber

Type of Farming - Dairy

Type of Soil - Class 2 Sandy Loam

Buildings Required for Adequate Farm Operation -
House
Barn
Poultry House
Granary
Machine Shed

Estimated Lumber Requirements - 100 M Board Feet

This 120 acre farm was purchased in 1938 by a client of the Farm Security Administration for $1600. The farm land can be made productive; market facilities are favorable; electric service is available; and the owner would like to make a home of this farm that would provide security for his family. As he says, this cannot be accomplished until the necessary buildings are constructed.

Material consisting of aspen, jack pine, and second growth white pine is now being cut for these buildings which will be constructed as soon as possible.

Figure No. 22

Farm - No. 8

Location - Clare County

Size of Farm - 120 Acres - Additional 240 Acres of Pasture Rented

Woodlot - 60 Acres of Small Hardwood - Mostly Aspen of Little Value - Will Eventually be Cleared

Type of Farming - General Livestock

Type of Soil - Class 2 Sandy Loam

Buildings Needed for Adequate Farm Operation -
House Remodeled
Barn for 20 Cows and 50 Sheep

Estimated Lumber Requirements - 40 M Board Feet

This farm is also being purchased by a client of the Farm Security Administration who is now working in an adjacent factory. He also has a small repair shop on the farm and the income is to be used for constructing the buildings needed on this farm.

The usable timber on the 60 acres of pasture land will be cut and additional lumber needed will probably be aspen purchased from neighbors and cut at a local saw mill.

Figure No. 23A

This log house was constructed of aspen logs in 1930 and is sound today. One of the advantages of using aspen logs for this type of construction is its relative freedom from cracking in the process of seasoning. This characteristic is shown in the enlarged section of a corner of the building.

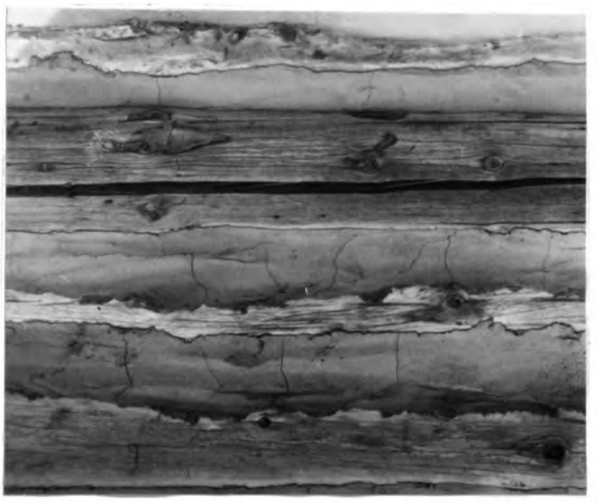


Figure No. 23B

Note freedom from cracking in all logs except one. This one is a spruce log.

Figure No. 24A

Figure No. 24B

This new poultry house was constructed in 1941 of aspen poles approximately four inches in diameter. It will replace the old poultry house also shown. The actual cash outlay for this building was less than $25, which includes the concrete foundation, roofing and windows. The poles were cut from the woods in the background.

The use of small aspen poles or logs is one practical method of using small dimension trees for much needed buildings on marginal or part time farms. The poles are slabbed on two sides to form a tight wall without making it necessary to chink the cracks. If aspen poles are used in this manner, placed upon a concrete foundation and preferably treated with some preservative, they should last for many years.

A small stack of well-piled aspen lumber has also been accumulated for needed repairs and other construction on this small farm.

Figure No. 25

This 36' x 72' dairy barn was recently constructed using native material consisting mainly of aspen and jack pine. The cash investment in this barn was approximately $1500, and the barn probably would never have been constructed had the owner not been able to use readily available native lumber. Part of this lumber was cut from the owner's wood lot and part of it purchased from the Tanner mill at East Tawas.

Figure No. 26A

Figure No. 26B

This barn constructed for a client of the Farm Security Administration illustrates the use of a combination of native materials; field stone picked from adjacent fields was used for the basement walls and foundation. The frame is constructed of native elm, jack pine and aspen.

Figure No. 27A

Figure No. 27B

This silo was constructed over 30 years ago from 2" x 4" hemlock lumber. About that time hemlock lumber was in much the same position as aspen lumber is today. It was considered a very inferior wood and it is inferior in many respects to white pine which had been so abundant in the years just previous to the time this silo was constructed.

This silo has been filled every year for the past 30 years. The silage has kept in good condition and the lumber is still sound. With continued painting, using asphalt or creosote on the outside, it should last for another 30 years.

Note the crib construction and the uniform width of the boards and also the freedom from cracks.

Figure No. 28A

Figure No. 28B

One of several cottages or tourist cabins constructed of aspen logs. There seems to be an increasing interest in this type of construction and it may provide a valuable market for aspen logs and lumber where they are readily available.

Figure No. 29A

This log cabin was constructed almost entirely of jack pine logs. A few spruce and norway pine were also used. It was constructed in 1940 and as yet shows no signs of weathering. The outside of the logs have been varnished and the inside walls are all panelled with knotty pine. Knotty pine is widely used for interior finishing and if knots are popular, jack pine is second to none. For this purpose it is just as serviceable as southern pine.

Figure No. 29B

A corner of above cabin showing method of fitting logs.

Figure No. 30A

A corner of above building showing siding too close to the ground causing rapid deterioration.

Figure No. 30B

With the exception of the foundation and roofing, this tourist cabin is constructed entirely of aspen. Aspen is used for such purposes as flooring both inside the cabin and on the porch floor. Aspen is used for all framing members and for siding. This cabin was constructed in 1935 and shows no indications of deterioration. It has been painted once since it was constructed.

Figure No. 31

This 36' x 50' barn was constructed by another Farm Security Administration client for a cash outlay of about $900. The lumber for this barn was obtained partly from the owner's woodlot and partly from the Huron National Forest.

The Farm Security Administration supervisor for this region says that before this barn was constructed, the owner was housing four cows and a like number of young stock in an entirely inadequate 16' x 24' barn, without feed storage, and the sales per cow for the year probably did not exceed $50. During the first half of the year after building the new barn, the owner was milking twelve cows, had about 18 head of young stock and the barn had adequate space for storing all required feed and bedding. Under these conditions, the income per cow was almost double what it had been previously.

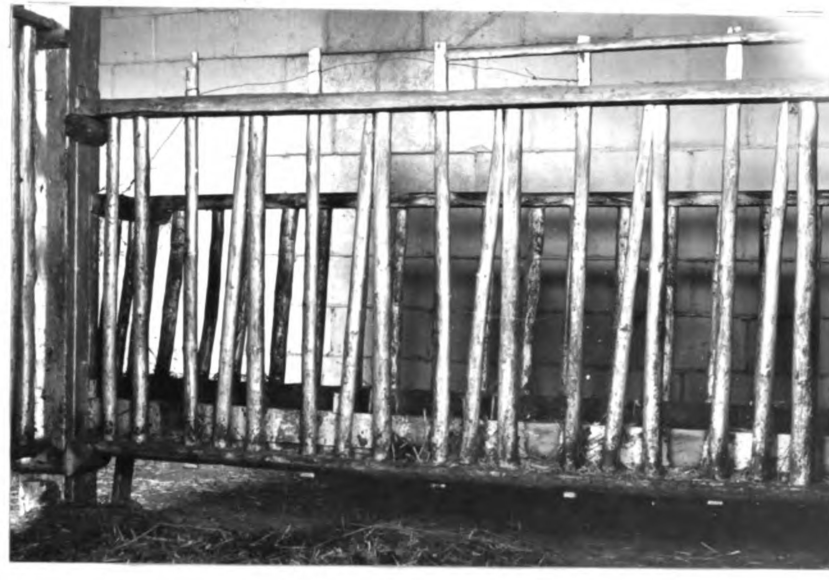


Figure No. 32

Another use for native lumber. These calf stanchions are constructed of cedar poles, but there is no reason why other species of native lumber could not be used for similar purpose if they were first properly treated with some preservative and kept reasonably free from moisture.

EXPERIMENTAL CONSTRUCTION

Since most of the prejudice against aspen is due to small dimension and relatively low grade lumber, it seems desirable to give some serious consideration to types of construction in which the sizes and grades of available aspen lumber could be used most profitably.

A high per cent of the aspen trees ready to be harvested in the cut-over area of Michigan are under six inches in diameter and the saw logs from these trees will vary from eight to twelve feet in length. The accepted practice is to saw these small diameter logs into narrow one-inch boards or into two-inch by four-inch dimension lumber.

Most standard designs for farm building construction are adapted to the use of this small dimension lumber. However, it is almost always used in conjunction with commercial materials such as flooring, siding or roofing. The suggestion that this native material be used exclusively for some low cost type of construction that would be practical for farmers in the cut-over area is a wide departure from recognized construction practices. However, when such a proposal was made, a type of construction known as "crib" construction was suggested as having possibilities. This particular type of construction was used quite extensively before the steel and reinforced concrete era for the walls of grain elevators and for storage bins, where a high degree of resistance to lateral pressure was desirable. A crib constructed silo is shown in Figure 27. This type of construction has also been used for rough floors of various

types of structures, but to use it for finished floors, walls and roof with neither an interior or exterior covering seemed extremely questionable. Per haps no further study would have been made had it not been for the critical farm housing situation in the cut-over area and the need for buildings requiring an absolute minimum of cash investment. In view of these facts, additional studies were made on the practicability of using crib construction for such buildings.

The advantages of "crib" construction are:

1. It is adapted to small dimension lumber manufactured from small diameter logs.
2. Only one size (cross-section) dimensioned lumber is required for any building.
3. Random length lumber reduces waste.
4. No skilled labor is required for construction.
5. No commercial building materials are required except nails and even these could be replaced by wood dowels in extreme cases.
6. Has greater insulating value than standard frame construction.
7. Has greater strength and rigidity than standard frame construction.

The disadvantages of "crib" construction are:

1. More lumber is required per unit of area enclosed. The per cent increase will depend upon the type of construction used for comparison.
2. It is difficult to obtain smooth surfaces free from cracks, unless carefully sawed or planed lumber is used.

Specifications for a crib constructed grain elevator are given in a text book, "Walls, Bins, and Grain Elevators" written in 1919 by Milo S. Ketchum as follows: (26)

> "The bins shall be constructed by planking in courses laid as follows: All walls shall be laid up plumb and true, forming square corners in the bins. Each course of planking shall be securely nailed with 30d wire nails 4½" long, said nails not exceeding 22 to a pound. At all interior crossings two nails shall be driven in each end of each piece of plank in the 4" and 6" walls. At all outside crossings five nails shall be driven in each end of each plank crossing the wall and four nails in the plank at right angles to it. The intermediate nails shall be spaced and staggered. At the base of the walls and for 11' -0" in height the nails shall be spaced not to exceed 14" centers, and for each additional 11' -0" in height the distance apart may be increased 2". The heads of the nails shall be well bedded in the wood."

Another reference to the use of crib construction for grain storages is quoted from Farmers' Bulletin No. 1636, "Farm Bulk Storage for Small Grains."

> "In the crib type, the walls are built up of 2" lumber laid flat and spiked together, the width being determined by the height of the structure. For building 24 feet or less in height, 2" x 4" lumber is used. In walls 24 to 40 feet high the lower 16 to 18 feet are usually build of 2" x 6" material. The crib type of framing is preferable when the storage capacity exceeds 10,000 bushels. A metal clad farm elevator of this type of construction costs no more than a baloon type building of the same capacity would have cost." (25)

Following the basic specifications for "crib" construction as outlined by Ketchum, a small experimental building was constructed of 2" x 2" basswood taken from the Sanford woodlot at Michigan State College. Basswood was used in place of aspen for most of this building to avoid delay, since the aspen originally requested was not as yet available. In many respects, basswood is similar to aspen and it was decided that most preliminary observations could be made by using basswood.

The factors upon which preliminary observations were to be made are:

1. General construction procedure.
2. Methods of closing the cracks between mis-sawed boards.
3. Dimensional variation in the building owing to expansion and contraction of the lumber with changes in atmospheric humidity.

A photograph of this first experimental building completed except for the door and window is shown in Figure 33. This building was constructed for a portable tool shed to be used by the Forestry Department of Michigan State College. The skids are cedar poles; the floor is composed of three different woods: aspen, balm of Gilead and basswood. The small amount of aspen and balm-of-Gilead available was used in the floor since it would be more rapidly subjected to deteriorating influences and evidence of decay could be more readily detected. One-half of the floor of each species was painted with creosote and the other half used without treatment. The treated lumber was painted on all four surfaces as it was nailed in place.

As construction with the side walls progressed, it became increasingly evident that one of the most serious objections to using unplaned, rough-sawed lumber was the irregularity in dimensions, and particularly the difference in thickness of the individual boards. This is not a criticism of the species used but of the method of manufacturing the lumber.

One of the first attempts to compensate for minor variation in the thickness of the 2" x 4" was to paint the top surface of the thinner one with a coat of heavy white lead paint or asphalt paint. This might have been practical if sufficient time had been given for the paint to dry, but as succeeding layers of 2" x 4" were nailed in place, the paint was forced from the cracks.

This method of attempting to fill the cracks between the 2" x 4" was discontinued in favor of laying 4" strips of heavy asphalt paper over the thinner 2" x 4". This method seemed to be satisfactory and was used for the remainder of the building. See Figure 34.

This building was constructed in the Agricultural Engineering laboratory during the summer of 1942 and was taken to the Forestry woodlot in the fall of that year. Observations were made at various times during the winter and the following summer to determine any variations in the dimensions of the wall owing to shrinkage or swelling with changes in atmospheric moisture. No significant variations were observed. It is entirely possible that the space between the 2" x 2" members of the wall compensated for any changes in thickness of the lumber. Although at no time were the open cracks completely closed by the swelling of the wood.

Insufficient time has elapsed since this building was constructed to make any predictions as to its ultimate durability. There is no evidence after three years of exposure to indicate a rate of deterioration more rapid than would be expected of other wooden structures.

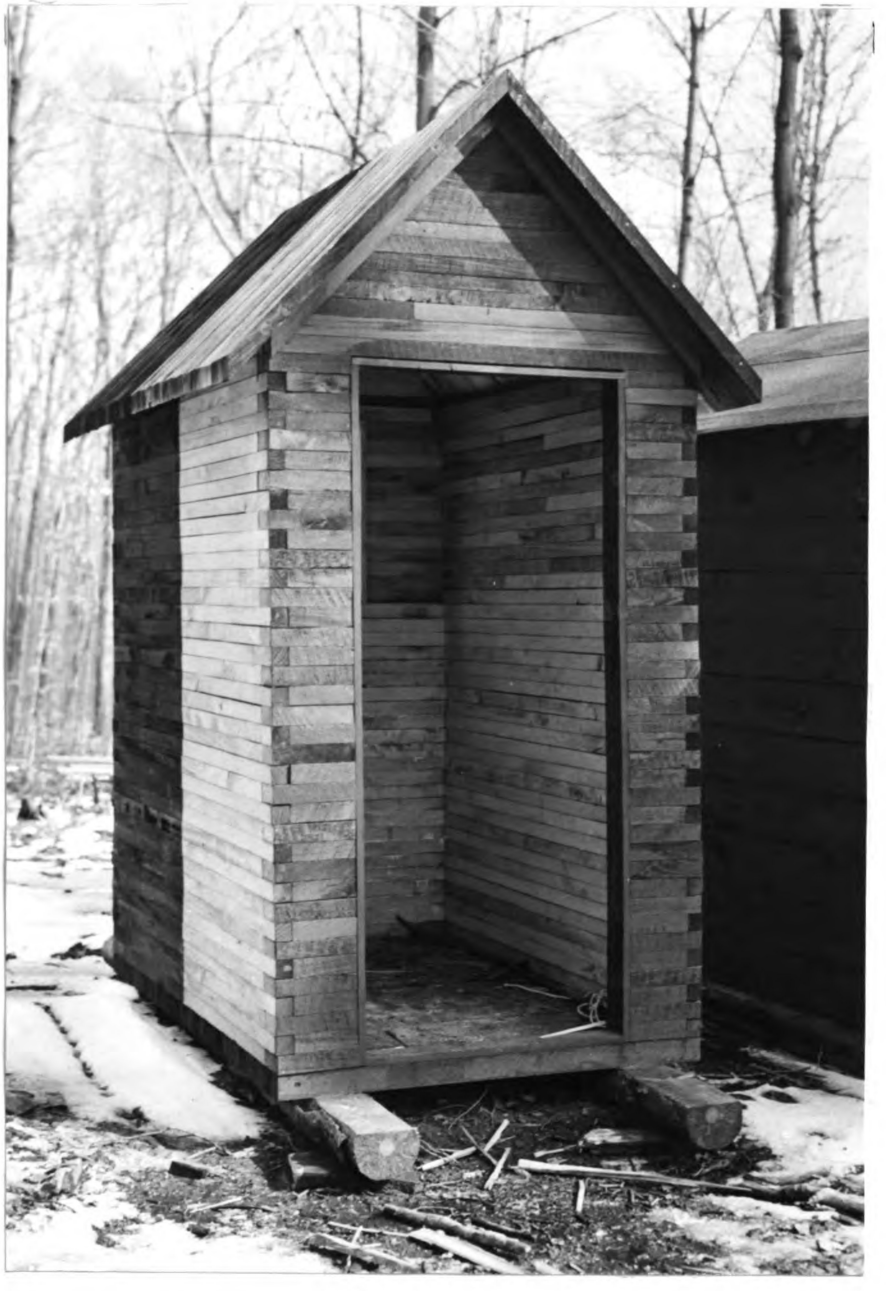


Figure No. 33

An experimental building made of crib construction, using 2" x 2" material (mostly bass-wood). This building is to be used in the college woodlot for tool storage. The door is to be hung.

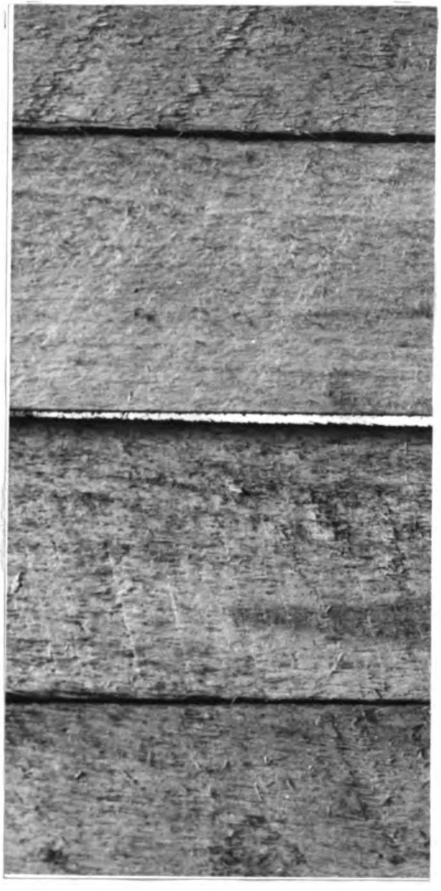


Figure No. 34

An enlarged section of the wall of the building shown in Figure 33. Note the wide unfilled crack and the cracks above and below it filled with tar paper strips.

A SMALL HOUSE MADE FROM SCRAP WHITE PINE LUMBER BY USING CRIB CONSTRUCTION

As a result of conferences with various individuals regarding the use of native lumber and the possibilities of using crib construction for various types of farm buildings, the small house shown in Figures 35A, B, C, and D was constructed.

This small house is particularly interesting. The outside walls, floors and interior partitions are constructed entirely of scrap lumber from a sash and door manufacturing plant. The cost of this scrap lumber was $60 and the owner of this building estimates that the total cost of material for the entire house was less than $350. Although the construction of this house was not undertaken as a definite part of this project on experimental construction, it was inspired by the project and built while this study was being made. Naturally this house was carefully observed during and after the construction.

The white pine blocks, of which the main part of the house was constructed, are approximately 1" x 3" in cross-section and of random length from 4" to 16". The material was waste from kiln dried stock, but no effort was made to control the moisture content of this lumber as it was being used. However, the outside walls were painted with a penetrating oil as the work progressed.

The outline for the outside walls and partitions was marked on the concrete floor slab and 1" x 3" boards were bolted to the concrete as a nailing base for the successive

layers of block. See Figure 35B. It was necessary to build all partition walls at the same time since all intersecting walls are tied together by courses of overlapping blocks. See Figure 35C.

Some additional precaution was taken in selecting blocks for the outside wall for the purpose of breaking joints properly and to find pieces with clear faces for the outside surface.

It was not particularly difficult to keep the walls straight and plumb owing to the fact that the blocks were uniform in width and if all edges of the blocks were flush, the wall was reasonably true to line. As an extra precaution, the walls were checked every few courses for any error that might tend to become cumulative.

Door and window openings were provided by building the wall to proper height and then letting the ends of the blocks overhang to be sawed off later when the door or window frames were inserted.

No record is available of the actual time required for constructing this house since it was built during spare time while the owner was working. The owner estimates that a similar house could be constructed in less time than would be required for standard frame construction owing to the fact that no extra labor is required for sheathing or siding and that the time could be still further reduced by using longer material. It certainly seems reasonable to believe that if a house could be so easily constructed of thin,

short blocks of uniform cross-section that it would be even more simple to construct a similar building using 2" x 4" pieces, providing these 2" x 4" could be sawed to uniform cross-section.

There was some question as to the amount of swelling which might be expected in the outside walls owing to absorption of moisture and the damage which might result in cracked plaster and cracks around windows and doors. Therefore before any interior finish was applied to the outside walls, measurements were taken over a period of several weeks including extremely humid and extremely dry weather to determine any variations in the height of the outside walls. These measurements were taken by driving a nail into the wall near the ceiling at a given distance from the floor and measuring at intervals the distance between the floor and the nail.

When no significant change was observed in the height of the wall, the original plan of applying the insulating lath over furring strips was discarded and the lath nailed directly to the interior surface of the wall.

As an extra precaution against moisture, the inside surface of the outside wall was painted with asphalt paint and 30-pound asphalt paper applied before the lath was nailed directly to the wall.

At the present time, after the house has been lived in for three years, there is no apparent indication of defects which could be contributed to shrinkage or swelling of the walls. See Figure 35D.

Figure No. 35A

Figure No. 35B

This attractive and livable house was built in 1941 at a cost for material of approximately $350 by using scrap soft pine lumber and crib construction.

Figure No. 35C

Detail of wall construction for house shown in Figure 35A.

Figure No. 35D

Detail showing method of framing partition into outside walls.

CRIB TYPE CONSTRUCTION FOR FARM GRANARIES

Perhaps one of the most practical uses of crib type construction would be found in the construction of farm granaries. This would be particularly true for deep bins which appear to be more practical than shallow bins from the standpoint of handling grain from a centrally located vertical elevator.

The following photographs show the construction of a crib type farm granary in which 2" x 4" yellow pine was used for all outside walls and bin partitions. The original granary (without the lean-to additions shown in Figure 36) was 30 feet square and 20 feet high, divided into bins 10 feet square.

This granary holds approximately 12,000 bushels of grain, most of which can be handled by the vertical elevator through spouts connecting each bin with the bottom of the elevator pit.

By substituting standard frame construction for the crib construction, it would have been necessary to use 2" x 14" studs, 12" on center or material of equivalent strength sheathed either outside and inside or double boarded on the outside. This type of construction would require 52 board feet of lumber for each square foot of wall against only 48 board feet for crib construction. While it is true that smaller dimension studs could be used if the walls were adequately braced, a higher quality lumber used was accurately dressed to proper dimension. However,

the simplicity of crib construction and the fact that it is adapted to the use of short length and relatively low grade lumber should make it more popular as a method of constructing certain types of farm buildings.

Note: Computations for determining the required strength for the walls of a grain bin 10 feet square and 20 feet high were based upon Janssen's formula:

$$L = \frac{WR}{f}\left(1 - \frac{1}{2.718^{\frac{kfh}{R}}}\right)$$ in which

L = Lateral pressure at depth h.
W = Weight per cubic foot of grain.
R = Hydraulic radius of the bin.
f = Coefficient of friction of grain on bin walls.
k = Ratio of lateral to vertical.
h = Depth of grain.

Figure No. 36

The central portion of the building is a 10,000 bushel granary made of crib construction. See Figures 37 and 38 for details of construction.

Figure No. 37

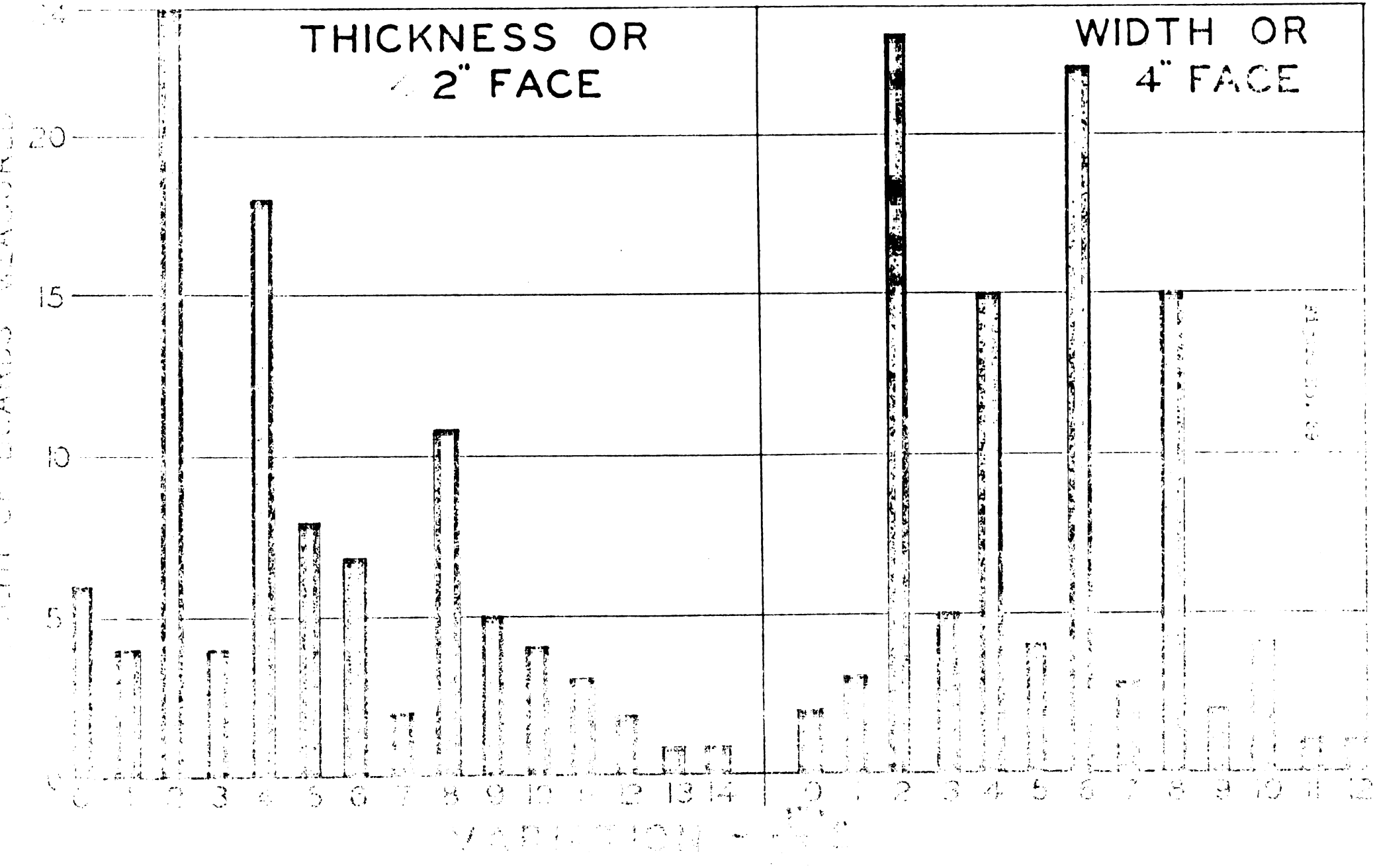
All bin partitions are tied into outside walls by overlapping alternated layers of 2" x 4", making an extremely rigid building.

Figure No. 38

The maximum value of crib construction is in deep bins which would require heavier construction members and extra bracing, if ordinary construction was used. The owner estimated that the cost of this granary is no greater than the cost of one of similar capacity using standard stud construction.

Figure 39

DIMENSIONAL VARIATION WITHIN INDIVIDUAL PIECES OF 8'-10'-12' JACK PINE 2" x 4"'S



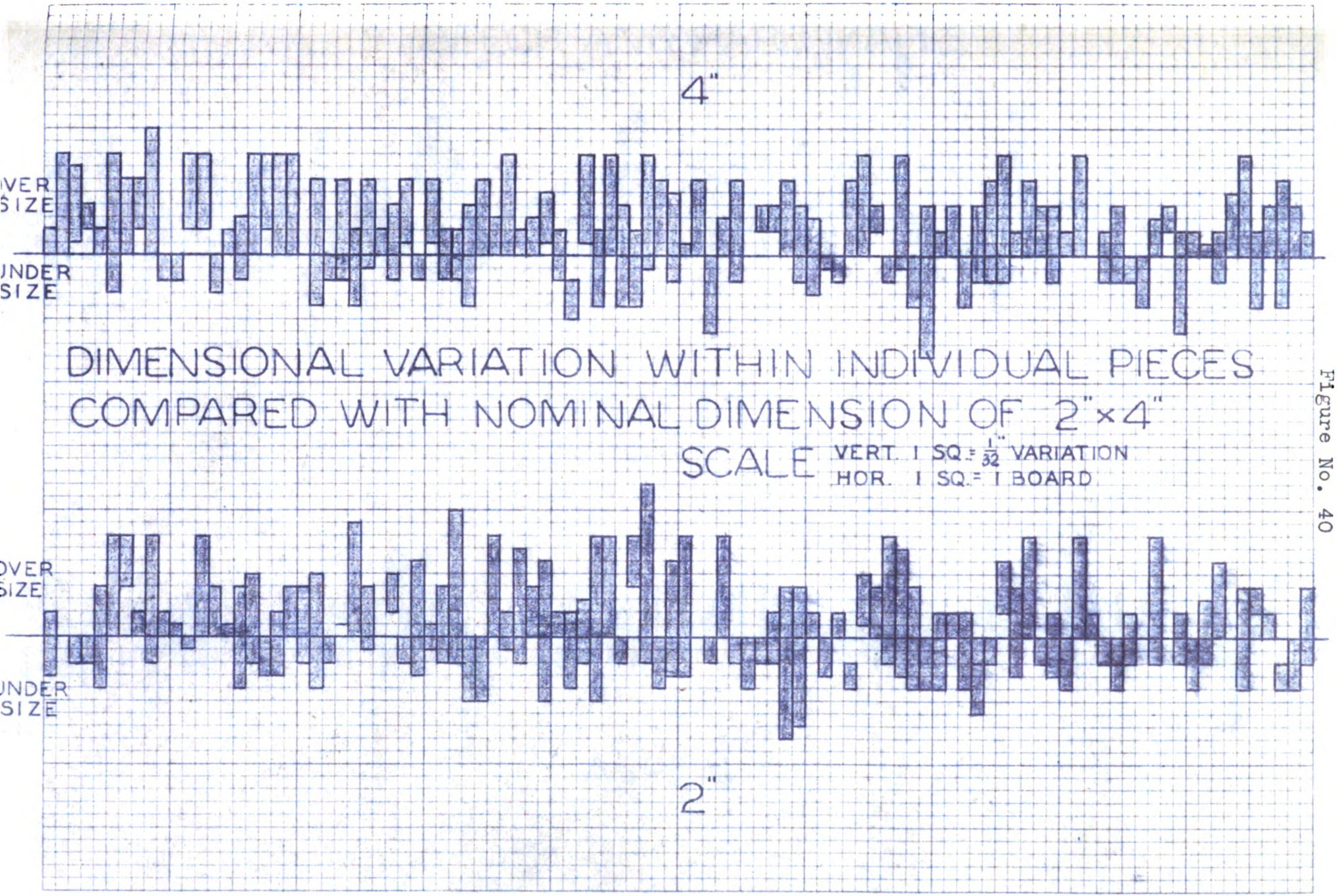

4"
OVER SIZE
UNDER SIZE
DIMENSIONAL VARIATION WITHIN INDIVIDUAL PIECES
COMPARED WITH NOMINAL DIMENSION OF 2"×4"
SCALE VERT. 1 SQ. = 1/32" VARIATION
HOR. 1 SQ. = 1 BOARD
OVER SIZE
UNDER SIZE
2"

Figure No. 40

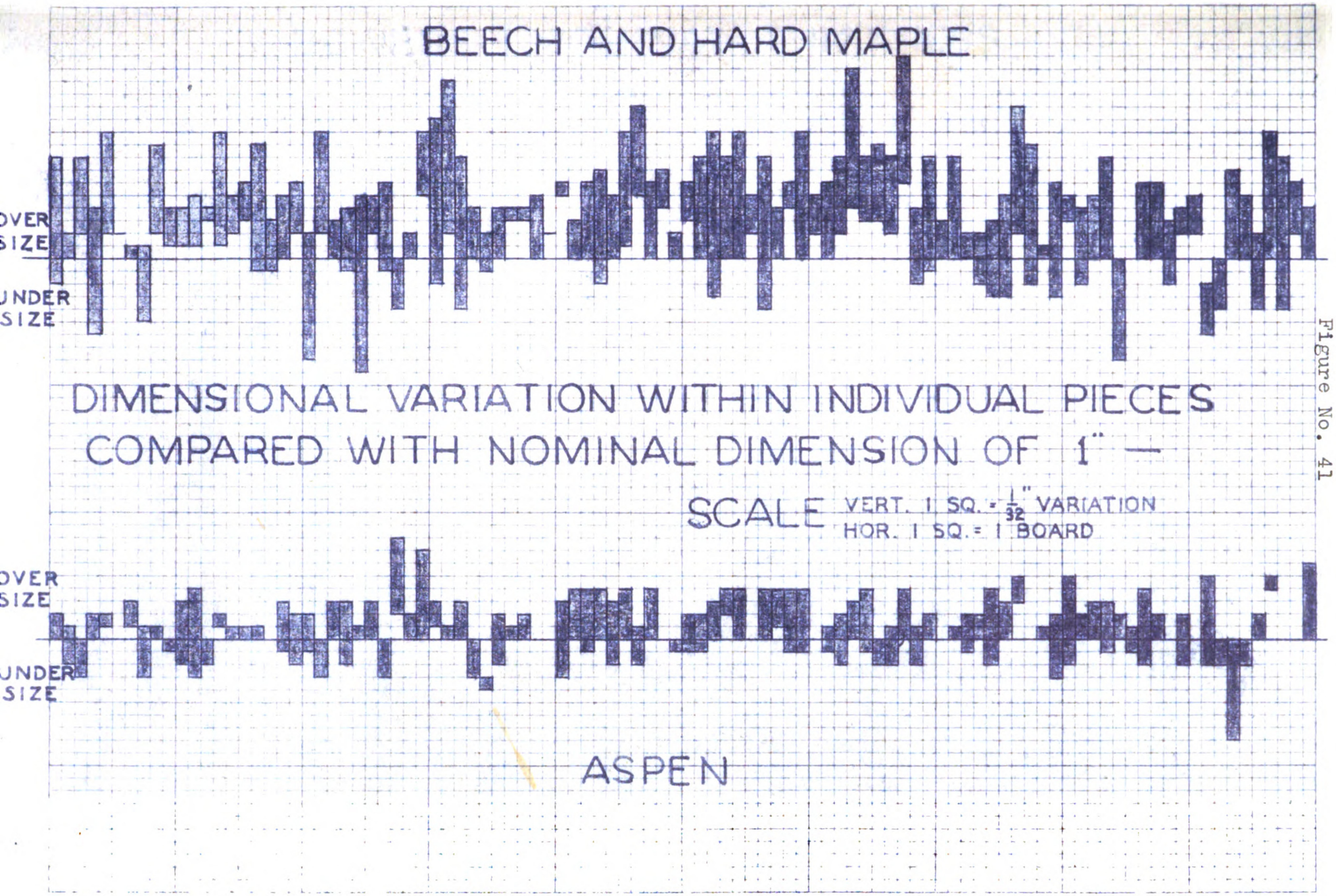

BEECH AND HARD MAPLE
OVER SIZE
UNDER SIZE
DIMENSIONAL VARIATION WITHIN INDIVIDUAL PIECES
COMPARED WITH NOMINAL DIMENSION OF 1" —
SCALE VERT. 1 SQ. = 1/32" VARIATION
HOR. 1 SQ. = 1 BOARD
OVER SIZE
UNDER SIZE
ASPEN

Figure No. 41

Figure No. 42

DIMENSIONAL VARIATION IN THICKNESS OF INDIVIDUAL BOARDS (NOMINAL THICKNESS - 1")

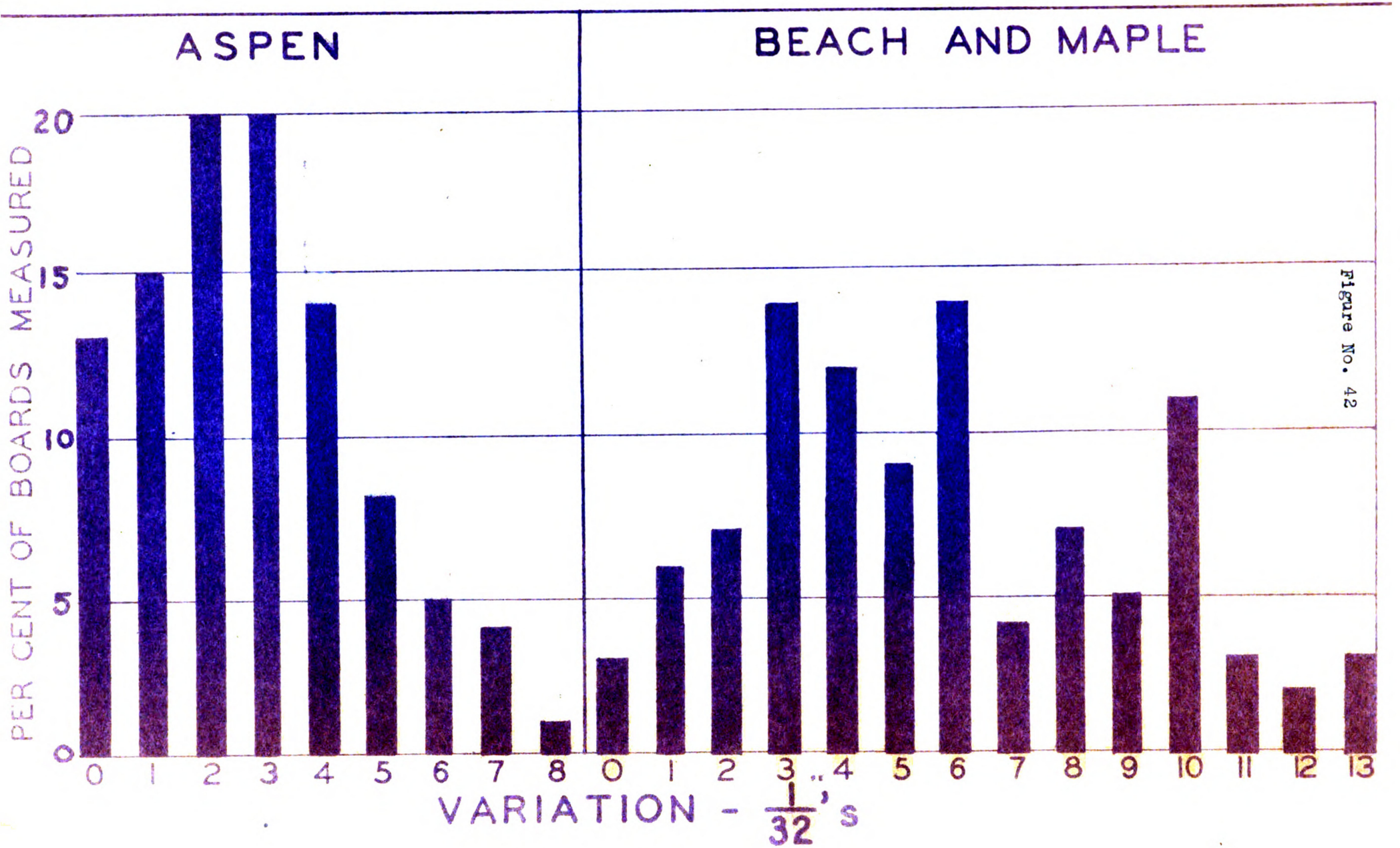
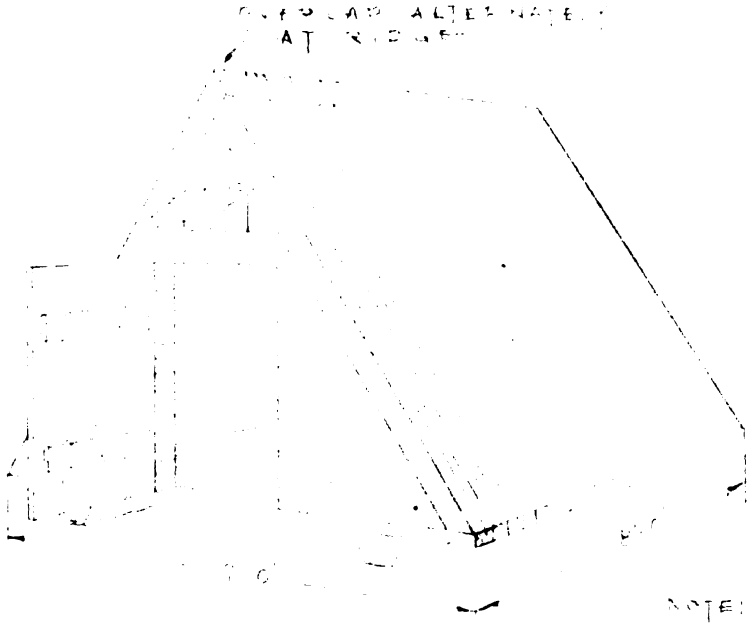
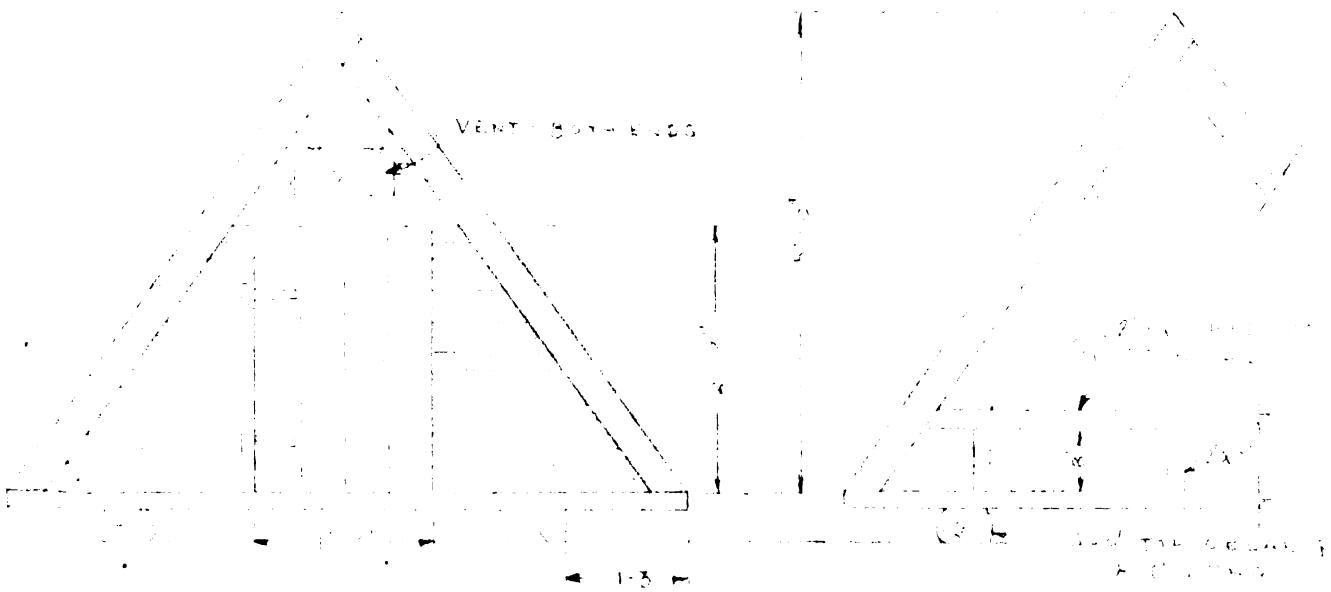
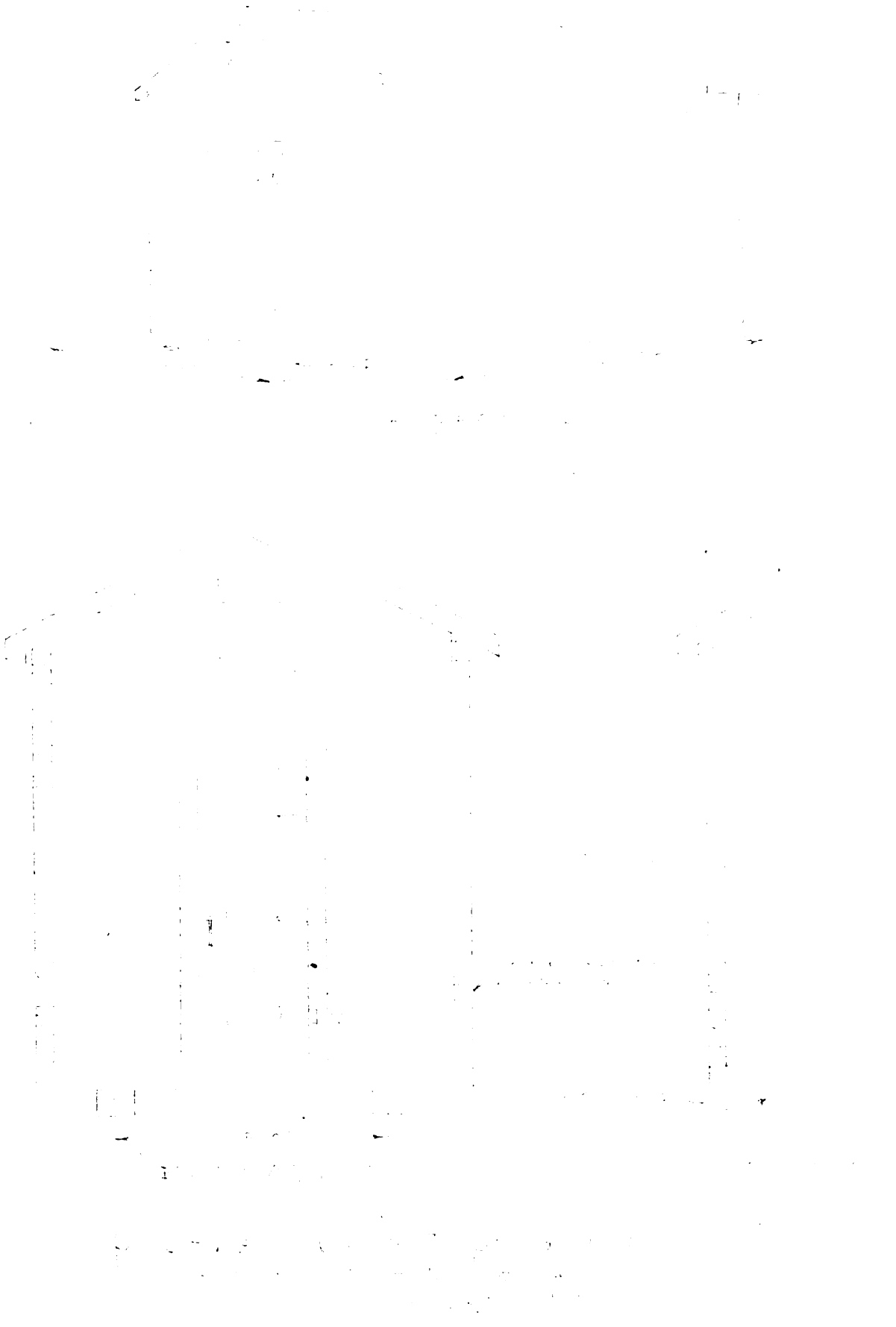


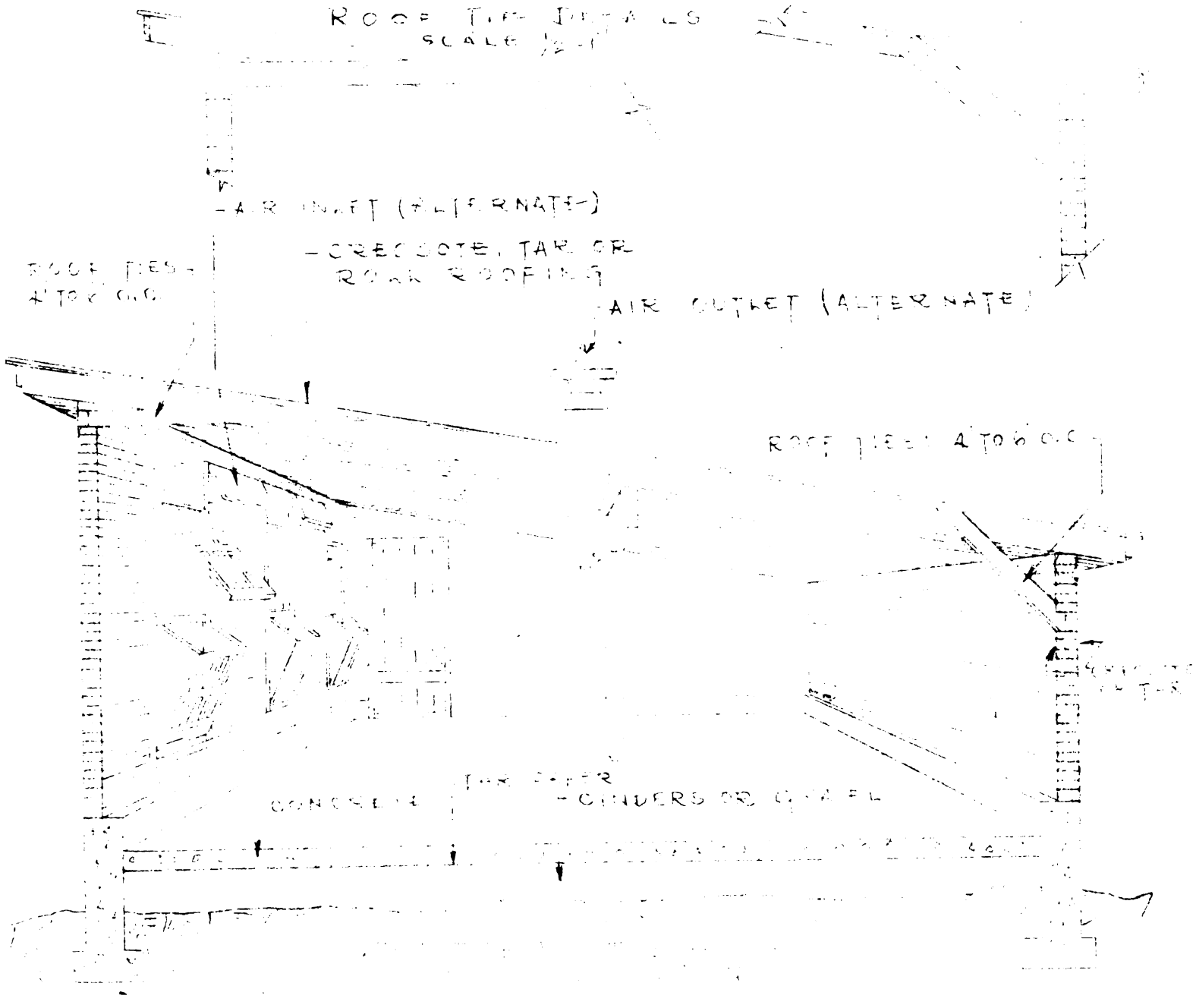
Figure No. 42

The following plans, although not specifically recommended, are included to show the adaptability of native lumber and the crib type of construction to many types and sizes of farm buildings.



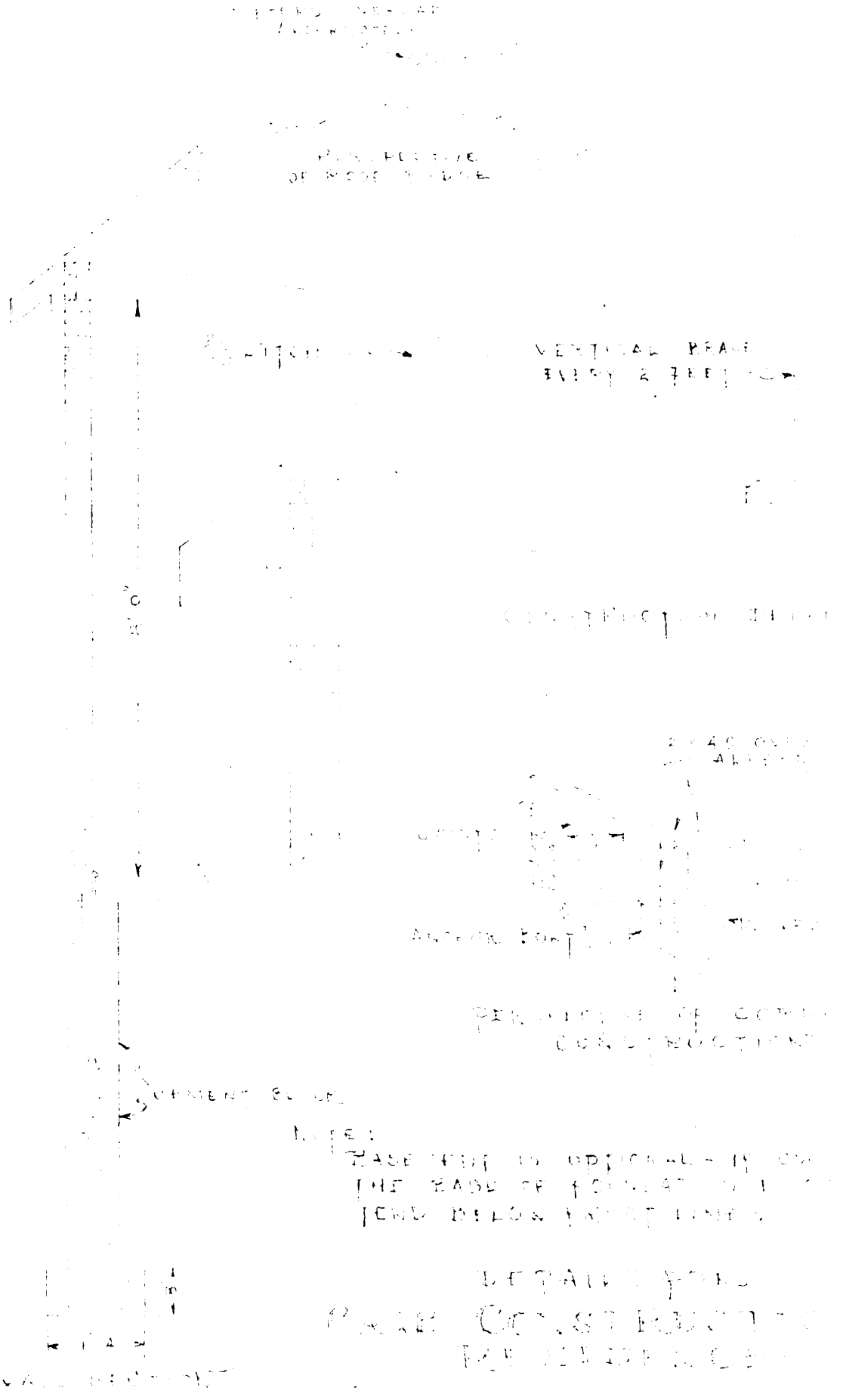

VENT

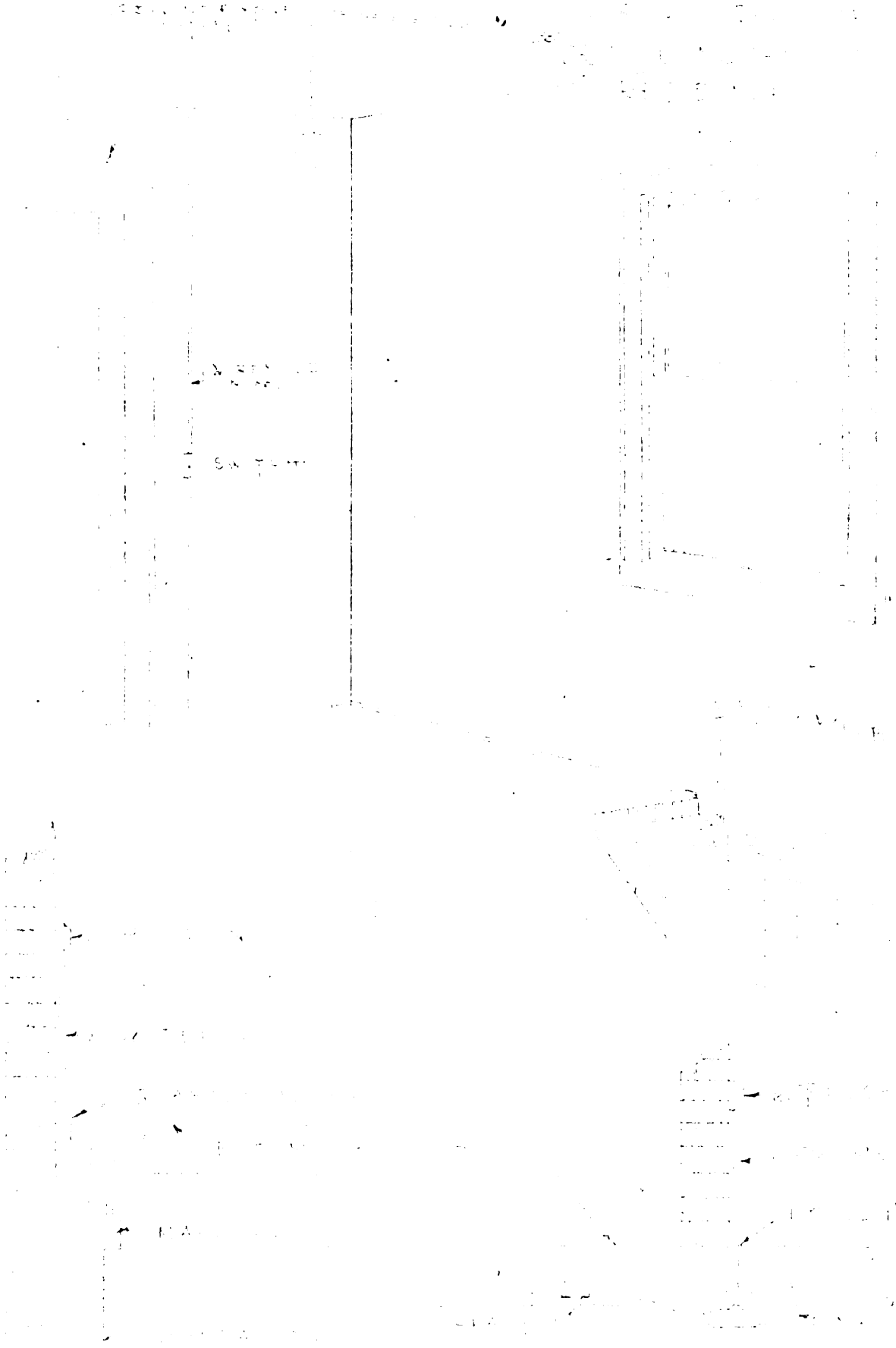



ROOF TIES
AT 6'0" O.C.
AIR INLET (ALTERNATE)
CREOSOTE, TAR OR
ROOF ROOFING
AIR OUTLET (ALTERNATE)
ROOF TIES AT 6'0" O.C.
CONCRETE
CINDERS OR GRAVEL

FLOOR PLAN

CRIB CONSTRUCTION





DIMENSIONAL VARIATION IN THE MANUFACTURE OF NATIVE LUMBER

As a result of the difficulties encountered in handling poorly manufactured native lumber, it seemed desirable to obtain additional data on the factors contributing to poor quality lumber, as a basis for making corrective suggestions.

One of the primary factors contributing to poor quality is improper sawing resulting in a large amount of off-dimension lumber. The extent of this defect in representative samples of native lumber is shown in the following tables. The data for these tables were obtained by visiting local saw mills and measuring samples of lumber produced in these mills.

Figure 39 indicates the dimensional variation within individual pieces of 2" x 4" jack pine and shows the per cent distribution of pieces with the same variation of mismanufacture regardless of actual dimension. For example, the chart shows that 24 per cent of the pieces measured varied 2/32" between their maximum and minimum thickness, but the actual dimensions of the pieces are not given.

Figure 40 shows in addition to the dimensional variation the relationship between actual dimensions and nominal dimensions as indicated by the base line which represents a thickness of two inches. For example, the first board represented by the bar at the extreme left of the chart varied in thickness from 1 29/32" to 2 2/32". The second board shows no variation. The third and fourth boards vary from 1 30/32" to 2".

Figures 41 and 42 show similar data for one inch boards of aspen, and beech and maple lumber.

It is not difficult to visualize the discrepancies which would occur in any building where such lumber is used.

The second factor contributing to poor quality lumber is careless piling. Most small saw mills, many of which are portable, do not have yard facilities nor adequate labor for properly piling the lumber as it is sawed. Therefore, most of it is improperly piled at the mill or is taken by the owners and carelessly piled as indicated in Figures 43 and 44.

Lumber properly piled is shown in Figure 45. This pile was made at the College saw mill and for convenience was piled among trees which is objectionable from the standpoint of air circulation through the pile of lumber.

Figure No. 43

Improperly piled lumber.

Figure No. 44

Unless this lumber is used soon, it will gradually deteriorate owing to stain and decay.

Figure No. 45

Properly piled lumber. Note the high, sloping foundation which permits adequate air circulation.

SUMMARY

This study has shown clearly the need for more adequate farm buildings in the cut-over area of Michigan. Most of the service buildings and many of the dwellings are so near total depreciation that they have no actual physical value, but are still standing, if somewhat precariously, and are still used for storage and shelter.

The younger farmers particularly are aware of the need for better buildings, more carefully designed to meet the needs of their type of farming and are willing to cooperate in most any way to get them. They do feel that the present prices of local building materials are too high and freely express their unwillingness to build if they have to pay these prices. In most instances, they cannot afford to buy standard materials. One farmer admitted that he might have to pitch a tent because his present house was almost unliveable and he could not afford a new one of standard construction. On the other hand, they cannot afford not to have adequate buildings. Every year losses are sustained which could be prevented and the entire community is handicapped owing to blighted moral.

For example, one farmer stored some beans in one of the typical storages found in this area and lost the entire crop valued at more than $200. A new building to house his entire grain crop could have been constructed for less than $200 by making use of native lumber on his own farm. A young, recently married couple were about ready to leave a

farm in Gladwin County. The husband was interested in farming and wanted to stay but the wife was fearful of losing their friends because she was ashamed to invite them to her "shabby" house. Perhaps a house similar to the one illustrated in this report would have solved the housing problem of these young people. Such houses when constructed of native lumber are entirely practical and would do much to keep our desirable young people on the farm and to stimulate a higher standard of living in their communities.

In addition to the need for new buildings, an extensive program for remodeling and repairing existing structures is imperative. It has been estimated that 850 board feet of lumber will be required annually on each farm in Michigan to meet this need. The demand for lumber in the cut-over area may be even greater than this estimate, owing to the fact that the farm buildings in this area have been neglected for so long.

If it was difficult for these farmers to obtain standard lumber for farm construction before the present war, their plight will be even more serious when building restrictions are lifted to prepare the way for an enormous program of post-war construction. One answer to this problem, and it seems a most logical one, is to make better use of our supply of native timber, particularly aspen and jack pine in the cut-over areas of Michigan. This study shows the volume of aspen alone is increasing at the rate of 66,250,000 board feet annually in the stands which are 25 years of age or older.

Even though a large part of the available supply of native lumber has been used to meet war requirements, as would seem reasonable, it is even more desirable to conserve and properly utilize the remainder where it can be used most economically. This would appear to be on the farms and in the rural areas where this lumber is available.

The prejudice against aspen as a building material that has consistently retarded its use may be partially overcome by the expanded utilization of this wood for war purposes. In addition to this stimulating influence, sufficient evidence has been presented here to show the desirable properties of both aspen and jack pine which alone should warrant their extended use.

However, if the use of such native lumber is to be increased fast enough to furnish any appreciable degree of relief in the anticipated post war building program, its advantages will have to be demonstrated in a more authentic manner by all interested agencies. Some consideration should be given to demonstration buildings constructed cooperatively by the Michigan State College Extension Service, the State Conservation Department, the Farm Security Administration and others, to show that the use of native lumber even of low grade is practical and to call attention to the structural details that will insure it greater durability. In this connection, it is interesting to note that the State Conservation Department offered to furnish the lumber for a number of such demonstration buildings.

In addition to encouraging farmers and local builders to properly use all species of native lumber, some effort should be made to obtain a higher quality of manufacture from small local mills. The disadvantages of using rough sawed, poorly dimensioned, warped, stained and knotty lumber should be more or less obvious to anyone whether or not he is familiar with all the details of building construction. It is difficult to persuade builders to use poor quality lumber even at a reduced price or to encourage farmers to haul their logs to a local mill that will only "butcher" them. It is equally difficult to arouse much enthusiasm on the part of local mills when the market for their products is so uncertain.

The most common defects found in locally manufactured lumber can be corrected by proper sawing promoted through an effective educational program on the same basis as suggested for promoting the proper use of native lumber. However, such programs are inadequate to insure a constant reliable source of native lumber. Additional equipment, such as edging and trimming saws, planing mills and in some cases even dry kilns will be required. Few local mill operators have sufficient capital to finance such an outlay of equipment. Although it is not in the realm of this study to make specific recommendations, it seems desirable that financial aid in some form should be available to local operators who show evidence of ability and interest in undertaking such a project. Additional studies should be made as to the most effective methods of providing this financial assistance.

The cooperative association formed in Alcona County by the Farm Security Administration for the sale of pulp wood is an effective possibility that warrants closer observation. In the report on the successful development of several forest products cooperatives in the United States, the author gives a brief summary of one.

> "Management plans are made for each woodland; farm building plans are prepared, and requirements in terms of trees are computed; trees are marked and cut on order to fill the bill for lumber; and then the lumber is seasoned and processed in the final stage for use. At the present time, 26 farm buildings are scheduled; 11 structures have been sawed out by portable mills since March 18, 1941, involving 70,000 board feet of native lumber (mostly oak and cottonwood); and five buildings are now under construction. Farmer members are delighted with the low-cost, high quality lumber which is making possible new construction and farm building repairs needed for many years." (13)

In addition to privately financed mills and cooperative associations, there is a possibility of combining small local mills with established retail lumber yards. This arrangement would seem to have certain advantages. The retail dealer through his financial interest in the mill could maintain quality lumber standards and a more constant and reliable source of supply. Some farmers would patronize the retail dealer through their contacts with the mill who might not otherwise do so. Casper Bloomer, the County Agent in Alcona County, cites several instances where farmers now have adequate buildings owing to the fact that they used native lumber for all dimension stock and by so doing saved enough to buy all the other materials, such as cement, siding, shingles, paint, hardware, electrical wiring, etc., which

they would not have been able to buy had they been forced to buy all their lumber from the retail yard.

To avoid some competition between local mill and retail yard, an arrangement could be worked out whereby the mill produced only dimension stock. Another reason for this arrangement is the difficulty of producing high quality one-inch lumber from the small logs which most local mills would be required to handle. Rather than to pile this lumber improperly and let it deteriorate, the retail yard should haul it to their yard where it could be properly piled, seasoned to use and, if necessary, re-sawed to dimension.

Lumber dealers, particularly those in the cut-over area, should realize the need for more adequate farm buildings in their communities. The dealers themselves would profit by living in a more tidy and prosperous community. They are the logical ones to promote better buildings, owing to their position as lumber dealers and servicing institutions for farm buildings. Also, they should realize that they would be increasing their own sales of supplementary lumber and other building materials such as cement, hardware, shingles and other materials of similar nature by promoting the sale of a better grade of native lumber.

SAWDUST AND PLANER SHAVINGS FOR FARM BUILDING INSULATION

The insulating value of dry sawdust or dry planer shavings has long been recognized and it compares favorably with commercial insulating materials. From unpublished

data compiled by the Forest Products Laboratory, the use of these materials might well be increased.

The primary consideration is to obtain dry material and use it in such a way that it will remain dry. It is not the intention here to propose that sawdust or shavings be substituted for commercial insulation in all cases even in this cut-over area where low cost housing is being promoted. However, there are numerous buildings including the house, vegetable storages and livestock buildings that need additional insulation and it seems logical to suggest that local materials be used wherever practical.

Interest in sawdust concrete is maintained by periodical reference to its merits as a lightweight concrete for the floors of livestock buildings, particularly for poultry houses. If the right kind of sawdust is used, it is possible to make a lightweight concrete having considerable strength. Samples of this material have been observed in small blocks which appeared to have possibilities as a wallboard. Its use is mentioned here because previous investigations have shown that jack pine and aspen sawdust are among the few types that can be satisfactorily used in sawdust concrete.

In most sections of the cut-over area it is difficult to obtain adequate supplies of straw for bedding farm animals. In these areas it is possible to use sawdust and shavings as a satisfactory substitute.

The above suggestions for using sawdust and shavings apply particularly to the small mills where the supply of these materials would not be commercially important. For

larger mills the expanding wood plastics and related industries might be a more profitable market.

THE USE OF SMALL DIMENSION TIMBER, EDGINGS AND TRIMMINGS

It is usually unprofitable to saw small dimension logs into dimension lumber, but it might be profitable to saw such logs into stock that could be resawed into slats for crates and boxes. Additional material for this purpose might be salvaged from the edgings and trimmings.

To supplement the manufacture of crates and boxes for which there is only a seasonal demand, the small logs and salvaged stock could be converted into woodenware, rustic furniture and novelties.

There are at the present time many such small industries in the cut-over area that furnish part-time employment for the local farmers and others.

FENCE POSTS AND FIREWOOD

In addition to the actual by-products of the sawmill for which suitable markets could be developed, there are timberland by-products which should be harvested to make way for more desirable young growth in some stands and for good woodlot management in others.

Where there are suitable stands of cedar or some desirable hardwoods, the sale of fence posts should be encouraged. One of the reasons for retarded livestock development in some cut-over lands is the absence of suitable fences. It might even be practical to install inexpen-

sive equipment for treating of nondurable woods to increase the life of fence posts cut from them.

In every timber stand there are crooked, multiple-branched trees that might better be converted into firewood or cut into bolts for pulp wood or excelsior. In addition to such trees, there are large limbs and the slabs from saw logs that can be and usually are converted into firewood.

The most discouraging angle is that little attempt is made to market these forest products in an orderly and profitable manner. But, the development of such markets for all timberland and sawmill by-products is as much a part of the problem of promoting the use of native lumber as the establishment of markets for the sale of the lumber itself.

CONCLUSION

1. There is a definite need for more adequate farm buildings in the cut-over area of Michigan. The investment in buildings on farms in this area is shown in Figure 8. The depreciation on this investment for a typical county such as Midland amounts to approximately $150,000. Yet, during the years preceding World War II, the money spent on farm buildings was insufficient to pay for this depreciation as indicated in Tables No. VI and No. VII.

2. Personal interviews with farmers, county agricultural agents and farm security administrators leave one with the impression that this delay in farm building improvement may be contributed partially to the high cost of lumber imported from other states. For the report on these personal interviews, see pages 47 to 66.

3. That native lumber, and particularly aspen lumber, can be and is being used by the farmers of the cut-over area for their buildings is amply demonstrated by photographic and other data collected during this study. Invariably the cost of these buildings is below the estimated cost of similar buildings erected with lumber obtained from the usual source.

4. The physical properties of aspen as discussed in this report (Pages 38 to 46) indicate that it is satisfactory for most farm building purposes. Present indications are that aspen will last for thirty years if used for such purposes as framing lumber, siding, sheathing, rafters, roof boards or

for other purposes where it is not subject to moisture.

5. Aspen timber is available to farmers in Michigan and discrimination against this readily available native wood as a source of potential lumber will decrease with expanded use for building purposes.

6. State and Federal Governments are anxious to find a market for the continually increasing volume of aspen which is reaching maturity and marketable age each year in state and national forests. The Michigan Department of Conservation expressed a particular desire to cooperate with farmers in the cut-over area to promote the use of aspen lumber for farm building construction.

7. The quality of locally sawed native lumber must be improved if it is to compete successfully with commercially produced lumber. The typically poor quality of native sawed lumber is indicated by the dimensional variations in 2" x 4" stock and one-inch boards shown in Figures 39 to 42. Several lumber dealers in the cut-over area rather grudgingly admitted that they would handle native lumber in their yards if the quality of this lumber was materially improved.

8. Additional studies are needed to: (1) encourage the production of better quality native lumber by improved methods of sawing and handling of this lumber, (2) develop methods of construction adapted to the use of native lumber.

9. The building industry of the entire nation is now engaged in trying to promote a program for farm building improvement. The use of native material and particularly aspen seems to fit definitely into this program.

COMMON AND SCIENTIFIC NAMES OF TREES
NATIVE TO MICHIGAN WITH SUGGESTED USES

SPECIES	SUGGESTED USE IN FARM BUILDING CONSTRUCTION
Ash, black (Fraxinus nigra)	Studs, interior finish
Ash, white (Fraxinus americana)	Framing
Aspen, popple (Populus tremuloides)	Sheathing
Balm of Gilead (Populus balsamifera)	Sheathing
Balsam (Abies balsamea)	Sheathing
Basswood (Tilia glabra)	Siding, sheathing, trim, cupboards
Beech (Fagus grandifolia)	Flooring, framing
Birch, yellow (Betula lutea)	Studs, sheathing, flooring
Butternut (Juglans cinerea)	Finish, sheathing
Cedar, white (Thuja occidentalis)	Shingles, siding, silos
Cherry, black (Prunus serotina)	Finish, sheathing
Cottonwood (Populus deltoides)	Sheathing
Elm, rock (Ulmus racemosa)	Stall flooring, framing
Elm, slippery (Ulmus fulva)	Sheathing, framing
Elm, American (Ulmus americana)	Sheathing, framing
Hemlock (Tsuga canadensis)	Sheathing, framing
Hickory (Hicoria spp.)	Sheathing, framing
Locust, black (Robinia pseudoacacia)	Sills, stalls

COMMON AND SCIENTIFIC NAMES OF TREES
NATIVE TO MICHIGAN WITH SUGGESTED USES (CONTINUED)

SPECIES	SUGGESTED USE IN FARM BUILDING CONSTRUCTION
Maple, hard (Acer saccharum)	Floors, finish
Maple, soft (Acer rubra)	Sheathing, framing
Oak, red (Quercus borealis)	Floors, sheathing, framing
Oak, white (Quercus alba)	Sills, trough, joists, floors. stall floors, finish
Pine, jack (Pinus banksiana)	Framing, sheathing, siding
Pine, red, Norway (Pinus resinosa)	Sheathing, framing, sash, doors, silos
Pine, white (Pinus strobus)	Siding, sheathing, sash, doors, silos, framing
Spruce, white (Picea glauca)	Sheathing, studs, framing
Sycamore (Platanus occidentalis)	Framing, sheathing
Tamrack, (Larix laricina)	Sheathing, silos, cabin logs
Walnut, black (Juglans nigra)	Finish
Willow, (Salix nigra)	Siding, sheathing, finish
Yellow poplar (Liriodendron tulipifera)	Siding, sheathing, finish

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