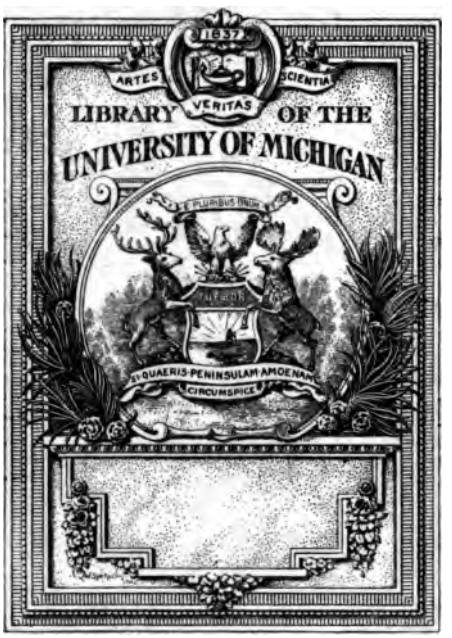


WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY
E. A. BIRGE, Director W. O. HOTCHKISS, State Geologist

BULLETIN NO. XXVI EDUCATIONAL SERIES NO. 8

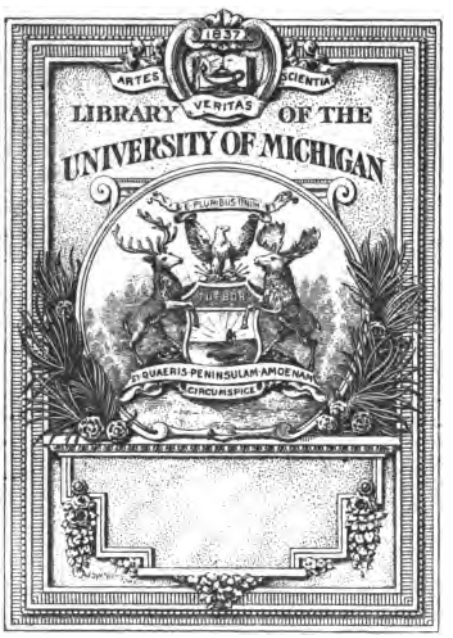
THE GEOGRAPHY AND INDUSTRIES OF WISCONSIN

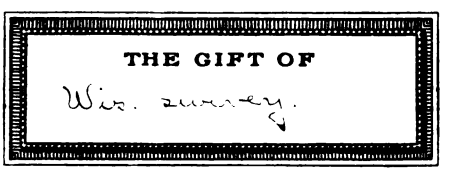
BY

RAY HUGHES WHITBECK,

Associate Professor of Physiography and Geography
University of Wisconsin

MADISON, WIS.
PUBLISHED BY THE STATE
1913





WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY
E. A. BIRGE, Director W. O. HOTCHKISS, State Geologist

BULLETIN NO. XXVI EDUCATIONAL SERIES NO. 8

THE GEOGRAPHY AND INDUSTRIES OF WISCONSIN

BY

RAY HUGHES WHITBECK,

Associate Professor of Physiography and Geography
University of Wisconsin

MADISON, WIS.
PUBLISHED BY THE STATE
1913

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY
E. A. BIRGE, Director W. O. HOTCHKISS, State Geologist

BULLETIN NO. XXVI EDUCATIONAL SERIES NO. 8

THE GEOGRAPHY AND INDUSTRIES OF WISCONSIN

BY

RAY HUGHES WHITBECK,
Associate Professor of Physiography and Geography
University of Wisconsin

MADISON, WIS.
PUBLISHED BY THE STATE
1913

Wisconsin Geological and Natural History Survey

BOARD OF COMMISSIONERS

FRANCIS E. McGOVERN
Governor of the State.
CHARLES R. VAN HISE, *President*
President of the University of Wisconsin.
CHARLES P. CARY, *Vice-President*
State Superintendent of Public Instruction.
JABE ALFORD
President of the Commissioners of Fisheries.
DANA C. MUNRO, *Secretary*
President of the Wisconsin Academy of Sciences, Arts, and Letters.

STAFF OF THE SURVEY

ADMINISTRATION:
EDWARD A. BIRGE, Director and Superintendent. In immediate charge of Natural History Division
WILLIAM O. HOTCHKISS, State Geologist. In immediate charge of Geology.
LILLIAN M. VEERHUSEN, Clerk.

GEOLOGY DIVISION:
WILLIAM O. HOTCHKISS, in charge Geology.
SAMUEL WEIDMAN, in charge Areal Geology.
T. C. CHAMBERLIN, Consulting Geologist, Pleistocene Geology.
R. H. WHITBECK, Assistant, Geography & Industries.
LAWRENCE MARTIN, Assistant, Physical Geography.
VERNOR C. FINCH, Assistant, Geography & History.
EDWARD STEIDTMANN, Assistant, Limestones.
RALPH E. DAVIS, Assistant, Report on Mine Costs.

NATURAL HISTORY DIVISION:
EDWARD A. BIRGE. In charge.
CHAUNCEY JUDAY, Lake Survey.
WILLARD G. CRAWFORD, Chemist.
H. A. SCHUETTE, Chemist.
W. R. BOORMAN, Assistant, Lakes.
L. G. STECK, Assistant, Lakes.

WATER POWER DIVISION:
LEONARD S. SMITH, Engineer. In charge.

DIVISION OF SOILS:
ANDREW R. WHITSON. In charge.
WARREN J. GEIB, Assistant to Mr. Whitson.
GUY CONREY, Chemist.
FRED L. MUSBACK, Field Assistant and Analyst.
THEODORE J. DUNNEWALD, Field Assistant and Analyst.
EDWARD J. GRAUL, Analyst.
CARL THOMPSON, Field Assistant.
OYVIND J. NOER, Field Assistant.
ALFRED BUSER, Field Assistant.

TABLE OF CONTENTS

PREFACE

This bulletin, dealing with the industrial geography of Wisconsin, is designed primarily for use in the schools of the state. Modern ideals of geography require that the important facts be traced back to their causes and forward to their consequences, and this ideal has been kept constantly in mind. While the bulletin is informational rather than scientific in character, a cause-to-effect method of treatment has been followed, and it is hoped that teachers who use the bulletin will lay the stress upon causal relations rather than upon details.

In many schools it is customary to lay some emphasis on the geography of the home states because of its interest and practical usefulness, and also because of its educational value as a Regional Type Study. In connection with this study of the home state there should be a first-hand study of the home locality, including the physiography, climate, resources, industries, and transportation facilities.

In preparing this bulletin an earnest effort has been made to secure reliable information, and so far as possible only statistics from official sources have been used, but even these are not free from errors. Some of these errors have been discovered and corrected; doubtless some others have escaped.

In so brief a treatise, all of the industries of the state could not be touched upon; therefore only main lines of industrial activity and some typical examples are discussed.

Acknowledgment is due to a number of state officials, members of the University faculty, manufacturers and others, from whom courtesies have been received, and by whom photographs have been furnished.

R. H. WHITBECK.

Madison,
June 1, 1913.

PREFACE

This bulletin, dealing with the industrial geography of Wisconsin, is designed primarily for use in the schools of the state. Modern ideals of geography require that the important facts be traced back to their causes and forward to their consequences, and this ideal has been kept constantly in mind. While the bulletin is informational rather than scientific in character, a cause-to-effect method of treatment has been followed, and it is hoped that teachers who use the bulletin will lay the stress upon causal relations rather than upon details.

In many schools it is customary to lay some emphasis on the geography of the home states because of its interest and practical usefulness, and also because of its educational value as a Regional Type Study. In connection with this study of the home state there should be a first-hand study of the home locality, including the physiography, climate, resources, industries, and transportation facilities.

In preparing this bulletin an earnest effort has been made to secure reliable information, and so far as possible only statistics from official sources have been used, but even these are not free from errors. Some of these errors have been discovered and corrected; doubtless some others have escaped.

In so brief a treatise, all of the industries of the state could not be touched upon; therefore only main lines of industrial activity and some typical examples are discussed.

Acknowledgment is due to a number of state officials, members of the University faculty, manufacturers and others, from whom courtesies have been received, and by whom photographs have been furnished.

R. H. WHITBECK.

Madison,
June 1, 1913.

RELIEF MAP OF WISCONSIN.

Made by Geological and Natural History Survey.

GEOGRAPHY AND INDUSTRIES OF WISCONSIN

CHAPTER I

INTRODUCTION

It is a matter of common observation that most of the industries which are extensively carried on in any region are dependent to a degree, at least, upon the climate, or the natural resources, or the topography, or the situation, coupled with the stage of development, of the region in which they exist. Men who live by the sea tend to become fishermen and sailors. People who live on semi-arid lands raise flocks of sheep and goats and herds of cattle; they lead a pastoral and perhaps a nomadic life. Fertile soil leads to farming, forests to lumbering, and minerals to mining. Texas grows cotton; California, oranges; Iowa, corn; Kentucky, tobacco, and Maine, potatoes, because conditions of soil and climate make the growing of these crops profitable. The ever increasing needs of a people advancing in numbers and in wealth call for manufacturing. As manufacturing develops it becomes evident that certain regions possess advantages for carrying on particular lines of manufacturing; Pennsylvania, for example, with its vast coal fields is found to be especially well suited to making iron and steel, Illinois to making farm machinery, Minnesota to grinding wheat, and Washington to producing lumber. In each state manufacturing is related to the state's natural resources, or its climate, its situation, or its topography, or all of these.

The same principle applies to the parts of a state. Certain parts of Wisconsin produce much butter and cheese; others, tobacco, and still others, potatoes. One city specializes in the

manufacture of paper, another in the smelting of lead and zinc, and another in the making of farm machinery. In each of these places there are favoring conditions which have led to the building up of these industries. On the other hand, there are some industries which, under good management, thrive in almost any city. It is often puzzling to know why certain manu-

Fig. 1. Sketch showing the relative areas of Texas, Wisconsin, and New Jersey.

factories exist in the places where they are found, for there seems to be no natural reason why they should be there.

This does not mean that men are actually controlled in their enterprises by their physical environment; man is a resourceful being and he sometimes accomplishes things in spite of an unfavoring environment. More commonly, however, he sees that it is better to work in harmony with natural conditions than to disregard them. Therefore, men build paper and pulp-mills near forests; they engage in dairying where grass and

forage crops thrive, and they raise potatoes and rye on sandy soils.

A state is seldom a natural geographic unit. Parts of its boundaries are, as a rule, merely surveyor's lines. The same geographical conditions which are found in southern Wisconsin are also found in northern Illinois. There is no sudden change as one crosses the boundary from Iowa to Minnesota, yet one is classed as a corn state and the other as a wheat state.

Among the older states of the East, where industrial growth has proceeded farther than it has in the West, certain geographical influences are seen to have effectively directed their development. The negative influence of a *thin soil* and the positive influence of *abundant water power* slowly led the people of New England away from general farming and toward manufacturing. Of course there were other causes. New York's *physiography* was, of all the eastern states, most favorable to the building of a canal which should connect the Atlantic Ocean and the Great Lakes, and the building of the Erie Canal turned the commerce of half the nation through that state. Manufacturing in Pennsylvania has been wonderfully stimulated by the state's *mineral wealth*. New Jersey, one of the smallest states, ranks among the first five in manufacturing, due very largely to an exceptionally *favorable position*. So it is that water power in New England, physiography in New York, minerals in Pennsylvania, and situation in the case of New Jersey, have exerted a directing influence upon the development of these states.

In a relatively young state like Wisconsin, industries have not reached a permanent adjustment, and the northern and southern halves of the state are in quite different stages. From the first settlement to the present the industries have been expanding in variety and in volume and the expansion is still going on. The first settlers in Wisconsin very generally found forests covering the ground. The hunting and trapping of animals for their furs was naturally a leading pioneer industry, and several of the most important trading posts of the Northwest were within the present boundaries of the state. About 1850 began the rapid growth of the great lumbering industry. In the southern half of the state, agriculture and dairying

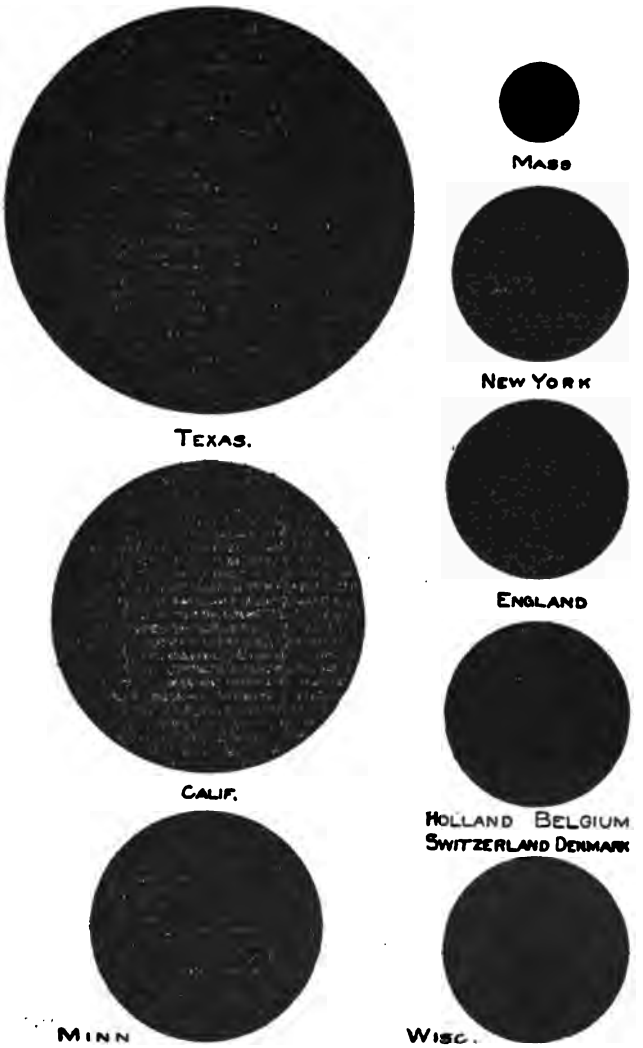


Fig. 2. The areas of these circles are in proportion to the areas of the states or countries named. Note that the area of Wisconsin exceeds that of Holland, Belgium, Switzerland and Denmark combined.

quickly followed. Today (1912) Wisconsin is the home of nearly two and a half million people. Its farm property is valued at about one and a half billion dollars,—enough to pay the national debt of the United States and build the Panama Canal in addition. Its forests are still producing tens of millions of dollars worth of lumber a year. Its mines and quarries yield nearly $20,000,000 annually. Over 8000 miles of railroads are in operation, and its manufactures in 1909 were valued at nearly $600,000,000. Every year the value of Wisconsin's milk and milk products about equals that of the gold produced in the whole United States.

CAUSES UNDERLYING INDUSTRIAL GROWTH

The causes which underlie the industrial development of a state fall into two classes which may be termed the *geographic,* or *natural,* and the *non geographic,* or *human.*

Some of these natural influences are:

1. THE CLIMATE,—mild or severe, damp or dry, variable or equable.
2. THE CHARACTER OF THE SURFACE,—level or rolling, hilly or mountainous.
3. THE QUALITY OF THE SOIL,—sandy, loamy, stony, swampy, fertile or sterile.
4. THE PRESENCE OR ABSENCE OF FORESTS.
5. THE NEARNESS OF IMPORTANT MARKETS, usually large cities.
6. THE PRESENCE OF VALUABLE MINERALS AND ORES.
7. THE AVAILABILITY OF WATER POWERS OR OF CHEAP FUEL.
8. THE EXISTENCE OF EASY TRAFFIC ROUTES either by land or water, giving cheap transportation of products to markets.

Besides these natural influences, there are others which have no direct connection with the physical geography of the region —conditions which are brought about by man or arise from what man does. These may be called *non-geographic,* or *human, influences.* For example, the forests of Wisconsin led to the great lumbering industry: the cutting of the forests caused a decline in the amount of lumber which was cut and led to more refined forms of wood working, such as the making of doors, blinds, sash and furniture. There was a geographical reason why lumbering was a great industry. The decline of lumbering and the change

to a different type of wood-working was due to causes for which man is responsible.

Again, the building of a railroad usually exerts a stimulating

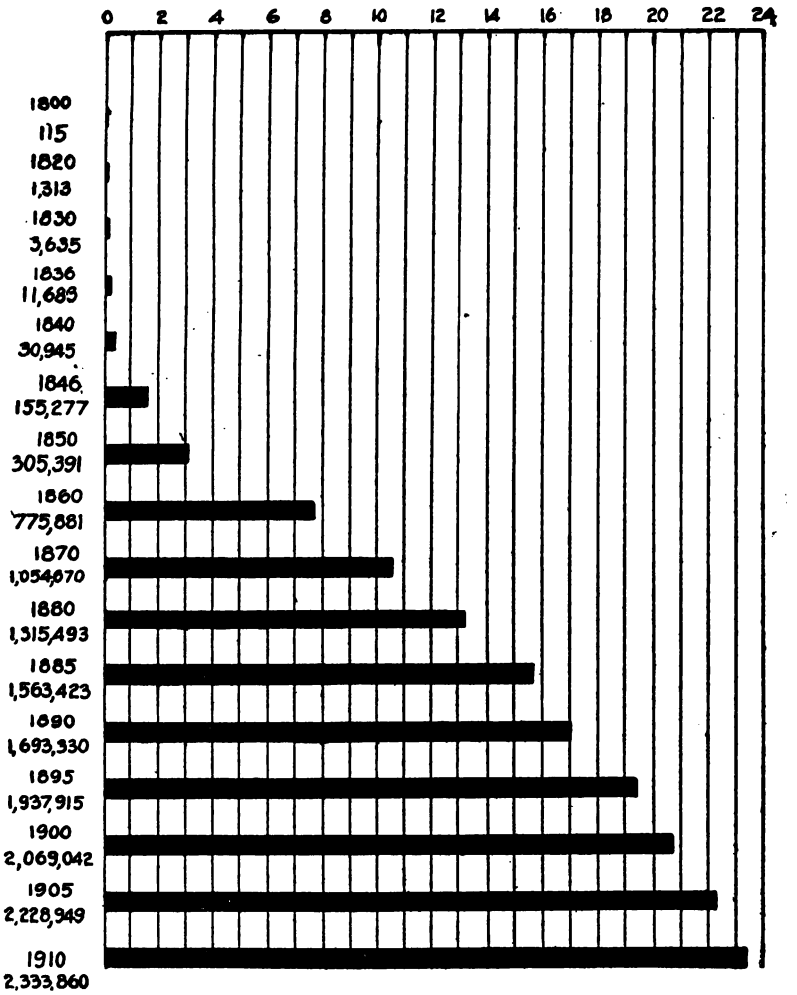


Fig. 3. Diagram showing Wisconsin's growth in population from 1800 to 1910.

influence upon the growth of industries along its route. Geographical conditions largely influence the engineers in deciding where a line shall go, but man is responsible for the final building of the road.

The state may put a bounty on the raising of sugar beets and stimulate the industry, or the government may make tariff laws which encourage certain industries. These are illustrations of non-geographic influences. Natural conditions may make an industry possible in a certain locality, but of course it is man who determines whether or not it shall be built up.

Furthermore, *the stage of development* in which a region is, at any given period, greatly influences the character of its industries. At one stage hunting and trapping are leading occupations; later, lumbering, and then agriculture and manufacturing. During these changes the climate, soil, physiography, mineral resources and geographical position of the state have not changed, but the industries have changed because of changing stage.

The industries at any given time depend

1. Upon the stage of development in which the region is at any time.
2. Upon the various natural conditions which prevail.
3. Upon what has been called "The purposeful activities of man."

Briefly stated, the chief natural conditions which have been influential in the industrial development of Wisconsin are:

1. *Its northerly position* and the consequent effect upon climate, crops and settlement.
2. *The geological formations* or the character of the bed rock and the consequent effect upon soil and topography.
3. *The natural resources*—such as soil, minerals, forests and water powers.
4. *Its situation* on the Mississippi River and Lakes Superior and Michigan, particularly the last.
5. *Its position* between Chicago and the Northwest.
6. *The regular topography of the land* and the favorable effect of this upon agriculture and transportation.
7. *The dense forests* and their retarding effect upon the agricultural development of Northern Wisconsin.

Each of these conditions has played some part—usually a decidedly important part—in the growth of Wisconsin's industries. What the part has been, we shall see as we progress.

CHAPTER II

MINERAL INDUSTRIES

While the mineral industries of Wisconsin are varied, and the output runs as high as $20,000,000 a year, yet the state does not rank high as a mineral producer; less than one per cent of the nation's mineral output is produced in Wisconsin. The value of the mineral products falls far below that of farm products, forest products or factory products. Pennsylvania easily outranks all other states in the value of its minerals, chiefly because of its wonderful coal deposits. If we look for the reasons why certain states have great mineral wealth, we shall find that, as a rule, at least one of the three following conditions exists:

1. The state is mountainous. The depositing of metallic minerals quite commonly, though not invariably, accompanies mountain-building. Examples of these are California and Colorado, rich in the precious metals; or

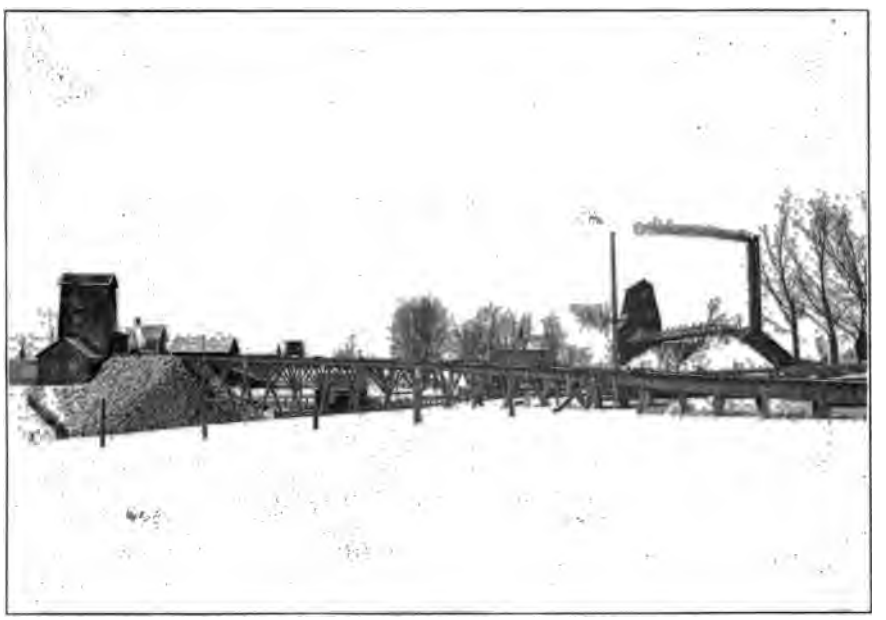
2. The state is underlain by rocks of medium age, rocks deposited during some of the great coal-forming periods; Pennsylvania and Illinois are examples; or

3. The state contains rocks of very great age; such states, for example, are Minnesota and northern Michigan, the richest of the states in iron ores.

These are not the only conditions under which minerals are formed; the lead and zinc deposits of southwestern Wisconsin, for example, are an exception.

Wisconsin is not now a mountainous state, though it was far back in the early geological ages. The underlying rocks of the state are old, and were all deposited before the coal-forming periods, so we cannot expect to find coal in Wisconsin. While the state does have a large area of extremely ancient rocks, including formations which are frequently found to contain rich

A. IRON MINE NEAR HURLEY, IRON COUNTY.



B. THE EMPIRE ZINC MINE AT PLATTEVILLE, GRANT COUNTY.

deposits of iron ore, yet when the northern boundaries of the state were fixed, it happened that what are now the most valuable iron ore beds, then unknown, fell to Minnesota and Michigan. Nevertheless, the mineral industries are of importance in portions of the state; for example, they played a large part in the development of the southwestern section, and present and future development of iron deposits in the northern part is likely to have an important influence in settling up that region.

The chief mineral industries are:

1. The mining of ores, such as iron, zinc, and lead.
2. The quarrying of stone, such as granite, sandstone, and limestone.
3. The digging of clay for making brick, tile, etc.
4. The bottling and sale of mineral waters.

IRON MINING

The presence of metallic ores in the rocks arises from both the character and composition of those rocks and the geological

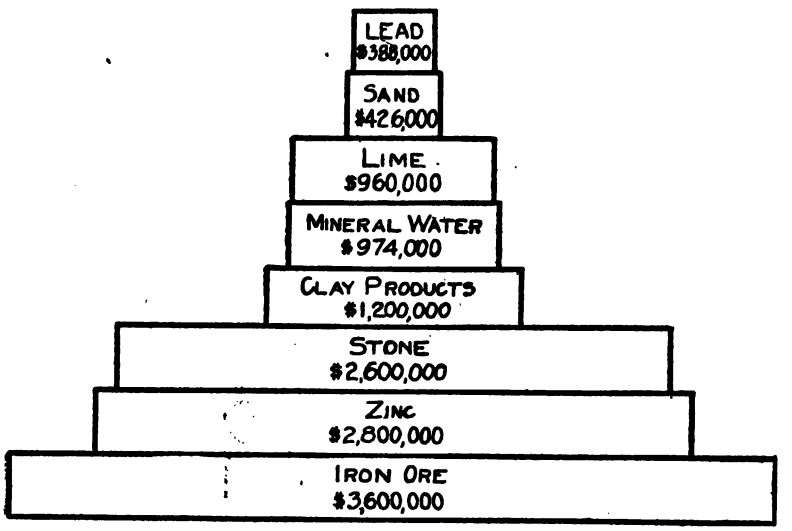


Fig. 4. Diagram showing the relative value of the chief mineral products of Wisconsin in 1910.

experience through which they have passed. Iron, for example, is found in minute quantities in nearly all rocks. In some igneous rocks it forms as high as six to ten per cent. Iron

gives the yellow, brown and reddish colors to soils, and it causes the rust-colored stain on rocks which have been exposed to the weather. In fact, the rocks, the soil and the underground water all contain iron. At times in the past, conditions have been right for the slow accumulation of this iron in beds, and for its further concentration through the work of underground water in carrying away other parts of the rocks until an ore is left in which iron makes up 50 to 70 per cent of the weight.

The region about Lake Superior produces more than three-fourths of the iron ore mined in the United States. The ore is not uniformly distributed through the rocks but is concentrated in certain districts called *Ranges*. At present the Mesabi Range in Minnesota is the greatest producer, yielding over 50% of the iron ore mined in the United States. Two of the ranges extend into Wisconsin, though the richer part of each is in the Upper Peninsula of Michigan. The Wisconsin portion of the Penokee-Gogebic Range is in Iron County, and a little of the Menominee Range extends from Michigan across the state line into Florence County.

From three to four million dollars' worth of iron ore is taken from Wisconsin mines annually, the major part coming from Iron County. This goes to Ashland, whence most of it is taken east by the lake steamers; some of it, however, is smelted at Ashland. Besides the ores mined from the ancient rocks of the north and from the Baraboo Range in Sauk County, a variable amount, averaging about 100,000 tons a year, is produced from two mines in younger rocks at Iron Ridge in Dodge County.

Among the states, Wisconsin ranks fifth in the value of iron ore produced (Minn., Mich., Ala., New York, Wis.). Smelting, or the separation of the metallic iron from the rock in which it occurs, is done by heating the ore. Coal, coke or charcoal is used for fuel. Coke, made from coal, is most largely employed. As Wisconsin has no coal beds, it is at a disadvantage in the smelting of iron ores, and comparatively little smelting is done. The earlier furnaces in Dodge County and elsewhere used charcoal, for wood was then abundant and cheap in Wisconsin. A smelter in Ashland now uses charcoal. Furnaces at Milwaukee and Mayville use coke. Although Wiscon-

gives the yellow, brown and reddish colors to soils, and it causes the rust-colored stain on rocks which have been exposed to the weather. In fact, the rocks, the soil and the underground water all contain iron. At times in the past, conditions have been right for the slow accumulation of this iron in beds, and for its further concentration through the work of underground water in carrying away other parts of the rocks until an ore is left in which iron makes up 50 to 70 per cent of the weight.

The region about Lake Superior produces more than three-fourths of the iron ore mined in the United States. The ore is not uniformly distributed through the rocks but is concentrated in certain districts called *Ranges*. At present the Mesabi Range in Minnesota is the greatest producer, yielding over 50% of the iron ore mined in the United States. Two of the ranges extend into Wisconsin, though the richer part of each is in the Upper Peninsula of Michigan. The Wisconsin portion of the Penokee-Gogebic Range is in Iron County, and a little of the Menominee Range extends from Michigan across the state line into Florence County.

From three to four million dollars' worth of iron ore is taken from Wisconsin mines annually, the major part coming from Iron County. This goes to Ashland, whence most of it is taken east by the lake steamers; some of it, however, is smelted at Ashland. Besides the ores mined from the ancient rocks of the north and from the Baraboo Range in Sauk County, a variable amount, averaging about 100,000 tons a year, is produced from two mines in younger rocks at Iron Ridge in Dodge County.

Among the states, Wisconsin ranks fifth in the value of iron ore produced (Minn., Mich., Ala., New York, Wis.). Smelting, or the separation of the metallic iron from the rock in which it occurs, is done by heating the ore. Coal, coke or charcoal is used for fuel. Coke, made from coal, is most largely employed. As Wisconsin has no coal beds, it is at a disadvantage in the smelting of iron ores, and comparatively little smelting is done. The earlier furnaces in Dodge County and elsewhere used charcoal, for wood was then abundant and cheap in Wisconsin. A smelter in Ashland now uses charcoal. Furnaces at Milwaukee and Mayville use coke. Although Wiscon-

gives the yellow, brown and reddish colors to soils, and it causes the rust-colored stain on rocks which have been exposed to the weather. In fact, the rocks, the soil and the underground water all contain iron. At times in the past, conditions have been right for the slow accumulation of this iron in beds, and for its further concentration through the work of underground water in carrying away other parts of the rocks until an ore is left in which iron makes up 50 to 70 per cent of the weight.

The region about Lake Superior produces more than three-fourths of the iron ore mined in the United States. The ore is not uniformly distributed through the rocks but is concentrated in certain districts called *Ranges*. At present the Mesabi Range in Minnesota is the greatest producer, yielding over 50% of the iron ore mined in the United States. Two of the ranges extend into Wisconsin, though the richer part of each is in the Upper Peninsula of Michigan. The Wisconsin portion of the Penokee-Gogebic Range is in Iron County, and a little of the Menominee Range extends from Michigan across the state line into Florence County.

From three to four million dollars' worth of iron ore is taken from Wisconsin mines annually, the major part coming from Iron County. This goes to Ashland, whence most of it is taken east by the lake steamers; some of it, however, is smelted at Ashland. Besides the ores mined from the ancient rocks of the north and from the Baraboo Range in Sauk County, a variable amount, averaging about 100,000 tons a year, is produced from two mines in younger rocks at Iron Ridge in Dodge County.

Among the states, Wisconsin ranks fifth in the value of iron ore produced (Minn., Mich., Ala., New York, Wis.). Smelting, or the separation of the metallic iron from the rock in which it occurs, is done by heating the ore. Coal, coke or charcoal is used for fuel. Coke, made from coal, is most largely employed. As Wisconsin has no coal beds, it is at a disadvantage in the smelting of iron ores, and comparatively little smelting is done. The earlier furnaces in Dodge County and elsewhere used charcoal, for wood was then abundant and cheap in Wisconsin. A smelter in Ashland now uses charcoal. Furnaces at Milwaukee and Mayville use coke. Although Wiscon-

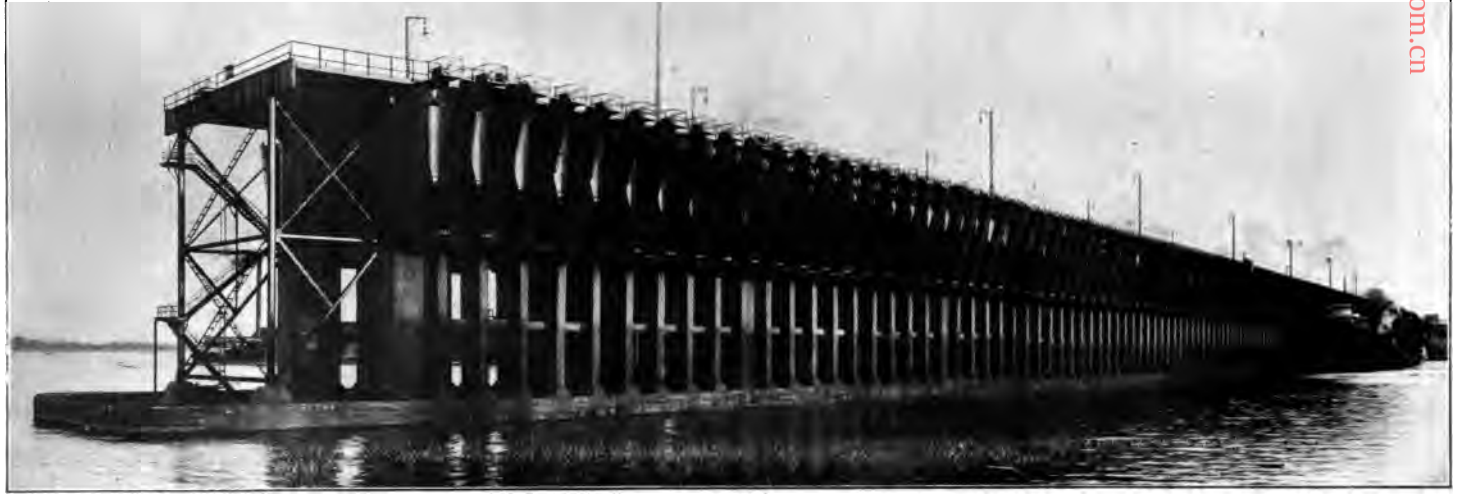
sin does not take high rank as a producer of iron ores, yet one of its cities, Superior, stands among the foremost ports on the lakes in the shipping of ore, all of which is mined in Minnesota. The ore is brought to the Lake Superior ports in trains which are run out over the lake on trestles, each a half-mile or so in length and containing hundreds of hopper-shaped bins under the railway tracks. Into these bins the ore cars are dumped, and from the bins long chutes deliver the ore to the great steamers, which carry it to various cities on the shores of Lakes Michigan and Erie, whence it is taken to the furnaces to be smelted. Ore steamers specially built for the purpose carry as high as 12,000 and 14,000 tons. So quickly are the boats loaded, and so cheaply are they unloaded by powerful machinery, and so large is the amount carried by a boat, that the freight rate is very low, being, in 1912, as low as 40 cents a ton from the head of Lake Superior to Lake Erie ports. The trip from Superior to, say, Cleveland, Ohio, and return requires from seven to ten days. This includes the loading and unloading of the ore. See plate III.

LEAD AND ZINC MINING*

The bed rocks of southwestern Wisconsin are made of sediments which were long ago laid down in the sea. In various layers of these rocks, and especially in one of the limestone layers (about 230 feet thick), lead and zinc ores are found. All of the Wisconsin mines are in the three southwestern counties, Grant, Lafayette and Iowa.

Lead ore was mined in Wisconsin by white men at least as early as 1827, and probably earlier. It lay nearer the surface than the zinc ore and was then more useful. The mining of zinc did not begin until about 1860. The early mining of lead was done by individual mine-owners or by companies with small capital. In many cases farmers opened "holes" on their land and in winter took out small quantities of ore and in summer worked their farms. There was no railroad in the district until 1854.

* For extended discussion of this topic see Grant, U. S., *Lead and Zinc Deposits of Wisconsin*. Bull. IV, Wis. Geol. and Nat. Hist. Sur. (1906); also Bain, H. F., *Zinc and Lead Deposits of the Upper Mississippi Valley*, Bull. XIX, Wis. Geol. and Nat. Hist. Sur. (1907); contains bibliography.



ORE DOCK AT SUPERIOR. BUILT OF REINFORCED CONCRETE.

Note vessel at the right being loaded with iron ore.

sin does not take high rank as a producer of iron ores, yet one of its cities, Superior, stands among the foremost ports on the lakes in the shipping of ore, all of which is mined in Minnesota. The ore is brought to the Lake Superior ports in trains which are run out over the lake on trestles, each a half-mile or so in length and containing hundreds of hopper-shaped bins under the railway tracks. Into these bins the ore cars are dumped, and from the bins long chutes deliver the ore to the great steamers, which carry it to various cities on the shores of Lakes Michigan and Erie, whence it is taken to the furnaces to be smelted. Ore steamers specially built for the purpose carry as high as 12,000 and 14,000 tons. So quickly are the boats loaded, and so cheaply are they unloaded by powerful machinery, and so large is the amount carried by a boat, that the freight rate is very low, being, in 1912, as low as 40 cents a ton from the head of Lake Superior to Lake Erie ports. The trip from Superior to, say, Cleveland, Ohio, and return requires from seven to ten days. This includes the loading and unloading of the ore. See plate III.

LEAD AND ZINC MINING*

The bed rocks of southwestern Wisconsin are made of sediments which were long ago laid down in the sea. In various layers of these rocks, and especially in one of the limestone layers (about 230 feet thick), lead and zinc ores are found. All of the Wisconsin mines are in the three southwestern counties, Grant, Lafayette and Iowa.

Lead ore was mined in Wisconsin by white men at least as early as 1827, and probably earlier. It lay nearer the surface than the zinc ore and was then more useful. The mining of zinc did not begin until about 1860. The early mining of lead was done by individual mine-owners or by companies with small capital. In many cases farmers opened "holes" on their land and in winter took out small quantities of ore and in summer worked their farms. There was no railroad in the district until 1854.

* For extended discussion of this topic see Grant, U. S., *Lead and Zinc Deposits of Wisconsin*. Bull. IV, Wis. Geol. and Nat. Hist. Sur. (1906); also Bain, H. F., *Zinc and Lead Deposits of the Upper Mississippi Valley*, Bull. XIX, Wis. Geol. and Nat. Hist. Sur. (1907); contains bibliography.

For a number of years the lead was laboriously dragged over almost impassable roads to the Mississippi River and sent to St. Louis and New Orleans, and thence much of it went by water to New York and other Eastern cities. Sending lead from Wisconsin to New York by way of New Orleans was a slow process and cost $30.00 a ton. After traffic through to New York City by the Great Lakes and the Erie Canal was established, loads of lead, drawn by twelve to sixteen oxen, went all the way across Wisconsin to Milwaukee to be sent East. It

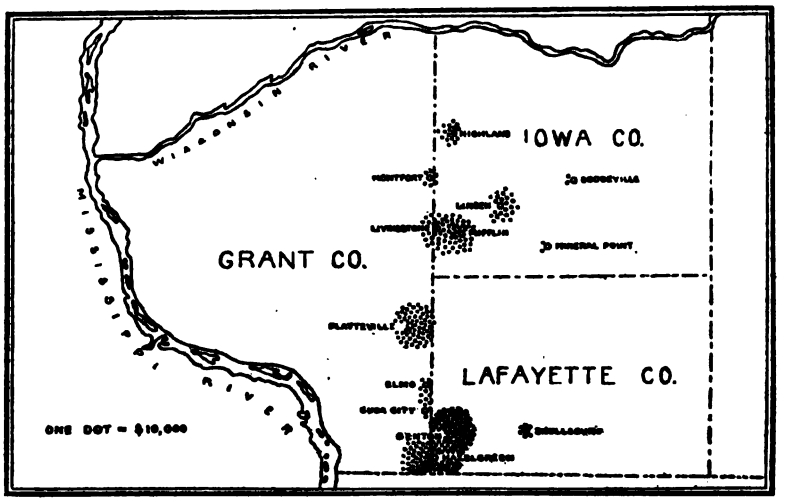


Fig. 5. Map showing the chief lead and zinc producing districts in 1911. The five dots around Montfort, for example, indicate that about $50,000 worth of lead and zinc was mined in that district in 1911, while near Platteville 60 dots indicate over $600,000 worth mined in that district.

cost in the neighborhood of $10.00 a ton, even in those days of cheap labor, to haul the ore to Milwaukee. Now iron ore is taken by lake steamers from Superior to Buffalo for 40 to 70 cents a ton. Lead was also sent to New York by way of the Fox-Wisconsin water route, the Great Lakes and Erie Canal. By this route the transportation cost was about $18.00 a ton.

Lead is easily smelted and all of the ore was reduced to pig lead in the district. In 1840 there were 49 lead smelting plants in the state. About 1845 the district produced annually some 30,000,000 pounds. In 1833 a shot tower was built at Helena, near the Wisconsin River, and here a considerable amount of lead was made into shot. At present from 3,000 to 4,500

tons of metallic lead, worth from $300,000 to $400,000 is obtained yearly. In 1860 the district sent out 160 tons of zinc. In 1872 the output rose to 5,000 tons. From 1875 to 1900, the output usually ran below 5,000 tons annually. In recent years the amount mined has rapidly risen, and in 1911 exceeded 28,000 tons, valued at $3,280,000. In the production of zinc Missouri ranks first, Colorado second, and Wisconsin third or fourth. For the most part, mining on a small scale has given place to mining by companies with large capital. The Kennedy Mine at Hazel Green, for example, is valued at $250,000. Wisconsin produces about 1/12 of the zinc, 1/100 of the lead and 1/50 of the iron ore mined in the United States.

THE QUARRYING INDUSTRY*

Because the region including Wisconsin has passed through a long and varied geological history, and because a variety of geological formations occur within the state, many kinds of rock are found. Rocks of each of the three great classes, igneous, metamorphic and sedimentary are quarried; some for building purposes, some for monuments and ornamental work, others for making lime, for paving-blocks, for crushed stone and for other purposes. In a section where rock or stone is easily obtained people do not appreciate its usefulness. There are parts of our prairie states and parts of foreign countries where a rock or a large stone is not to be found, but must be brought long distances at a considerable cost. The presence of suitable stone near at hand for buildings, for foundations of houses, for making concrete, etc., is a greater advantage than we are likely to think. The building of good macadam, or crushed stone, roads is one of the greatest benefits to a region, and is done much more cheaply when stone does not have to be shipped great distances.

Granite. This is an igneous rock, that is, rock that has cooled from a molten state. At least thirteen differently colored and textured granites are quarried in Wisconsin, ranging from beautiful red to somber gray and from fine-grained rock to

* For extended treatment of this topic, see Buckley, E. R., *Building and Ornamental Stones of Wisconsin*, Bull. IV, Wis. Geol. & Nat. Hist. Sur. Beautifully illustrated.

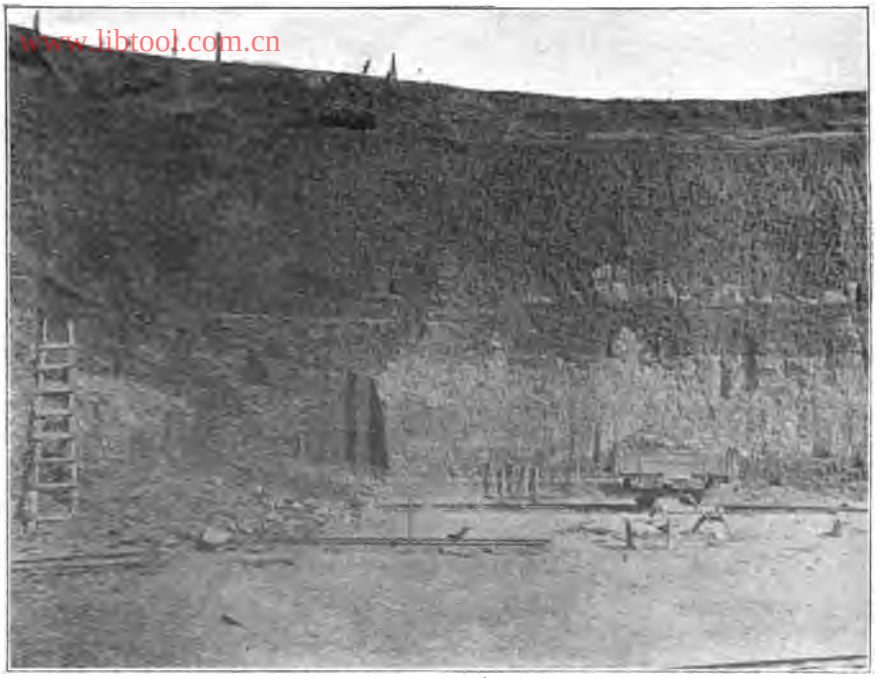
rock with crystal faces as large as a half dollar. The beauty of some of these granites, and their durability, place them among the finest granites produced anywhere. The splendid sarcophagus in which the body of General Grant lies, in his tomb by the Hudson River, is carved from granite quarried at Montello, Marquette County.

There are scores and perhaps hundreds of places in the northern half of the state where granite may be quarried. The supply is almost inexhaustible. The principal producing areas are in the vicinity of Montello, Berlin, Utley, Marquette, Red Granite Waupaca, Wausau, and Amberg. Much the larger part of the granite quarried in the state is used for paving blocks. Wisconsin ranks fourth or fifth among the granite producing states.

Sandstone. This is a sedimentary rock, formed by the natural cementing of sand. Sandstone is the bed rock over a considerable part of the state. Practically all of the sandstone in the state which is now used for building purposes belongs to what is known as the Potsdam formation. Along the shore of Lake Superior is an older sandstone which is colored a deep red or brown by iron oxide. In the central and south central part of the state the sandstone is usually, though not always, light yellow. The brown stone quarried near Bayfield, Washburn and other points on or near Lake Superior was formerly much sought and was sold widely. Many of the beautiful public buildings of Wisconsin and neighboring states are built of it, e. g. the Central High School of Duluth, the Law School Building of the University of Wisconsin at Madison, and the Lumber Exchange Building of Minneapolis. The change of style to light colored stone has in recent years practically destroyed the market for the brown stone of the Lake Superior region.

The Potsdam sandstone, quarried at various places in the southern half of the state, is mostly used in the locality where it is quarried, for the foundations of buildings, piers of bridges, etc. A variety known as Madison sandstone is quarried near that city and has been used in the construction of several of the State University buildings. The quarry at Colfax sends considerable stone to St. Paul, the nearest large city.

Limestone. This is also of sedimentary origin and forms the bed rock over more than a third of the state. There are



A. A DEEP CLAY PIT AT MENOMONIE.

Dunn County is one of the leading brick-making districts of the state.

B. LIMESTONE QUARRY TYPICAL OF THOSE IN THE EASTERN COUNTIES OF WISCONSIN.

more limestone quarries in Wisconsin than any other kind, though the stone is not widely used for buildings. However, the old state capitol, now torn down, was built of limestone from the Bridgeport quarry in Crawford County.

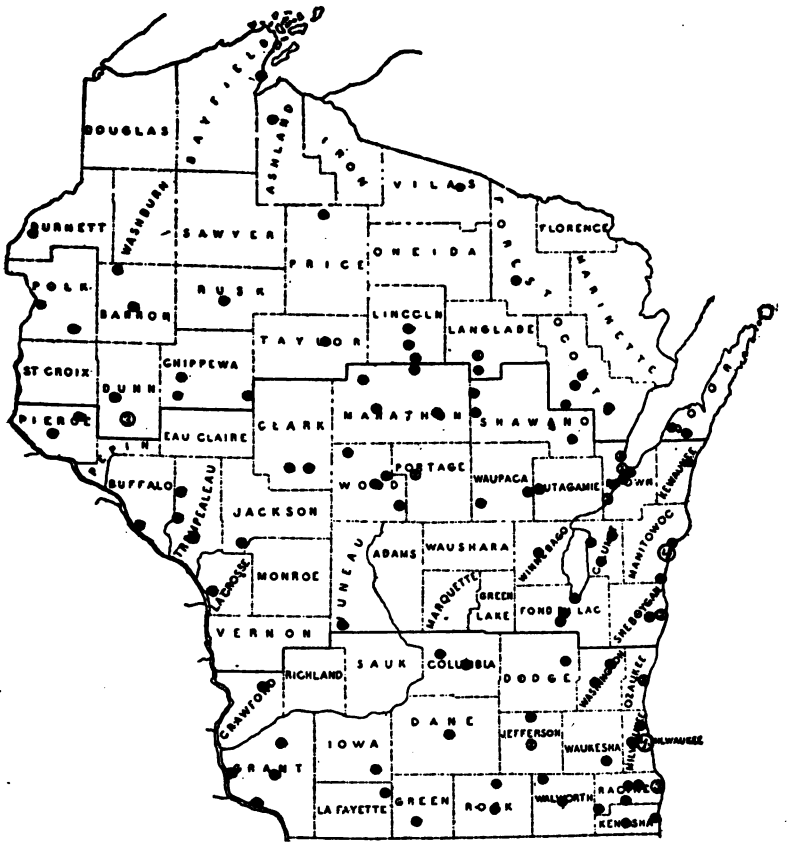


Fig. 6. Map showing the distribution of brick-making establishments in 1910. The number in a circle indicates the number of establishments at that place.

The limestones of Wisconsin are chiefly used for three purposes:

1. For foundations, piers, arches, etc.
2. For crushed stone to be used in making concrete, for railroad ballast, or for macadam roads.
3. For making lime.

No other kind of rock quarried in the state is so widely useful. Two million dollars, the amount reported, does not by any

means measure the annual value of this stone to the people of the state, for much that enters into local use is never taken into account in the state or government reports.

Lime. The burning of limestone to make lime is common in the eastern counties and the value of the lime amounts to about a million dollars annually. Wisconsin is one of the leading producers.

Other kinds of rock. Granite, sandstone and limestone make up more than nine-tenths of the rock quarried in the state. A few other kinds, such as quartzite, rhyolite, greenstone and gneiss are quarried in limited quantities, but their use is not large.

Clay products. Kaolin, the chief ingredient of clay, results from the decay of certain minerals, particularly feldspar. Clay is one of the most indestructible of substances. It is so exceedingly fine that it floats for a long time in water before it settles, and when washed into lakes or into the sea, it sinks very slowly to the bottom,—usually where the water is relatively quiet. The fine clay sediments thus deposited may afterwards be compressed into a shale rock or they may remain as beds of clay which may eventually become parts of the dry land. Shale may be ground up by glaciers, or other agencies, or it may weather back into clay and again be deposited in beds. Because clay and quartz sand are so indestructible they constitute the greater part of all soils. It is only by the thorough washing out, by natural processes, of other substances usually mixed with it that clay becomes pure enough to be used in the manufacture of finer grades of clay products, like pottery. But in hundreds of places in the state clay is found which is suitable for making brick and tile. The total value of the clay products of the state amounts to over one million dollars annually.

Mineral Waters. The mineral springs of Waukesha have attained a nation-wide reputation. Much the larger part of the state's mineral waters that are bottled for sale comes from this city. Over 6,000,000 gallons, (nearly 50,000,000 pints) are sold annually. These mineral springs have been an important influence in the growth of the city of Waukesha. The hotels and sanitariums which were built because of the mineral waters attracted thousands of people yearly. The White Rock water

LARGE BRICK-MAKING PLANT NEAR RACINE.

bottled there is one of the most widely sold table waters on the market.

In the annual value of commercial mineral waters (about $1,000,000) Wisconsin is foremost among the states.

Fig. 7. Map showing location of mineral springs producing and selling mineral waters. The number enclosed in a circle indicates the number of springs at that place. Wisconsin leads in the annual value of mineral waters produced.

SUMMARY

While Wisconsin does not rank high in the value of mineral products, yet its mineral industries are important. Since its bed rocks were all laid down before the coal-forming periods, Wisconsin has no native coal. Although the ancient rocks around Lake Superior contain exceedingly rich deposits of

iron ore, the richest beds now known lie outside the boundaries of the state, but further exploration may reveal abundant ores in regions as yet unworked. The most productive of the iron mines at present are in Iron County. In one of the thick limestone formations of Southwestern Wisconsin are deposits of lead and zinc ore. The lead was mined first and the deposits which were worked in the early days are exhausted, the lead now being obtained as a by-product of zinc mining. Zinc is actively mined, and Wisconsin ranks third or fourth among the states in the production of this ore. Granites of large variety and high quality are quarried in the central part of the state; red and brown sandstone are found near Lake Superior; buff sandstone is quarried in the south-central and western counties, especially at Madison; limestone is quarried at many places, particularly in the eastern part of the state. The clay products, the lime, and the mineral waters of the state each yield in the neighborhood of a million dollars annually. In the years around 1911, the total reported value of all minerals produced in the state was nearly $20,000,000.

SCENE IN ONE OF THE MAGNIFICENT FORESTS OF NORTHERN WISCONSIN, NORTH OF CHIPPEWA FALLS.

These forests have yielded far more wealth than the gold mines of California.

CHAPTER III

FOREST INDUSTRIES

UNDERLYING CAUSES AND INFLUENCES

For some reason, not fully understood, the prairies of the United States, excepting along the streams, did not have a forest covering when the White Man came. A part of southern Wisconsin was included in the prairie belt, but most of the state was covered with timber, the most valuable of which was the white pine of the North. The pine forests of Wisconsin were a part of the long belt that extended through New England, New York, Lower Canada, Michigan, and Minnesota.

Trees are one of nature's crops and marked differences in soil and climate give rise to differences in kinds of trees. Pines are easily masters in poor, sandy soils. Not that pines prefer poor soil; they grow taller and hardier in loamy soil. The growth of a forest is a struggle among the trees for existence, and those that are fittest to survive in that particular place, crowd out others and gain possession of the land, although one kind of tree is never able to gain a complete monopoly. On the poorest forest soils in Wisconsin, the jack pine usually predominates; on the medium grade of sandy soil, the Norway pine, and on the better of these soils the valuable white pine. On the mixed soils, mixed forests of pine and hardwood grow.

Following are the chief forest trees of Northern Wisconsin: It will be noted that each kind of tree has its favorite habitat.*

White Pine was found in all parts of Northern Wisconsin as scattering mixture in the better hardwood mixed forests of the

* See Roth, Filibert, *Forestry Conditions of Northern Wisconsin*, Bulletin No. 1, Economic Series No. 1 of the Wis. Geol. & Nat. Hist. Sur. (1898). This bulletin contains a detailed forest map, statistical tables and an excellent account of forest conditions up to 1897.

heavy soils, predominant on lighter sandy and gravelly loams, and as pinery proper on the extensive loamy sand areas. It is the largest and most valuable tree of the region.

Red Pine (Norway pine) grew on all sandy pinery areas.

Jack Pine, either pure or mixed, stocked all poor sandy lands.

Hemlock grew on all clay and loam lands of the eastern half of Northern Wisconsin. It was mixed with the hardwoods or predominated in bodies of variable extent. Much still remains.

Cedar grows in the swamps and on moist lands.

Tamarack is the common tree in the northern swamps.

Spruce is a small tree on the moss-covered bogs and a medium-sized tree on the more humid portions of the loam and gravel land of mixed forests.

Basswood is common in all hardwood forests.

Birch is predominant in the hardwood forests within the hemlock area, but rarely is found in the regular pinery.

Elm and Maple are common in all hardwood forests.

Red Oak is common on both sandy and clay soils, but white oak is scarce.

Ash is generally restricted to the swamps.

Aspen (commonly called poplar) is common on nearly all soils.

THE RISE AND DECLINE OF LUMBERING

When Jean Nicolet came to Wisconsin in 1634, more than one hundred billion feet (board measure) of white pine stood in its splendid forests. Today these white pine forests are scarcely more than a memory; but for forty years lumbering was the dominant interest in the northern half of the state. Into the pineries every winter went small armies of men. Down its rivers every spring the river-men drove thousands upon thousands of pine logs. Along these rivers hundreds of saw mills stood. Around the mills grew up the lumbering towns, many of them the cities of today. Almost every city north of a line drawn from Fond du Lac to La Crosse grew up as a lumber town. When lumbering was at its height, a single mill at Chippewa Falls cut 65,000,000 feet of lumber annually and one company cut and drove down the Chippewa River 400,000,000 feet in a single season. In some of the best areas, a million

A. HAULING LOGS IN THE LUMBER WOODS OF NORTHERN WISCONSIN.
Scene near Crandon, Forest County.

B. LOGGING SCENE NEAR STANLEY, CHIPPEWA COUNTY.
***Hauling* logs by specially designed locomotive.**

feet of pine was cut from a forty-acre tract. It is said that a single tree cut on the Jump River scaled 7,000 feet of lumber which, at the *present retail price* of finished white pine would be worth $250. Yet the land upon which such timber stood not infrequently was purchased for a few dollars an acre.

Naturally the trees near the rivers were cut first, for the principal method of transporting the logs to the mills was by floating them down the rivers. At first only the best parts of the choice trees were taken. Each season the logging camps pushed farther up the streams and farther back from the

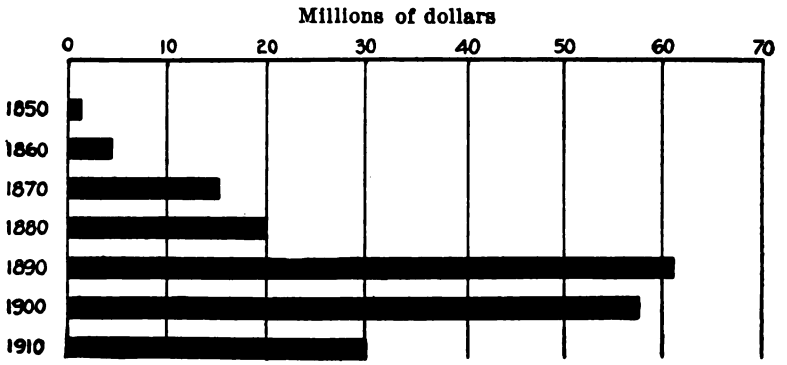


Fig. 8. Diagram showing the rise and decline of lumber production in Wisconsin, 1850 to 1910. Figures refer to rough lumber only.

banks as the timber was cut away. The logs were hauled by horses or by logging railroads to the rivers, and by thousands were piled on the ice and along the banks, awaiting the spring break-up, when the melting snow turned the river into a torrent. When the break-up came and the mass of logs moved the most exciting and dangerous employment of the lumbermen began. To guide and control this plunging, driving, rolling avalanche of timber, and to prevent or to break a jam called for the coolest heads, and the most alert, most daring men on the river.

The saw-mills were practically always built on the banks of some river or creek. The logs came down the river and were held in the boom, and during the spring and summer were cut into lumber.

Like all of our great industrial movements in the United States, the lumbering industry moved from east to west. It did not assume large proportions in Wisconsin until 1870. In

1900, Wisconsin passed Michigan and took first rank among the lumber-producing states, a place which it held until 1905, when it yielded the place to Washington. At the industry's height, the value of the lumber produced reached well towards $70,000,000 a year, or more than the average annual value of the gold mined in the entire United States.

The United States Census Bureau gives the following as the annual value of the rough lumber cut in Wisconsin in the different census years. It must be borne in mind that these figures represent value at the mills. The lumber was finally sold to the consumer for much more than this.

1850	about	$1,250,000	1890	about	61,000,000
1860	"	4,500,000	1900	"	58,000,000
1870	"	15,000,000	1905	"	44,000,000
1880	"	18,000,000	1910	"	30,000,000

There were upwards of a thousand lumber mills in the state during the years of greatest activity. Many of these were very large, cutting many millions of feet of lumber annually. Some of these great mills still exist. The present tendency is toward fewer mills and larger ones, for in most cases the logs must now be brought to the mills by railroads, and it is economical to concentrate the work at points with good railway facilities. The output per mill averaged 35% greater in 1905 than in 1900.

At some time in the past, if not at present, practically every village and city in the timbered parts of the state had one or more saw mills; some had a dozen. But those places which were selected for the mills of the great lumber companies became centers of a vast business.

During the most active logging years, 1895 to 1900, there were invested in the saw milling industry more than $100,000,000, a sum equal to one-third the assessed value of all the land in the state. The lumber companies paid out in wages from fifteen to twenty million dollars annually.

A. ONE OF THE GREAT SAWMILLS OF NORTHERN WISCONSIN. MILL OF THE NORTHWESTERN LUMBER COMPANY AT STANLEY.

Capacity of mill about 35,000,000 board feet per season.

B. ROLLWAYS ON THE WISCONSIN RIVER NEAR TOMAHAWK, LINCOLN COUNTY.

Showing the method by which logs were commonly transported to the mills in the earlier days of logging.

EVOLUTION OF WOOD-WORKING INDUSTRIES

In an expanding nation like the United States industries are constantly undergoing a process of evolution. This is conspicuously true of lumbering and wood-working in Wisconsin. The early mills, as a rule, simply cut the logs into rough lumber and sent it to market in this form. The enormous quantity of logs which poured into the mills left them little time to do more. As long as the supply of logs kept the mills employed in cutting rough lumber, there was no pressing reason for carrying the operations beyond that stage. But when the supply of logs

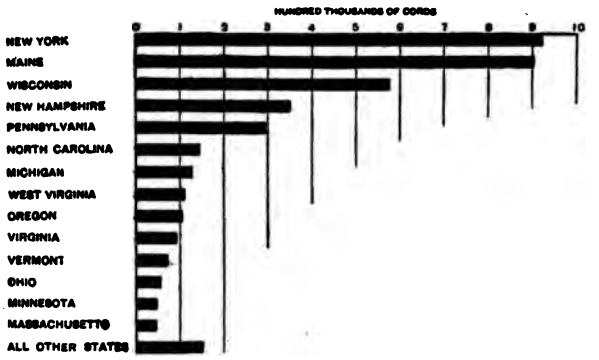


Fig. 9. Diagram showing the amount of pulp wood consumed, by states, 1909. (From *Bull. U. S. Forest Service*)

began to diminish, many mill owners added machinery for planing, matching, or otherwise finishing the lumber. In this way they kept their plant employed, utilized waste products and made use of other kinds of wood than pine. As time went on many mills found it impossible to get sufficient logs, and some shut down entirely and were dismantled. Other saw mills that were favorably located for securing logs or for marketing their products, became also planing mills; some carried the process of manufacture still farther and made doors, blinds, sash, moldings and all kinds of shaped lumber for interior and exterior finishing. Thus, by combining in one mill phases of the business which had formerly been done in two or three mills, the mill owners were enabled to continue operations, and much less of the timber went to waste. In fact, the price of wood

has so advanced that very little indeed is now allowed to go to waste.

In other instances the evolution progressed in another direction. At certain places men or companies owned dams, had valuable water rights, and owned a large amount of other property, much of which could not be moved or disposed of to advantage; yet they could no longer get sufficient logs to continue their saw-milling operations. Scores of men and companies came to face this condition in the years following 1905. These men were familiar with lumber and they knew its sources, qualities and markets. Quite naturally they turned to some line of manufacturing in which their accumulated experience and knowledge could be employed. The chief raw material of the vast region lying north and northwest still was wood. The white pine was disappearing, but spruce, hemlock, basswood, maple, birch and other woods remained. Out of these conditions almost inevitably grew the varied forms of wood-working which constitute a large part of the manufacturing of the northern half of the state.

In these establishments some forty different kinds of wood are used, not all of which, however, come from Wisconsin. Most of these establishments originally got their lumber from Wisconsin but at present half of it comes from outside the state.

Our state board of forestry lists twenty-one different classes of wood-using industries. So extensive is the industry that in 1900 one-fourth of all the wage earners reported for all lines of manufacturing were engaged in the manufacture of lumber and timber products, and nearly one-fifth of them in 1905.

In 1900, 18% of the value of all manufactures in the state was lumber and timber products. Despite the decline of logging, the wood-woring industry as a whole is still on the increase. There were twenty-six more planing mills and twenty-two more furniture factories reported in 1905 than in 1900. The number of saw mills is, of course, declining. White pine ceased to be the leader in 1910 and hemlock took its place.

Closely associated with the production of hemlock lumber is the production of hemlock bark, used in the tanning of leather. More than a million dollars' worth of this bark is used annually in the state.

A. STEAM LOG LOADER. CAPACITY 15 CARS PER DAY.
Scene near Crandon, Forest Co.

B. WOODENWARE FACTORY AT TOMAHAWK, LINCOLN COUNTY.
A type of the leading form of manufacturing in the forested portion of northern Wisconsin.

Lumbering has passed its zenith in Wisconsin. The finest of the white pine has been cut. Vast areas have been cut over and burned over and now yield no merchantable timber. Yet the forest resources of the state are far from exhausted. It is estimated that 45% of the area of Wisconsin is still woodland of some sort. Good timber still remains and for a long time the forests will yield an annual income measured in millions of dollars.

SUMMARY

Originally nearly all of Wisconsin was covered with forests, only a few thousand square miles in the south being in the treeless prairie region. The heaviest forests were in the northern half of the state. The most valuable timber was the white pine which is now nearly exhausted. Several million acres of mixed hardwoods, hemlock and inferior pine remain. Nearly half of the area of the state is still in some sort of woodland. The character of the forests depended upon the conditions of the soil and climate; the pines predominated in the sandy soils and the hardwoods in the clay loam soils. Logging culminated in the years between 1890 and 1900. From 1900 to 1905 Wisconsin stood first as a lumber producing state; the value of the rough lumber reached nearly $70,000,000 a year, four or five times the value of mineral products, but somewhat less than the present value of dairy products. In these years lumbermen had more than $100,000,000 invested in the industry and yearly paid out the great sum of fifteen to twenty million dollars in wages. For many years the annual value of the lumber produced in Wisconsin exceeded the annual value of the gold produced in the entire United States. The present output of rough lumber is about $30,000,000 a year. Most of the desirable timber near the rivers or railroads has been cut. The present tendency is toward fewer saw mills and larger ones, situated at advantageous points. Log-driving on the rivers is practically past, railroads now doing about all of the hauling. Wisconsin's many rivers, fairly even topography, and nearness to the Great Lakes and the Mississippi, favored the rapid exploitation of its forests. With the decline of logging there has come an evolu-

tion in the wood-working industry. All kinds of wood are being utilized; waste is more and more carefully avoided; instead of merely sawing rough lumber, many mills carry the manufacturing process farther, and make doors, sash, blinds, all kinds of finished lumber and mill work, packing boxes, veneer, etc. There has come a marked development of pulp and paper making, furniture manufacturing, and leather tanning. Manufacturing of wood products is the largest single line in the state and nearly a fifth of all the wage earners engaged in manufacturing are engaged in the wood-using industries. These mills are, of course, most largely found in the northern half of the state.

CHAPTER IV

AGRICULTURE

The Upper Mississippi Valley is a region of unusual fertility; one of the garden spots of the world. Wisconsin is included in this area. In the southern and eastern parts of the state, practi-

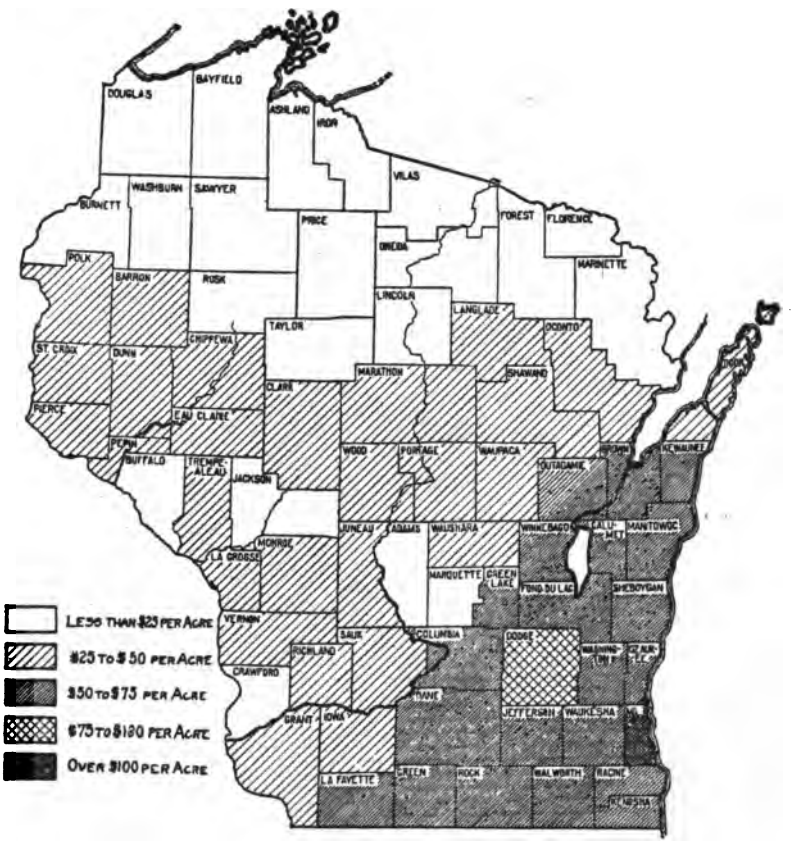


Fig. 10. Map showing the average value of farm lands by counties, according to U. S. census report of 1910. Note that the values are *averages for entire counties.* The best land in any county has, of course, a much higher value than this average.

cally the whole area is farm land. In productiveness and value the land of this region ranks with the best in the United States. In the central part of the state is an area of sandy soil of much lower productivity, while in the northern part there are several million acres that are still in the condition of cut-over, burnt-over and forest-covered land, awaiting development. Hence,

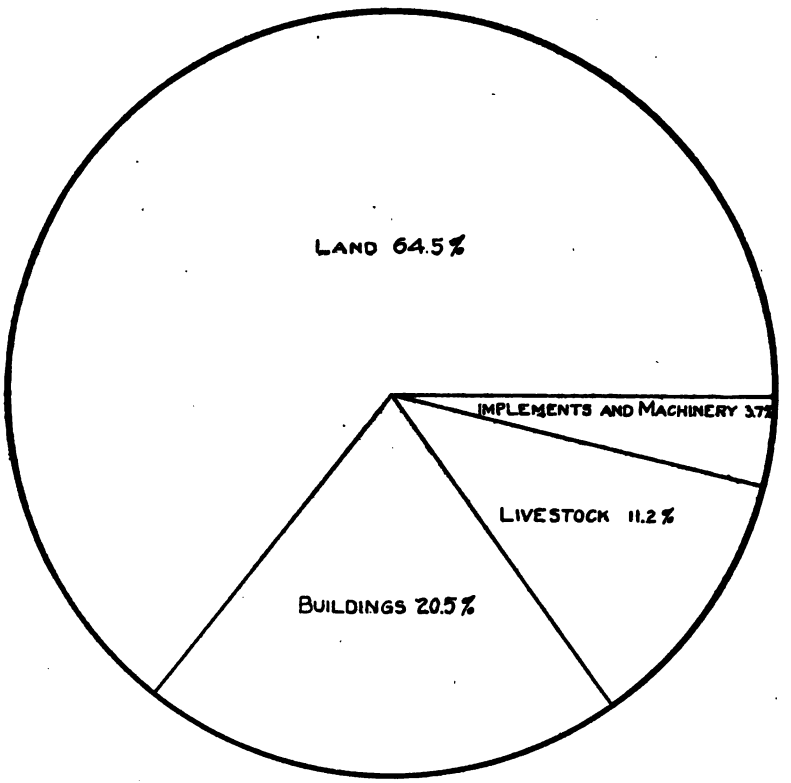


Fig. 11. Diagram showing the relative value of the four chief items of farm property in Wisconsin, 1910.

when the whole state is taken into account, Wisconsin is outranked by such prairie states as Illinois and Iowa, and by some of the eastern states that have been settled longer. Among the states Wisconsin ranks about tenth in the annual value of farm products.

The following facts are here presented to give a basis for understanding agricultural conditions in the state:

1. As yet, only 60% of the land is actually in farms. The remainder is chiefly wild land owned by lumber companies and land companies, by railroad companies, by the state, by the United States (Indian Reservations), or is otherwise held by people who do not use it for farming.

2. About three-fifths of the area which is classed as farm land is tilled or is cut for hay. This means that not over 4 acres in every 10 of Wisconsin lands are devoted to field crops but much of the unimproved land in farms is used for grazing.

While this ratio of improved land to total area is nearly double that of the United States as a whole, it is less than half that of the states of Illinois or Iowa.

3. About one-half of Wisconsin is woodland and a considerable portion of this still consists of valuable forests.

4. Yet, the amount of land actually under cultivation in Wisconsin is greater than the *total* area of some of the eastern states and greater than the area of some European nations.*

TABLE 1.

LAND AND FARM AREA (U. S. Census 1910)

	Acres.
Approximate land area	35,363,840
Land in farms	21,060,066
Land in farms in 1900	19,862,727
Improved land in farms	11,907,606
Improved land in farms in 1900	11,246,972
Woodland in farms	5,377,580
Other unimproved land in farms	3,774,880
Per cent of land area in farms	59.6
Per cent of farm land improved	56.5
Average acres per farm	119
Average improved acres per farm	67

* The cultivated land of Wisconsin is equal to the combined areas of Massachusetts, Connecticut, New Jersey and Rhode Island, and greater than the area of Holland, Belgium, Denmark or Switzerland.

TABLE 2.

Census Year.	Population.	Farms.		Land in Farms.			Per cent of land area in farms.	Per cent of farm land improved.
		Number.	Per cent of increase.	All land (acres).	Per cent of increase.	Improved land (acres).		
1910....	2,333,860	177,127	4.3	21,060,066	6.0	11,907,606	59.6	56.5
1900....	2,069,042	169,795	16.0	19,862,727	18.3	11,246,972	56.2	56.6
1890....	1,686,880	146,409	9.0	16,787,988	9.3	9,793,931	47.5	58.3
1880....	1,315,497	134,322	30.5	15,353,118	31.0	9,162,528	43.4	59.7
1870....	1,054,670	102,904	48.6	11,715,321	48.4	5,899,343	33.1	50.4
1860....	775,881	69,270	243.3	7,893,587	165.2	3,746,167	22.3	47.4
1850....	305,391	20,177	.....	2,976,658	.....	1,045,499	8.4	35.1

TABLE 3.

Census Year.	Farm Property.							
	Total.		Land and buildings.		Implements and machinery.		Domestic animals, poultry, and bees.	
	Value.	Per cent of increase.	Value.	Per cent of increase.	Value.	Per cent of increase.	Value.	Per cent of increase.
1910.....	$1,413,043,000	74.1	$1,201,633,000	75.1	$52,957,000	81.1	$158,454,000	64.5
1900.....	811,712,000	44.8	686,148,000	43.7	29,237,000	52.5	96,328,000	51.0
1890.....	560,476,000	33.5	477,525,000	33.5	19,167,000	22.5	63,784,000	37.1
1880.....	419,865,000	45.8	357,710,000	48.8	15,647,000	37.4	46,509,000	28.3
1870[1].....	287,971,000	96.2	240,331,000	83.3	11,391,000	97.8	36,249,000	166.6
1860.....	154,683,000	341.1	131,117,000	359.4	5,759,000	250.7	17,807,000	263.6
1850.....	35,068,000	.....	28,529,000	.....	1,642,000	.....	4,897,000	.....

[1]Computed gold values, being 80 per cent of the currency values reported.

5. In the northern third of the state less than one-fourth of the land is in farms. In the middle third, more than one-half; in the southern third, more than 90 per cent.

6. The value of the farm land of the state was about a billion dollars in 1910—enough to pay the entire interest bearing debt of the United States—while the farm buildings, machinery and live stock had a value of nearly 500 million dollars in addition.

TABLE 4.

VALUE OF FARM PROPERTY (U. S. CENSUS, 1910).

All farm property	$1,413,043,345
All farm property in 1900	811,712,319
Per cent increase, 1900–1910	74.1
Land	911,938,261
Land in 1900	530,542,690
Buildings	289,694,462
Buildings in 1900	155,604,970
Implements and machinery	52,956,579
Implements, etc., in 1900	29,237,010
Domestic animals, poultry, and bees	158,454,043
Domestic animals, etc., in 1900	96,327,649
Per cent of value of all property in—	
Land	64.5
Buildings	20.5
Implements and machinery	3.7
Domestic animals, poultry, and bees	11.2
Average values:	
All property per farm	7,978
Land and buildings per farm	6,784
Land per acre	43.30
Land per acre in 1900	26.71

DOMESTIC ANIMALS

Farms reporting domestic animals	171,017
Value of domestic animals	153,624,810
Cattle:	
Total number	2,678,160
Dairy cows	1,471,591
Other cattle	1,206,569
Value	$67,399,856
Horses:	
Total number	614,654
Value	$68,585,513
Mules:	
Total number	2,872
Value	$316,066
Swine:	
Total number	1,809,331
Value	$13,620,741
Sheep:	
Total number	929,783
Value	$3,669,572

POULTRY AND BEES

Number of poultry of all kinds	9,433,110
Value	$4,468,703
Number of colonies of bees	95,638
Value	$360,530

7. One farm in every six has less than 50 acres; about two in every ten have from 50 to 100 acres; about two in six have from 100 to 175 acres; about one in six has over 200 acres.

The following table shows the distribution of farms by size groups in the census years of 1910 and 1900:

TABLE 5.

Size Group.	Number of Farms.		Increase.[1]		Per Cent Distribution.	
	1910	1900	Number.	Per cent.	1910	1900
Total	177,127	169,795	7,332	4.3	100.0	100.0
Under 3 acres	273	948	—675	—71.2	0.2	0.6
3 to 9 acres	5,491	4,264	1,227	28.8	3.1	2.5
10 to 19 acres	4,883	4,316	567	13.1	2.8	2.5
20 to 49 acres	23,460	25,479	—2,019	—7.9	13.2	15.0
50 to 99 acres	54,007	52,590	1,417	2.7	30.5	31.0
100 to 174 acres	58,439	54,232	4,207	7.8	33.0	31.9
175 to 259 acres	20,196	18,171	2,025	11.1	11.4	10.7
260 to 499 acres	9,271	8,659	612	7.1	5.2	5.1
500 to 999 acres	966	991	—25	—2.5	0.5	0.6
1,000 acres and over	141	145	—4	—2.8	0.1	0.1

[1] A minus sign (—) denotes decrease.

8. Taking all of the farms together, the average size in 1910 was 119 acres, and the average value about $8,000.

9. The farm lands of the state nearly doubled in value during the decade between 1900 and 1910.

10. The average yearly value of farm products is about 20 times that of the mineral products; it is also more than that of manufactured goods, when the value of the materials used in making those goods is deducted from the value of the finished product.

Soil Belts

The origin of Wisconsin soils will be better understood if it is remembered that there are three main geological divisions of the state. Fig. 15. These are,

1. The ancient crystalline rocks of the northern part,—somewhat more than one-third of the total area of the state.

Most of the ancient crystalline rocks of the north are covered with a mantle of glacial drift, in some places sandy and poor: elsewhere, composed of a mixture of clay and sand, forming a fertile loam.

2. The sandstone rocks of the central portion,—less than one-third of the total area.

The eastern half of the sandstone belt is mantled with glacial

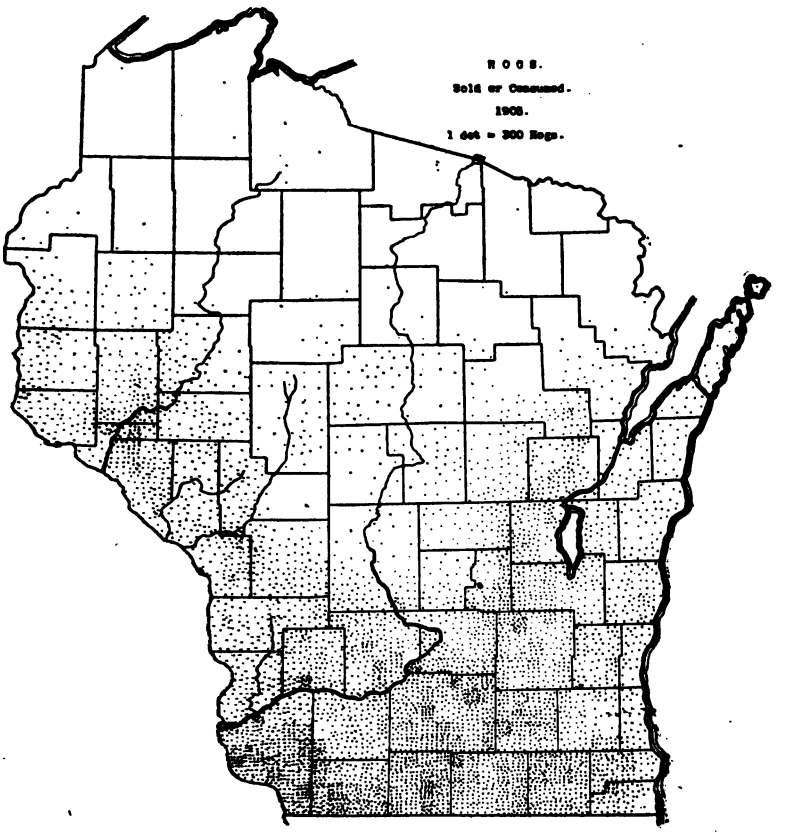


Fig. 12. Map showing the distribution of hog-raising in Wisconsin. Based upon census of 1905. Map furnished by the College of Agriculture.

drift and is decidedly better than the driftless half which is largely sand, in which many crops will not thrive.

3. The third portion of the state, the limestone region, is the most fully developed and most productive part of Wisconsin. Whether the soil is glacial or residual, it is fertile. The undeveloped condition of the northern counties makes it impossible to compare them fairly with the well developed, thickly settled southern counties. From 90 to 100 per cent of the land of the

limestone region is in farms; the value of this land is highest in the east and southeast, where it averages from $50 to above $125 per acre. In the sandstone area only about half of the land is in farms, the remainder being woodland, marsh or other uncultivated land. The eastern or glaciated portion of the

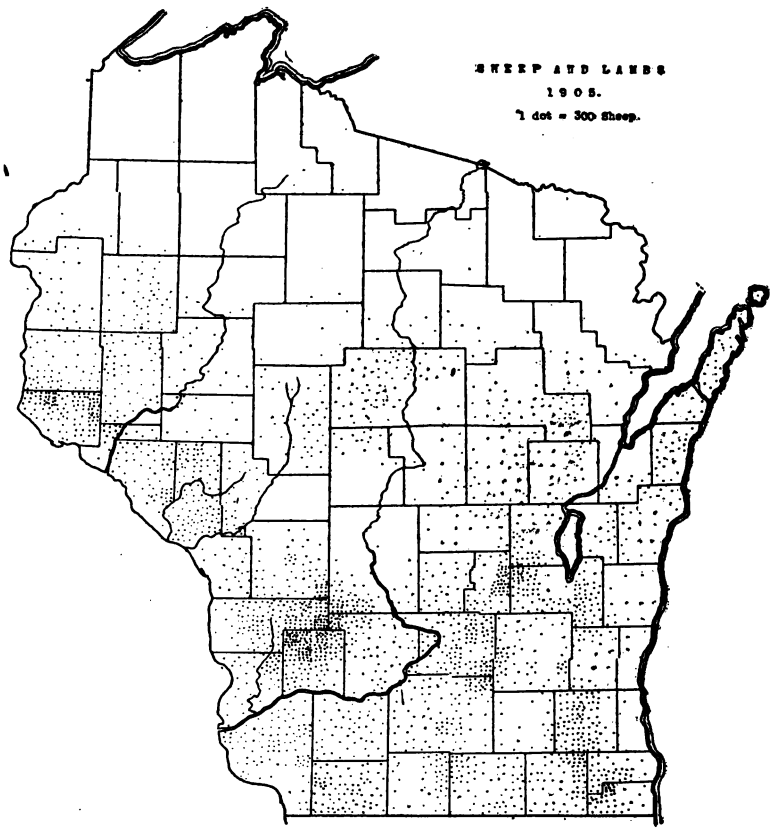


Fig. 13. Map showing the distribution of sheep and lambs in Wisconsin. Based upon census of 1905. Map furnished by the College of Agriculture.

sandstone area, into which considerable clay was carried by the glacier, is the more advanced part agriculturally. There are portions of the northern third of the state in which only 14, 10, 5 and even 3 per cent of the land is in farms, the remainder being largely timber land, and cut-over land.

NORTHERN WISCONSIN

Why is Northern Wisconsin so largely undeveloped?

The main reasons are the *situation* of this part of the state, and the heavily forested condition of the land, requiring time to remove the timber and large expense to put it in condition for farming.

The following digest of farming conditions in Northern Wisconsin is found in Bulletin No. 196 of the Agriculture Experiment Station of the University of Wisconsin, *Opportunities for Profitable Farming in Northern Wisconsin*, by E. S. Delwiche (1910).

The farm land of Northern Wisconsin is still to a great extent undeveloped but farming in this section has passed beyond the experimental stage. Not all of the land in this section is suitable for farms. Much of it should be left for forest reserves but the larger part of this region, including about 10,000,000 acres, is available for farming. The soils of these lands are mostly fertile and well adapted to a variety of crops.

The climate is favorable to the rapid development of vegetation since the rainfall is well distributed through the growing season and unseasonable frosts are rare due to the moderating influence of the Great Lakes. A variety of crops may be grown, including grasses, clovers, corn, small grains, potatoes, garden vegetables, small fruits and, in certain sections, the hardy tree fruits.

The leading type of farming for this section seems destined to be dairying, owing to the natural advantages of good grazing lands, favorable markets for dairy products, etc. Sheep raising will undoubtedly increase in extent as an aid in clearing land and in combination with the growing of such crops as peas and clover.

Fruit growing is a paying industry in some sections and is being rapidly extended, particularly in the vicinity of Superior and Duluth. Strawberries have proved profitable as the crop ripens later than in regions farther south and reaches the market at a favorable time. Trial orchards conducted by this Station have shown that selected varieties of apples yield well under good care.

The growing of special crops is profitable in certain sections upon soils particularly suitable to these crops. Field peas for feed and canning purposes give profitable returns upon the heavy clay soils. Potato raising is a paying industry in a large part of the sandy and sandy loam sections. The raising of clover for seed has given good returns in several localities. Sugar beets yield well on the loam soils and are above the average in sugar content, and wheat does well on the heavy clay lands near Lake Superior, yielding grain of high quality.

The experience of older settlers shows that farmers in this region should practice rotation of crops and grow clover to increase the humus and nitrogen in their soils. The greater part of the produce raised should be fed to live stock and the manure carefully returned to the fields. Small, well cultivated farms operated intensively are advocated as the most profitable.

1. Its northerly situation gives it a shorter growing season and long, cold winters. Fig. 27 shows that a portion of North-

ern Wisconsin has a growing season of 100 to 120 days, while southeastern Wisconsin has from 140 to 150 days. The longer the growing season, the greater the variety of crops that can be successfully grown and the greater the certainty that these will mature.

2. It is much more difficult, and hence more expensive, to clear pine land than hardwood land, because pine stumps decay very slowly and are removed only with much labor.

3. Settlement and development proceeded from the southern and eastern part of the state, the part first reached by settlers.

4. The peculiar position of the northern part of the state, partly enclosed by two of the great lakes, removed it from the

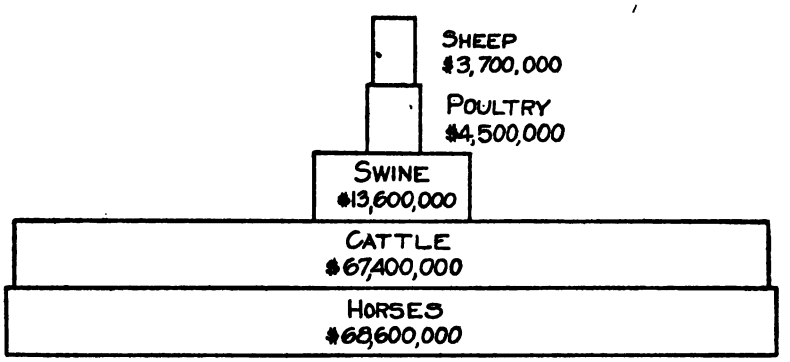


Fig. 14. Diagram showing the value of different classes of farm animals, U. S. census of 1910.

territory traversed by the earlier trunk line railways between the East and West or between the Northwest and Chicago, while the southern half of Wisconsin lies directly in the natural path of the great traffic lines toward the Northwest.

Certain sections of the United States, like Ohio and Indiana for example, have profited enormously by their position. They lie athwart the natural arteries of the nation's trade. The trunk railways from East to West *must* pass through them. But regions which, like Northern Wisconsin, do not lie athwart these natural routes, must wait until their own resources attract capital, settlers and railways.

THE SANDSTONE BELT

Since the farming conditions of the sandstone belt are generally below those in the limestone belt, there must be a reason. That reason is *the character of the soil.*† The eastern part of the sandstone area was glaciated and here the average

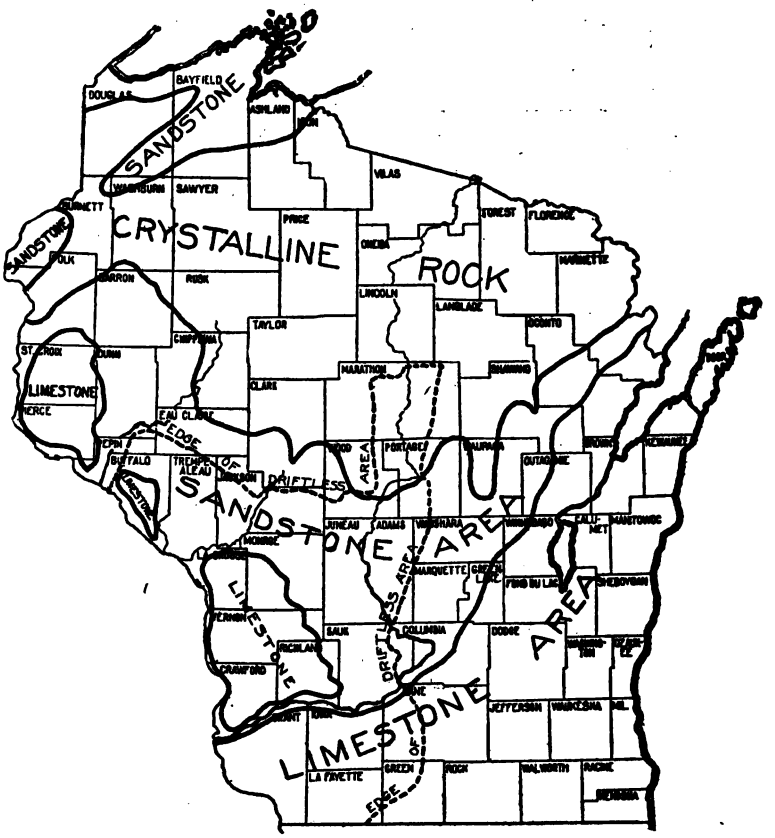


Fig. 15. Generalized map showing the bed rocks which predominate in various parts of the state.

value of the land is about $30.00 an acre,* while the average value of the land in the unglaciated portion is about $24.00 an acre.* In one county it is $17.25 an acre, but this county had

† See Whitson, A. R. and Sievers, F. J., Bull. 204, Uni. of Wis. Agr. Exp. Sta., *The Improvement of Sandy Soils*, (1911).

* According to the U. S. Census of 1910.

no railroad up to 1911. The limestone land which lies immediately east of the sandstone belt is valued at an average of $61.00 an acre, or twice as much as the average glacial soil of the sandstone region, and two and one-half times as much as the average driftless soil of the sandstone region.

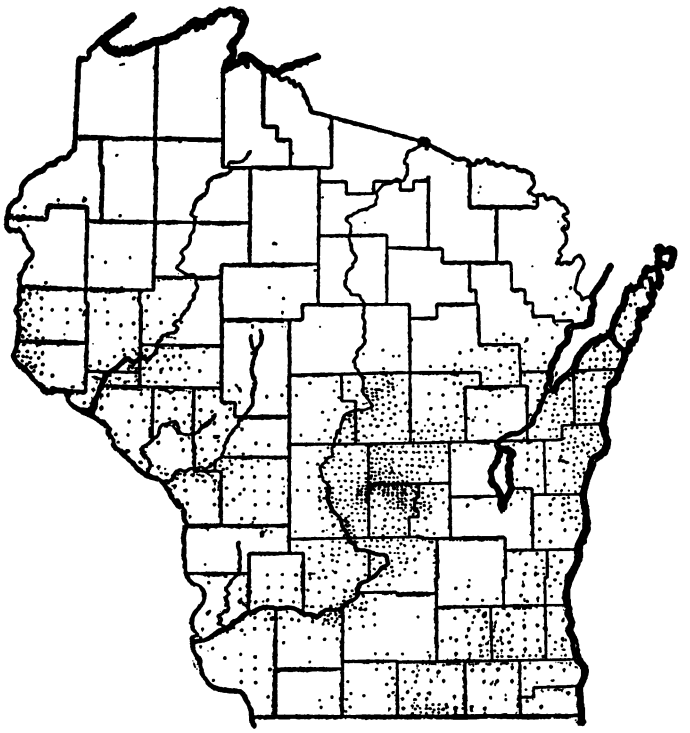


Fig. 16. Map showing where the rye-crop of Wisconsin is grown. Figures from census of 1905. Map furnished by the College of Agriculture. One dot equals 200 acres.

There are approximately 3,000,000 acres of sandy soil in this belt. These soils have three drawbacks:

1. Their low water-holding capacity,
2. The readiness with which they are blown by the wind,
3. Their general lack of fertility.

Of the three important elements of fertility, phosphoric acid, nitrogen and potash, these sandy soils possess, on an average, one-half or one-third as much as the clay and loam soils. Yet, sandy soils have some advantages. They become dry and warm earlier in the spring, and hence are suited to early vegetables and

small fruits. Certain crops which require frequent cultivating, like potatoes, thrive in sandy soils. The chief potato-growing counties of Wisconsin are in the sandstone belt. Rye grows well in sandy soil, and the leading rye-producing counties are in the sandstone area, and along the shore of Lake Michigan. Buckwheat, a quick-maturing crop, is grown more extensively

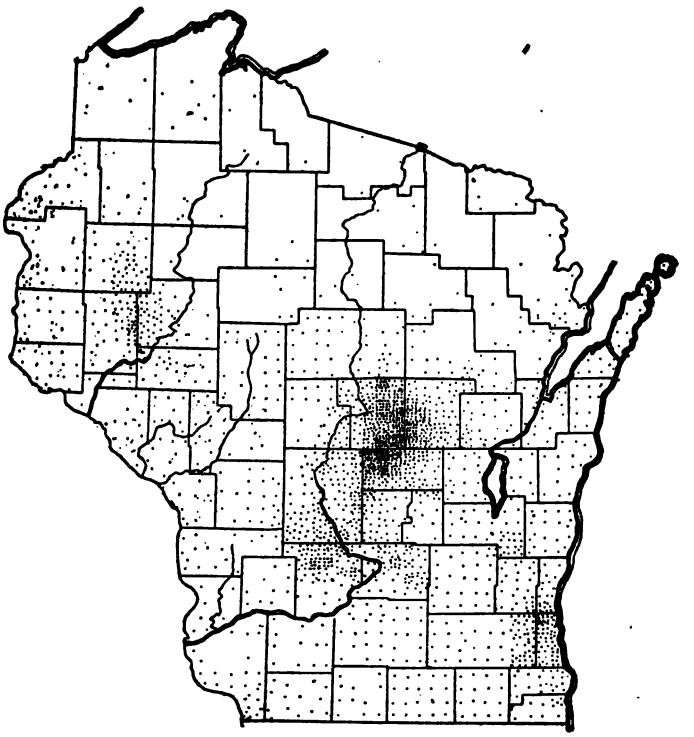


Fig. 17. Map showing where the potato crop of Wisconsin is grown. Figures from census of 1905. Map furnished by the College of Agriculture. One dot equals 200 acres.

in the sandstone belt than in any other part of the state. On the whole, however, this middle belt of Wisconsin produces a limited variety of crops and the major part of the land is, as yet, producing almost no commercial crops at all.

THE LIMESTONE BELT

About two-thirds of this area has a glacial soil and the remaining third has a residual soil with alluvium in the main

valley bottoms; there are also regions where loess covers the surface.*

About one-tenth of the substance composing the Wisconsin limestones is clay, which is practically insoluble in the underground water. The remaining nine-tenths of these surface

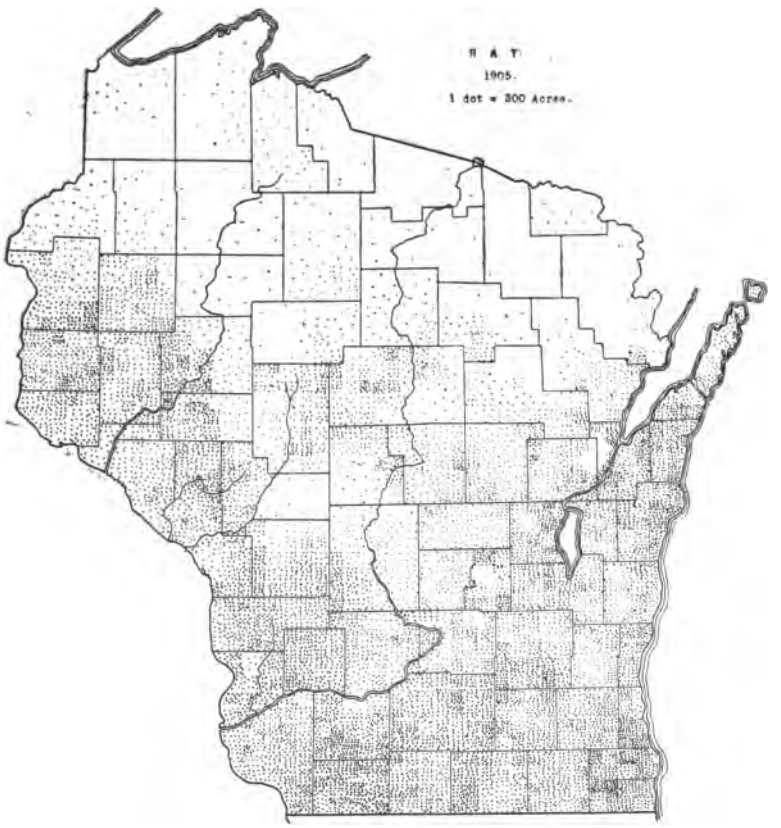


Fig. 18. Map showing where the hay crop of Wisconsin is grown. Figures from census of 1905. Map furnished by the College of Agriculture.

rocks are slowly dissolved and carried away by the waters which come in contact with them. The soluble portions of the rock are leached out, leaving the less soluble and the insoluble parts to

* Loess is a very fine, rich soil, believed to have been carried and deposited by the wind.

A. ROCK EXPOSURE SHOWING THE FORMATION OF SOIL BY THE WEATHERING OF SANDSTONE.

B. ROCK EXPOSURE SHOWING THE FORMATION OF SOIL BY THE WEATHERING OF LIMESTONE.

make up the soil. This residual material of the driftless limestone area is of varying depth.†

While it is true that most of the lime has leached out of these

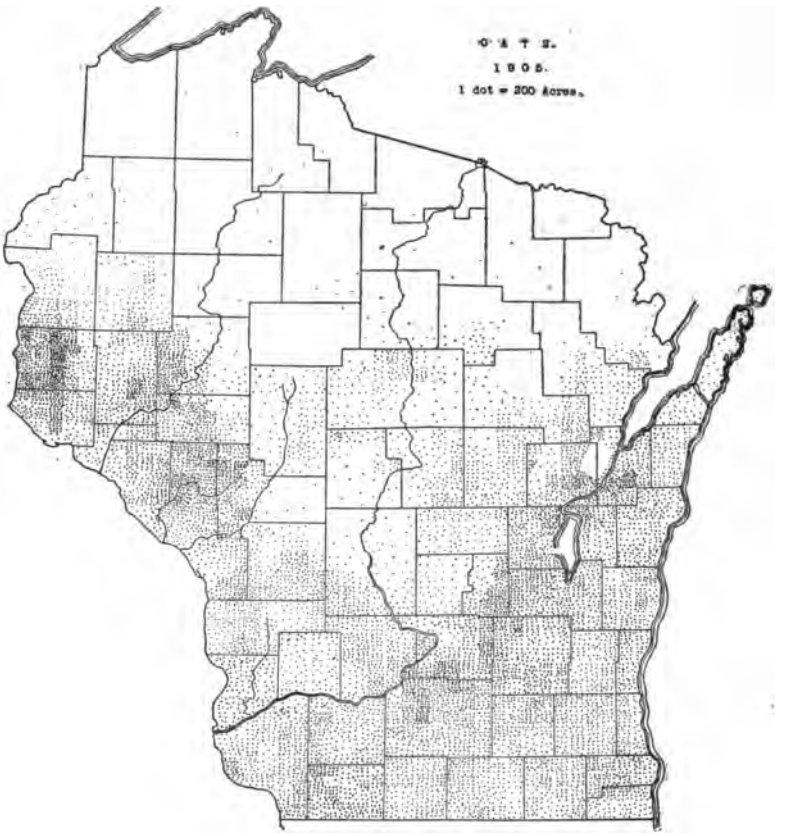


Fig. 19. Map showing where the Wisconsin oat crop is produced. Based upon census of 1905. Map furnished by the College of Agriculture.

surface soils, enough remains to prevent acidity and keep the soil sweet. The exceedingly fine-grained texture of these

† Professors Chamberlin and Salisbury report that: "Of about 1,000 measurements on slopes, steep and gentle, the average depth is 4.61 feet. On ridges, not including broad tracts of upland, the average as shown by 360 measurements is 8.06 feet. Two hundred and nineteen measurements on broad upland tracts give an average of 13.55 feet. The average for broad ravine bottoms, or short, wide valleys unoccupied by streams is 6.93 feet as indicated by 123 measurements. The average of 55 valley measurements is 18.17 feet." *Sixth Ann. Report, U. S. Geol. Survey*, 1884–5, p. 254.

Note. In these measurements, no distinction is made between the residual soil and any possible coating of loess which may have covered it.

clay loams gives them a high capacity for holding moisture, and this quality makes them excellent soils for grass, pasture land, and most grains. The extensive development of dairying and stock raising in southwestern Wisconsin is closely connected with this grass-producing quality of the residual clay

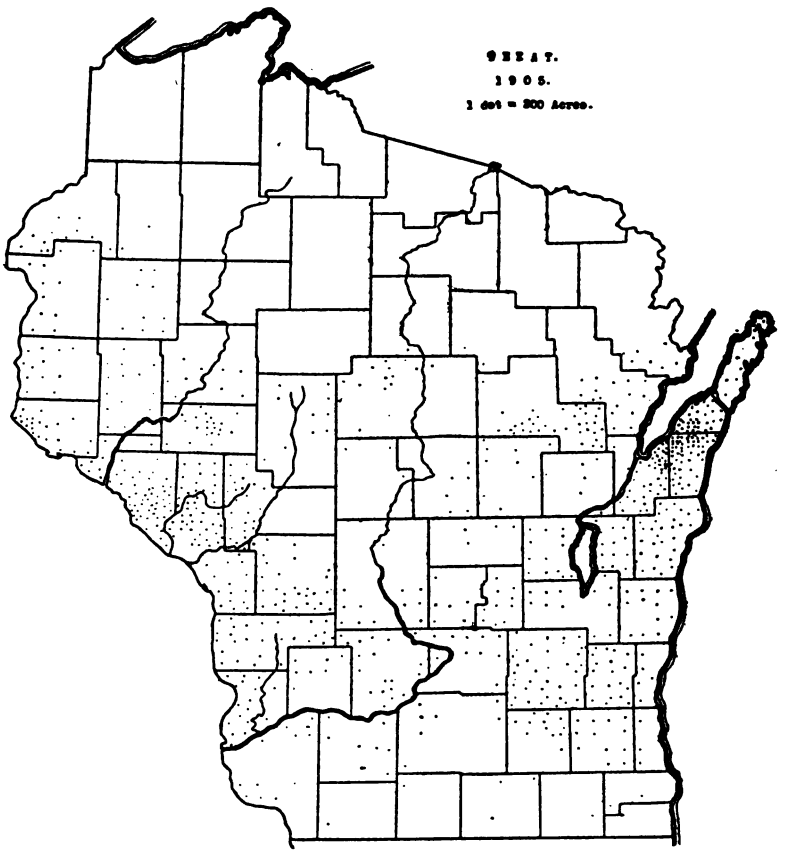


Fig. 20. Map showing where the wheat crop of Wisconsin is grown. Based upon census of 1905. Map furnished by the College of Agriculture.

soils. In this respect it resembles the famous Blue Grass region of Kentucky.

There is in this belt another geographical condition which has a marked influence upon farming, perhaps as much effect as the quality of the soil itself, namely, *the topography*. Southwestern Wisconsin is hilly. The streams have eroded their

A. ALFALFA FIELD AT BLACK EARTH, DANE COUNTY.

B. TYPE OF FARM LANDS IN THE HILLY PART OF THE DRIFTLESS AREA OF WISCONSIN.

Scene near Black Earth, Dane County.

valleys deeply into the limestone and in many cases entirely through it into the softer sandstone below. The hills are steep, and many of the slopes cannot be cultivated, for if they were plowed, the soil would rapidly wash away. So the farmers leave them in pasture land and woodland. Such conditions quite naturally give rise to dairy farming and to sheep and cattle raising. Not that more cattle are raised on these hills than upon the level land, but that a larger proportion of the land is given over to grazing, while the raising of crops claims a smaller proportion.

However, in the region south of the Military Ridge, excepting near the Mississippi River in Grant County, the streams do not flow in deep and narrow valleys; many of the valley sides have gentle slopes. Here most of the lands may be plowed, and here are found some of the best farms in Wisconsin. Great numbers of beef cattle and dairy cattle are also raised. In fact, the southern counties in the driftless area are noted for their dairying and stock raising.

GLACIATED PART OF THE LIMESTONE BELT

The greater part of the limestone belt was covered by the glacier and this has modified the soil, the drainage, and the topography, and all of these changes have affected farming. In this belt the glacial soil is largely clay loam, with a mixture of ground-up limestone. It is of variable character from place to place, of greatly varying depth and often imperfectly drained. In productivity, this glacial soil does not differ greatly from the good residual soils of the same belt.

In many cases the natural course of the streams was obstructed by the hills and ridges of drift which were left when the ice melted away. This difference is illustrated in the Rock River basin, the western part of which is in the driftless area, and the eastern part in the drift-covered area. In the driftless portion, the streams divide and subdivide into a perfect and symmetrical net work of branches, completely draining all of the land. In the drift-covered portion the streams branch in the most disordered way, drainage is imperfect and marshes are numerous.

From the standpoint of agriculture, then, two significant changes, besides the effect upon the soil, were introduced by the glacier:

1. The partial and irregular filling of valleys by the glacial drift. Where the surface was hilly, glaciation made it more even,

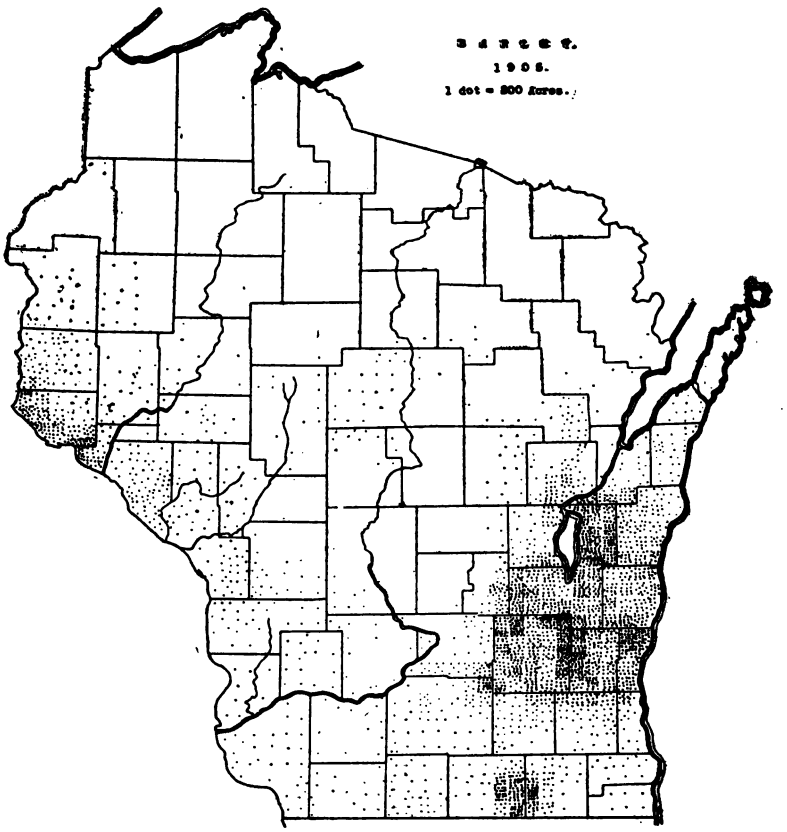


Fig. 21. Map showing where the Wisconsin barley crop is grown. Based upon census of 1905. Map furnished by the College of Agriculture.

while on level lands the glacier added new hills of drift, and made the surface more uneven.

2. By obstructing the valleys with drift, the glacier produced a very great number of lakes and swamps. Many of the shallowest lakes have since slowly changed to swamps, partly due to filling by sediment washed in by streams, and partly due to the growth and partial decay of vegetation, making peat and

muck. Some of these marshes are worthless or worse than worthless to the farmer. Some of them have been drained, and where the land is muck and not peat, it is often exceedingly productive.

The net results of the glaciers' visits have proved distinctly beneficial to agriculture, though a large part of the two and a half million acres of marsh land in Wisconsin must be charged to the work of glaciers.

MARSH LANDS

In the digest of Bulletin 205 of the University of Wisconsin Agricultural Experiment Station, *The Development of Marsh Soils* (1911), Professors Whitson and Sievers say:

> **Wisconsin marsh lands comprise 2,500,000 to 3,000,000 acres, some of which lies in large marshes of 25,000 to 50,000 acres, but a large part is in small tracts. Through proper drainage and soil management much of this land can be made very productive and will add greatly to the farm area of the state.**
>
> **The chemical composition and the possibility of thorough drainage are the chief factors which determine the value of marsh lands for cultivation.**
>
> **The drainage of marshes is the first step toward improvement. On large marshes the organization of drainage districts and the co-operation of a number of adjoining land owners is necessary, but thousands of farms include some marsh land which can be readily drained by the owners without legal difficulties.**
>
> **Fertilization of marsh soils is important on account of the unbalanced condition of the elements which they contain.**
>
> **Acidity develops in marsh soils quite commonly where lime carbonate is not brought in from surrounding higher land. This acidity, however, does not interfere with the growth of crops provided the soil is properly fertilized. The acidity of marsh soils in the southeastern part of the state is very generally neutralized by the lime carbonate in the water seeping in from the surrounding higher lands of this limestone section.**
>
> **The crops best adapted to marsh lands include corn, potatoes, cabbage, buckwheat, and timothy and alsike clover for hay.**

The Chief Crops of Wisconsin

The same progressive change which is going on in all other industries in the state is going on in farming. When Wisconsin had a virgin soil and a small population, wheat was a leading crop, and a surplus was produced. Now not enough wheat is grown in the state to supply our own needs. Wheat is most profitably grown on new, low-priced land. As population increases and cities grow, land advances in value, taxes increase,

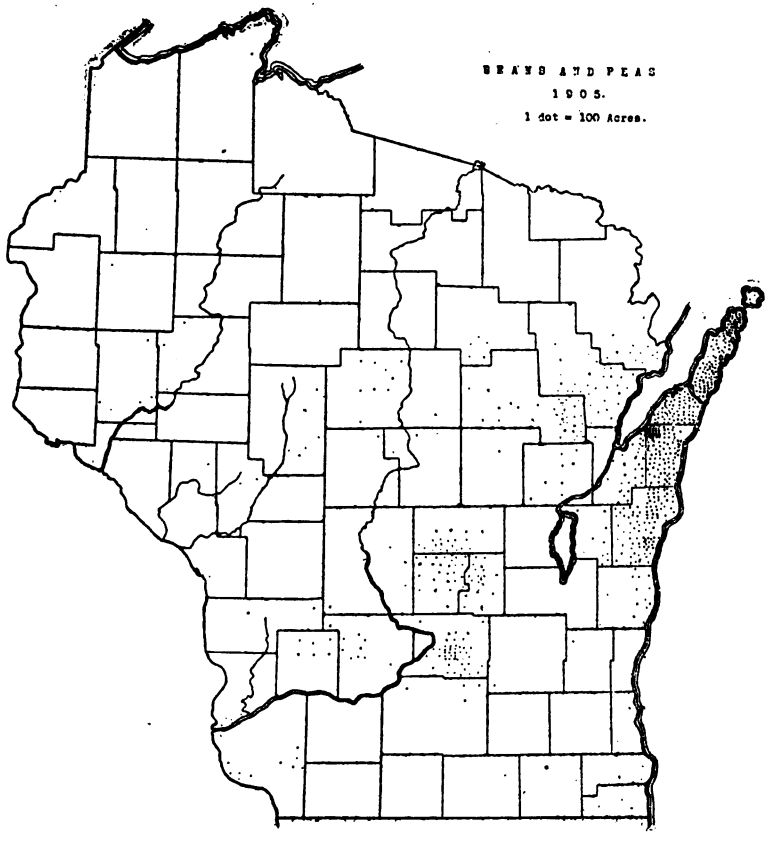


Fig. 22. Map showing counties where beans and peas are extensively grown, generally for canning purposes. Map furnished by the College of Agriculture.

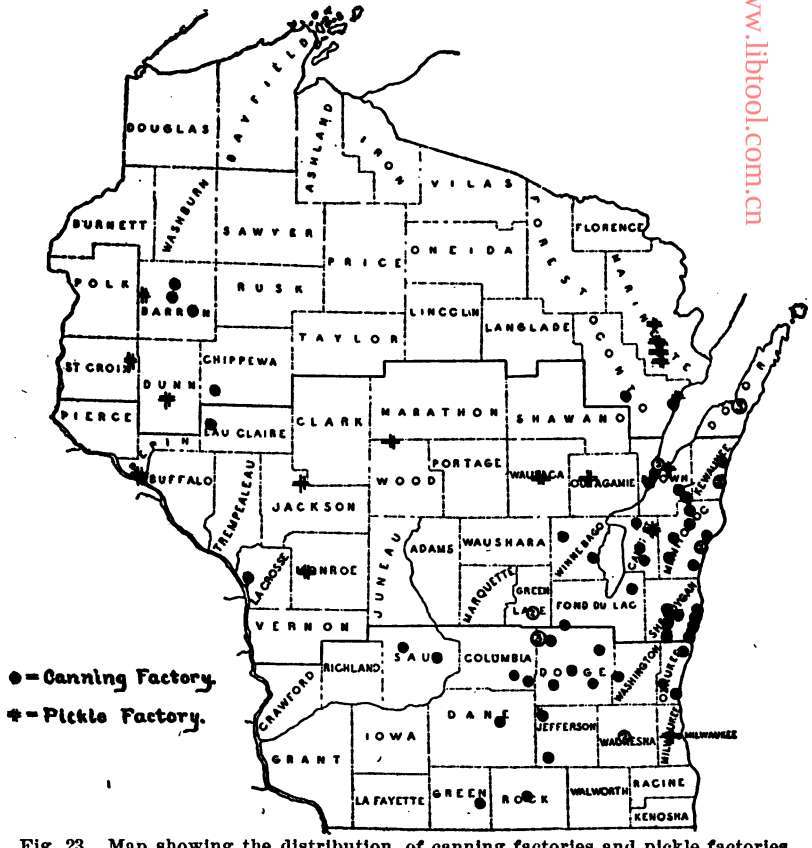


Fig. 23. Map showing the distribution of canning factories and pickle factories in 1910.

and the farmer must get a higher return per acre in order to make farming pay. The average yield of wheat in the United

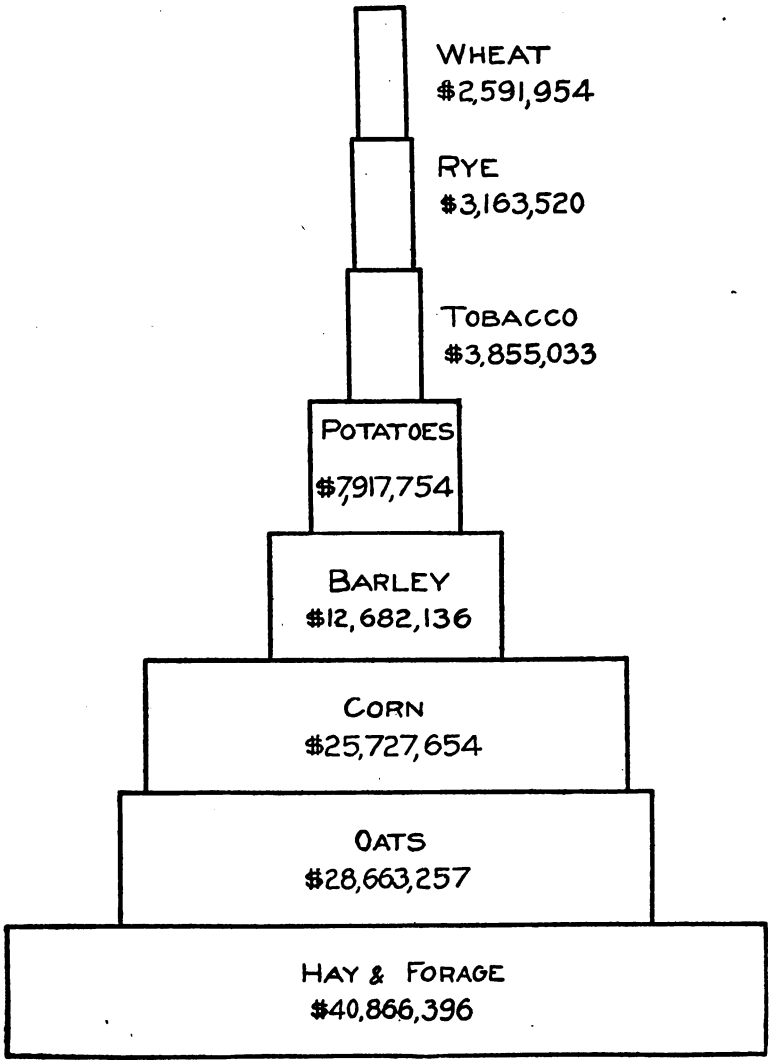


Fig. 24. Diagram showing the value of leading crops grown in Wisconsin in 1909.

States gives the farmer only a gross annual return of $12 to $15 an acre. The need of a larger return from the land and the growing demands of the cities lead to diversified farming, to poultry

raising, garden farming, fruit growing, etc. Agriculture becomes more varied and more intensive. Over eight million acres, two-thirds of the improved land of the state, were devoted to seven crops in 1909. These crops, in order of value, were hay, oats, corn, barley, potatoes, tobacco and rye. Five million acres

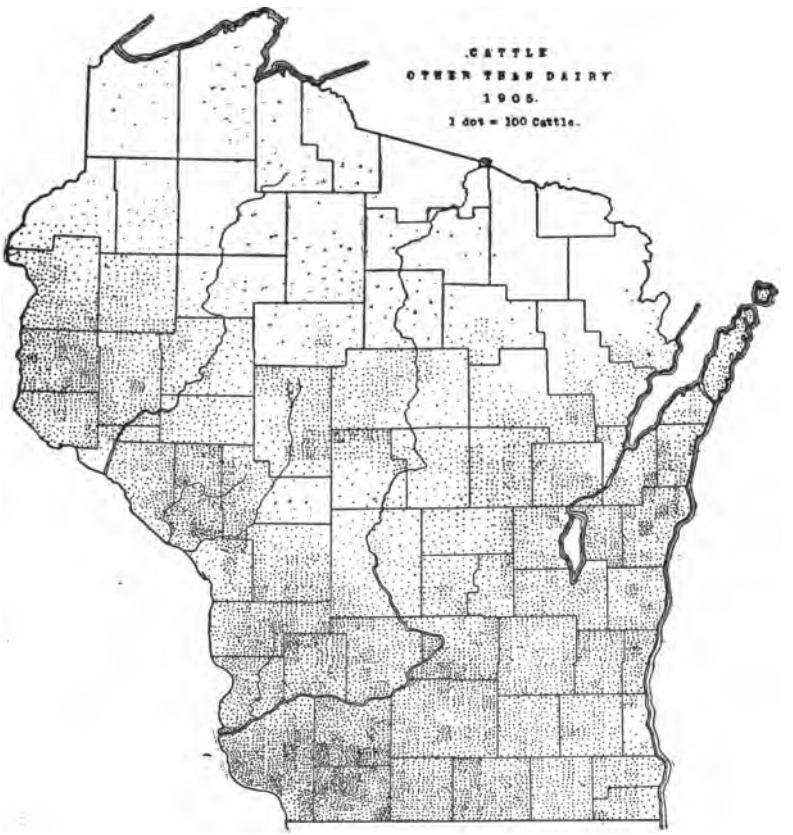


Fig. 25. Map showing the distribution of cattle other than dairy cows in Wisconsin. Based upon census of 1905. Map furnished by the College of Agriculture.

were devoted to the cereals and three million acres to hay and forage. Some crops, such as hay and potatoes, are raised by nearly all farmers. Other crops, such as tobacco and sugar beets, are raised by comparatively few. The extent to which certain crops are grown is shown by the following:

There were 177,127 farms in the state in 1909.
161,248 of these farms in 1909 raised hay as one crop.
158,658 raised potatoes as one crop.
136,670 raised oats as one crop.
129,335 raised corn as one crop.
87,540 raised barley as one crop.
40,170 raised rye as one crop.
9,390 raised tobacco as one crop.

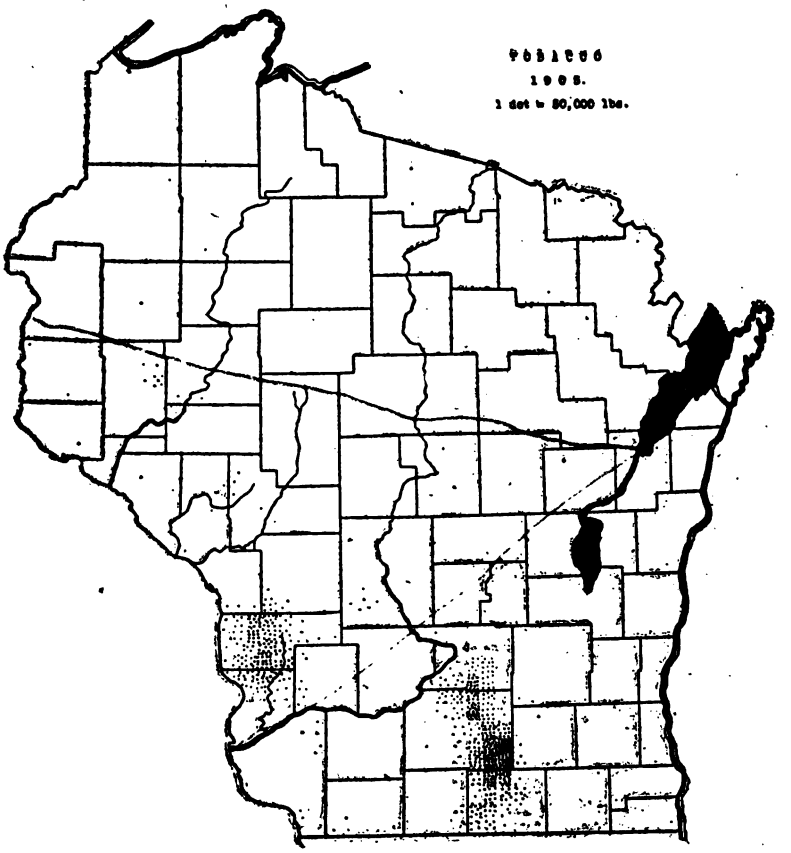


Fig. 26. Map showing where the Wisconsin tobacco crop is grown. Based upon census of 1905. Map furnished by the College of Agriculture.

The raising of livestock and poultry is another important phase of agriculture. In 1910 Wisconsin farmers had nearly 2,700,000 cattle, somewhat more than the total number of people (2,333,860), in the state. There were also 600,000 horses, nearly 2,000,000 swine, a million sheep and nine and a half million poultry.

Wisconsin devotes 40,000 acres to tobacco.

TABLE 6.

Relative Acreage of Tobacco by Counties, 1909.

County.	Acres.
Dane	14,000
Vernon	6,317
Rock	6,270
Columbia	2,920
Crawford	2,228
Other counties	6,509

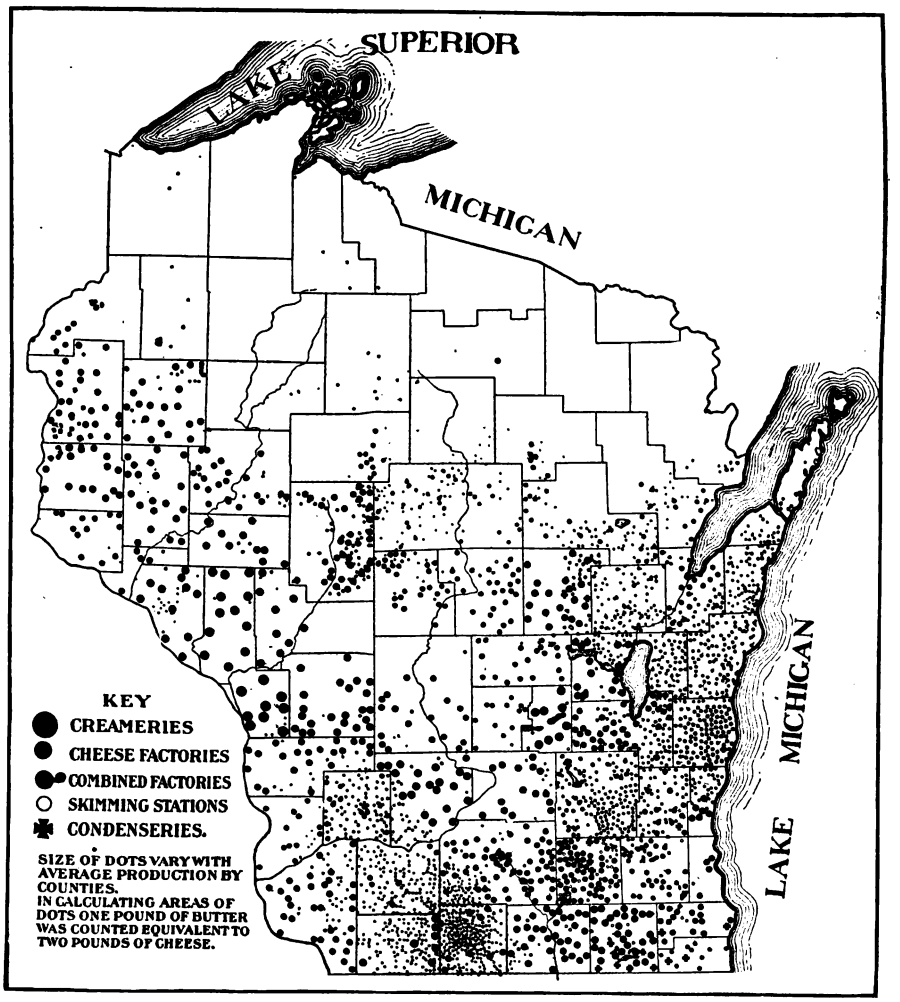
Tobacco growing began in Wisconsin some 50 years ago. The annual crop amounts to about 50,000,000 pounds, worth from $5,000,000 to $6,000,000. Sandy loam is the best soil for tobacco; light clay loam and prairie soil are next best.

DAIRYING AND DAIRY PRODUCTS

The most notable development in agricultural lines in Wisconsin during the last decade has been in dairying. The state now stands at the head of the dairying states of the union. In 1912 there were over 3,000 cheese factories and creameries in the state, and the shipping of milk to cities is rapidly increasing in southeastern Wisconsin, due especially to the growing demands of Chicago and Milwaukee. The production of condensed milk is largely confined to the southeastern part of the state.*

In Experiment Station Bulletin 210, (1911) on "*The Progress of the Dairy Industry in Wisconsin,*" Professors C. E. Lee and H. C. Taylor say, "The dairy industry has become the most important branch of agriculture in Wisconsin. The changes which have occurred during the period, 1905 to 1910, show that both dairy farming and dairy manufacturing are securing a firm footing in the newly developed regions of the north. This, to-

* These condenseries handled 115,000,000 quarts of milk in 1909.



MAP SHOWING THE DISTRIBUTION OF CREAMERIES, CHEESE FACTORIES, SKIMMING STATIONS AND CONDENSERIES IN 1911.

Map Furnished By the College of Agriculture.

gether with an increase in production in the older dairy regions, indicates a stable and permanent industry. Dairying as a farm industry is adjusting itself to the influences of the various factors,—soil, climate, competing enterprises, and location with respect to the markets."

Plate XII showing the distribution of cheese factories, creameries, skimming stations and condenseries, is worth careful study. The following condensed statements give the chief facts concerning this great industry in 1910–12*:

1. There are as yet relatively few factories or creameries in the northern part of the state, due to undeveloped agricultural conditions.

2. Cheese factories and creameries are few in seven counties in the central portion of the state—largely due to the sandy character of the soil, unfavorable to pasturage.

3. Practically all of the 3,000 cheese factories and creameries are in the region of clay soils whose water-retaining capacity favors pastures and meadows.

4. The creameries are most numerous in the corn belt; butter making is a response to winter as well as to summer dairying; corn, in the form of ensilage, is the economical winter feed for cows; the corn belt closely coincides with the region of 150-day growing season, and in this belt cheese factories seem unable to meet the competition of butter factories.

5. The cheese factories almost monopolize a region near Lake Michigan and another in the rougher and higher lands of the southwest; for cheese-making is a response to summer dairying, prospers where the weather, especially the nights, are cool, and hence where corn growing is less important.

6. Wisconsin leads in the making of Swiss cheese, chiefly carried on in the Swiss settlements in the southern part of the state. This cheese is more sensitive to soil and climatic conditions than any other kind; the Swiss factories are nearly all on land 900 to 1000 feet in altitude, and 95% of the 275 factories are on

* For a large part of the data on dairying, the writer is indebted to Mr. O. E. Baker formerly of the Agricultural College. For reviews of the growth of dairying see the following bulletins of the Wis. Agr. Exp. Sta.: Bul. 60, May, 1897; Bul. 88, Sept., 1901; Bul. 140, Sept., 1906; Bul. 210, June, 1911.

limestone land, while 70% of the 106 factories making Limburger cheese are grouped in the low valleys on sandstone land.*

7. Northern Wisconsin, with its clay soil and cool climate, promises to develop into another great cheese-making section.

8. Wisconsin's dairy products now amount to over $80,000,

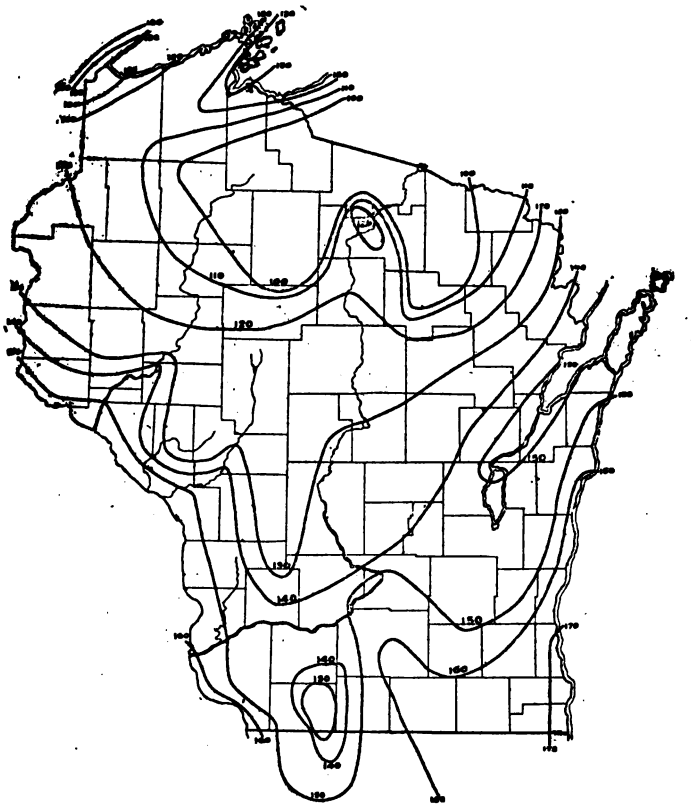


Fig. 27. Map showing length of growing season in days—the average period between last killing frost in spring and first killing frost in autumn. Map furnished by the College of Agriculture.

000 annually, have doubled in ten years, and are greater than those of New York, heretofore the leader.

9. This trend toward dairy farming is most beneficial to the agricultural interests of the state.

The great prosperity and the rapid development of the dairy

* Whitson, A. R., and Baker, O. E., *The Climate of Wisconsin and its Relation to Agriculture*, Uni. of Wis. Agr. Exp. Sta., Bull. 223, July, 1912, pp. 52, 53.

A. STOCK FARM NEAR MINERAL POINT IN SOUTHWESTERN WISCONSIN.
The raising of beef-cattle is an important industry in this part of the state.

B. A TYPICAL FARM SCENE IN THE PARTIALLY DEVELOPED PORTION OF NORTHERN WISCONSIN.

industry in Wisconsin cannot be explained alone on the basis of geographic causes. A farsighted man, Ex-Governor Hoard, and an institution, the College of Agriculture of the State University, through their continuous campaigns of education, have been significant factors in the growth of this industry. Natural conditions made profitable dairying possible; a well directed policy of education brought it to its present high development.

SUMMARY OF AGRICULTURE AND DAIRYING

Wisconsin is grouped with the agricultural states, although the *gross* annual value of its manufactures exceeds that of its farm products. About 60% of the land area of the state is in farms. Nearly all of the southeastern third is improved; but eleven counties in the northern part of the state had, in 1910, only about one-tenth of their land in farms. About 36% of the land area of the state is improved farm land, and the farm property is valued at over one and a half billion dollars. In the southeastern third of the state the average value of land in around $100 an acre.

Speaking in very general terms, there are three soil belts in the state, based upon the character of the underlying rock:

1. The glacial soils on the crystalline rocks of the north, both sand and clay.
2. The light soils on the sandstone rocks in the middle belt, both glacial and non-glacial.
3. The clay-loam soils on the limestone rocks in the southern belt, both glacial and non-glacial.

Over four-fifths of the soil of Wisconsin is glacial, and it is, as a whole, somewhat better than the average soil of the driftless region, though one of the best farming regions in the state is found in the driftless area in the southern tier of counties. The wide difference between the well developed farming conditions in the southern half of the state and the partially developed condition of the northern half is due chiefly to three causes:

1. A milder climate and a longer growing season in the south,
2. The greater ease with which the hard wood lands were cleared,
3. Earlier and better transportation facilities,

4. A longer period of settlement due to the fact that the settlement of the state proceeded from the south and east, and that the densest forests were in the north.

The northern half of the state is developing steadily and it is proving to be well adapted to farming, and especially to

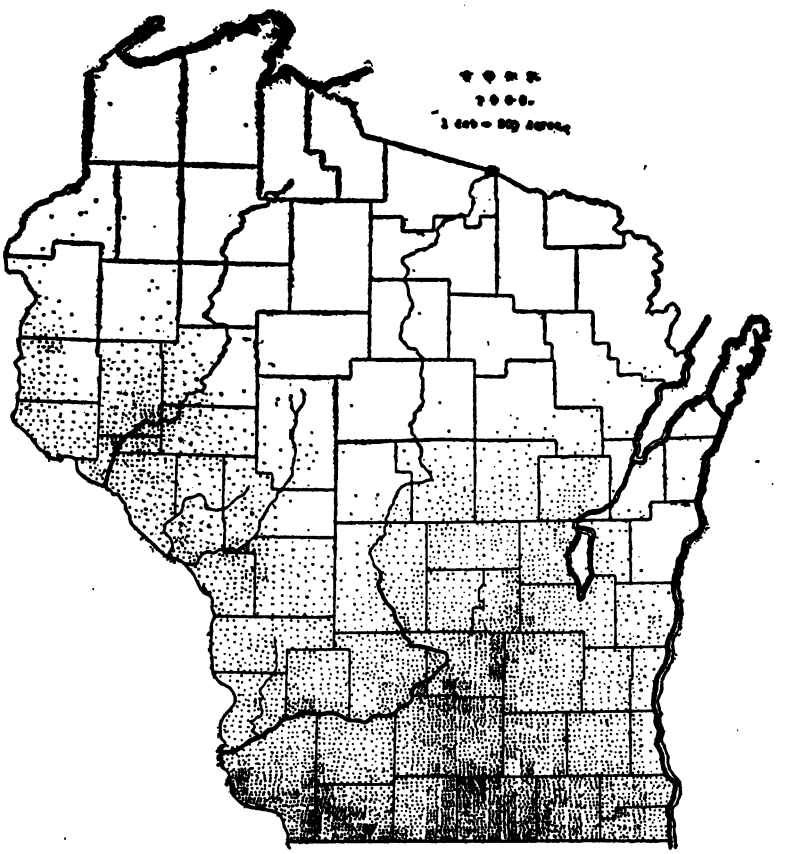


Fig. 28. Map showing where the corn crop of Wisconsin is grown. Based upon census of 1905. Map furnished by the College of Agriculture.

dairying. The sandy soils in the central part of the state are less productive than the clay soils, because of (1) their low water-holding capacity, (2) the readiness with which they are blown by the wind and (3) their lower degree of fertility. Rye, buckwheat, and especially potatoes are the profitable crops of the sandy soils.

A. SEVEN-YEAR-OLD McMAHON APPLE TREE IN DOOR COUNTY, ONE OF THE LEADING FRUIT DISTRICTS OF THE STATE.

B. EXHIBIT OF WISCONSIN-GROWN FRUIT AT STATE FAIR IN 1908.

The glacial till and the residual loam of the limestone belt are largely clay. These soils hold water, contain considerable lime; and are the most productive.

The hilly character of the southwestern part of the state has led to dairying and stock raising. The clay soils favor the production of grass and hay and also lead to grazing. Cheese factories are particularly a response to summer dairying and are most numerous in the cooler parts of the dairying region. Creameries are a response to winter as well as summer dairying and are most numerous in the corn belt of the state.

In order of value, the leading crops of Wisconsin are, (1) hay, (2) oats, (3) corn, (4) barley, (5) potatoes, (6) tobacco, (7) rye, (8) wheat. The total value of dairy products is greater than any of these; equal, in fact, to the leading two. Fig. 24.

FRUIT GROWING

Southern Wisconsin is in the same latitude as the famous fruit belts of New York, Ontario, and Michigan, but a significant climatic difference exists. The influence exerted upon climate by the Great Lakes is most effective on the lands which lie immediately east of these lakes, because the prevailing winds come from the west. Large bodies of water warm slowly in the spring and cool off slowly in the fall. Winds blowing over water-bodies, such as the Great Lakes, are cooled or warmed according to the temperature of the water over which they blow. The climatic effect of the Great Lakes, especially upon the lands lying immediately east of them, is to hold back the warm temperature of spring and thus to retard the opening of the sensitive buds of the fruit trees; thereby they are saved from injury or destruction from belated spring frosts. In the fall, the lakes have the opposite climatic effect. Their stored-up heat is given off to the passing winds and prolongs the summer temperatures in their immediate neighborhood; this makes a warmer autumn and permits the maturing of the fruit.

Lake Superior and Lake Michigan exert a beneficial climatic influence upon fruit growing in parts of Wisconsin, but it is less marked than it is in Michigan, because the prevailing direction of the wind is from the west. In Wisconsin the influence of the water is particularly effective in the Door County

peninsula, situated between Green Bay and Lake Michigan, for this narrow strip of land has water on both sides. The Bayfield peninsula projecting into Lake Superior, is similarly though less influenced by the waters of Lake Superior. These two peninsulas are becoming important producers of fruits. Door County in 1911 had 2,000 acres of cherry orchards, a quarter of a million trees, mostly on the northern side of Sturgeon Bay. The success of fruit growing in this region will inevitably lead to its extension. Successful cherry orchards have yielded several hundred dollars an acre a year. The raising of strawberries in this region is also a profitable and growing industry.

Most of the counties bordering on Lake Michigan produce fruit successfully. In the region about Sparta, Monroe County, the production of small fruits, especially berries, has become a conspicuous industry; this is one of the leading small-fruit sections of the state. Here hundreds of acres are devoted to strawberries. The higher lands extending from the Baraboo ranges in Sauk County westward to the Mississippi produce apples abundantly. A region extending westward from Dane County and another made up of parts of Waupaca, Outagamie and Winnebago counties are also producing apples in considerable quantities. Experience seems to show that limestone soil and an upland topography are favorable to fruit trees and that sandy soil, muck soil or low-lying land is not favorable. It is now known that, during cool nights, the cooler and heavier air flows down the slopes of the hills into the valleys, making them colder than the slopes and thus sometimes causing the low valley lands to have frost when the higher lands escape. The fruits most successfully produced are apples, such as the Dutchess, McMahon and Wealthy, cherries, berries and plums. Cranberries will be spoken of separately. Pears, peaches, winter apples and grapes are grown, but scarcely as yet on a commercial scale. Berries of nearly all kinds can be successfully grown in all parts of the state.

Cranberries:—Wisconsin is one of the few states in which cranberries are grown on a commercial scale. During the decade from 1890 to 1900, the state produced approximately one-eighth of the cranberries grown in the United States or over 100,000

bushels annually. Connecticut, New Jersey and Cape Cod are still larger producers. Cranberries grow in marshy soil, or bogs. The best type is a peat bog with an acidic soil, capable of being

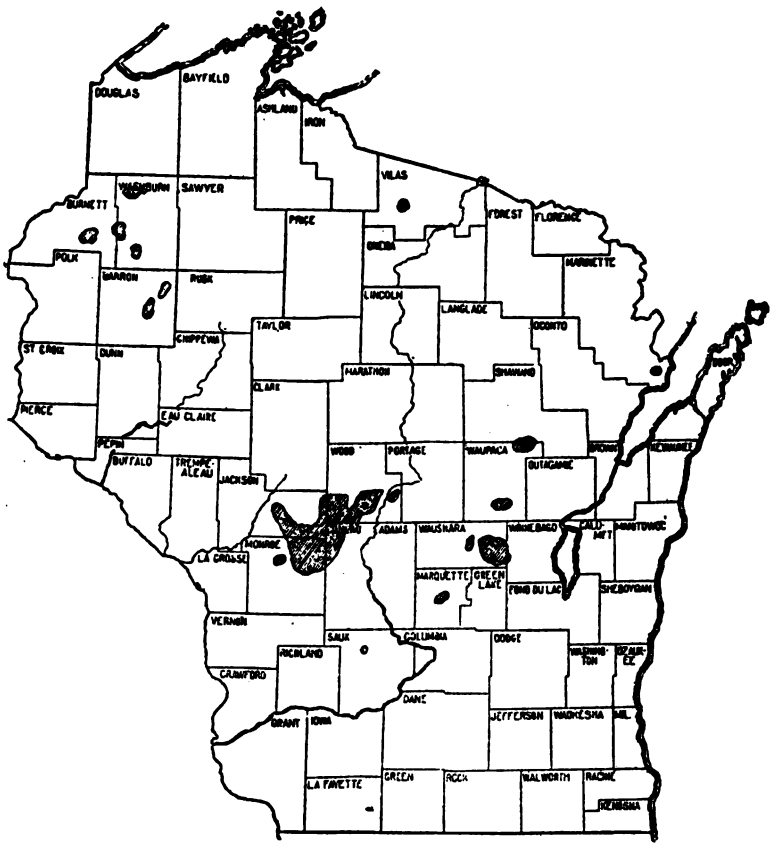


Fig. 29. Cranberry-growing districts of Wisconsin. Map furnished by the College of Agriculture. Wisconsin produced over 50,000 barrels of cranberries in 1912.

thoroughly flooded with soft water when flooding is desired, and capable of being readily drained when desired.

There are thousands of acres of marsh lands suited to cranberry-growing in Wisconsin; about 2,500 acres are now producing. The chief cranberry region is the extensive marsh lands of Jackson, Juneau, Wood and Monroe counties, in the region

of the residual sandy soils of the driftless area. The cranberry industry requires that an abundance of sand be available for sanding the bog.*

* The University of Wisconsin Agr. Exp. Sta. Bulletins 119, 159 and 213 deal with phases of the cranberry industry.

CHAPTER V

MANUFACTURING

General Conditions Affecting Manufacturing in Wisconsin

Importance of Stage and of Location. Manufacturing in a small way takes place even in a frontier community, but manufacturing on a large scale takes place only in the developed, thickly populated, and wealthy parts of a country. In the United States, development began in the East and has moved westward. Massachusetts and New York, for example, have had time to build up manufacturing more extensively than Ohio or Illinois, and Ohio and Illinois have had a longer time than Wisconsin or Minnesota. A state's development along industrial lines is affected by a variety of influences.

Manufacturing is one of the forms of activity in which men engage for profit. We sometimes speak of the growth and decline of a certain industry, say the sawing of lumber, as if it came into being, grew, and declined because of some power inherent in itself—as if it were a kind of organism. The fact, of course, is that the growth of an industry is the result of man's work, directed by his intelligence and succeeding or failing largely as he is wise or unwise in what he does. While the impelling force behind industries is man, yet man can make an industry successful and profitable only as he works in harmony with the natural conditions around him. Rarely can he arbitrarily declare that this industry or that shall be developed in a given place. For example, he cannot successfully manufacture cotton goods where raw cotton is very difficult to secure, or silk goods in remote parts of the country far from the centers of wealth and population. He cannot operate cheese factories or creameries in sections where grass does not thrive. He cannot make iron smelting profitable in a place far removed from both the coal and iron-ore regions. In short, man must

take account of a variety of considerations when he is about to enter upon an important industrial undertaking. Since manufacturing is carried on for profit and the products must be sold in a competitive market, men find that a profit can be made only when the articles or goods are produced under favorable conditions; conditions which make many economies possible. In so far as he is shrewd in selecting a phase of industry which fits the environment in which it is to be con-

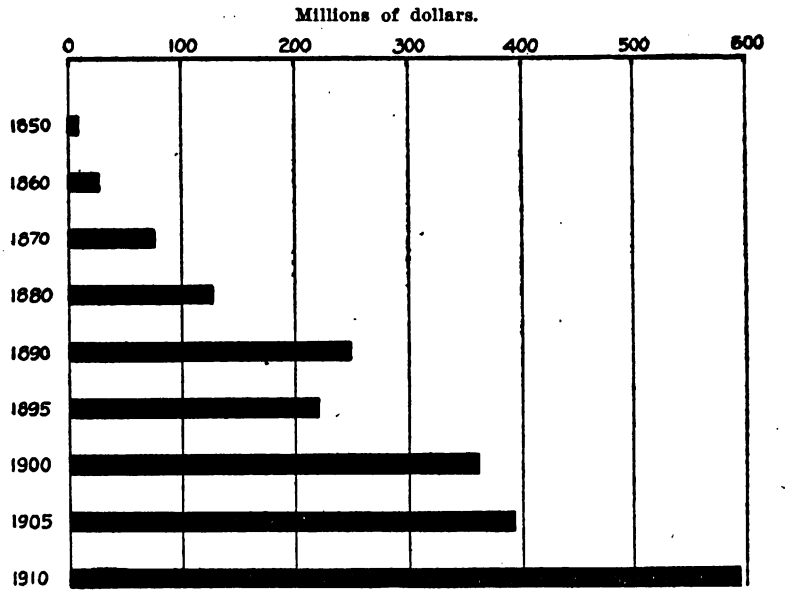


Fig. 30. Diagram showing the growth of manufacturing in Wisconsin from 1850 to 1910.

ducted, in just so far man has taken the first steps toward success in his enterprise. His undertaking is not likely to prosper unless it is well suited to its location, but it is not sure to succeed even though it is thus well suited. In other words, the location may *prevent,* but it cannot *insure* success. Recognizing the importance of wise and efficient direction on man's part, we shall discover that the manufacturing industries of Wisconsin, as of any other state, are to a large degree an outgrowth of certain natural or geographical conditions which prevail there; *the industries are a response to their geographical environment.*

The earlier the stage of development in which a state or a region is, the more fully its industries are shaped by natural conditions. The early manufacturers in Wisconsin had a limited choice among the lines in which they might engage. There were saw mills, planing mills, tanneries and wood working factories because the country had forests. Only industries which utilized the raw materials obtainable near by could succeed. As time went on, and more people came, and railroads furnished better transportation, men had larger choice among the lines of manufacturing which they might carry on. Yet it is still true that manufacturing in Wisconsin is prevailingly shaped by the natural resources of the state. With occasional exceptions, one can discover why a certain phase of manufacturing exists in a certain place. This is not true to the same extent in the older states of the East. For the more advanced the stage of industrial development, the less simple are the causes which determine men's choice of the enterprises in which they engage. Where population is dense and transportation facilities are ample, there is a market for everything, and a person may pursue any one of several lines of manufacturing with almost equal advantage. The cities of the North Atlantic states may manufacture hundreds of kinds of things at a profit, even though the raw material may be brought long distances. The dense population of these states provides a ready market. For example, of some 24 leading lines of manufacturing carried on in New Jersey, only two or three use raw materials produced to any considerable extent in the state. Much the same is true of three of the New England states. But in a state like Wisconsin, whose population is still rather small and scattered, whose northern half is just passing from the lumbering to the farming stage and most of whose southern half is in the agricultural stage, the prominent lines of manufacturing are usually based upon the natural resources of the regions in which they exist. The chief exception to this will prove to be Milwaukee, for Milwaukee has passed the stage of industrial development which prevails elsewhere in the state. To a certain extent it will also be true of other cities in the southeastern counties.

The Importance of Transportation. Manufacturing involves the bringing together of raw materials and the distribution of finished products, and means of transportation are an all-important factor. Water transportation is cheaper than rail, and cities which can offer both rail and water transportation have an advantage. The long line of cities on the shore of Lake Michigan exemplifies this principle. These cities do not make use of water transportation so much as they do of rail transportation; but the fact that, if railroad rates are not reasonable, shippers *can* use the lakes, tends to keep railroad rates lower.

The Importance of Fuel and Power. Another factor of primary importance is the cost of power for running machinery. To a large extent this depends upon the cost of coal, delivered at the factory. Other kinds of power, as electric power and water power, are used, and the latter is growing in importance in Wisconsin. In fact, the state is among the foremost in available water powers. Steam power now constitutes three-fourths of all the power used in the mills of the state.

The Influence of Wisconsin's Situation. One geographical factor which has steadily influenced the industrial expansion of Wisconsin is its northerly location. This is notably true of Northern Wisconsin. The center of population and manufacturing in the United States has moved westward along the 39th parallel of latitude; while middle Wisconsin is 300 miles north of this. The colder climate of the northern border states and their dense forests naturally hindered the rapid settlement and industrial growth which went on in the next tier of states to the south.

The larger part of Wisconsin was densely wooded. Clearing the forests, getting rid of the brush, removing the stumps and putting the land in shape for cultivation is a tremendous task. This is particularly true of the land on which the pine forests grew. Pine stumps decay very slowly, and they are pulled or dug out with difficulty. On such lands it frequently costs a settler more in labor or money to clear the land of brush and stumps than the original price of the land. This is one of the reasons why Northern Wisconsin develops slowly.

The position of the state with respect to two of the great lakes, especially Lake Michigan, has also affected its industrial growth. On the one hand, these lakes have materially benefitted the state. On the other hand, Lake Michigan cuts Wisconsin off from direct land connection with states east of it. The early trunk line railways were built west from the Atlantic ports. The Great Lakes forced them to keep to the south, and they converge upon Chicago, whence they radiate like a great fan northwest, west and southwest. The railroad centers of the immediate northwest are St. Paul and Minneapolis. The trunk lines seek short-cuts between great commercial centers, while branch lines serve the outlying territory. The trunk lines run between Chicago or Milwaukee and the Twin Cities or Duluth; this means that a part of northern Wisconsin was compelled to wait for adequate railway service. Several railway lines save time by transferring cars bodily across Lake Michigan by means of car ferries. See A., Plate XIX.

The value of Situation on One of the Great Lakes. That Wisconsin's situation on Lake Michigan has been a very great advantage to the development of the eastern part of the state may be seen from these facts:

1. Both the largest city of the state and the next largest are on this lake, and one of these cities manufactures goods whose value is nearly ten times that of any other city in the state.
2. There are eleven manufacturing cities on the shore of Lake Michigan and Green Bay, as against two on the Mississippi River.
3. The population of the eleven counties touching on Lake Michigan is greater than that of any thirty other counties in the state.

The Lack of Coal Mines. Wisconsin produces no coal, a fact which might be expected to operate unfavorably upon manufacturing. Possibly it does, though only to a limited extent. A comparison with other states of the Middle West will aid in forming an estimate of the probable effect of Wisconsin's northerly location and of its lack of coal upon the state's growth in manufacturing. Indiana lies directly in the trunk line territory. It is crossed by the 39th and 40th parallels, along which

the centers of population and of manufacturing have moved. It has a milder winter climate, was more readily cleared of forests, was settled earlier and has abundance of coal. Yet the value of manufacturing per capita in 1910 was $215 as against Wisconsin's $254. Missouri has coal, lies directly in important trunk line territory, and has a mild climate, yet the

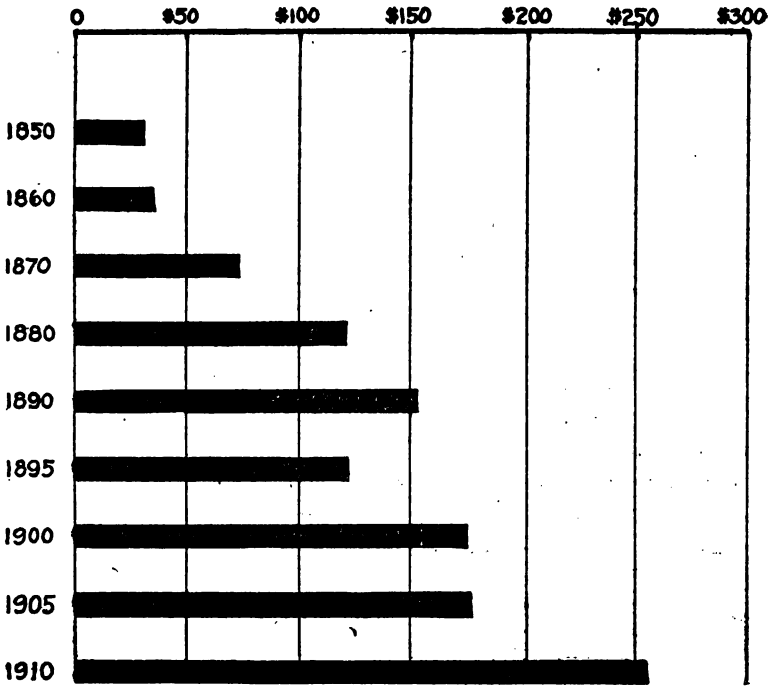


Fig. 31. Diagram showing the increase of manufacturing per capita of the population from 1850 to 1910. In this, Wisconsin leads even Michigan and Illinois.

per capita value of manufactures in 1910 was only $177. The per capita value in Michigan the same year was $245, and in Illinois $206. Thus, Wisconsin leads all of the states west of Ohio in value of manufactures in proportion to population.

It seems evident that, whatever small disadvantage arises from its northerly location or whatever handicap may be imposed by the lack of native coal, there are in Wisconsin other advantages favorable to manufacturing which have more than offset these.

Conditions Which Make for Diffusion or for Concentration of Manufacturing. Of nine important branches of manufacturing in Wisconsin, six may be regarded as diffused and three as concentrated. There are, of course, varying degrees of diffusion or concentration shown by the different branches. The

Fig. 32. Map showing the distribution of pulp and paper mills. The numbers in the circles indicate the number of mills in these places. Note the concentration of mills in the Fox River Valley.

lines of manufacturing which are widely or considerably diffused are (1) butter and cheese, about 3000 factories; (2) lumber and timber products, about 1000 mills; (3) flour and grist mills, over 300; (4) malt liquors, about 140 breweries; (5) furniture, about 100 factories; (6) metal working, chiefly

iron and steel products, about 300 plants, not counting railroad round houses or places which regularly employ less than ten men. Nearly one-half of the metal working plants are in Milwaukee and approximately 80% are in the southeastern quarter of the state. Metal working is, then, a diffused industry

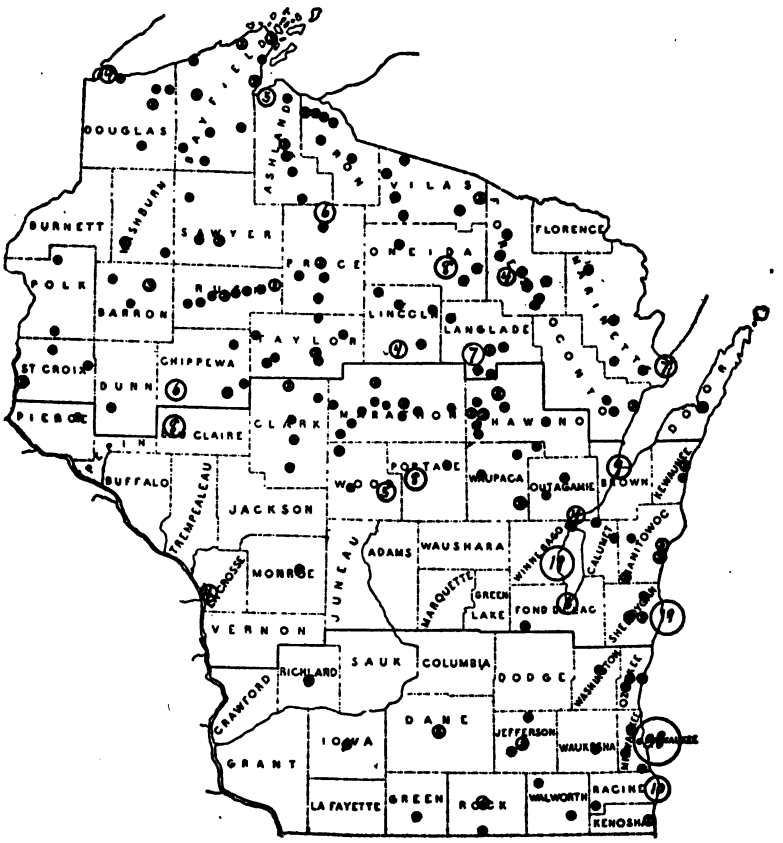


Fig. 33. Map showing the distribution of wood working mills. Based upon the Annual Report of the State Factory Inspector 1910. Mills which employ less than 20 men not considered.

from one standpoint and a somewhat concentrated industry from another.

The manufacture of paper-pulp and paper and of leather, and the packing of meat on a large scale are carried on in a relatively small number of plants, of large output and not widely scattered. Of 57 paper and pulp mills, more than

thirty are along the lower Fox River between Lake Winnebago and Green Bay. Of 32 tanneries, 12 are in Milwaukee.

Causes of the Diffusion of Certain Manufactures. The three thousand butter and cheese factories are widely scattered over the state, but they are by no means uniformly scattered. Since their raw material is milk or cream, which is produced on the farms and which must be made into butter or cheese without delay, the factories are scattered among the dairy farms at frequent intervals. This means many small factories. In the manufacture of butter, the use of the home cream-separator and the practice of sending the cream by haulers or railways to central points, is tending to enlarge the output of such creameries. The making of butter and cheese must, however, remain a diffused industry. In the value of its products, this is one of Wisconsin's leading branches of manufacturing.

The forests yield the raw material for the lumber mills and other wood-using establishments. The timber is scattered over the entire northern half of the state and this has naturally led to a diffusion of saw mills, planing mills and other wood working establishments. In this branch of manufacturing there is a tendency toward concentration, as the forests grow thinner. The number of saw mills is declining, but the number of big mills increased from 1900 to 1905. Because of the wide distribution of the raw material, wood working establishments of various kinds, including furniture factories, are likely to continue to be numerous and scattered. The tendency of the age is, however, toward concentration wherever profits may thereby be increased.

Throughout farming communities there is a demand for flour and feed mills. Once it was more common than it is now for the farmer to depend upon his own wheat and other grain, which he took to the neighboring mill to be ground into flour for his family and feed for his stock. Then every community had its flour and grist mill. Over 300 of these mills are still scattered over the state, but more and more the great mills like those at Minneapolis are supplying the farmers with flour and feed, and many of the village mills have been abandoned. This branch of manufacturing also is tending toward concentration.

The local flour and grist mills and many of the saw mills existed because there was in every community a market for their products. The same explanation accounts for the wide distribution of breweries. Most of the cities and large towns in the state have one or more breweries. In many instances

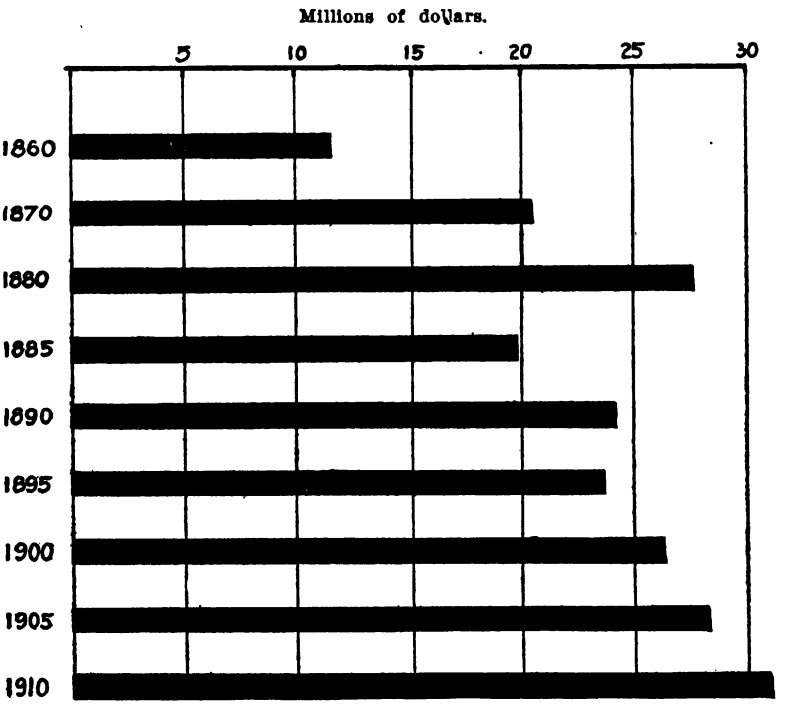


Fig. 34. Diagram showing the value of flour and grist mill products in Wisconsin from 1860 to 1910.

they sell the bulk of their product near home, and are merely local industries. To this extent they belong in the class of diffused industries. Milwaukee, however, has become a brewing center and its products are sent throughout the United States and to foreign countries. The output of Milwaukee's nine breweries exceeds that of all the rest of the state, and to this extent brewing belongs to the class of concentrated industries.

Metal working is both diffused and concentrated, and for much the same reasons as those which apply to the industries just discussed. There is a demand in every community for

iron and steel products and local establishments are sure to spring up to supply this demand. Some of these establishments will grow and will send their products to an ever widening circle of markets and will take on a national or even an international character. Then there comes concentration, as in the

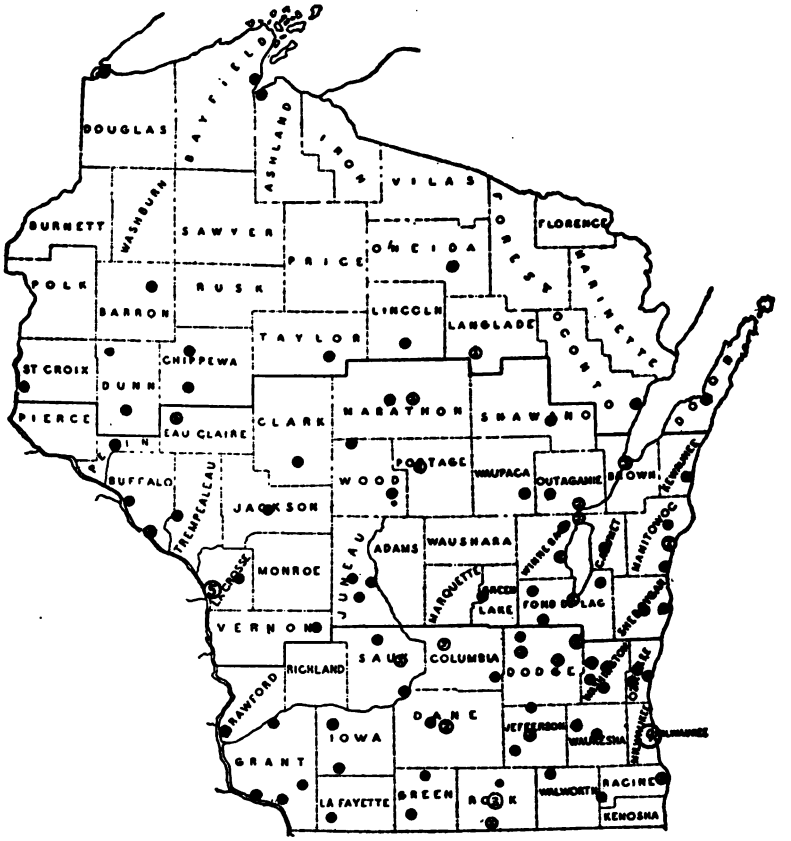


Fig. 35. Map showing the distribution of breweries in Wisconsin. The number in a circle indicates the number of breweries in that place. Milwaukee manufactures more beer than all the rest of the state.

case of the great plants in Milwaukee, West Allis, South Milwaukee and Racine.

In the earlier stages of a state's development small mills or factories, largely local in character, are the rule. Since Wisconsin is not in an advanced stage of industrial growth, the majority of her manufactures are diffused, and to a consider-

able extent, they use raw materials produced in the state. This condition is passing and many plants of large capacity making textiles, knit goods, and boots and shoes have already been established, mostly in the southeastern part of the state. The following cities are reported (1910) by the State Factory

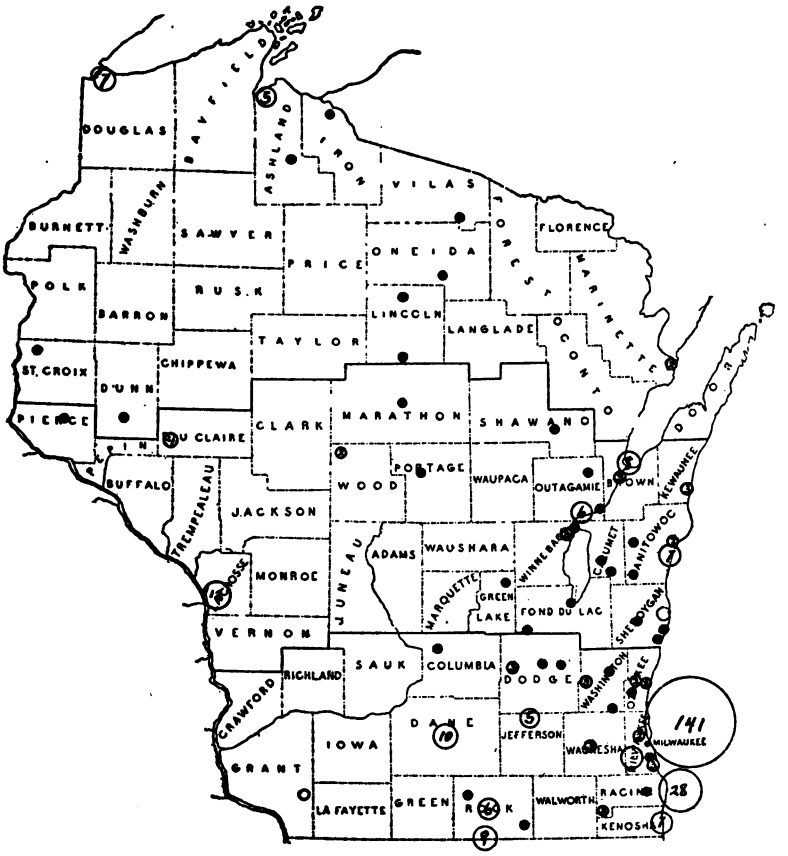


Fig. 36. Map showing the distribution in 1910 of metal working establishments employing an average of ten or more men. The number in a circle indicates the number of such establishments in that place.

Inspector as having one or more manufacturing establishments employing 1000 or more persons; Beloit, Cudahy, Kenosha, Menasha, Milwaukee, Oshkosh, Racine, South Milwaukee, and West Allis. This is probably an incomplete list, but it indicates how fully the large plants are as yet confined to the southeastern part of the state.

Causes of the Concentration of Certain Industries. The reasons for the concentration in one region of plants engaged in the same branches of manufacturing are usually the following:

1. Because the raw materials are most economically assem-

Fig. 37. Map showing the distribution of villages and cities in which an average of 500 or more employees are engaged in manufacturing establishments. The smallest dots represent places having an average of 500 to 1,000 such employees. The size of the dot indicates the importance of the place as a manufacturing center. Based upon reports of the State Factory Inspector and of the U. S. census of 1910.

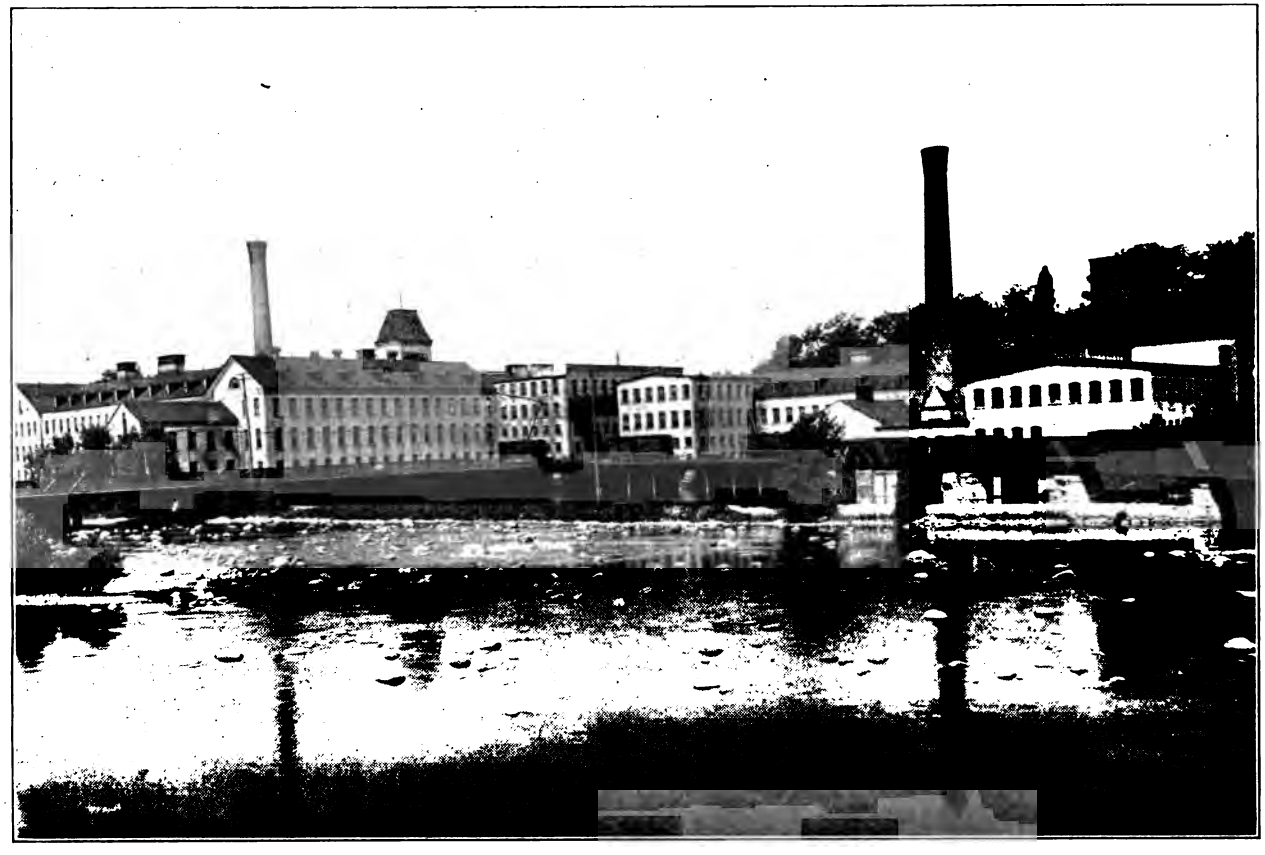
bled there. This may be either because they are produced in the neighborhood or because transportation facilities make it easy to assemble them there. This is one of the causes of the concentration of pulp and paper mills in the Fox River Valley.

2. Because the products may be most economically marketed

in or from this particular region. This may be due either to a large demand for the products in the region or to central location and excellence of shipping facilities. The concentration of tanning, brewing, meat-packing and the making of heavy machinery in and near Milwaukee, is chiefly due to this cause.

Fig. 38. Map showing the location of tanneries employing an average of 20 or more men (1910).

3. Because of cheap fuel or the presence of water power. A region that has means of securing coal cheaply, as is true of the cities on Lake Michigan, or that offers abundant water power, as is the case in the valley of the lower Fox, attracts industries which require a large amount of power. The paper



THE FOX RIVER PAPER COMPANY'S MILLS, APPLETON, WIS.

Wisconsin ranks high among the states in the manufacture of paper. This industry uses nearly three-fourths of the developed water power in the state. It is especially concentrated in the Fox River Valley.

making industry is an illustration. It is particularly dependent upon water power. Nearly 75% of the utilized water power of the state is employed by the pulp and paper mills, and these mills are notably concentrated in the Fox River Valley.

4. Because of what is called "the momentum of an early start." It often happens that an industry is started in a certain place as an experiment. If it proves profitable to its owners, its success tempts other men to take up the same line. The expansion of the original plant and the establishment of new plants which are off-shoots of the original one may eventually make the region a center of this particular branch of manufacturing. A case in point is the making of aluminum articles in Manitowoc, Two Rivers, and vicinity. Perhaps the most interesting instance of this kind in the United States is found in the city of Troy, New York, where 80% to 90% of the collars, cuffs, and dress shirts of the United States are made.

WATER POWER AND ITS RELATION TO MANUFACTURING

In a state that has no coal, waterpower is particularly important. Only three states in the Union have developed more waterpower than Wisconsin: they are New York, Maine, and Massachusetts, all of them long-settled states. No state west of the Appalachians has developed so much waterpower as Wisconsin, which has three times as much as Michigan, and twice as much as Minnesota. The total waterpower in use in the state in 1911 was about 180,000 horsepower, but this is only a small part of that which can be developed by building dams at scores of other places. Only one river in the state, the Fox, has anything approaching its total available power developed. It is estimated that Wisconsin rivers can supply a million horse power, or nearly twice the total mechanical power now used in all of the mills of the state.

Before the days of electricity, it was necessary for a factory or mill that used waterpower to locate on the bank of the river where the power was to be obtained. In many cases these

waterpower sites were in out-of-the-way places, perhaps far from railroads and cities, and hence were unfavorable locations for manufacturing plants. Now, however, the waterpower may be turned into electricity and then sent by wires to places miles away. The waterpower developed at the Dalles of the Wisconsin at Kilbourn is sent to Watertown and Milwaukee, more than a hundred miles away. The ability thus to generate the power at one place and then transmit it to places where it is convenient to use it, is making waterpower, the world over, of greater value than it ever was before.

Why has Wisconsin extensive waterpowers? It is largely a matter of the topography of the state. The highest part of the state is the extreme north. Here in some 1400 glacial lakes a number of rivers take their rise and flow down the slopes to the Mississippi, Lake Michigan or Lake Superior. In many places, glacial deposits have turned rivers out of their old channels and have forced them to flow in new courses which the rivers have not yet had time to reduce to grade, and so they contain rapids and falls. At other places, the rivers flow from the hard crystalline rocks, which form the northern half of the state, out upon the softer sedimentary rocks which underlie the southern half of the state, and at these places rapids naturally occur. Wisconsin rivers have a "fall line" not unlike the fall line of the Atlantic states, along which so many important eastern cities have grown up. Chippewa Falls, Black River Falls and Grand Rapids are on or near Wisconsin's fall line.

Because the grade of the streams is greater in the northern half of the state, giving rise to more rapids and falls, the majority of the waterpowers are located there. In the Driftless Area, the streams have well-graded courses while in the eastern counties, glacial deposits have seriously clogged and obstructed the streams, so that throughout the whole southern half of the state relatively few good waterpower sites exist. Such sites exist, however, as at Kilbourn, Prairie du Sac and Janesville.

In the days when hundreds of logging camps were busy along Wisconsin's rivers, the lumbermen objected to having many dams on the rivers for they interfered with log-driving. The saw mills were built along the streams. Around these the manufacturing

ST. CROIX FALLS DAM AND POWER HOUSE.

Head 50 feet. Cost $3,500,000. 27,000 horse power.
A type of modern water power development generating electricity for long distance transmission.

towns and cities of the north have grown up. At nearly a score of points along the upper half of the Wisconsin River, valuable waterpowers have been developed. Such, for example, are Nekoosa, Port Edwards, Grand Rapids, Stevens Point, Mosinee, Wausau, Merrill, Tomahawk and Rhinelander. A still greater number of undeveloped powers exists.

The Lower Fox from Appleton to Green Bay, 35 miles, has 32,000 horse power now in use. This is the region of greatest concentration of waterpowers and likewise one of the chief manufacturing sections. The Chippewa, St. Croix, Menominee, Black, Oconto, Peshtigo, Flambeau, and many others have waterpowers both developed and undeveloped. All these rivers have been important factors in the great lumber industry. Practically every paper and pulp mill in the state uses waterpower. In fact, about three-fourths of all the waterpower used in Wisconsin is used by the pulp and paper mills. No other line of manufacturing is so dependent upon waterpower. Wisconsin's high rank as a paper-making state is as much due to available waterpower as to the forests which supply the pulp wood. The use of waterpower is steadily increasing as is shown by the following figures:

In 1870 the waterpower developed was 33,700 horse power,
in 1880, 45,300 horse power,
in 1890, 56,700 horse power,
in 1900, 99,000 horse power,
in 1910, 129,500 horse power.†

In 1909 the total horsepower used in Wisconsin manufacturing was about 550,000 of which 337,000 was derived from steam and 129,550 from water wheels.*

---

* New York leads in waterpower with 394,221 h. p. Maine has 254,000 h. p. Massachusetts, 186,000 h. p. (1909).

† These figures are from the U. S. census of 1910. Prof. L. S. Smith, in the *Wisconsin Engineer*, June, 1909 states that the developed water power of the state was 183,105 h. p.

CITIES

As a rule, manufacturing on a large scale is most advantageously carried on in cities. There, new manufactories are likely to locate, while large and long-established plants may cause towns or even cities to grow up around them, as in the

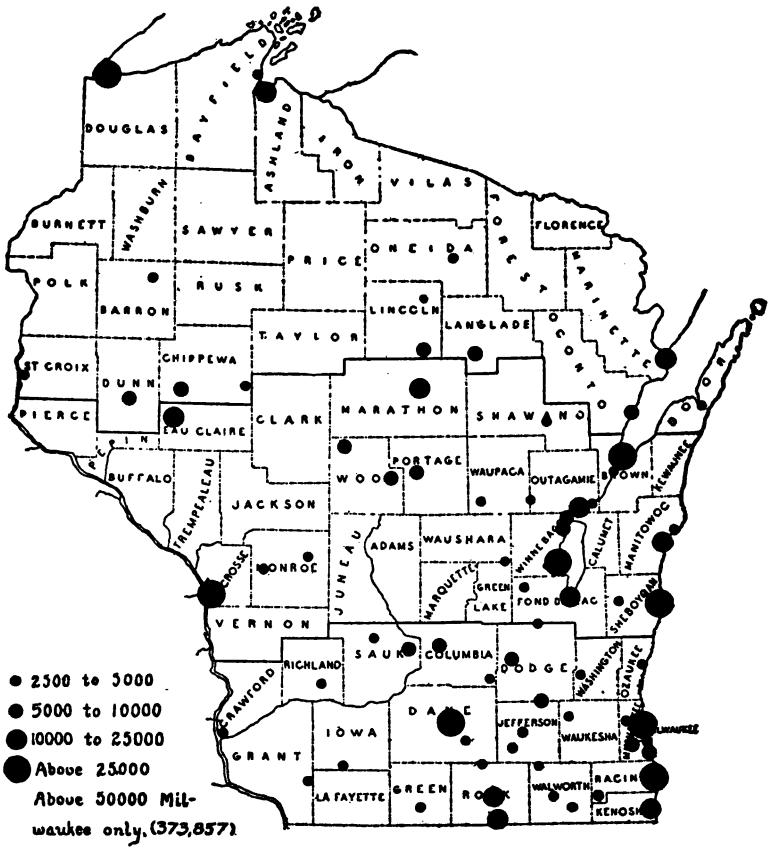


Fig. 39. Map showing the distribution of places having a population of 2,500 or more in 1910. There are 46 such places in the southeastern fourth of the state, and 27 in the remaining three-fourths.

case of Racine or Oshkosh. Wisconsin has few large cities, but the small cities of this half-century are the beginnings of the large ones of the following half-century. Since the growth of cities and of manufacturing is almost one and the same

thing, it is a matter of interest to note where Wisconsin's cities or manufacturing centers are located, and to consider why they are there. Fig. 39 shows the location of the cities of 2,500 or more people in 1910. The geographic influences which determined their location are very clear. The Mississippi River, strangely enough, has called forth only one large city, La Crosse (pop. 30.417). The Chippewa Valley has given us Eau Claire. Lake Superior has two, Superior and Ashland, both of them owing their location to excellent harbors and both of them outlets of iron mining regions. It seems unusual that the entire length of the main river of the state—the Wisconsin—has only one city, Wausau, of over 10,000 population. The reason for this is evident. The lower half of the Wisconsin was not in the white pine area; and important lumber centers did not grow up. The lower river had few places where waterpower was available and the region developed as an agricultural, not as a manufacturing section; hence there are no cities of large size. Quite different was it farther up the river where the pine forests were: waterpower is available and six fair sized cities are located along this part of the river. Only one of these cities is as yet in the 10,000 class. The Rock River basin has developed three good sized cities, Madison, Janesville, and Beloit. The river has not been the important factor; it is the *valley,* which offered a natural route for two of the leading railroads, giving these cities exceptional transportation facilities and making them the railroad centers of a very rich farming country.

The most notable concentration of manufacturing cities and towns on any river of Wisconsin is in the Fox River Valley, including the shore of Lake Winnebago. Here are Oshkosh, Fond du Lac, Appleton and Green Bay, and four other small but vigorous manufacturing cities. Most of their manufacturing arose from the vast wealth of timber which poured into the valley, and supplied the materials for the wood-using industries which now center there.

By far the most effective geographic influence in promoting the growth and fixing the location of cities in Wisconsin has been Lake Michigan, including Green Bay. The number of cities which are located here shows how effective deep-water

transportation is in encouraging the growth of commercial and industrial centers. Here are Milwaukee, the chief city of Wisconsin, and Racine, the second city in manufacturing; Kenosha, Sheboygan, Manitowoc, Marinette, and we might add Green Bay which we placed in the Fox River Valley group. All are distinctly manufacturing cities, though Milwaukee is a mercantile and shipping center as well.

TABLE 7.

Statistics of Manufacturing of the cities of 10,000 or more population, U. S. census of 1910.

City.	Number of Establishments.		Average Number of Wage Earners.		Value of Products Expressed in Thousands of Dollars.	
	1909	1904	1909	1904	1909	1904
Milwaukee	1,764	1,527	59,502	43,366	208,324	137,985
Racine	142	148	8,381	6,504	24,673	16,459
Kenosha	62	45	6,449	4,354	23,182	12,363
Oshkosh	159	134	5,778	4,840	14,739	8,652
La Crosse	151	150	3,329	2,644	14,103	8,139
Sheboygan	109	96	5,988	5,903	11,299	9,751
Fond du Lac	97	85	2,707	2,566	8,227	5,600
Appleton	97	108	2,125	2,486	6,734	6,673
Superior	99	72	1,847	1,343	6,574	6,357
Wausau	67	58	2,092	1,945	6,287	4,645
Green Bay	102	103	2,579	2,111	6,235	4,873
Manitowoc	80	76	1,525	1,321	5,939	4,428
Beloit	51	44	2,986	2,471	5,886	4,485
Eau Claire	75	73	2,524	1,985	5,355	3,602
Madison	116	84	1,792	1,476	5,467	3,291
Janesville	78	73	1,451	1,348	5,156	3,846
Marinette	43	37	1,491	1,645	3,309	3,633
Ashland	38	37	1,116	1,361	2,748	4,210

In addition to the facts shown by the foregoing table, it is worthy of note:

1. That Milwaukee manufactures more goods in value than all of the remaining seventeen cities combined, and has nearly doubled its output in ten years.

2. That Racine ranks second and has more than doubled its manufacturing output in ten years.

3. That Kenosha has nearly overtaken Racine and has more than tripled its output in ten years.

4. That Manitowoc and Fond du Lac have tripled their

MAP OF THE MILWAUKEE-RACINE-KENOSHA SHORE OF LAKE MICHIGAN

FROM GEOLOGICAL AND ROAD MAP OF WISCONSIN

output and that Beloit, Green Bay and Madison have doubled theirs in the same period.

Milwaukee, the largest city in the state, shows an increase of 51 per cent in value of manufactured products between 1904 and 1909. The city ranked eleventh among the cities of the United States in value of manufactured products in 1899, twelfth in 1904, and tenth in 1909. In 1910 it reported 35.3 per cent of the total number of wage earners of the state; over one-

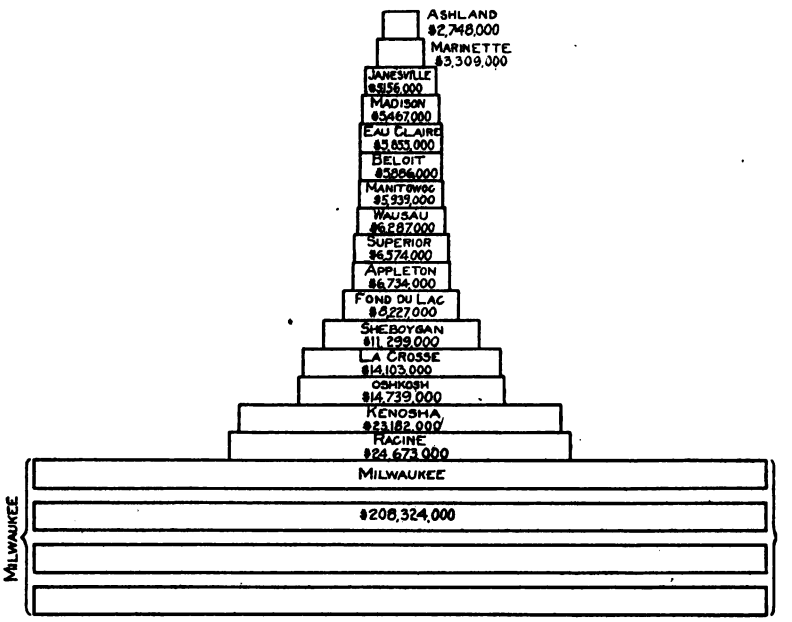


Fig. 40. Diagram showing value of manufactures produced in cities of 10,000 or more people, U. S. census of 1910.

third of the total value of the foundry and machine-shop products of the state; about three-fifths of the value of products for the leather, brewery, and printing and publishing industries; nine-tenths of the fur-goods and of the paint and varnish products. The larger part of the products of the steel works and rolling mills also was made in Milwaukee.

Figure 39 shows the distribution of cities or villages of 2,500 or more people. A line drawn across the state from the northeast to the southwest corner so divides the state that about one-fourth of the total area is southeast of this line and

about three-fourths is northwest. In the one-fourth there are 46 places having 2,500 or more people, while in the remaining three-fourths are 27 such places (1910). In other words, there are, in proportion to area, five times as many cities and villages of 2,500 or more people in the southeastern quarter as there are in the remainder of the state. The explanation is not difficult to discover:

1. This quarter of Wisconsin was settled early.
2. The farm land is especially fertile.
3. The best of railroad facilities are available.
4. The long shore line of an important waterway, Lake Michigan, is in this quarter of the state.
5. The best markets are in this section of the state, and Chicago, the nation's greatest interior market, is near by.

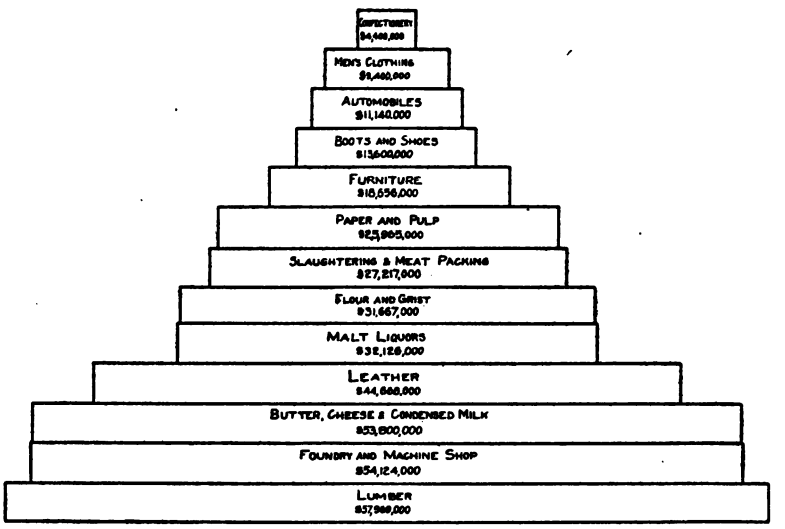
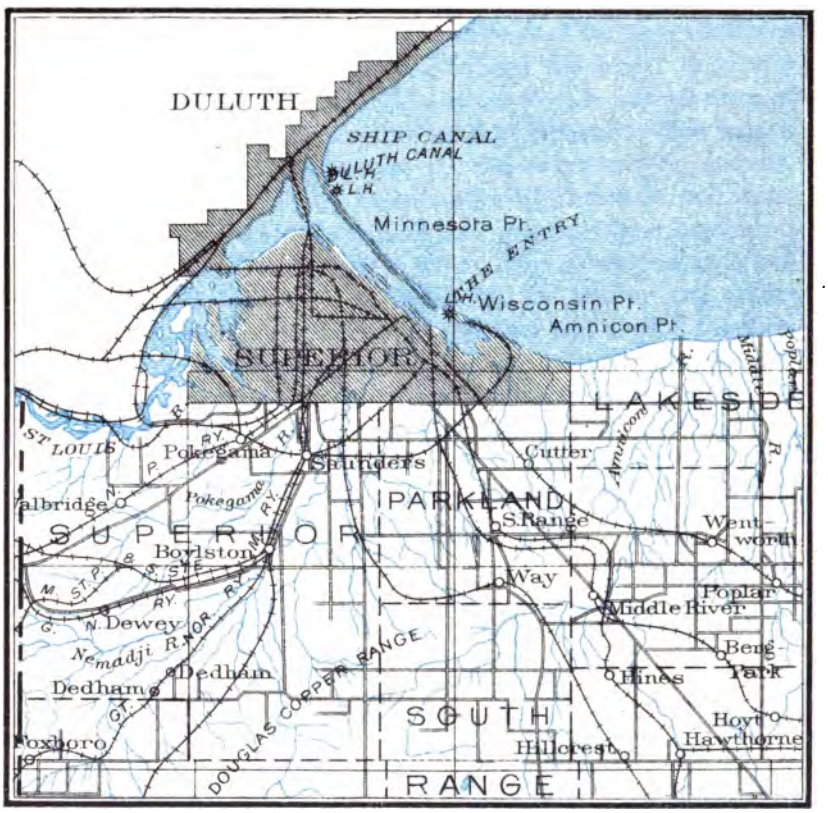


Fig. 41. Diagram showing value of certain manufactures in Wisconsin, U. S. census of 1910.

These are all conditions favorable to manufacturing and commerce, the food upon which cities grow. The line of manufacturing cities along the Fox River and the upper Wisconsin brings out forcibly the importance of waterpower in developing industrial centers.

Specialization in Manufacturing. Many of the cities of the state have developed specialized lines of manufacturing. The



MAP OF THE DULUTH-SUPERIOR REGION

FROM GEOLOGICAL AND ROAD MAP OF WISCONSIN

U. S. census of 1910 shows that about 60 per cent of the manufactures of *Appleton* was made up of wood pulp and paper. Eighty per cent of the manufactures of *Beloit* was foundry and machine shop products. The blast furnaces constituted the most important industry of *Ashland,* while in *Eau Claire* the lumber and timber products and the paper and wood-pulp industries predominated. The chief industry of *Fond du Lac* was the tanning, currying, and finishing of leather; in *Green Bay* the flour mills and grist mills and the paper and pulp mills were most important; and in *Janesville* the manufacture of agricultural implements was the leading industry. The principal industries in *Kenosha* were the tanning, currying and finishing of leather and the manufacture of furniture and automobiles; in *La Crosse,* flour mills and gristmills and breweries; in *Madison,* the foundry and machine-shop industries; in *Manitowoc,* the malt industry; in *Marinette,* the lumber and timber products industry; in *Oshkosh,* the lumber and timber products and the match industries; in *Racine,* the manufacture of agricultural implements, automobiles, carriages and wagons; in *Sheboygan,* the manufacture of furniture and the tanning, currying, and finishing of leather; in *Superior* flour mills and gristmills; and in *Wausau,* the lumber and timber products and flourmill and gristmill industries.

SUMMARY OF FACTS PERTAINING TO MANUFACTURING

1. By far the most important branch of manufacturing in the state has ever been the wood-working industries. Down to the present, the value of the lumber cut in Wisconsin mills totals some two billions of dollars, equal to the value of all the gold mined in the United States since 1873. The gold of California is a minor item when compared with Wisconsin's lumber. There are more than a score of different branches of the wood-working industry in the state, among which the making of wood-pulp and paper, of furniture, of doors, sash and finishing lumber, of wooden ware, and of parts of vehicles and of farming machinery, are most important. The total value

of the wood products of Wisconsin exceeds $100,000,000 a year, made up of lumber, rough and finished, $58,000,000; pulp and paper, $26,000,000; furniture, $19,000,000.

2. In point of *value to the state*, the manufacture of butter and cheese is probably second to the wood-working industry. Three thousand factories and creameries are producing about $60,000,000* worth of butter, cheese, and condensed milk

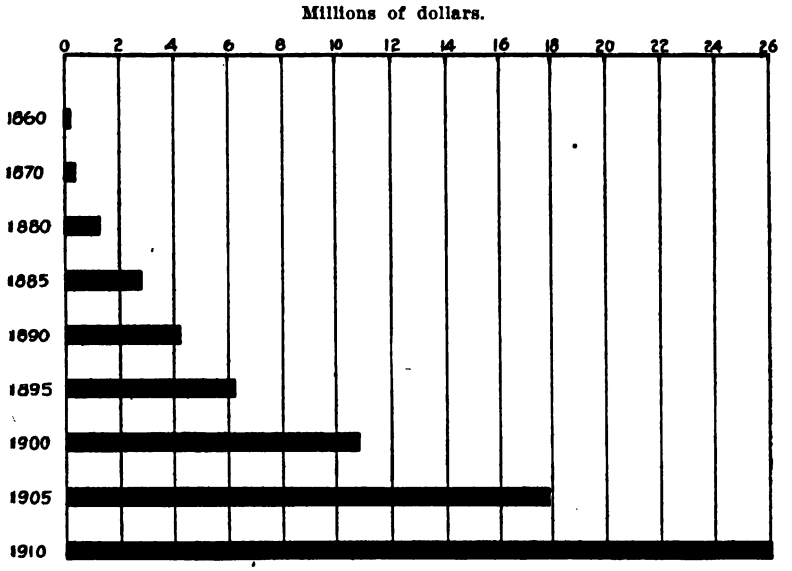


Fig. 42. Diagram showing the growth of the manufacture of wood-pulp and paper in Wisconsin from 1860 to 1910.

annually. The industry has made phenomenal progress in recent years, the value of the product having tripled during the last decade. The reason for placing the manufacture of butter and cheese ahead of the manufacture of iron and steel in point of *value to the state* is that butter and cheese-making require dairy farming and dairy farming materially helps in maintaining the fertility of the soil.

3. There has been a remarkable growth in the manufacture of iron and steel products in the state in recent years. According to the U. S. census figures of 1910, foundry and ma-

* $54,000,000 worth in 1909.

chine shop products rank second among the manufactures. The making of many kinds of machinery in Milwaukee and other cities in the southeastern counties has become a very important branch of manufacturing. The total value exceeded $54,000,000 in 1909.

4. The tanning of leather is the fourth most valuable branch

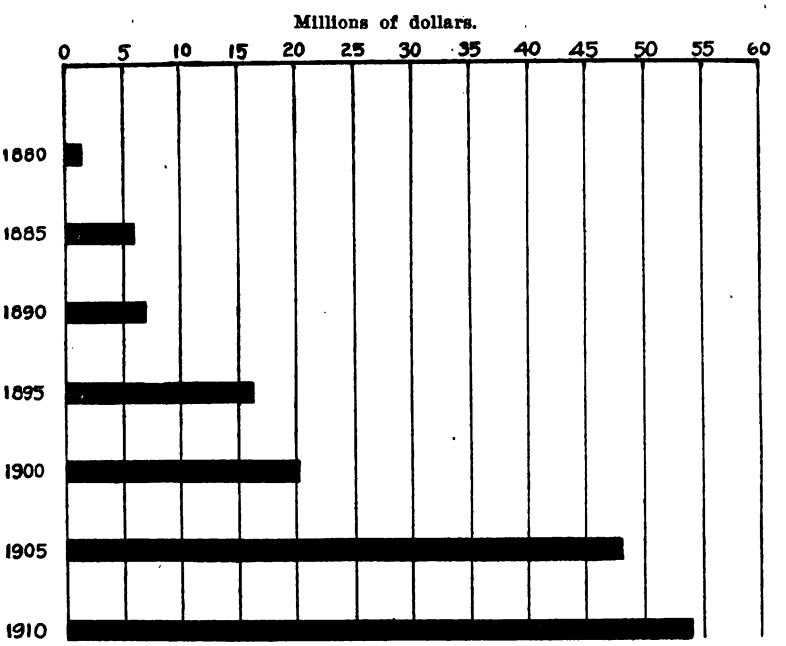


Fig. 43. Diagram showing the growth of the manufacture of butter and cheese in Wisconsin from 1880 to 1910.

of manufacturing. Milwaukee leads all of the cities of the Union in this industry, having doubled the value of its output in the past decade. It owes its beginning and growth to the abundance of hemlock and oak bark in the Wisconsin forests. Formerly the tanneries were scattered but now they are largely located in Milwaukee and a few other cities in the eastern part of the state; the total output reaches $45,000,000 a year.

5. The brewing of malt liquors is especially prominent in Milwaukee, where nine breweries make a greater product than all the rest of the state, and give the city third rank in the

United States as a brewing center. This is not, however, the largest industry of the city, and it ranks fifth among the manu-

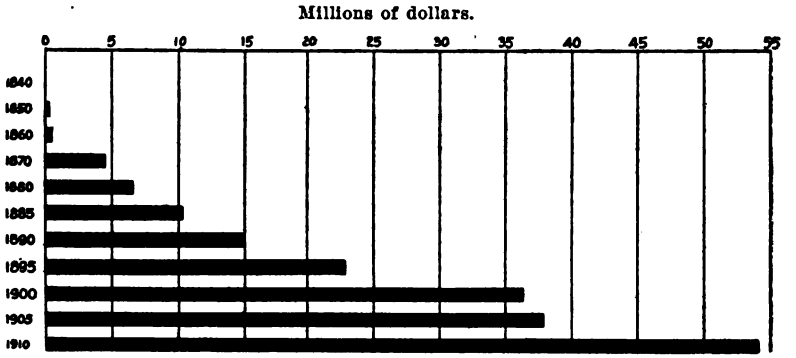


Fig. 44. Diagram showing the increase in the value of the products of foundries and machine shops from 1840 to 1910.

factures of the state, having a value of over $32,000,000 a year.

6. The manufacture of flour and feed, sixth in rank, is

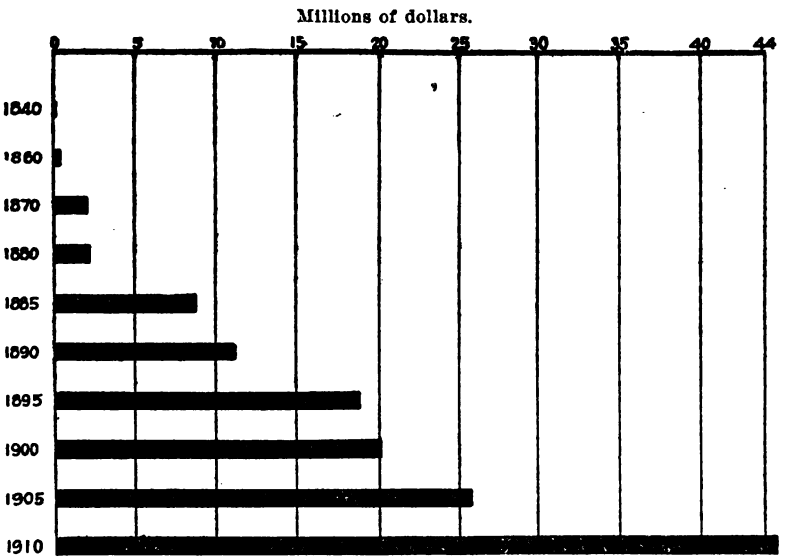


Fig. 45. Diagram showing the growth of the tanning, currying and finishing of leather in Wisconsin from 1840 to 1910.

nearly stationary. This is largely due to the decline in wheat-growing in the state. The value is about $30,000,000 a year.

7. Slaughtering and meat packing has grown very rapidly in recent years; the major part of this work is carried on in Milwaukee and nearby cities; this industry ranks seventh, with a value of $27,000,000 a year.

8. The four regions of Wisconsin where manufacturing cities have become most numerous are (1) along the shore of Lake Michigan, (2) in the Fox River Valley, (3) in the Rock River

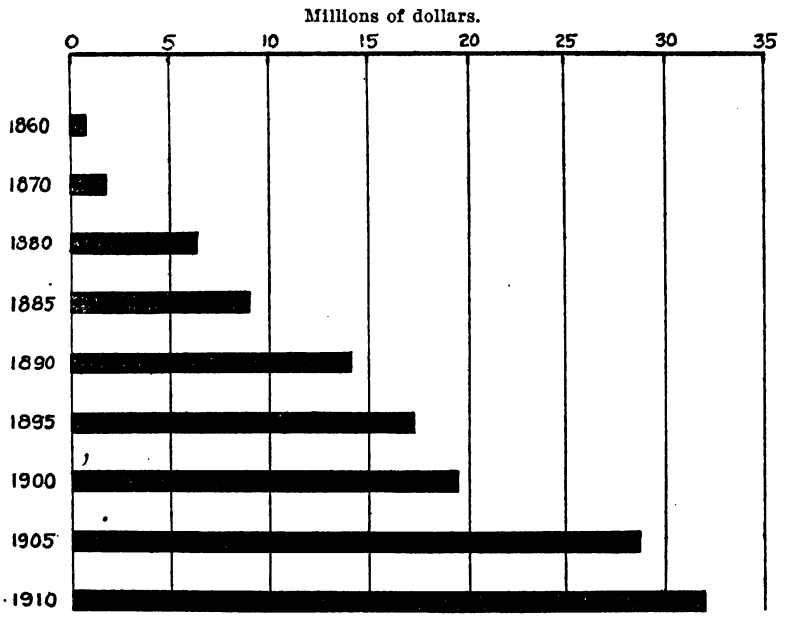


Fig. 46. Diagram showing the growth of the manufacture of malt liquors in Wisconsin from 1860 to 1910.

Valley including Madison, (4) in the valley of the upper Wisconsin River.

9. Over one-third (in value) of the manufactured products of the state are made in Milwaukee and fully 80% are made in the southeastern quarter of the state.

10. The southwestern quarter of the state is almost wholly agricultural, La Crosse being the only city with large manufacturing interests.

11. In 1849 Wisconsin ranked 19th among the states in manufacturing, and in 1909 it ranked eighth, but in propor-

tion to population it leads all of the states west of Ohio, surpassing even Michigan and Illinois.

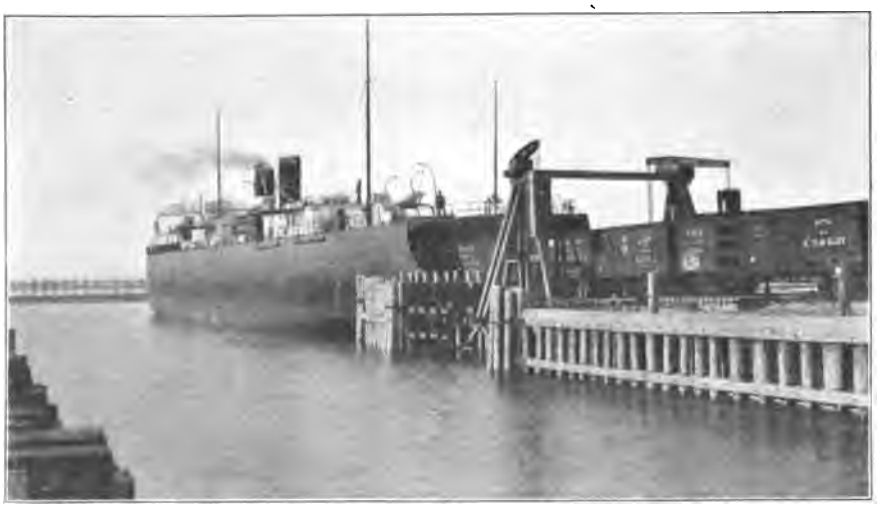
12. Down to recent years, the manufacturing industries have been closely related to the natural resources of the state, deriving the larger part of the raw materials from the state. There is now a lively growth of manufacturing which is quite independent of the state's natural products; for example, the iron and steel and the textile industries. With the growth of population in the Middle West, Wisconsin is absorbing a large share of the increased manufacturing required by increasing population.

13. Aside from the natural resources, the Lake Michigan water-front seems to be the state's greatest geographical asset. This is evidenced by the large number of manufacturing cities on the shore of the lake.

14. There were nearly 10,000 manufacturing establishments in Wisconsin when the U. S. Census of 1910 was taken, but 9,000 of these were relatively small; that is, the entire product of the largest one of these 9,000 factories did not amount to $100,000 a year, and the vast majority of them manufactured much less than that.

15. Three-fourths of the manufactured goods made in Wisconsin were produced in less than 1,000 mills, (less than one-tenth of the total number) and 86 of the largest establishments turned out over one-third (in value) of all the goods manufactured.

16. While there were 322 flour and grist mills in the state, seven of them ground more flour and feed than the remaining 315. There were 444 foundries and machine shops, but ten of them turned out nearly as great a product as the remaining 434. Of 136 breweries in the state, five made two-thirds of the total product. There were 48 establishments engaged in wholesale slaughtering and meat packing, but four of them did about six-sevenths of the total business.



A. CAR-FERRY AT MANITOWOC.

These large boats carry trains of cars across Lake Michigan from various ports and thus avoid the long haul around the lake.

B. SCENE IN MANITOWOC HARBOR.

Note the large number of lake freighters, both steam and sail, tied up for the winter.

CHAPTER VI

TRANSPORTATION

The St. Lawrence and the Great Lakes led the French explorers westward and the present city of Green Bay was founded earlier than Philadelphia. The Fox River led inland almost to the Wisconsin. By an easy portage the explorers' and traders' canoes passed from the Fox to the Wisconsin and thence to the Mississippi. This was one of the most used of the pioneer routes of the West. The U. S. Government sought to make it still more useful by connecting the two rivers with a canal at Portage and by improving them for navigation. Dams were built across the lower Fox so as to deepen the water, locks were constructed to enable boats to pass the dams, and a costly effort was made to secure a commercial waterway along this route, but the effort was unsuccessful. With the growth of railway transportation, the Fox-Wisconsin water route fell almost wholly into disuse.

The first rails for a railroad in Wisconsin were laid in 1851, the road extending from Milwaukee to Waukesha. There was great public rejoicing when this 20-mile stretch of railway was completed. In 1854 the line was built as far west as Madison and in 1857 it reached the Mississippi at Prairie du Chien. The Chicago and Northwestern reached Janesville in 1855 and Fond du Lac in 1858. Thenceforward, railway building has gone on steadily; the latest important addition being the new Northwestern line between Milwaukee and Sparta. In the earlier days, it was believed that the important traffic routes must necessarily extend east and west between the two great waterways—Lake Michigan and the Mississippi River. With the growth of railways, the Upper Mississippi has declined very greatly in importance as a water route. At the same time, the growth of Chicago and Milwaukee which lie

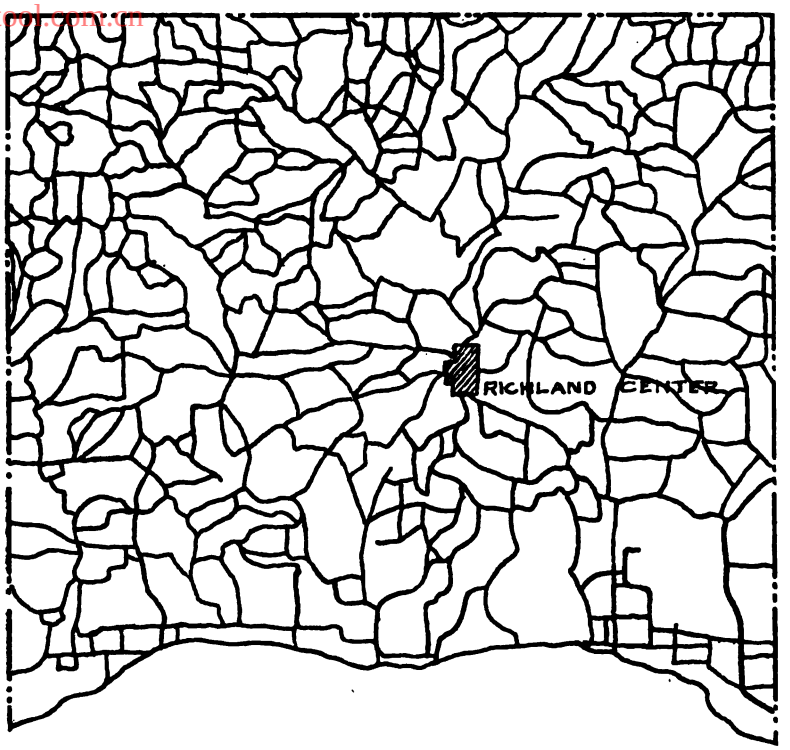


Fig. 47. Drawing to show the irregularity of the highways in a very hilly region. (Richland County)

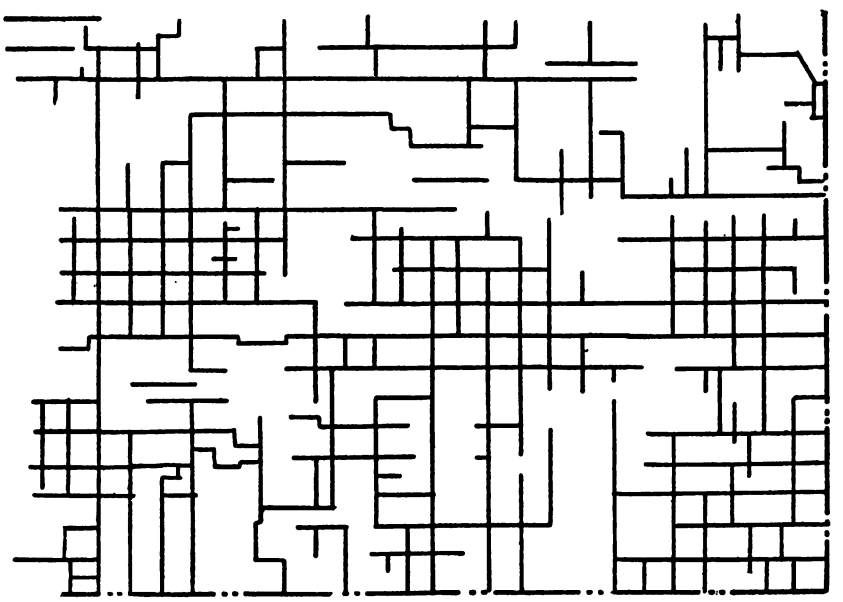


Fig. 48. Drawing to show how highways are laid out by surveyors in a fairly level country. It is customary to place roads one mile apart in both directions. In this region (Marathon County), the road system is not yet completed.

A. LOG RAFT ON THE MISSISSIPPI RIVER AT PRAIRIE DU CHIEN.

Note wide-opening of pontoon drawbridge necessary for the passing of large rafts.

B. VIEW ILLUSTRATING THE INFLUENCE OF TOPOGRAPHY UPON RAILWAY ROUTES.

Northwestern railroad passing through the gap at Ableman, Sauk County. By means of this gap and another at Devils Lake the Northwestern Railroad gets through the Baraboo Ranges.

near the southern end of Lake Michigan, and of St. Paul-Minneapolis on the upper Mississippi, has given a pronounced northwest-southeast trend to the main transportation lines. Whether we consider the early transportation routes east and west between the lake and the Mississippi or the later railway routes northwest and southeast between great urban centers on these waters, it will be seen that Wisconsin's geographical position has given the state exceptional importance as one of the railway thoroughfares of the nation.

Railway building in the Middle West was relatively easy because of the general levelness of the land. There were no mountains or other serious difficulties to prevent the building of a railroad in almost any direction in Wisconsin; nevertheless the topography of the various parts of the state has determined the routes which the railroads could most advantageously follow. Because of the expense of hauling trains up grade, routes of proposed railroads are carefully surveyed and are finally adopted only after careful consideration. One aim is to touch as many large towns as possible, yet the securing of a direct line between important cities and the securing of easy grades are even more important considerations. In most parts of the state, railroad builders had little difficulty in finding practicable routes. The only really rugged surface is in the southwestern quarter and here the country is so hilly that topography exerted a very direct control over the routes which railroads might follow. In a hill-and-valley country a railroad usually follows the valleys and thus secures a gentle grade. However, one of the east-west lines in southwestern Wisconsin, since it could not follow a valley, follows the crest of a continuous ridge, the so-called Military Ridge. By doing this, bridges were largely avoided, for the ridge is a water parting away from which the streams flow in both directions, and an approximately level grade is secured for 50 miles. A branch of this line running south into the lead and zinc region also follows a ridge. Some miles north of Military Ridge is the broad, open valley of the Wisconsin River which leads to the Mississsippi at Prairie du Chien. A branch valley, the Black Earth valley, leads off from this toward Madison and Milwaukee. These valleys form an easy and direct route from Madison to the

Mississippi River, and it was only natural that they should be adopted as a part of the route of the first railway across the state. Still further north, on the western side of the state, is another broad, open depression leading to the Mississippi River at LaCrosse. This lies more directly in the route of the main lines than does the Wisconsin River valley, and some of the most important railways in the state use this opening to get into Minnesota on their way to the West and Northwest.

Another of the important trunk lines, the Burlington (C. B. & Q.) follows the Wisconsin side of the Mississippi channel as a part of its route between Chicago and St. Paul.

The surface features of the state lead several railroads to converge upon Portage at the great bend of the Wisconsin River, and also upon Fond du Lac at the south end of Lake Winnebago. The basin of the Rock River directs important parts of the Chicago, Milwaukee & St. Paul and of the Chicago and Northwestern, and makes Janesville and Madison natural railway centers.

In the northern part of the state the topography presents few obstructions. There are no pronounced valleys anywhere. There are, however, many lakes and swamps and ranges of hills built of glacial drift. Within any given township these lakes, swamps and morainic hills have influenced the courses of the railroads; they have caused the road to swerve a few miles this way or that way, but an examination of a railroad map will show that the main railroads in the northern part of Wisconsin are notably direct. Nowhere in the state did any railway find difficulties at all comparable to those which roads had to surmount in the East and in the West. Yet it would be a mistake to think that any railway built in Wisconsin was not materially influenced by the topographic features of the regions through which it runs.

INDEX