

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

E. A. BIRGE, Director

W. O. HOTCHKISS, State Geologist

Bulletin XLII

Educational Series No. 5

THE GEOGRAPHY
OF THE
FOX-WINNEBAGO VALLEY

BY

RAY HUGHES WHITBECK
Professor of Physiography and Geography
University of Wisconsin

ivm

MADISON, WIS.
PUBLISHED BY THE STATE
1915

Wisconsin Geological and Natural History Survey

BOARD OF COMMISSIONERS

EMANUEL L. PHILIPP

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

HENRY L. WARD, *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
Division.

LILLIAN M. VEERHUSEN, Clerk.

GEOLOGY DIVISION:

WILLIAM O. HOTCHKISS, In charge.

T. C. CHAMBERLIN, Consulting Geologist, Pleistocene Geology.

SAMUEL WEIDMAN, Geologist, Areal Geology.

E. F. BEAN, Geologist, Chief of Field Parties.

O. W. WHEELWRIGHT, Geologist, Chief of Field Parties.

R. H. WHITBECK, Geologist, Geography of Lower Fox Valley.

LAWRENCE MARTIN, Geologist, Physical Geography.

E. STEIDTMANN, Geologist, Limestones.

F. E. WILLIAMS, Geologist, Geography and History.

NATURAL HISTORY DIVISION:

EDWARD A. BIRGE, In charge.

CHANCEY JUDAY, Lake Survey.

H. A. SCHUETTE, Chemist.

DIVISION OF SOILS:

A. R. WHITSON, In charge.

W. J. GEIB,* Inspector and Editor.

GUY CONREY, Analyst.

T. J. DUNNEWALD, Field Assistant and Analyst.

CARL THOMPSON, Field Assistant and Analyst.

C. B. POST, Field Assistant and Analyst.

W. C. BOARDMAN, Field Assistant and Analyst.

* Scientist in Soil Survey, Bureau of Soils, U. S. Department of Agriculture.





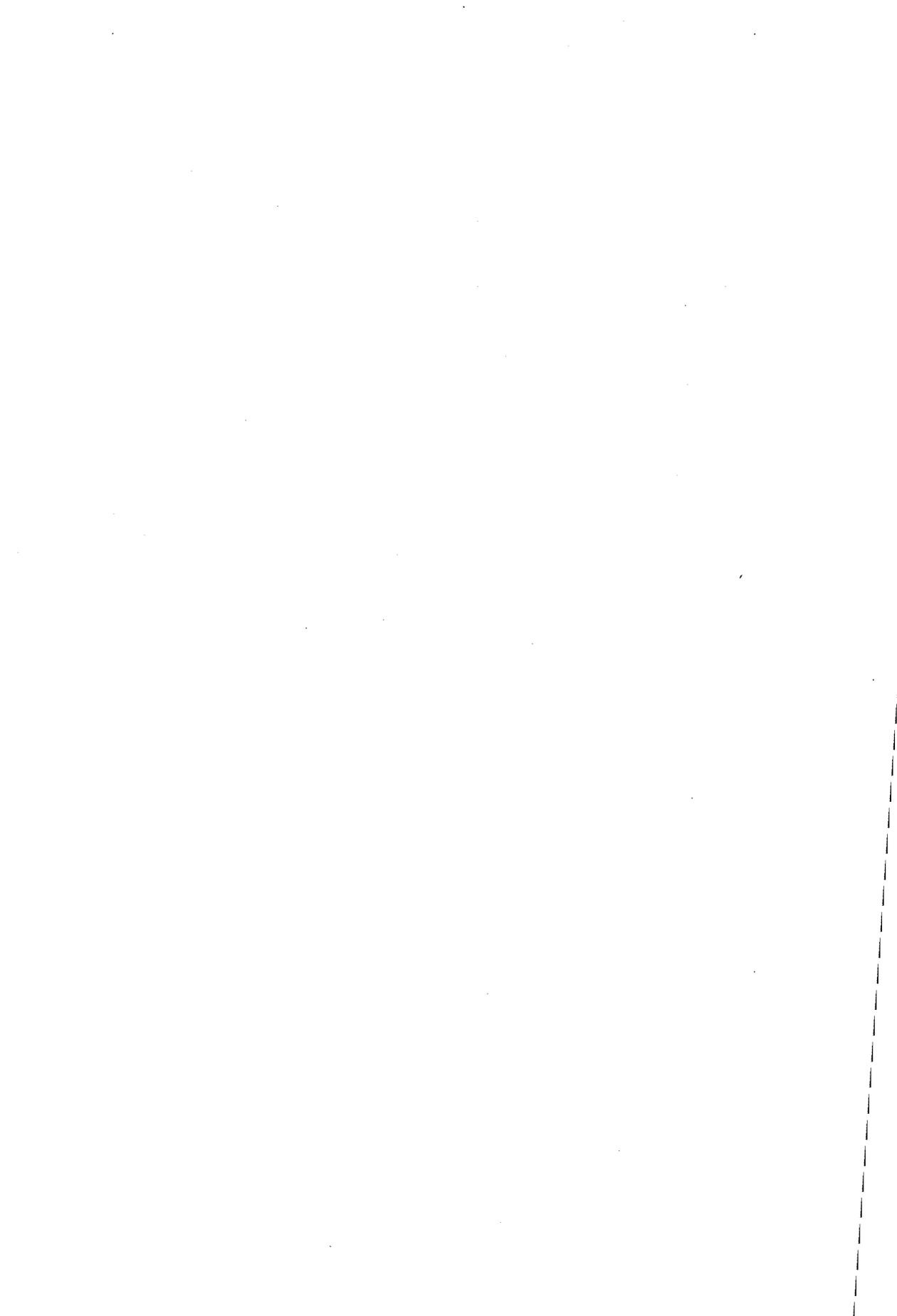
RELIEF MAP OF WISCONSIN
Photographed from Relief Model of the State.

TABLE OF CONTENTS

	Page.
INTRODUCTION	
Man and his geographical environment.....	1
The aim of applied geography.....	2
Two other factors in geography.....	2
The race factor.....	2
The stage of development.....	3
 CHAPTER I. VALLEYS	
Valleys and mankind.....	4
Valleys of the old world.....	4
Valleys in American history.....	5
The historic Fox River Valley.....	5
 CHAPTER II. THE ORIGIN AND PHYSICAL FEATURES OF THE FOX-WINNEBAGO VALLEY	
How the rocks of the valley were made.....	7
The uplift of the rocks.....	7
The differing character of the rocks.....	8
Cause of the valley.....	8
The glaciation of the valley.....	9
Cause of the gentle slope on the west and of the steep slope on the east.....	11
The valley at present.....	11
Natural resources.....	12
 CHAPTER III. PECULIARITIES OF THE FOX RIVER	14
The Upper Fox River.....	14
Lake Winnebago past and present.....	14
Origin of the present lake.....	15
The red clay and its relation to larger Lake Winnebago.....	16
Cause of the larger lake.....	17
Characteristics of the Lower Fox River.....	17
The rapids.....	18
Concentration of fall.....	19
The water power.....	21
Uniformity of discharge.....	22
 CHAPTER IV. THE NAVIGATION OF THE FOX RIVER PAST AND PRESENT	
Part of a famous historic route.....	24
The importance of rivers in history.....	24
The Fox River as a commercial waterway.....	27
Methods of navigation.....	28
Canoes and batteaus.....	28
Durham boats.....	29

The canal epoch.....	29
The improvement of the Fox.....	29
The State's attempt.....	30
Navigation during the period of improvement.....	30
The entire river opened to steamboat navigation.....	31
Taken over by the U. S. government.....	32
Period of greatest use.....	33
Period of government control.....	34
CHAPTER V. CITIES AND INDUSTRIES.....	
Fond du Lac.....	42
The growth of the city.....	43
North Fond du Lac.....	46
Oshkosh.....	47
Its situation.....	47
Other cities of the same type.....	48
Early history of the city.....	48
The development of manufacturing.....	49
Present industries.....	51
Transportation.....	52
Neenah and Menasha.....	53
Neenah-Menasha as a type city.....	54
The waterpower and industries.....	54
Menasha.....	56
Appleton.....	58
Early history.....	58
Waterpower.....	59
Early manufacturing.....	60
Present manufacturing.....	62
Appleton as a type city.....	64
Kaukauna.....	65
Early history.....	65
Waterpower and industries.....	66
Kimberly, Little Chute, Wrightstown, Little Rapids.....	66
Kimberly.....	66
Little Chute.....	67
Wrightstown.....	67
Depere.....	68
Green Bay.....	69
Its long history.....	69
Historical synopsis.....	70
Green Bay as a type city.....	72
Green Bay as a lake and river port.....	73
Manufacturing industries.....	74
General summary of cities and industries.....	76
CHAPTER VI. AGRICULTURE.....	
Fond du Lac county.....	84
Condition of agriculture.....	84
Reasons for high agricultural development.....	84
The soil.....	86
The leading farm products.....	87

Winnebago county.....	89
General conditions of farming.....	89
The work of glaciers.....	89
The red till and clay.....	90
Crops.....	90
Dairying.....	91
Outagamie county.....	93
The soil.....	93
Value of farm property.....	95
Principal crops.....	96
Dairying.....	96
Brown county.....	97
General conditions of farming.....	97
The soil and crops.....	98
Dairying and stock-raising.....	99
Ownership and size of farms.....	99
Bibliography.....	100
U. S. government documents.....	103
Maps.....	105



PREFACE

Bulletin XXVI* of the Wisconsin Geological and Natural History Survey is devoted to the geography and industries of the state as a whole. It is the introductory number in a series of educational bulletins which will treat of the industrial geography of the state and of selected regions of the state. The present volume is the first of the regional bulletins. Well defined valleys, if not too large, nearly always have a more or less characteristic industrial life; their various activities are knit together and show a notable degree of interdependence; hence, a valley like that of the Lower Fox and Lake Winnebago forms a geographical unit, serving ideally as a type study.

So different are the geographical and industrial conditions in the basin of the Upper Fox from those in the lower valley that the former is not specifically treated in this bulletin. The same is true of Calumet county on the east side of Lake Winnebago.

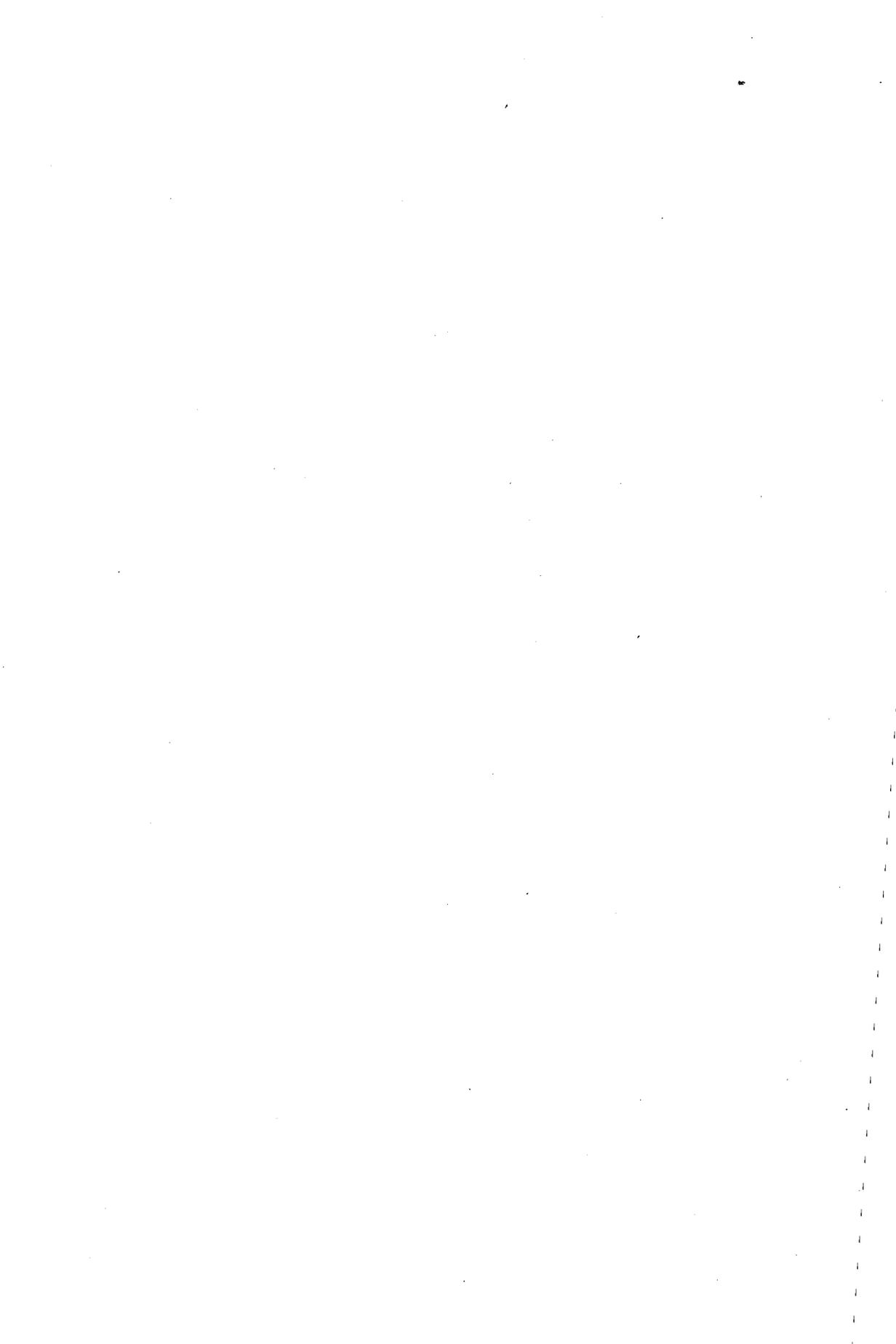
The bulletin is intended primarily for use in schools, particularly in the schools of the region with which it deals, yet it is hoped that the general reader may find it of some interest.

The writer is indebted to manufacturers, county and city officials, editors, librarians, and others in the valley, whose courtesies he appreciatively acknowledges. In addition to information obtained directly from such sources, county and local histories, newspaper files, and other published material have been consulted. A persistent effort to secure accurate information has been made, but only one who has attempted such a task can realize how difficult is the attainment of accuracy in historical matters. It is hoped that any errors which may have crept in are neither numerous nor important.

R. H. WHITBECK

Madison, June 1, 1915.

*Issued in 1913 and distributed to the schools and libraries of the state, but now out of print.



INTRODUCTION

There are two phases to the geography of a region; one deals with the *physical features* as such, and is termed Physical Geography. The other deals with *the region as the home of man*; this is geography in its larger meaning. The non-physical phase of the study is sometimes called human geography, and sometimes it is called applied geography. Physical geography reaches back into geology and includes a discussion of:

- (1) the rock structure of the region,
- (2) the surface features—both land and water,
- (3) the climate,
- (4) the natural resources, including
 - (a) the soil,
 - (b) the minerals,
 - (c) the forests,
 - (d) the fisheries,
 - (e) the navigable waterways,
 - (f) the water powers,
- (5) the plant and animal life.

The human or applied geography, while it is never distinctly separable from the physical, includes those geographical conditions for which man is responsible, such as:

- (a) the establishing of cities, towns, counties, states, roads, railroads, ports, etc.;
- (b) industries—mining, lumbering, farming, fishing, manufacturing, trading, and transporting.

Physical geography has its foundation in the science of geology; and applied geography, while having its foundation in physical geography, deals mainly with the industries, commerce, and other occupations of the people.

Man and His Geographical Environment. On account of his intellectual superiority civilized man dominates lower animals and lower races of men and is able greatly to modify the physical

conditions amid which he lives. Lower animals and savages do little more than passively accept the conditions in which they find themselves, getting a living and a degree of comfort out of the natural world about them, but doing practically nothing to improve their own condition. Civilized man seeks constantly to utilize the resources and forces of nature in ways that will advance his own well being. As man rises in the scale of civilization his wants increase, and he applies himself to such industries as he thinks will satisfy these increasing wants. But, while man may cultivate, and improve, and manufacture, he cannot create the elements of his own physical world. These he must take as he finds them and turn them to his use, improving and adapting them wherever he can. He must accept the hills and mountains, rivers and lakes, climate and soil, minerals and forests, as he finds them in nature, and then turn them to his advantage if he can. He may develop industries, but those industries will be closely shaped by the physical conditions and natural resources which already exist.

The Aim of Applied Geography. Applied Geography seeks to explain how the people of a region utilize the resources of the region, what industries they develop, where and why they build cities and establish routes of communication. One man may cultivate the soil, another catch fish, or mine coal, or cut timber, or follow any one of many occupations. Yet he cannot successfully cultivate the soil unless the soil and climate are favorable to agriculture; he cannot mine coal unless nature has placed it there; he cannot catch fish in the desert or cut timber on the prairie.

Two Other Factors in Geography. But there are two other very important factors besides the nature-made ones which enter into the making of the applied geography of the region.

The Race Factor. We may anticipate some matters which are to follow and use the Fox River Valley to illustrate our point. During the last 300 years, three quite different types of people have lived in the Valley,—the Indians, the French, and the Americans. During the Indian, French, and early American occupation, the natural resources, the topography and the climate of the Valley were about the same, yet the life and industries of the Valley differed widely from period to period. The Indians—prior to the white man's coming—did little more than eke out an existence while they fought the tribes around them. They moved about, lived in wigwams, dressed in skins, followed the chase, raised a little corn, but carried on only the most primitive indus-

tries. Had they been unmolested down to the present they would still be doing the same. In the 17th and 18th centuries the French came; not mainly the French directly from Europe, but Canadian French from the St. Lawrence Valley, often mixed with Indian blood. As a class, they were roving, light hearted, pleasure-loving sons of the forest. They did not settle upon the land and cultivate it, but preferred the hunt, the fur trade and the free life of adventure. Had Wisconsin and the rest of the Northwest been left wholly to these people and to the Indians with whom they so easily mingled, the country would have been long retarded in its development. In the second quarter of the last century a third class of people came into the Valley; they came from New England and New York and from the agricultural lands of Europe. They loved settled homes, loved the land, loved order and education, had mechanical and business genius, and found little in common with either Indians or adventure-loving French. The French period, a century and a half in length, was a fur-trading period and little else. The American period quickly became a period of agriculture, of lumbering, of roads, railroads, and manufacturing. Neither Indians nor French used the Valley as the Americans used it. This illustrates the second point in the discussion, namely, the importance of the human factor, the race-factor, in determining what use is made of a region and its resources. The physical geography was substantially the same in all of the three periods of occupation of the Fox River Valley, but not so with the applied geography.

The Stage of Development. A third point requires emphasis. As we called the second point the human, or race, factor, so we may call the third the *time factor* or the *stage*.

With the progress of time, the applied geography of a region does not remain the same even though the physical factors and the race factor do. As time goes on, exhaustible resources like the forests may be used up, new resources may be discovered, better means of communication are effected, population increases, cities spring up, and the entire industrial life of the region changes. The story of the Fox River Valley will amply illustrate this. Thus, there are three primary considerations in the geography of any region:

- (1) the region as nature made it;
- (2) the kind of people who inhabit it;
- (3) the stage of development which the region has reached.

CHAPTER I

VALLEYS

VALLEYS AND MANKIND

During the long ages of the past the land surface of the earth has been worked upon by air and frost, furrowed by streams, and wrinkled by the mountain-making forces. For ages, of whose great length we have no conception, the rains have fallen upon the land, collected into brooks, joined into rivers, and flowed to the sea. In so doing they have slowly carved the valleys in which they now flow. Some valleys are narrow and deep with steep sides. Others are broad and open. From the earliest times men have chosen to live in the broad, open valleys because life in them is easier than life on the hills or among the mountains or on the plateaus.

VALLEYS OF THE OLD WORLD

It is a notable fact in history that most of the rich and powerful nations of the ancient world grew up in the valleys of the great rivers, particularly in those which had fertile flood plains—in the valleys of the Nile, of the Tigris-Euphrates, of the Indus and the Ganges, and on the rich alluvial plains of China. The rivers and valleys of Europe were for centuries the main routes along which trade and travel moved, and at favorable places the principal centers of population have grown up. The richest and most cultured part of Italy is the flood plain of the Po, known as the Plain of Lombardy. The larger part of the people of Austria-Hungary live in the broad basin drained by the Danube and its branches. For 2000 years the Rhine has been the great natural highway of western Europe. In the rugged plateau of Spain the broader valleys are almost the only cultivated and populous parts; and the valleys of the Rhine and the Garonne, of the Loire and the Seine, are the most thickly peopled regions of France.

VALLEYS IN AMERICAN HISTORY

In America the rivers and their valleys played an important part in the exploration and settlement of the continent. The vast area of New France, reaching from the mouth of the St. Lawrence to the Mississippi and down that river to its mouth, was held by the French for more than 150 years through their control of the rivers and of the Great Lakes. The English settlements along the Atlantic grew inland from the coast as settlers worked their way up the New England rivers, the Hudson, the Delaware, the Susquehanna, the Potomac, the James and the rivers of the South. The great "westward movement" of settlers over the Appalachians and on into the Mississippi Valley, was a movement up the valleys of the east-flowing rivers and down those that led westward. The Mohawk Valley in New York, along which a portion of the Erie Canal was built, is known as the "Eastern Gateway of the United States" and the river gap at Pittsburgh at the head of the Ohio as the "Gateway to the West."

THE HISTORIC FOX RIVER VALLEY

Among American rivers it is true that the Fox ranks only as a small river and its valley as a small valley, yet for more than 200 years this river and valley occupied one of the commanding positions of the Northwest; the Fox will always hold a place in history far out of proportion to its size. But this is not the main reason why the Fox River Valley is an ideal geographical "type study." It is because in it and in its history is found much that is typical or illustrative of valleys in general. And, as has already been pointed out, valleys have ever been the chief theatres of man's greatest achievements.

It is a principle of geography that back of every feature of the earth's surface,—stream, mountain, or plain—lie the causes which produced it; and furthermore that every mountain and valley, every stream and waterfall, in the inhabited parts of the world have had some influence, great or small, in shaping human history.

VALLEYS DUE TO EROSION

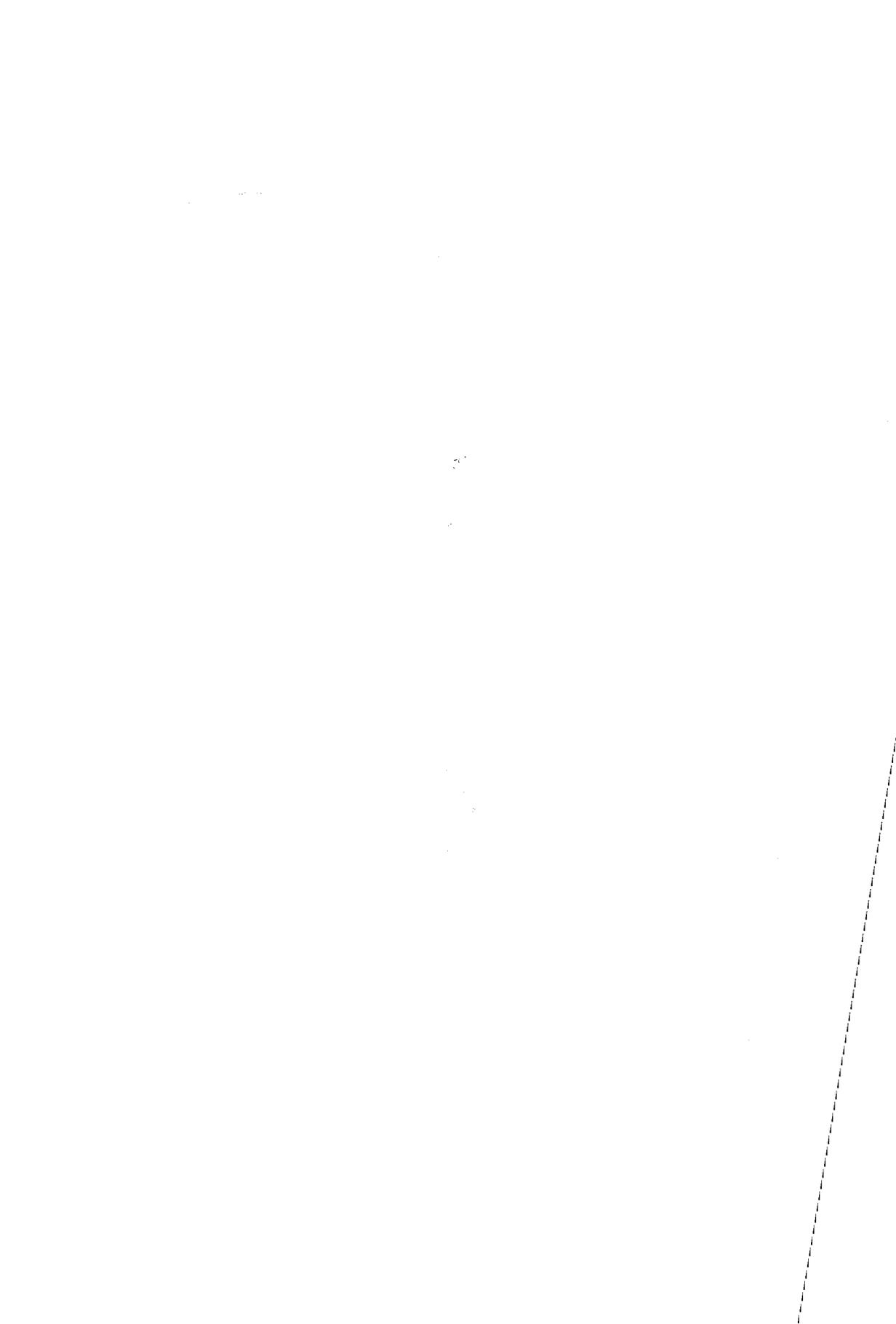
Most valleys are due mainly to the work of streams which gradually wear channels for themselves in the surface of the earth. Rivers erode valleys in the hardest rocks, but they erode more freely and more rapidly in the softer ones; ordinarily they choose

the path of least resistance. If the rocks over which the river flows are of different degrees of hardness, rapids and falls will occur here and there where the more resistant rocks are encountered. If the gradient, or slope, of the river channel is steep, the stream is capable of eroding rather rapidly. If, on the contrary, the slope is gentle, the stream flows slowly and erodes slowly; possibly it may not erode at all, but may, on the contrary, deposit some of the silt which it carries and thus fill up its channel, as the lower Nile, the lower Mississippi and many other rivers are doing. Naturally a stream of large volume has greater power than a small stream. These factors—the hardness of the bed rock, the swiftness and the volume of the stream—affect the rate at which the stream works and hence the rate at which it erodes its valley.

But even the most vigorous stream does not enlarge its valley very much in a man's life time, and the great valleys of the earth have required at least hundreds of thousands of years for their making. During this long time many things have had opportunity to happen to the stream, and these might cause its work either to be retarded or to be intensified; the stream may even be turned out of its accustomed channel; or, in rare instances, caused to reverse the direction of its flow. In Wisconsin the cause which has most commonly interfered with the rivers has been the deposits left by glaciers during the Ice Age. Glaciers have played a large part in the geological history of the Fox River Valley, as they have in that of most of the rivers of the state.



RELIEF MAP OF FOX-WINNEBAGO VALLEY AND THE ADJACENT COUNTRY
Photographed from Relief Model of Wisconsin.



CHAPTER II

THE ORIGIN AND PHYSICAL FEATURES OF THE
FOX-WINNEBAGO VALLEY

HOW THE ROCKS OF THE VALLEY WERE MADE

In very remote ages—to be reckoned in millions of years—a broad, shallow sea extended into the very heart of the present continent of North America. North of this sea lay an ancient land-mass which makes up a large part of what is now Canada, and from which a shield-shaped portion projected southward. Part of that shield of ancient rock now forms northern Wisconsin. During this period, much (if not all) of Wisconsin was covered by the sea. From the old land-mass at the north, the streams eroded rock waste and carried it to the ocean, as streams are now doing. This rock-waste was spread upon the bottom of the adjacent sea and slowly built up layers of sediment, which in time became beds of sandstone, made of sand; beds of shale, made of clay; and beds of limestone, made of limey matter which settled from the sea-water or accumulated from the skeletons of corals and other lime-using creatures. In this way the old shield became enclosed on three sides by beds of sediments which accumulated in the sea around it, and which lapped over one another like shingles. The layers which were deposited first rest upon the seaward part of the shield, while those next deposited rest upon the ones laid down first, the third upon the second, and so on.

THE UPLIFT OF THE ROCKS

All of these layers of rock, together with the still older shield which was well-nigh buried under the sediments, were in a later period gradually uplifted into dry land. The sea slowly withdrew and land took its place. This uplift caused a gentle warping of the land now included in Wisconsin, so that the highest ground is in the northern part of the state, while the rock layers gently dip, or slope, toward the south, southeast, and southwest.

THE DIFFERING CHARACTER OF THE ROCKS

As already stated, some of the rocks are sandstone, some are shale, and some are limestone. Most people who live in the Fox River Valley know the limestone, for it may be seen in many places. The shale is soft and is readily eroded. The limestone is more resistant to wear than the shale, and some beds of the limestone are harder than others. And so it has come about that where softer beds of rock are exposed to the wearing action of streams and weather, valleys have been made, and between them the harder layers form low ridges, though none of these are conspicuous except the one which forms the bluff along the east side of the Valley.

CAUSE OF THE VALLEY

The *Valley* of the Lower Fox and Lake Winnebago is due partly to the less resistant shale which lies under the limestone, while the *cliff* of the Niagara limestone which forms the steep eastern side of the Valley is due to the resistant character of that rock.

It is noteworthy that the two main rivers of eastern Wisconsin, the Fox and the Rock, do not take short-cuts directly to Lake

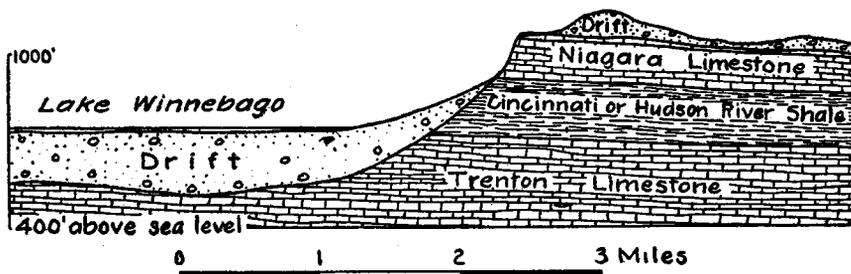


FIG. 1. CROSS SECTION OF VALLEY AND UPLAND ON THE EAST
Note the depth of the glacial drift in the Valley and the shallowness of Lake Winnebago.
(Diagram by Martin)

Michigan, but flow respectively north and south; the latter from the Horicon marsh flows southward into Illinois and thence to the Mississippi River. The reason for this longer journey to the sea is the presence in eastern Wisconsin of the Niagara limestone ridge which extends north and south roughly parallel to the shore of Lake Michigan, and prevents the streams from the interior of the state from flowing directly to the lake; thus the Fox is turned northward to Green Bay and the Rock southward to the Mississippi River.

But the Valley of Lake Winnebago and the Lower Fox is not alone due to erosion by a river. It is altogether probable that from an early geological period, a river has flowed in this valley—in fact eroded the valley in the weaker rocks which have already been referred to. Even before the Glacial Period, the hard Niagara limestone stood out as a ridge or cliff. At that time there was no Lake Michigan and, of course, no Green Bay, although there probably was a valley occupied by a river* where Lake Michigan now is, and a river probably flowed in the present Fox-Winnebago Valley.

At a comparatively recent period, as geology counts time, the climate of North America became so cold that great glaciers spread over the northern part of the continent and an enormous body of ice crept southward from Canada as far as the present Ohio and Missouri rivers; this was the Ice Age or Glacial Period. It was made up of several cold epochs and between these were warmer ones during which the glacial ice melted back to the north, only to return long afterward with the return of another cold epoch. Each of these alternating periods of warm and cold climate was tens of thousands of years in duration; it is quite possible that we are now living in one of the warm epochs and that this may be followed, thousands of years hence, by another return of the glacial ice, another Ice Age.

THE GLACIATION OF THE VALLEY

The mass of slowly-moving ice which spread over northern and eastern Wisconsin had its center of supply in Labrador, and the front of the glacier was in the form of great lobes. If a part of the ice flowed in a valley which extended in the same general direction as the ice was moving, then that part of the glacier was able to move more freely, and a lobe of ice pushed forward a little more than it did where uplands or ridges retarded it. Thus, lobes of ice developed in certain valleys and gave the front of the glacier a lobate shape. (Fig. 2). It is now possible to discover where these lobes were by the great loops of terminal moraine, or ranges of rounded hillocks, which were built of the debris transported by the ice and heaped up along its margin as it melted.

A good reason for believing that valleys existed in the Lake Michigan and Green Bay depressions before the coming of the glaciers is the fact that the front of the glacier in eastern Wis-

* It is suggested that this river probably flowed southward. See Martin, Lawrence, *The Physical Geography of Wisconsin*. Bull. XXXVI, Wis. Geol. & Nat. Hist. Survey.

consin was divided into two lobes such as are shown in (Fig. 2). There is equally good reason for believing that the scouring action by the ice lobes in these valleys both deepened and widened them.

The Fox-Winnebago Valley is therefore due, first, to the presence of alternating soft and hard layers of rock; second, to the erosion of a valley in the softer layers by an ancient river; and, third, to the somewhat further deepening and widening of that valley by glacial erosion.

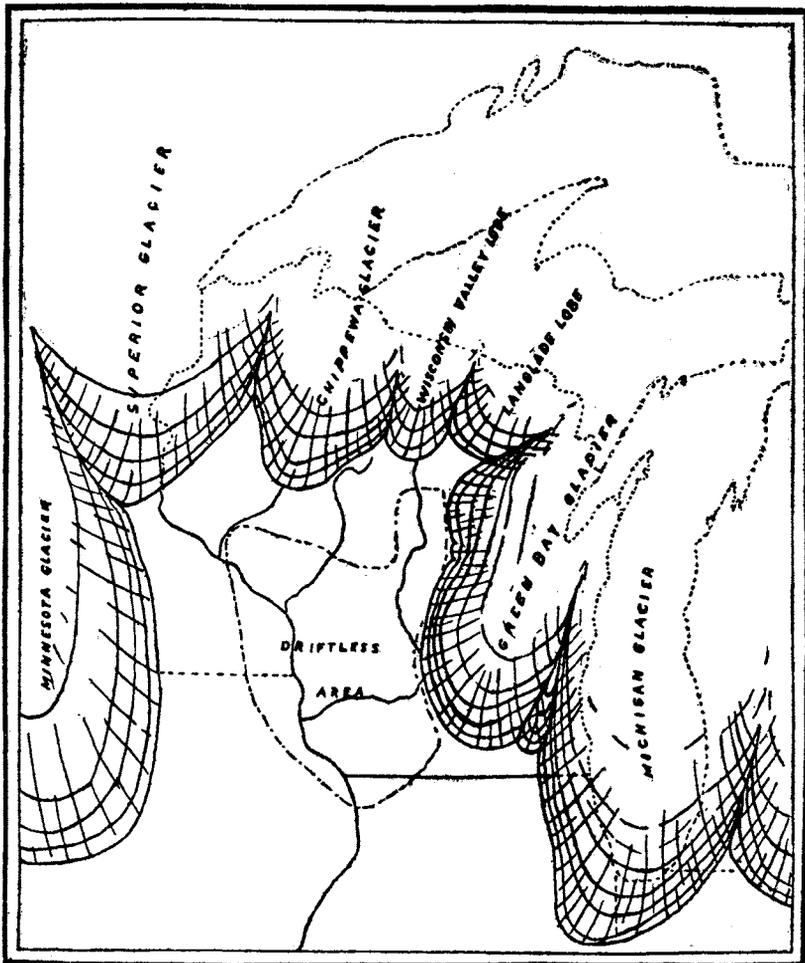
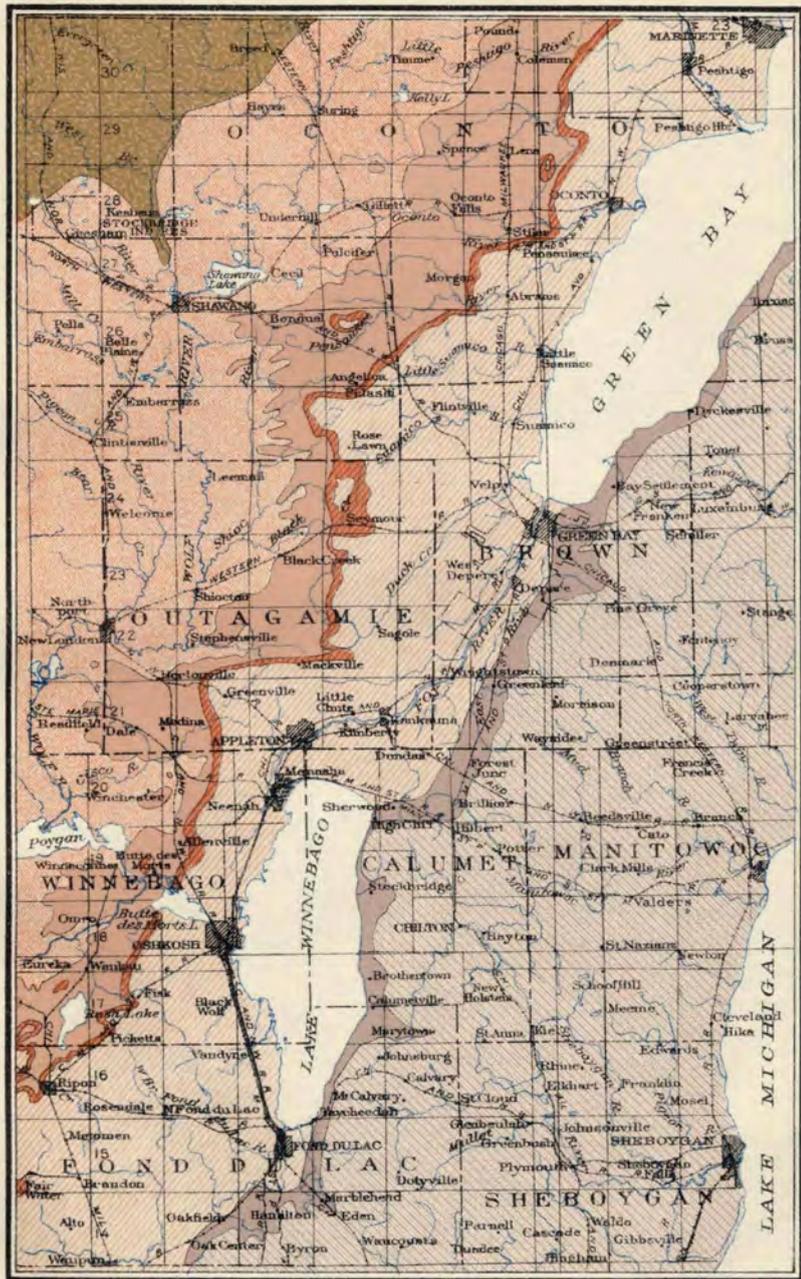


Fig. 2. Sketch map showing the various tongues or lobes, of the glacier in Wisconsin at one period of the Ice Age.



- LEGEND**
-  Niagara Limestone
 -  Cincinnati Shale
 -  Galena-Platteville Limestone
 -  St. Peter Sandstone
 -  Lower Magnesian Limestones (includes the Shakopee and the Oneota)
 -  Upper Cambrian Sandstone
 -  Pre-Cambrian

GEOLOGIC MAP OF THE FOX-WINNEBAGO VALLEY
 From Geologic Map of Wisconsin, Plate I, Bulletin XXXV,
 Wisconsin Geol. and Nat. Hist. Survey (Weidman)
 Scale: 1 to 1,000,000 = about 16 miles to the inch

CAUSE OF THE GENTLE SLOPE ON THE WEST AND THE STEEP SLOPE ON THE EAST

The cross section of the Valley shown in Fig. 1 brings out the fact that the Winnebago-Lower Fox Valley is not of the usual valley-shape, but that the eastern slope is steep, almost precipitous in places, while the western slope is very gentle. The drawing (Fig. 1) shows why this is so. The Valley has been widened by the slow wearing back (toward the east) of its steep eastern side. The layers of the bed rock themselves dip or slope toward the east, so that the river and the glaciers have always done their eroding mainly against the eastern side of the Valley, and this side is kept steep by the slow wearing back toward the east of the Niagara limestone cliff and the underlying shale, while the western slope of the Valley is very gentle, due to the gentle eastward dip of the underlying rock. Seldom is a valley so definitely bounded on one side as is this one, and seldom does a valley have a boundary less conspicuous than that of the Lower Fox on the west. For the most of the distance, so far as the traveler can see, there is no water-shed between the Lower Fox and the Wolf, which drains the land immediately west.

THE VALLEY AT PRESENT

The Winnebago-Lower Fox Valley is a lowland with

- (1) a shallow depression in the southern half which is mostly covered by Lake Winnebago;
- (2) a north-sloping plain from the foot of Lake Winnebago to Green Bay.

Through this sloping plain the Fox River has cut a channel down to the bed rock upon which it flows with many rapids. Near Lake Winnebago and again near Green Bay the river has very low banks, but throughout three-fourths of its length it flows between steeply rising banks of red clay averaging thirty or forty feet in height. The present river channel shows by the steepness of its earth banks that it is youthful. The flat surface of the upland on either side of the channel is somewhat cut up by ravines, the courses of temporary or extinct tributaries; it is a rich farming region with little waste land.

The average width of the valley of the Lower Fox between the inconspicuous divide on the western side and the steep limestone ridge on the eastern side, is twelve or fourteen miles, and the river flows a little east of the median line. Southward from

Fond du Lac the valley floor gradually rises for 10 or 12 miles until a low divide is reached from which the drainage is southward to the Rock River.

NATURAL RESOURCES

Originally, hard wood forests covered most of the land near the Fox and Lake Winnebago, but there were prairie-like openings, some of which were utilized by the Indians for corn fields. The greatest timber resources tributary to the Fox River Valley were, however, the Wolf River pineries, which were among the finest in the state or in any state. Although the forest products have dominated the manufacturing industries at every stage, the *soil* of the Fox-Winnebago Valley is its greatest natural resource. In addition to these natural resources are the brick clays and the limestone, the basis of small industries. So far as the river itself is concerned, the two geographical conditions which cause the Fox to stand out prominently are

- (1) its great waterpower, and
- (2) its use as a waterway.

No other stream in the state except the Wolf is or ever has been used to any extent for steamboat navigation, and no other river has its waterpower so fully developed, or has so much waterpower in so short a distance. Growing out of these two conditions is a third fact—in no other valley of the state is there such a chain of cities in close succession. Only along the Lake Michigan shore has city-growth been more rapid than in the Fox-Winnebago Valley.

CHAPTER III

PECULIARITIES OF THE FOX RIVER

In all of its main features the Fox River is an abnormal stream, due to the changes imposed upon it by the action of glaciers. As we find the river to-day it is quite unlike the original Fox, although it is not certain just where that river rose, flowed, or emptied. On account of the alternating belts of hard and soft rocks in eastern Wisconsin it is perfectly natural that a north-south valley should be formed where the Fox-Winnebago lowland now is, with the Niagara limestone escarpment as its eastern

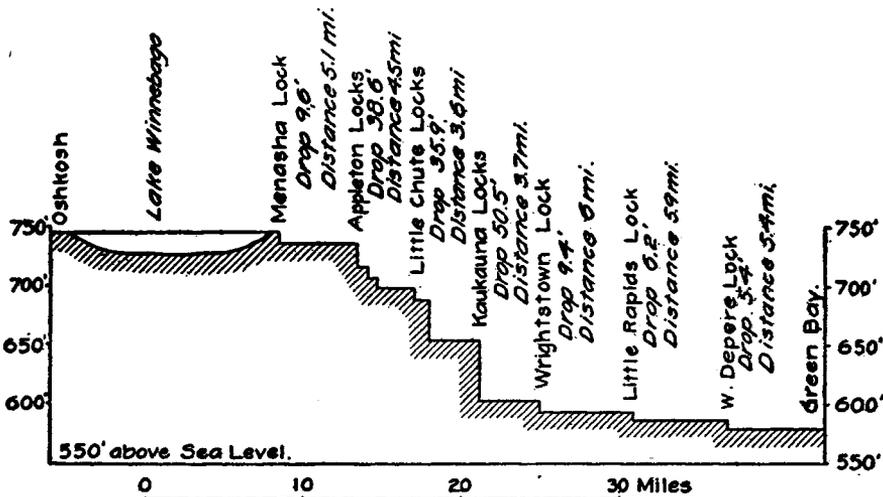


FIG. 3. PROFILE OF THE LOWER FOX AS IMPROVED

boundary. The natural slope of the land of Wisconsin is mainly toward the south; for, not only do the large rivers of the state flow in a general southerly direction, but the whole Mississippi basin slopes in that direction. It is worthy of note that the only important river in the state which flows northward is the Lower Fox.

Whatever may have been the ancient course by which the waters of the Wolf and Upper Fox reached the sea, that course

could scarcely have been the present one. The Wolf River now heads in Forest County and flows a hundred miles south to its present junction with the Fox, a few miles west of Oshkosh, and then its waters reverse their direction and flow 125 miles northward from Oshkosh to the foot of Green Bay before they reach Lake Michigan. This is certainly an unusual procedure. (See plate IV.)

THE UPPER FOX RIVER

The natural course of this part of the river has been so interfered with by glacial deposits that the present course bears little resemblance to the original one. At present the river winds for 107 miles with a sluggish flow through a maze of marshes and lakes, with an average fall of only 4 inches to the mile. Near Portage both the Wisconsin River and the Upper Fox flow in horse-shoe curves and come so close together (about a mile and a quarter) that at times of very high floods the Wisconsin overflows into the Fox. A canal now connects the rivers and between Portage and Lake Winnebago nine locks render this part of the Fox navigable, but it has not been used to any large extent.

The principal tributary of the Fox is the Wolf, a larger river than the Upper Fox. In the logging days this river and its branches were used to an enormous extent in driving logs to the mills, especially to those at Oshkosh. At one time there were 43 dams on the upper Wolf and its tributaries, built to facilitate the log-driving operations.

An impressive illustration of the way in which waterpower aids in building up cities is seen by comparing the upper and lower portions of the Fox. More manufacturing is done at any one of several rapids on the Lower Fox than is done on the entire 107 miles of the upper river; Berlin, with 4700 population, is the only city on this portion of the river, while there are 6 cities all larger than Berlin, in the 35 miles of the Lower Fox.

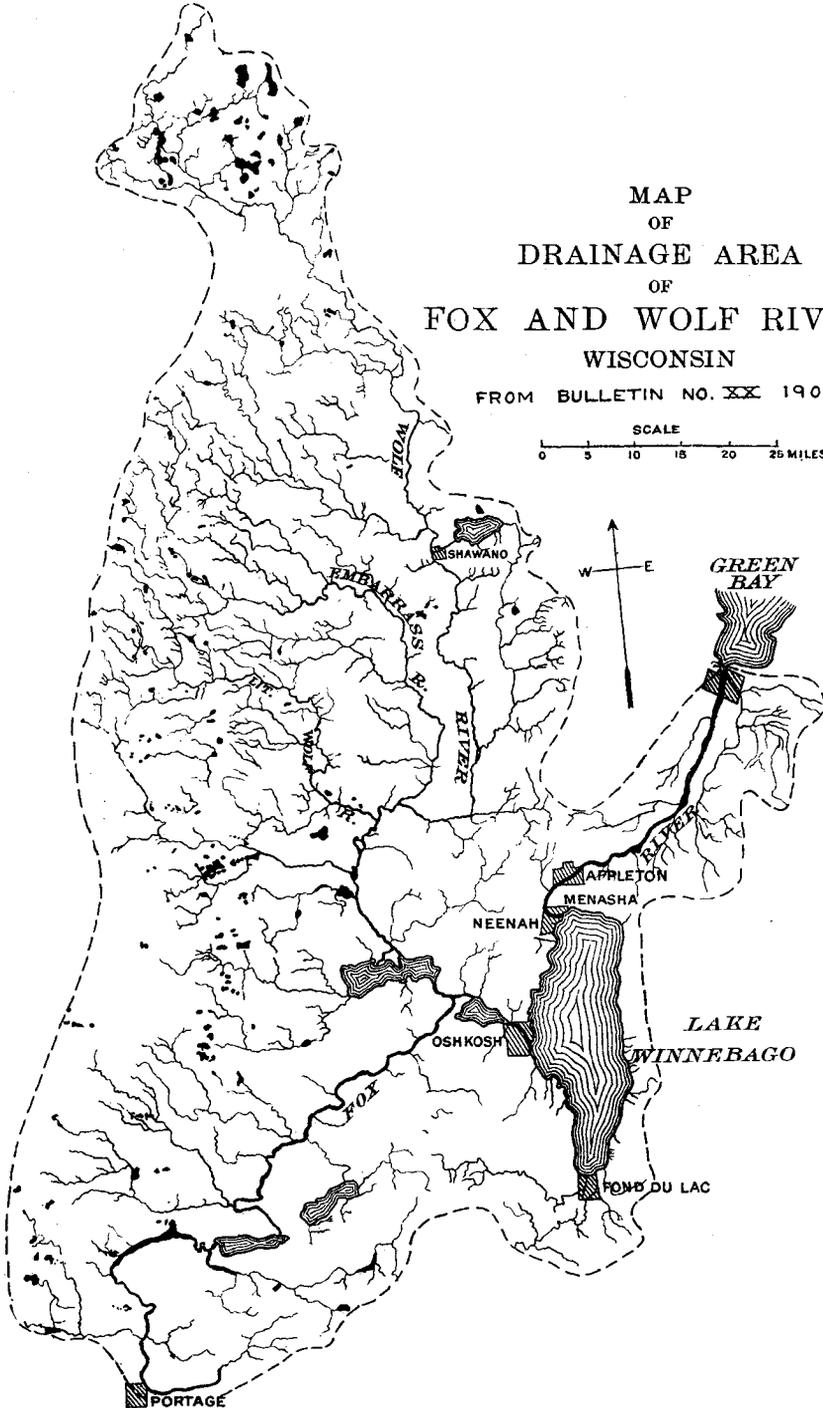
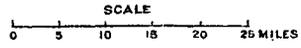
LAKE WINNEBAGO PAST AND PRESENT

This lake is unusual in two respects: (1) It is one of the largest of the glacial lakes entirely within the limits of one state; it is 28 miles long and 10.4 miles broad in the widest part, and covers an area of about 215 square miles.* (2) It is remarkably

* The extreme shallowness of Lake Winnebago may be illustrated thus: take a sheet of paper so thin that a pile of 350 sheets is one inch high; cut out an oval shaped piece 8 inches wide and 21 inches long; this piece of paper will represent correctly the proportional length breadth, and thickness of the sheet of water which forms Lake Winnebago.

MAP
OF
DRAINAGE AREA
OF
FOX AND WOLF RIVERS
WISCONSIN

FROM BULLETIN NO. XX 1908



shallow, having a maximum depth of only 21 feet. Many of the glacial lakes of New York and New England have depths ranging from 200 to 300 feet. Lake George, in New York, for example, is 400 feet deep. With the exception of the land on the eastern side of Lake Winnebago, its banks are low. The lake is merely a film† of water spread over a slightly depressed portion of a plain. It is, like many glacial lakes, a shrunken portion of a body of water which was once larger.

ORIGIN OF THE PRESENT LAKE

Why is there a Lake Winnebago? It is readily seen that the cliff or escarpment of Niagara limestone on the east holds the water on that side. But this would not produce a lake unless a dam of some sort extended east and west across the Valley and impounded the water. Most of the lakes in a glaciated region are due to dams of drift extending across streams. There is such a natural dam across the Fox River basin at the northern end of Lake Winnebago. This dam does not in the least resemble those which men build, and would not be recognized as a dam except by careful examination. The only man-made dam that resembles it is the great Gatun Dam which the engineers have constructed on the Isthmus of Panama to make Gatun Lake, a part of the Panama Canal waterway. Here the engineers have caused millions of carloads of earth and broken rocks to be dumped into the valley of the Chagres River, forming a massive obstruction which acts as a dam, impounds the water of the river, and produces Gatun Lake. In the Lower Fox Valley a similiar result was produced by a natural cause—the glacier that moved through the valley thousands of years ago. This glacier carried earth and rocks, mingled with the glacial ice; when the ice melted, it left this material, sometimes spread out more or less evenly in what is called a *till sheet* or *ground moraine*, and at other times heaped up in ranges of low hills in the form of *terminal moraines*. If one of these masses of glacial drift, or ranges of low hills, chanced to extend across the course of a river, it formed a low, perhaps hardly noticeable dam of earth; thus the water of the river was held back and a lake was produced. This is what happened in the case of Lake Winnebago. The water flowing in from the Upper Fox River filled the shallow basin, and the lake rose until the water flowed out through the lowest notch or sag around the margin of the lake. Naturally the overflow occurred

† Juday, "Inland Lakes," p. 96. Bull. XXVII, Wis. Geol. and Nat. Hist. Survey, 1914.

at the place where the ground was lowest, whether it was over bed rock or glacial drift. It chanced in the case of Lake Winnebago that the lowest place in the margin of the basin was at the northwest corner (see map, Plate IV.) where the bed rock is at the surface of the ground. This is not the point where we should expect the lowest place to be. Since the underlying rock slopes toward Lake Michigan, we should expect the outlet of the lake to be at the northeastern corner. The shortest cut from Lake Winnebago to Green Bay is from this northeastern corner of the lake, as the map shows. Yet, on account of the uneven character of the drift the lowest ground at the foot of the lake chanced to be at the other corner, and so the Fox flows out of the lake at that point. Well-borings show that the drift is thicker and the rock surface considerably lower at the northeastern corner. There is evidently an old buried valley there.*

THE RED CLAY AND ITS RELATION TO LARGER LAKE WINNEBAGO

In the region between Fond du Lac and Green Bay, the traveler notes the prevalence of a peculiar red soil. It is so distinctly unlike the usual soils of Wisconsin that it early became a subject of enquiry. Examination shows that it not only differs in color from other soils but that it also contains an unusually high proportion of clay. In various places it is so fine and pure that it is used for making brick. Near Depere, for example, it is found in stratified beds 50 feet deep, showing unmistakably that it was deposited in quiet water, such as a lake or enclosed lagoon. In most places, however, the red clay is mixed with pebbles, and with some sand and bowlders. Dr. Wm. C. Alden of the U. S. Geological Survey has recently studied and mapped the region south of Neenah-Menasha and confirms the fact that the red material as it now exists in that region is glacial till. The high proportion of clay and the strikingly level surface at once suggest that the surface till is not the ordinary unsorted, miscellaneous drift left by the retreating glacier, but that the material was deposited in water and was afterward worked over and distributed by the waters of a larger Lake Winnebago. But that the red material as we now find it is a glacial deposit is shown by the fact that the "red till area" is bounded by a terminal moraine composed of red till, and that this moraine is at various levels ranging from about 1000 feet on the limestone ledge on the east

* T. C. Chamberlain speaks of this buried channel in the "Geology of Wisconsin," Vol. II, p. 666. W. C. Alden of the U. S. Geological Survey has gathered further proof by means of well records which show the existence of this buried valley.

to a level only slightly above Lake Winnebago (747 ft.) on the plain. Alden interprets this as evidence of a late stage of the Green Bay lobe, whose extent is now shown by the loop of red moraine within which the red till of the Lake Winnebago region is included. This lobe represents a very late and relatively short period of re-advance of the Green Bay ice tongue, following the accumulation of the red clay in the Lake Winnebago lowland. The red clay extends westward in the Fox River Valley as far as Berlin, and northward as far as Shawano, and down the Valley of the Lower Fox to Green Bay. This peculiar red deposit is not confined to the region under discussion, but also occurs along the Wisconsin shore of Lake Michigan from Milwaukee northward, and along the south shore of Lake Superior.

CAUSE OF THE LARGER LAKE

Remembering that the entire Fox River-Lake Winnebago basin is a lowland, enclosed by higher land on all sides except for a narrow opening at the north end, it is easy to understand that if anything should obstruct this opening, the northward drainage of the entire basin would be blocked, and a lake would be produced. This is evidently what occurred when the Green Bay lobe of the glacier pushed its way into the valley from the north. The ice itself acted as a dam, not a fixed one, but a slowly advancing or receding one, and as the ice lobe pushed slowly up the valley, the lake became smaller and smaller and finally disappeared entirely as the glacier spread over the whole basin and beyond. Long afterward, as the Glacial Period was coming to a close and the glacial ice was melting, the ice front melted back toward the north and the Green Bay lobe again became a dam across the Fox River Valley, and again produced a lake in the Fox River-Lake Winnebago lowland. Still later, when the glacier had entirely withdrawn from Wisconsin, and the ice dam had melted away, the glacial lake, whose waters had been flowing westward into the Wisconsin River, now drained northward by the Fox River and the lake shrank to about its present size. Why the lake was not entirely drained has already been explained (p. 15).

CHARACTERISTICS OF THE LOWER FOX RIVER

As the Upper Fox is noted for its extremely slight fall (4 inches to the mile), so the Lower Fox is notable for its rapid fall, and especially for the fall in a nine-mile stretch between the Grand Chute (Appleton) and the Grand Kaukauna. A profile of the river is shown in Plate VIII.

From Lake Winnebago to Green Bay the distance by the river is 35 miles, and throughout practically all of this distance the river flows between banks of red till, in places 60 feet high. At the outlet of the lake there are no banks, and below Neenah and Menasha the river expands into Little Lake Butte des Morts, four miles in length (Plate XVI.) At the lower end of this lake the present river channel begins, and continues all the way to Depere. This channel is merely a young valley cut by the river in the red till beds which were laid down in the larger Lake Winnebago. Were it not for the bed rock which is buried under a few score feet of till, the river would have cut a much deeper channel than it has. The Lower Fox has no tributaries of any size, but the plain adjacent to the river is cut by deep, narrow ravines in which small streams once flowed, but most of which are now dry.

THE RAPIDS

There were eight sets of rapids in the river before it was improved for navigation. Their location and amount of fall are shown in the following table.

TABLE I

RAPIDS ON THE LOWER FOX BEFORE IMPROVEMENT

(From Major G. K. Warren's Report. Executive Document No. 28, 44th Congress, 1st Session, 1876, p. 29.)

NAME	DESCENT	DISTANCE APART
	FEET	MILES
Depere.....	8	.....
Little Kaukauna.....	8	6.0
Rapide Croche.....	8	6.0
Grand Kaukauna.....	50	4.5
Little Chute.....	38	2.5
Cedar Rapids (Kimberly).....	10	.75
Grand Chute (Appleton).....	38	4.0
Winnebago Rapids (Neenah-Menasha).....	10	4.25
Lake Winnebago to Depere.....	170	28.00

Four-fifths of the total fall of these rapids is in a relatively short stretch, and three of them include 126 feet of the total fall of 170 feet between Lake Winnebago and Green Bay; these are Grand Chute at Appleton (38 feet fall), Little Chute, (38 feet fall), and Grand Kaukauna, (50 feet fall). To overcome the rapids and render steam navigation possible, 17 locks have been constructed.*

CONCENTRATION OF FALL

In the stretch between the crest of the Menasha dam and the upper dam at Appleton, the total fall is only 10 feet, mostly concentrated at the Winnebago Rapids below Neenah-Menasha.

In the 9-mile stretch between the upper dam at Appleton and the foot of the Grand Kaukauna, the fall is 134 feet, or an average of 15 feet to the mile.

In the 21-mile stretch between the foot of the Grand Kaukauna and Green Bay the fall is 24 feet, or an average of only a little over one foot per mile.

The most notable portion of the entire river is the 9-mile stretch from the head of the Grand Chute (Appleton) to the foot of the Grand Kaukauna, in which short distance is concentrated 80 per cent of the fall of the Lower Fox and hence 80 per cent of the great water power.

At once the question arises—Why should 80 per cent of the river's fall be concentrated in a single 9-mile stretch? By consulting a map (Plate II.) it will be seen that this part of the river is that portion which is in Outagamie County, and that from the upper dam at Appleton, to the foot of the Grand Kaukauna, *the river flows almost due east, while the rest of its course, both above and below, is almost due north.* Is there any reason why this 9-mile portion of the river where it flows eastward should contain 80 per cent of the entire fall of the Lower Fox? Plainly there is. It is in this east-flowing stretch that the river is engaged in offsetting the accident which made it flow out of Lake Winnebago at the northwestern corner instead of the northeastern corner as, according to geological structure of the valley, it ought to do. As soon as the new-born Fox River, at the end of the Glacial Period, had found its way out of Lake Winnebago at the northwestern corner, its flow was naturally in the direction of Green Bay, which is both *north* and *east* of the outlet of the lake. Now nearly all of the necessary *eastward* flow of the river is accom-

* For list of these see page 36.

plished between the present cities of Appleton and Kaukauna. The river easily cut a channel through the soft till which partly fills the valley and soon was flowing on the bed rock below.

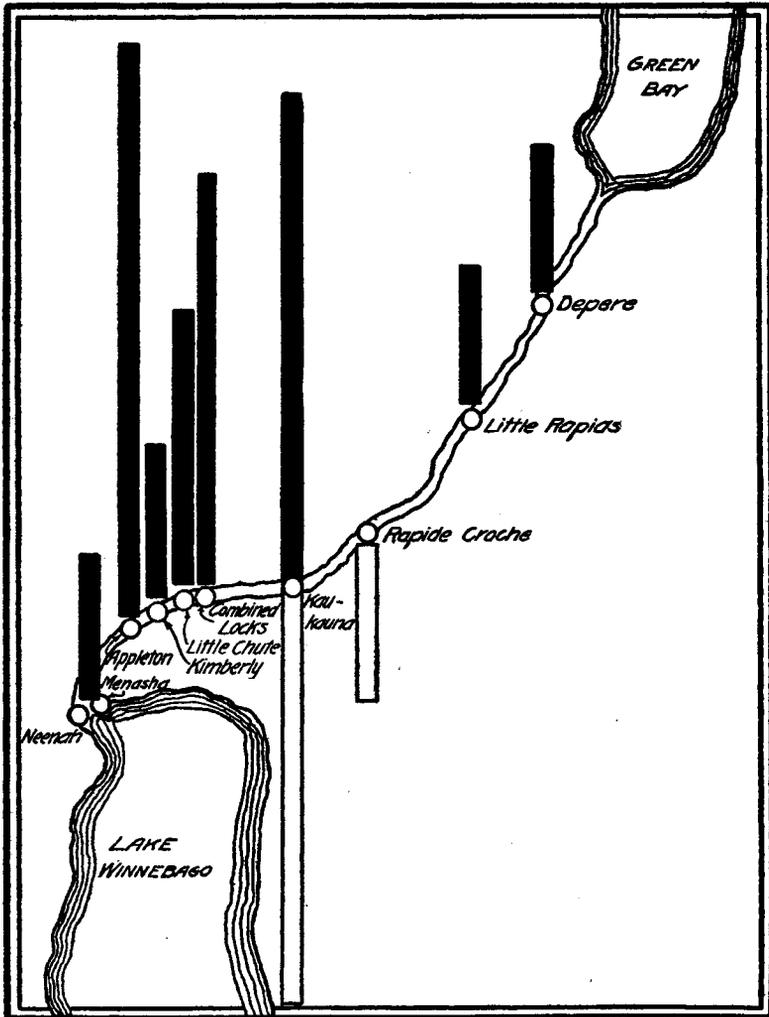


FIG. 4. DIAGRAM SHOWING THE RELATIVE AMOUNT OF WATER-POWER AT DIFFERENT POINTS ON THE LOWER FOX RIVER

The black bars extending upward represent developed power, and the unshaded ones extending downward represent undeveloped power. Note the concentration of power along the east-flowing portion of the river. See table II, p. 22.

The underlying rock surface evidently slopes rather rapidly and unevenly toward the east and has a number of steep pitches where rapids occur and which give rise to the water powers. The

presence of a deep, buried river channel near the cliff on the east side of the valley has already been mentioned (p. 16). The rapids between Appleton and Kaukauna are evidently due to the fact that here the river is flowing down the side-slope of this buried valley.

And so it is due to the glaciers that Lake Winnebago exists at all, and it is due to a chance occurrence that the lowest place in the drift-dam which caused the Lake was at the northwest corner, causing the outlet to be at that point, and giving the Lower Fox a stretch nine miles long where it flows down the easterly slope of a buried valley and thus concentrates 80 per cent of its fall within nine miles, and creates an enormous water power.

Had the outlet of Lake Winnebago chanced to be at the north-eastern corner, where the buried river channel is, then the river would have cut down through the soft red till into the old channel and the lake would long since have been entirely drained. Where the lake now is would be a level plain and through it would run a deep, narrow, Fox River channel, with steep clay banks. The fall of the entire Fox River would thus be more evenly distributed all along its course from Portage to Green Bay, and there would be few, if any, places where the fall would be sufficiently concentrated to produce valuable water power. Thus, while it is quite a matter of accident that the Lower Fox has to flow out of Lake Winnebago at Neenah-Menasha, the 9-mile east-flowing stretch of the river in Outagamie County, where 80 per cent of the water power is produced, is not an accident, but is the expectable thing in view of the eastward slope of the rock surface which lies buried beneath the till in the Valley. The accident by reason of which the Fox flows out of Lake Winnebago at the "wrong corner" is a fortunate one, worth hundreds of thousands of dollars a year to the industries of the Valley.

THE WATER POWER

The amount of available water power along the river and the places where it is concentrated are shown in the following table:

TABLE II

WATER POWER OF THE LOWER FOX RIVER*

Neenah-Menasha.....	2,400 H. P. developed
Appleton.....	8,400 H. P. developed
Kimberly.....	2,200 H. P. developed
Little Chute.....	4,000 H. P. developed
Combined Locks.....	6,000 H. P. developed
Kaukauna.....	7,400 H. P. developed (not all used)
Kaukauna.....	6,000 H. P. undeveloped
Rapide Croche.....	2,200 H. P. undeveloped
Little Kaukauna (Little Rapids).....	2,000 H. P. developed
Depere.....	2,100 H. P. developed
Total developed.....	34,500 H. P.
Total undeveloped.....	8,200 H. P.
Total.....	42,700 H. P.

UNIFORMITY OF DISCHARGE

The annual rainfall of eastern Wisconsin rarely falls below 26 inches and seldom exceeds 37 inches. The proportion of the rainfall that reaches the Lower Fox and is available for water power is notably small because of the excessive evaporation from Lake Winnebago and the other lakes and marshes along the sluggish upper stretches of the river.

At the Rapide Croche dam, where the U. S. Government maintains a gaging station, the river seldom discharges more than $\frac{1}{4}$ of the rainfall of the 6200 square miles included in the river's catchment basin. It is said that on a hot summer day, the evaporation from the surface of Lake Winnebago is practically equal to the outflow of water through the river.

Lakes in the course of a river steady the flow and prevent a rapid rise after a heavy rain. Sometimes the Upper Fox basin receives an excessive downpour and discharges a great amount of water into Lake Winnebago. The rapid rise of the water in the upper course of the river is not accompanied by an equally rapid rise in the lower course, because the inflowing water spreads out over the entire area of Lake Winnebago and raises its level but little. The outflow of the lake into the Lower Fox increases,

* The figures are for theoretical horsepower; 20 per cent must be deducted to give actual horsepower. The figures are based upon an average flow of 150,000 cubic feet of water per minute which gives an average of 300 horse power for each foot "head." At high stages of water a much greater power is developed, and at the lowest stages the available power falls below this amount. The figures do not coincide exactly with those given in L. S. Smith's report on *The Water Powers of Wisconsin*, Bull. XX, Wis. Geol. & Nat. Hist. Survey, pp. 26-54.



WATER POWERS OF WISCONSIN

Circles indicate power owned by a Water power company, and leased or sold to manufacturers. Squares indicate power owned by manufacturers. From map of the United States in Report of Commissioner of Corporations on *Water Power Development in the United States* (1912).

of course, but this is gradual, and the high water stage is distributed throughout a considerable period of time. Such terrific floods as the one which destroyed half of the city of Black River Falls in 1911 are quite impossible in the Lower Fox, and the rise and fall of the water is much more gradual than in any other large river in the state.

Notwithstanding this regulating influence of Lake Winnebago and the other lakes in the Fox River system, there are high stages in the Lower River during the spring or early summer, and then there is more water than the mills can use for power and the surplus is wasted. The maximum flow occasionally reaches 1,000,000 cubic feet a minute. In the late summer the flow of the water declines to its lowest stage and for a period of two or three months there may be too little for the needs of the mills and steam power must be used.

For years a project has been under consideration looking to the building of dams for producing extensive storage reservoirs in the upper waters of the Wolf River. It is believed by some that in this way the flood waters may be stored and afterwards released when needed. The project has both advocates and opponents. But even under present conditions the water power of the Lower Fox is exceptionally large and exceptionally uniform when compared with that of other rivers of its size.

CHAPTER IV

THE NAVIGATION OF THE FOX RIVER
PAST AND PRESENT

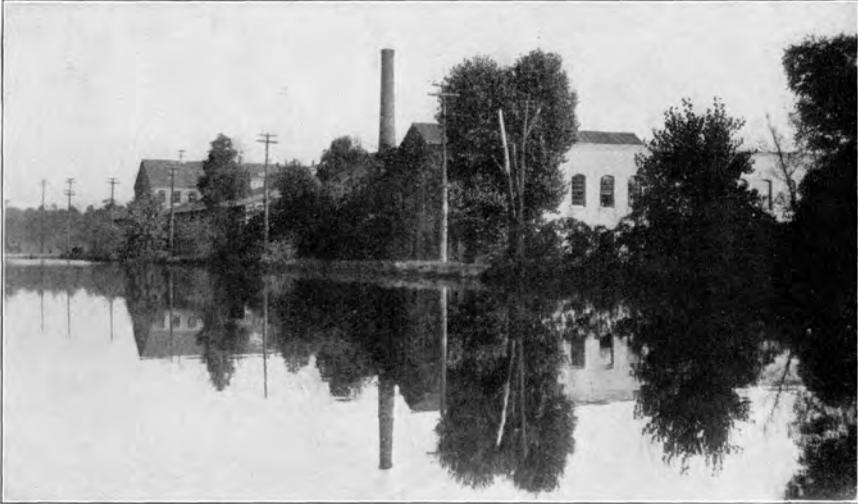
PART OF A FAMOUS HISTORIC ROUTE

Exploration. For more than two centuries the kings of France laid claim, by right of discovery, to a vast but undefined area in North America which they called New France. French navigators chanced to discover the mouth of the St. Lawrence River (1534); by means of this river and the chain of Great Lakes, the canoes of the French explorers worked their way westward into the very heart of the continent. One of these explorers, named Jean Nicolet, sent out by Champlain, Governor of New France, discovered an arm of Lake Michigan (Green Bay) opening toward the west; he entered it hoping that it might lead to China which was supposed to be much nearer than it is, and in 1634 he landed at some point near the mouth of Fox River, probably at Red Banks.* Clothed in a gorgeous silken robe and with great pomp and ceremony, Nicolet met the Winnebago Indians, feasted with them, and smoked the pipe of friendship. Thus began the French regime in the Fox River Valley, fifty years before Philadelphia was founded, and a century before Oglethorp's colony settled on the coast of Georgia and founded Savannah (1733). Green Bay was reached by Europeans 135 years before Daniel Boone and the English colonists from the Atlantic seaboard had pushed across the eastern mountains and had made their trans-Allegheny settlements.

THE IMPORTANCE OF RIVERS IN HISTORY

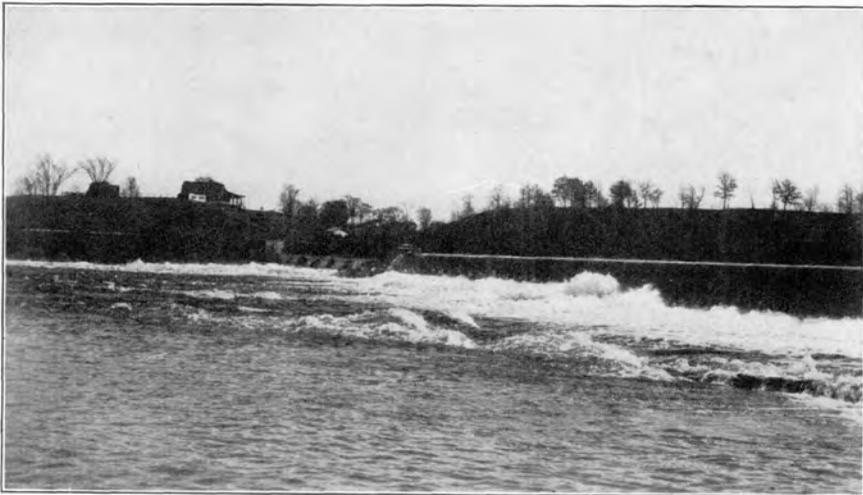
This fact raises the question "How did it come about that the French penetrated into the very heart of the continent before the English had gained even a narrow coastal strip along the Atlantic?" The answer fittingly introduces the idea of the chapter

* It is maintained by some that the landing took place near the present site of Menasha.



A.—SCENE BELOW THE LOWER DAM AT APPLETON

By means of frequent dams, the Lower Fox River is transformed into a series of lake-like reaches which provide slack water navigation.



B.—THE UPPER DAM AT APPLETON

Note the level upland which borders the river. The clay banks here are nearly 50 feet high; the river flows on a rock bed.

which follows. The answer is—"The French found a great natural waterway, 2000 miles long, which led them from the Gulf of St. Lawrence to the head of Lake Superior."

In an unknown, nearly untrodden, wilderness such as the white man found in North America, travel is difficult beyond anything which we can picture. On land an occasional Indian trail threaded its crooked way through the tangle of brush and timber. The fallen trees, the swamps, and the dense and thorny undergrowth made travel slow, and exceedingly difficult. In traveling through such a place, even the Indian trail was a luxury, for on the trail the explorer might carry a load of 50 pounds or more and possibly cover 20 or 25 miles in a day. But his outfit and the necessary provisions made load enough. To transport furs or goods for any distance by land on the backs of men was rarely profitable even when possible. Travel in a canoe was a marvel of comfort when compared with carrying a load on one's back. And so it followed as a natural consequence that in those early days the rivers and the lakes were almost the sole highways of exploration, travel, and trade. In such a wilderness as that which closed about the Great Lakes, the canoe routes were the only ones which tempted men. By these water routes the explorers pushed into new lands; the *coureurs de bois** and the *voyageurs* reached the Indian villages on the river banks and traded with the Red men; the occasional black robed priest from the mission visited his scattered flock; and small squads of soldiers reached the little forts placed at strategic points on the rivers or lakes. Quoting from Professor Turner:†—

"The rivers (of Wis.) not only *permitted* exploration, they also *furnished a motive* to exploration by the fact that their valleys teemed with fur-bearing animals. This is the main fact in connection with the Northwestern Exploration."

"So powerful was the combined influence of these far-reaching rivers, and the 'hardy, adventurous, lawless, fascinating fur trade' that the scanty population of Canada was irresistibly drawn from agricultural settlements into the interminable recesses of the continent."

"In short, this trade (in furs) may be regarded as the force that caused the first detailed exploration through the wilderness,

* The *coureurs de bois* or forest rangers were mainly French or French-Canadians engaged in fur-trading with the Indians. *Voyageurs* were usually employees of the fur-trading companies, acting as porters and boatmen.

† Turner, F. J., The Character and Influence of the Fur Trade in Wisconsin, *Proc. Wis. Historical Society*, 1889, pp. 52-98.

opened up the waterways, and led to the earliest outlying establishments in this country."

"Stockade trading posts were established at such key points as a strait, a portage, a river mouth, where also there was likely to be an Indian village."

In the settled parts of French Canada the farms were narrow strips of land facing on the rivers and often reaching indefinitely back into the interior. No one cared for a farm unless it faced on a river or lake as city lots face on streets. It is said that at one time, every settler's house in New France could be seen by paddling a canoe up the St. Lawrence and Richelieu rivers.

The long water route of the St. Lawrence and the Great Lakes reached almost to the Mississippi, the great waterway leading into the interior of North America from the south. Between these two lay the territory which now makes Wisconsin.

THE HISTORIC WATERWAY

Branching off from Lake Michigan on the west was Green Bay, offering safe sailing and shelter for the little boats of the explorer, trader and missionary. From Green Bay the Fox River led to within a mile and a quarter of the Wisconsin at its big bend. Here, by a short portage, the canoes were carried to the Wisconsin and thence they reached the Mississippi. Of all the canoe routes between Lake Michigan and the Mississippi, the Fox-Wisconsin was the most used, and remains to this day the most historic. The importance of this water route is suggested by the large number of historic events in which it shared, some of which are mentioned in the following paragraphs.

In 1654 the French adventurers, Radisson and Goseilliers, came to Green Bay, ascended the Fox, and crossed the portage to the Wisconsin. In 1673 the now famous explorer-priest, Marquette, and the fur trader, Joliet, followed this same route on the memorable journey in which they discovered and explored the Upper Mississippi; ten years later, Le Sueur followed the same route. It soon became a regular route of the French fur traders, and the fur trading post at Green Bay was one of the most widely known and most profitable in the Northwest. At Depere was established in 1671, the historic old Jesuit Mission of St. Francis Xavier. Along the Fox occurred some of the bloodiest battles in early Indian warfare in the West; in one of these battles, nearly a thousand Indians belonging to the Fox nation perished.

Later (1766) Jonathan Carver in search of the Northwest Passage (?) passed through the Fox-Wisconsin route; and in 1809 the party of John Jacob Astor, founder of the Astor fortune, used this same route on its way to the Pacific coast for the founding of the important fur-trading post, Astoria. Throughout the 127 years of French control, down through the 25 year period of English control, and on to the days of the American railroad in the '60's this nature-made highway of travel between the Great Lakes and the Mississippi was a link in a great continental waterway—a part of a Pathway of Empire.

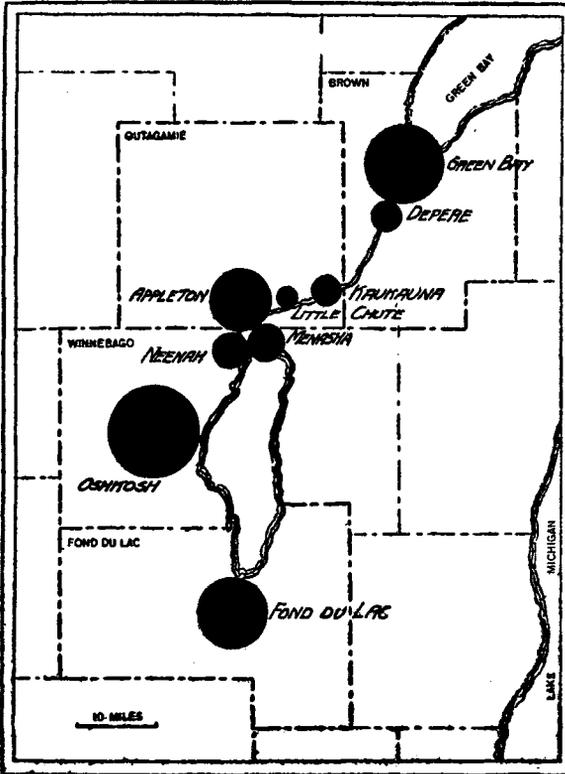


FIG. 5. PRINCIPAL TOWNS OF THE FOX-WINNEBAGO VALLEY
The size of the circle is in proportion to the population of the town. See table X, p. 41.

THE FOX RIVER AS A COMMERCIAL WATERWAY

The steep gradient of the Lower Fox—170 feet in 35 miles—would ordinarily take the river out of the navigable class for all but small boats. There were many rapids and some violent ones, and it now requires seventeen locks to enable boats con-

veniently to pass the frequent rapids. Two factors tended to make the river a much-used waterway; one, the easy portage of less than two miles between it and the Wisconsin; the other, the outlet which it gave to a rich fur-yielding region. The French, who really dominated northern Wisconsin long after New France fell, were interested almost exclusively in the fur trade with the Indians. Boats were the only practicable means by which furs could be brought out and goods for exchange taken in, and even a rapid river like the Lower Fox was far better than laboriously carrying loads along Indian trails.

METHODS OF NAVIGATION

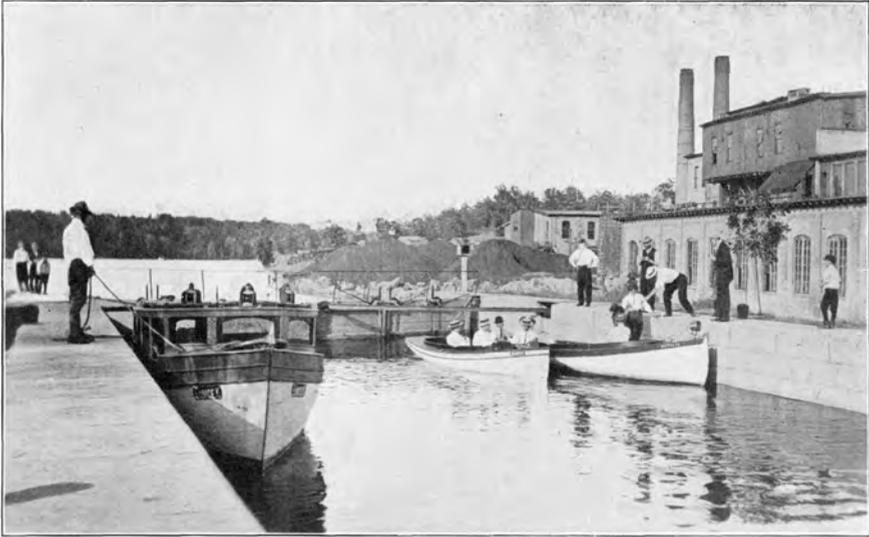
During five periods of time, five different methods of navigation have succeeded one another on the river:

1. the Indian canoe, propelled by paddles;
2. the French batteau, propelled by oars;
3. the Durham boat, pushed by poles;
4. the steamboat, and
5. the barge and steam tug.

Canoes and Batteaus. At first only light canoes were used; they could readily be lifted out of the water and carried around rapids or even from one river to another, and could navigate shallow water and narrow channels. The French batteaus were larger, usually thirty feet long; and they were rowed by from four to ten French-Canadian voyageurs, beating time to their boat songs; these boats came into use later and were employed in connection with canoes throughout the French period.

Professor Turner thus describes transportation by the canoe: "There are the rapids to be run, the portage where the canoe must be emptied and where each voyageur must bear his two packs of 90 pounds apiece, and there are the *decharges*, when the canoe is merely lightened and where the voyageurs, now on land, now into the rushing waters, drag it forward till the rapids are passed. There is no stopping to dry, but on until the time for the hasty meal, or the evening campfire underneath the pines. Every two miles there is a stop for a few minutes' smoke or 'pipe,' and when a portage is made, it is reckoned in 'pauses,' by which is meant the number of times the men must stop to rest."*

* Turner, F. J., *The Character and the Influence of the Fur Trade in Wisconsin*, *Proc. Wis. Hist. Soc.* 1889, p. 80.



A.—SCENE AT APPLETON

One of the 17 locks in the Government canals around the rapids of the Lower Fox River. The waterway is one of great scenic beauty and is much used by pleasure boats.



B.—ONE OF THE GOVERNMENT CANALS AT APPLETON

The canals are higher than the river and the drop between canal and river gives the water power.

The American Fur Company is said to have sent up the Fox River flotillas which included from fifty to one hundred canoes and batteaus.

The Durham Boats. By 1825 the Durham boats, originally devised for use on the Pennsylvania rivers, had largely displaced the batteaus. They were larger and carried more freight with proportionately fewer men. They were ten to twelve feet broad, forty-five to sixty feet long, carried twenty-five to thirty tons of freight and were propelled by six to twelve men using poles.* These boats drew only eighteen or twenty inches of water and so were well adapted to river navigation.

Daniel Whitman's Narrative describes a trip up the Fox by a Durham boat in 1821. At Grand Kaukalo (Kaukauna) they had to unload and cart the goods about one mile, the Indians going into the water, pushing, lifting and hauling the boats over the rapids, then reloading and poling them up to the Grand Chute (present Appleton). There they had to unload and carry the goods up a hill and down the other side above the Chute, which was a perpendicular fall of three or four feet. When the boats had been hauled over the rapids by the Indians, they were reloaded and then pushed ahead and poled from there to Fort Winnebago. At "the portage" (the present city of Portage) boats and cargoes had to be transported by land over a distance of between one and two miles. Dr. R. G. Thwaites says the creoles charged \$10.00 for transporting a boat across the portage and fifty cents a hundred pounds for the cargoes.

THE CANAL EPOCH

In 1825 the most important and most celebrated canal in the United States was completed. This was the Erie Canal in New York State connecting Lake Erie with the Hudson River, and through that river with the Atlantic Ocean at New York City. This waterway was so successful that canal-building came into sudden favor and scores of canals were projected and many of them built; most of these were in the states which touch the Great Lakes or the Atlantic Ocean.

THE IMPROVEMENT OF THE FOX

As early as 1829—four years after the opening of the Erie Canal—an agitation was begun in the Fox River Valley for the improvement of the Fox-Wisconsin waterway so that it might be

* Arndt, J. W., *The Early History of Green Bay and the Fox River Valley*. Depere, 1894, 57 p.

used by steamboats, which were then becoming common. In 1836 the U. S. government engineers made a survey of the mouth of the Fox River and three years later, a survey of the river itself. Six years afterward the War Department made a survey of Green Bay. Finally, in 1846, Congress granted a large amount of public land in the Territory of Wisconsin and stipulated that the funds derived from the sale of this should be used for the purpose of making a waterway navigable from the mouth of the Wisconsin to Green Bay. A canal was to be built at the portage between the Fox and the Wisconsin, and both rivers were to be cleared of logs, snags, and sand bars; overhanging trees were to be cut away, and the rocks at the frequent rapids in the Lower Fox were to be blasted out, or canals with locks were to be built around the rapids.

THE STATE'S ATTEMPT

In 1849—twenty years after the agitation began—the State of Wisconsin commenced work upon the improvement. At first the public land sold rapidly, and for a year or two things appeared promising; a lock at the Depere rapids was completed and opened for navigation in 1850. The short canal joining the two rivers at the portage was completed and a little dredging of the river channels was done. But land sales soon declined, the money ran out and the project nearly came to a halt. The state officials declined to continue the undertaking as a public enterprise, and in 1852, after spending \$400,000 on the work, the state turned it over to a private company, called the Fox and Wisconsin Improvement Company.

NAVIGATION DURING THE PERIOD OF IMPROVEMENT

The Durham boats continued in general use on into the '50's, when a portion of the Fox was opened to steamboat navigation.

In the early '50's there was an epidemic of plank roads—real or projected. One was built to connect Kaukauna and Menasha. Steamboats ran from Green Bay to Kaukauna and heavy freight was then hauled by teams over the plank road to Menasha. In 1853, for example, the railroad iron for the Rock River Union Railroad (now the C. & N. W.) came from the East by way of the Great Lakes to Green Bay, thence up the Fox to Kaukauna, thence by plank road to Menasha and thence by barges to Fond

du Lac.* It is said that the big wheat crop of 1855 kept 100 teams making daily trips between Menasha and Kaukauna.

The most difficult rapids of the Lower Fox were between Kaukauna and Appleton, and steamboat navigation was carried on both below Kaukauna and above Appleton several years

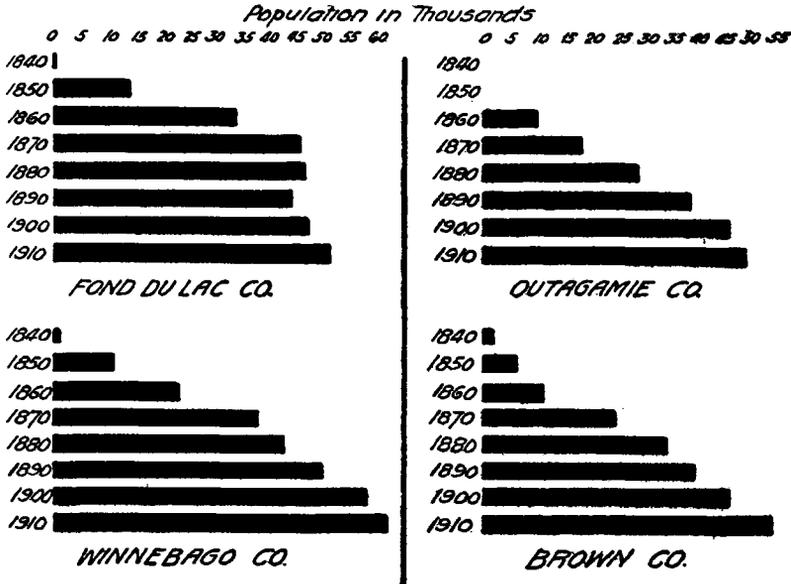


FIG. 6. DIAGRAM SHOWING THE GROWTH OF POPULATION IN FOUR COUNTIES FROM 1840 TO 1910

Note the difference between the growth in Fond du Lac County and that of the other three counties. Fond du Lac was the first of the four to get a railroad, (in the '50's).

before it was possible on the entire river. The *Walk in the Water*, the first steamer to reach Green Bay from the East, came in 1821. It was some twenty years later that the first steamboat—the *Black Hawk*, a cumbersome old Erie Canal boat fitted up with an engine—navigated the Lower Fox below Depere. In 1844 the *Manchester*, fitted up with machinery from the old *Black Hawk*, was the first steamer on Lake Winnebago, and the only one until 1850.

THE ENTIRE RIVER OPENED TO STEAMBOAT NAVIGATION

By 1856 the Fox River from Lake Winnebago to Green Bay could be traversed with difficulty by boats drawing three feet of water. Comparatively little was done on the Upper Fox or on the Wisconsin, yet it was possible for a small steamer, the *Aquila*,

* Harney, Richard J., *Hist. of Winnebago County*. Oshkosh, 1880.

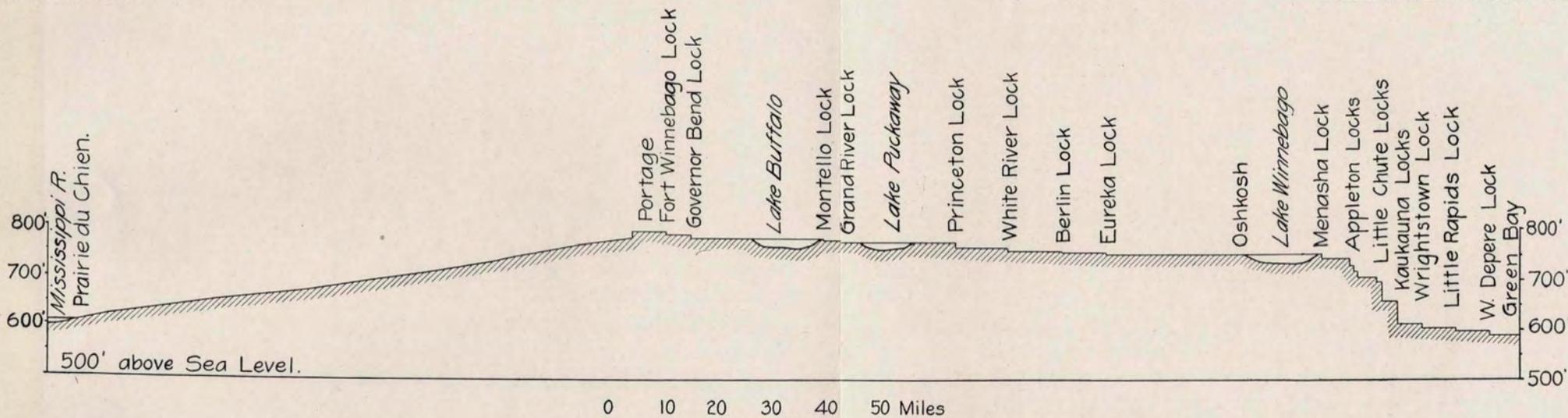
coming from Pittsburgh by way of the Ohio and the Mississippi, to ascend the Wisconsin to Portage at time of high water, traverse the portage canal and descend the Fox to Green Bay. This successful navigation of the entire waterway by a steamboat was the cause of great rejoicing. At Green Bay a public celebration, banquet, and ball were held. Enthusiasm ran high and many people believed that their hopes were about to be realized, that the Fox-Wisconsin waterway was surely going to become one of the nation's thoroughfares of travel. But the improvement was still far from complete.

In the early '50's, six steamers made trips more or less regularly between Green Bay and Kaukauna. The *Peytona* ran between Menasha and Fond du Lac, the *Enterprise* and the *Oneonta* tried the experiment of carrying lead and other freight between Galena, Ill. and Fort Winnebago, (Portage); a little steamer built on the Shioe River made weekly trips from Fond du Lac to Oshkosh, thence up the Fox and Wolf to New London. In 1858, five steamers ran on the Upper Fox and Wolf rivers, connecting Eureka, Omro, Buttes des Mortes, Fremont, Gills Landing and New London, with points on Lake Winnebago. Stage lines connected the principal places and competed with water transportation. The Oshkosh Daily Courier of May 1, 1857, says: "Six or seven stages arrive here daily loaded with passengers. There are eight steamboats owned in this place, all of which run from this point each day."

TAKEN OVER BY THE U. S. GOVERNMENT

In 1859 a railroad was completed between Fond du Lac and Milwaukee, and by 1862 it had reached Green Bay. This event marked the downfall of the waterway as a private enterprise. It fell into decay, was sold on foreclosure to the Green Bay and Mississippi Canal Company in 1866 and four years later the waterway itself was taken over by the U. S. government. The government did not take over the land grants or water power franchises of the Green Bay and Mississippi Canal Company. This company still exists and holds the right to use all surplus water in the Fox River and canals after the needs of navigation are supplied. The majority of the mills using the water power of the Lower Fox pay a yearly rental, averaging six or seven dollars a horsepower per year, to the Green Bay and Mississippi Canal Company.

Years of agitation followed in an effort to induce Congress to complete the work. A great convention, called by the governors



PROFILE OF FOX-WISCONSIN WATERWAY FROM PRAIRIE DU CHIEN TO PORTAGE TO GREEN BAY
 The U. S. Government has expended about \$4,000,000 on this waterway.

of four states, was held at Prairie du Chien (1868). The delegates drew up a memorial to Congress in which they declared that "The immediate opening of said channel is demanded by the interests of the people of the entire country; the work is one of national importance, required as a channel of commerce, as a ligament to bind together the states, insuring national unity and as a defense in case of war."

It is interesting to note that during our Civil War a commission was appointed to consider the feasibility of making Lake Winnebago a U. S. naval station; it was urged that by enlarging the Fox and Wisconsin rivers, gun boats from both the Mississippi and the Great Lakes could assemble in Lake Winnebago and thus greatly add to our national safety in case of war with Great Britain. In fact, one of the reasons frequently presented why the United States government should make the Fox-Wisconsin waterway navigable, was the great service which such a water route would be in case of war, particularly a war in which Canada was involved. The other reason urged was that by connecting the Mississippi with the Great Lakes by a waterway of considerable size, the grain-growing states of the West would have direct and much needed water connection with the manufacturing states of the East.

Between 1866 and 1875 Major G. K. Warren, acting for the government, made the most thorough investigation of the problem that has ever been made. His report,* issued in 1876, is unusually full and conclusive. He concluded that the constant formation of sand bars in the lower Wisconsin River would always impede navigation and render its use uncertain, if not impossible.

And so the half-century-long dream of constructing in Wisconsin a great national waterway which should connect the Father of Waters to the Great Lakes gradually faded. The chief difficulties lay in the Wisconsin River, not in the Fox. Yet, for all the disappointments, the improved Fox was of great service in the development of the parts of the state tributary to it. By means of it thousands of immigrants were able to enter the interior counties and bring in the needed household effects and farming implements. By it large quantities of wheat, flour, lumber, shingles and other products reached outside markets.

PERIOD OF GREATEST USE

The sixties and seventies were the decades of most active steamboat building in the valleys of the Fox and Wolf rivers.

* Executive Document, No. 28, 44th Cong., 1st Session.

In his chapter on "Steamboating on the Fox River" in Lawson's *History of Winnebago County*, Thomas Roach lists the steamboats built between 1844 and 1908. A summary of his detailed account gives the following:

Steamboats built between 1844 and 1849.....	2
Steamboats built between 1850 and 1860.....	18
Steamboats built between 1861 and 1870.....	21
Steamboats built between 1871 and 1880.....	10
Steamboats built between 1881 and 1890.....	8
Steamboats built between 1891 and 1908.....	3
Total.....	62

According to the same authority, the boats were built at the following places:

Built at Menasha.....	3
Built at Neenah.....	4
Built on the Wolf River.....	8
Built on the Lower Fox and Green Bay.....	6
Built on the Upper Fox.....	14
Built at Oshkosh.....	27
	—
	62

The majority of these boats eventually went to the Mississippi River.

PERIOD OF GOVERNMENT CONTROL

The United States government has enlarged and improved the locks, maintains navigation about eight months in the year, has lock-tenders at all of the locks, has a gaging station at Rapide Croche and has an office in charge of an engineer* at Oshkosh. No tolls are charged. The maintenance of navigation at public expense is defended on the ground that navigable waterways are effective in securing lower freight rates on the railroads. That this is true of the Fox River waterway to a certain, though not large extent, is attested by some shippers and receivers of freight in cities along the river. Coal is now the only commodity shipped in large quantities on the river. It is brought by barges from Green Bay to Appleton, Oshkosh and other places for upwards of 25 cents a ton less than the railroads charge, yet the railroads carry much

* Capt. L. M. Mann, from whose records many of the statistics in this chapter were obtained.

more of the coal used in the Valley than does the river. Moreover, the railroad rate on coal from any of the Lake Michigan ports to Wisconsin cities which are not in the Fox River Valley (Madison for example) is the same as it is to cities in the Fox River Valley. If, then, the competition of the waterway keeps freight rates on coal lower for places along the river, it must also

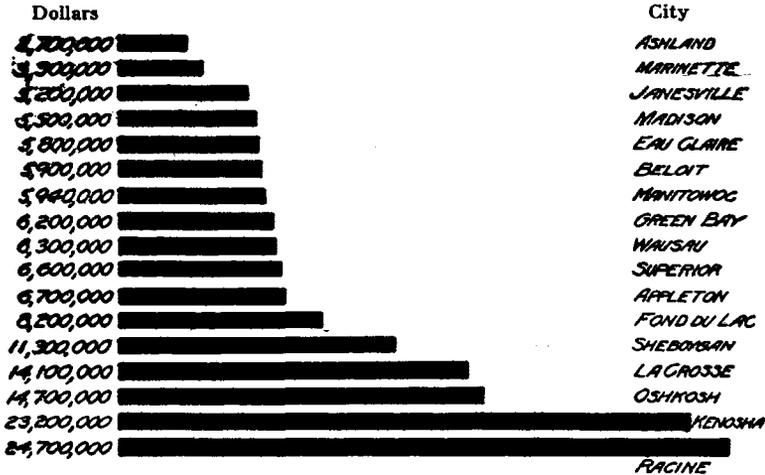


FIG. 7. DIAGRAM SHOWING THE VALUE OF MANUFACTURES IN WISCONSIN CITIES OF 10,000 TO 40,000 POPULATION. (Census of 1910).

accomplish the same service for cities throughout the whole southern and central portions of the state, for these cities enjoy the same railroad rates on coal from Lake Michigan ports as those given to the Fox River cities.

No regular lines of steamboats now run on the Lower Fox. On the Upper Fox and the Wolf, 2 or 3 small steamers or power boats make more or less regular trips. One runs from Omro to Berlin twice daily and two run from Oshkosh up and down the Wolf. A line of barges, largely but not wholly engaged in carrying coal, runs from Green Bay to up-river points, mainly to Oshkosh. The tonnage of freight carried on the river has remained practically stationary in recent years, being 812,000 tons in 1905, and 822,000 tons in 1913. Excursion steamers carry parties from time to time up or down the Lower Fox, and many small pleasure boats use the river. The total number of lockages made by the 26 locks in the entire waterway has doubled since 1900, due to the increased use of pleasure boats, especially gasoline launches. In 1913, the 26 locks all taken together were opened and closed over 20,000 times, which would give an average

of 800 to each lock, or about three per day during the season of navigation. However, the number of boats passing through the various locks differs widely. The lock at Depere was used 1283 times during 1913, those at Appleton, about 700 times, the one at Berlin, 1336 times and the one at Portage, 116 times.

TABLE III

LOCKS IN THE LOWER RIVER

At Neenah-Menasha.....	1 lock.....	8.6 feet fall
At Appleton.....	4 locks.....	35.5 feet fall
At Kimberly.....	1 lock.....	9.7 feet fall
At Little Chute.....	1 lock.....	14.4 feet fall
At Combined Locks.....	2 locks.....	21.8 feet fall
At Kaukauna.....	5 locks.....	50 feet fall
At Rapide Croche.....	1 lock.....	8.6 feet fall
At Little Kaukauna.....	1 lock.....	7 feet fall
At Depere.....	1 lock.....	9 feet fall

17 locks

TABLE IV

NUMBER OF LOCKAGES ON FOX RIVER FOR THE CALENDAR YEAR 1890

Lock	Lockages	Lock	Lockages
Depere.....	700	Appleton 2nd.....	406
Little Kaukauna.....	657	Appleton 1st.....	564
Rapide Croche.....	547	Menasha.....	773
Kaukauna 5th.....	696	Eureka.....	649
Kaukauna 4th.....	747	Berlin.....	625
Kaukauna 3rd.....	674	White River.....	160
Kaukauna 2nd.....	686	Princeton.....	165
Kaukauna 1st.....	706	Grand River.....	396
Little Chute 4th.....	469	Montello.....	158
Little Chute 3rd.....	469	Governor Bend.....	98
Little Chute 2nd.....	417	Ft. Winnebago.....	185
Little Chute 1st.....	418	Portage City.....	51
Cedars (Kimberly).....	465		
Appleton 4th.....	350		
Appleton 3rd.....	403		
		Total.....	12,634

TABLE V

NUMBER OF LOCKAGES ON FOX RIVER FOR THE CALENDAR YEAR 1913

Lock	Lockages	Locks	Lockages
Depere.....	1,283	Appleton Second.....	643
Little Kaukauna.....	904	Appleton First.....	715
Rapide Croche.....	729	Menasha.....	1,157
Kaukauna Fifth.....	605	Eureka.....	1,038
Kaukauna Fourth.....	610	Berlin.....	1,336
Kaukauna Third.....	610	White River.....	348
Kaukauna Second.....	653	Princeton.....	440
Kaukauna First.....	657	Grand River.....	996
Little Chute Fourth.....	} 593	Montello.....	483
Little Chute Third.....		Governor Bend.....	850
Little Chute Second.....		688	Fort Winnebago.....	1,955
Little Chute First (guard lock).....		Portage.....	116
Cedars.....	689	Total.....	20,019
Appelton Fourth.....	686		
Appleton Third.....	642		

TABLE VI

LIST OF ARTICLES TRANSPORTED ON THE FOX RIVER DURING THE CALENDAR YEAR 1890

Articles	Tons	Articles	Tons	Articles	Tons
Logs.....	211,350	Pig Iron.....	2,886	Grain.....	30
Lumber.....	8,976	Stone.....	23,146	Potatoes.....	150
Cordwood.....	23,668	Gravel.....	1,560	Apples.....	23
Pulpwood.....	33,446	Sand.....	17,528	Cranberries.....	40
Shingles.....	1,354	Lime.....	5,990	Beer.....	33
Laths.....	16	Brick.....	35,034	Fish.....	75
Stave Bolts.....	506	Sewer Pipe.....	400	Live Stock.....	200
Pine Slabs.....	600	Salt.....	2,005	Merchandise.....	2,510
Broomsticks.....	5	Flour.....	158		
Coal.....	10,900	Mill Stuffs.....	1,702	Total.....	389,291

TABLE VII
LIST OF ARTICLES TRANSPORTED ON THE FOX RIVER DURING
THE CALENDAR YEAR 1913

Articles	Amount	Short tons	Valuation
Beer.....	985 barrels.....	177	\$7,578
Brick.....	.....	9,209	31,079
Building Material.....	.....	48	721
Butter and cheese.....	.....	144	46,857
Cement.....	11,069 barrels.....	2,490	24,351
Cinders.....	400 cubic yards.....	120	400
Coal.....	.....	39,862	229,370
Cordwood.....	878 cords.....	1,756	4,390
Fish.....	.....	4	735
Grain, flour, and feed.....	.....	3,007	94,525
Hay.....	.....	498	7,474
Lath and shingles.....	1,397,000.....	187	5,038
Lime.....	634 barrels.....	63	475
Logs.....	530,640 feet.....	2,123	4,245
Lumber.....	3,999,300 feet b.m.....	5,198	113,787
Meat.....	.....	31	4,650
Merchandise, general.....	.....	902	54,132
Potatoes.....	42,600 bushels.....	1,278	21,306
Pulp plaster.....	.....	42	525
Salt.....	1,205 barrels.....	169	1,325
Sand and gravel.....	40,498 cubic yards.....	60,747	50,632
Stone, building.....	287 cords.....	3,444	1,722
Sugar.....	50 barrels.....	9	875
Sugar beets.....	.....	3,130	18,780
Total.....	.....	134,638	\$724,972

TABLE VIII

EXPENDITURES FOR OPERATING AND KEEPING IN REPAIR CANALS AND OTHER
PUBLIC WORKS ALONG THE FOX RIVER

Total expenditures to June 30, 1902 (H. Doc. No. 421, 57th	
Cong., 2d sess., p. 328).....	\$993,974.12
Fiscal year ending June 30—	
1903.....	68,482.59
1904.....	50,861.52
1905.....	46,427.20
1906.....	44,983.29
1907.....	104,565.07
1908.....	45,171.78
1909.....	52,940.17
1910.....	55,449.28
1911.....	50,921.48
1912.....	56,206.67
1913.....	59,296.45
1914.....	56,073.32
Total	<u>\$1,685,352.94</u>
Average yearly cost of operation and care since 1884 .....\$56,000 00	
Average yearly cost of improvement (40 years) .....\$80,000 00	

TABLE IX

APPROPRIATIONS FOR THE IMPROVEMENT OF THE FOX-WISCONSIN WATERWAY*

Total to May 14, 1886 (H. Doc. No. 421, 57th Cong., 2d sess., p. 328).....	¹ \$2,693,993.97
Aug. 4, 1886.....	² 129,403.10
Aug. 5, 1886 (for Fox River).....	56,250.00
Feb. 1, 1888.....	² 100,024.53
Feb. 1, 1888.....	² 1,067.09
Feb. 1, 1888.....	² 10,539.25
Aug. 11, 1888 (for Fox River).....	100,000.00
Oct. 19, 1888.....	² 15,318.26
Sept. 19, 1890 (for Fox River).....	100,000.00
Sept. 30, 1890.....	² 156,552.70
July 13, 1892 (for Fox River).....	75,000.00
July 28, 1892.....	² 109,022.33
Mar. 3, 1893.....	³ 30,985.50
Aug. 18, 1894 (for Fox River).....	37,500.00
Aug. 23, 1894.....	³ 6,263.34
June 3, 1896.....	³ 3,000.00
June 3, 1896 (for Fox River).....	⁴ ⁵ 37,500.00
Mar. 3, 1899 (for Fox River).....	⁶ ⁷ ⁸ 27,500.00
June 13, 1902 (for Fox River).....	⁹ 70,000.00
Mar. 3, 1905 (for Fox River).....	35,000.00
Mar. 2, 1907 (for Fox River).....	¹⁰ 35,000.00
Mar. 3, 1909 (for Fox River).....	20,000.00
June 25, 1910.....	¹¹ 25,000.00
Mar. 4, 1913.....	20,000.00
Oct. 2, 1914.....	10,000.00
Miscellaneous receipts.....	9,819.49
<hr/>	
Total cost of Improvement to 1914.....	\$3,914,739.56
Less items returned to U. S. Treasury.....	2,543.38
<hr/>	
Portion expended on the Wisconsin River.....	\$3,912,196.18
<hr/>	
	591,161.39

* From Ann. Report, U. S. Engineer 1914, Appendix J. J.

¹ Including all appropriations for Wisconsin River.

² For payment in connection with the subject of flowage damages.

³ For investigation of subject of property rights of the United States in connection with the improvement of Fox and Wisconsin Rivers.

⁴ \$1,500 used on Wolf River.

⁵ \$3,500 used for a harbor of refuge, east shore of Lake Winnebago.

⁶ \$2,000 used for further improving harbor of refuge, east shore of Lake Winnebago.

⁷ \$2,500 used for retaining wall, Kaukauna.

⁸ \$3,000 used on Wolf River.

⁹ \$40,000 used for construction of a dredge, \$5,000 on Calumet and Stockbridge Harbors, and \$10,000 on Wolf River and on Miller Bay, on west shore of Lake Winnebago.

¹⁰ \$5,000 used in Brothertown Harbor, east shore of Lake Winnebago.

¹¹ \$3,000 used on Wolf River.

CHAPTER V
CITIES AND INDUSTRIES

TABLE X

FOUR PRINCIPAL CHAINS OF CITIES IN WISCONSIN

<i>On Lake Michigan (9 cities)</i>	<i>In Fox River Valley (8 cities)</i>
Kenosha.....21,371	Fond du Lac.....18,797
Racine.....38,002	Oshkosh.....33,062
So. Milwaukee.....6,092	Neenah.....5,734
Cudahy.....3,691	Menasha.....6,081
Milwaukee.....373,857	Appleton.....16,773
Port Washington.....3,792	Kaukauna.....4,717
Sheboygan.....26,398	Depere.....4,477
Manitowoc.....13,027	Green Bay.....25,236
Two Rivers.....4,850	
Total (1910).....491,080	Total (1910).....114,877
<i>In Rock River Basin (8 cities)</i>	<i>In Wisconsin River Valley (7 cities)</i>
Beloit.....15,125	Portage.....5,440
Janesville.....13,894	Grand Rapids.....6,521
Edgerton.....2,513	Stevens Point.....8,692
Stoughton.....4,761	Wausau.....16,560
Madison.....25,531	Merrill.....8,689
Ft. Atkinson.....3,877	Tomahawk.....2,907
Jefferson.....2,582	Rhinelanders.....5,637
Watertown.....8,829	
Total (1910).....77,112	Total (1910).....54,450

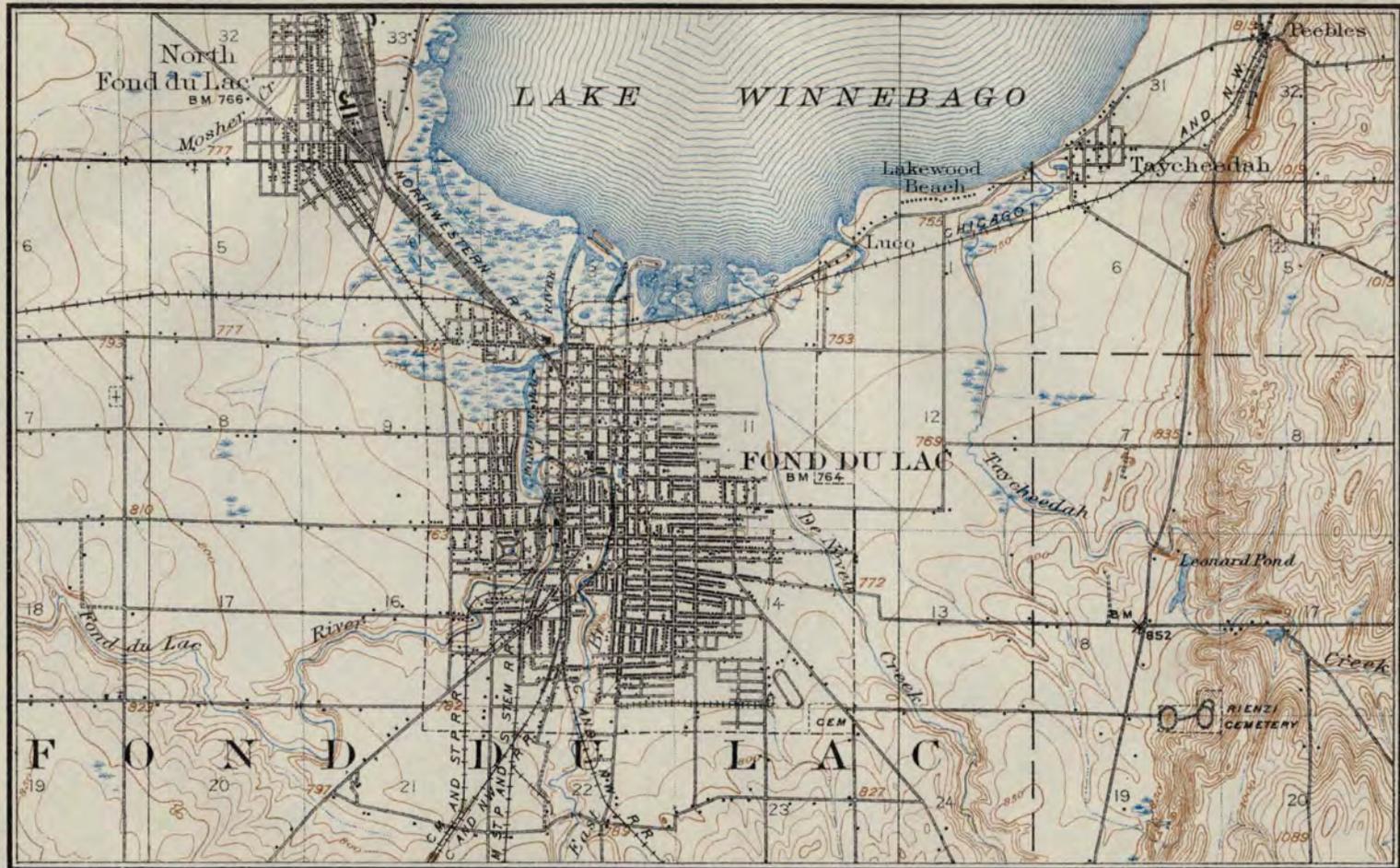
POPULATION OF COUNTIES (1910)

Fond du Lac.....51,610	Outagamie.....49,102
Winnebago.....62,116	Brown.....54,098

FOND DU LAC

Modern cities are essentially business centers, using the word "business" in its broadest sense as including manufacturing, trading, reshipping, and all similar activities. There are cities which, like Pittsburgh and Paterson, are mainly engaged in manufacturing, while others, our great seaports for example, are also engaged in vast commercial enterprises. No matter what the chief activities of a city are, one factor is always a dominant one in its growth, and that factor is *transportation*. It may be by water, or rail, or both; but neither manufacturing nor trade can thrive in any place which does not have good transportation facilities. Hence the villages that have grown into cities are those which either chanced to be, or else were deliberately located at, sites where lines of transportation naturally would be established. The mouths of rivers, the junctions of navigable streams, the ends of lakes, and certain other positions on rivers, lakes, and seas, are favorable places for commercial centers. There are, of course, many other factors in the making of a city besides that of transportation. On Lake Winnebago there are three places which a person would select as favorable points for cities—at the head of the lake, at the foot, and at the point where the main river, the Fox, enters it. And true to expectation, cities are located at these three places on the lake and not elsewhere. Yet we shall see that each city has had its own dominant reasons for growth. By its position Fond du Lac belongs to the commercial type of cities, rather more than to the manufacturing type. This is true in spite of the fact that it is, in proportion to its size, extensively engaged in manufacturing. In the same way, Chicago, though the second greatest manufacturing city in the United States, belongs to the commercial type, on account of the wonderful web of transportation lines that center there, and center there for natural and evident reasons. All of the railroads from the Northwest and Central West, seeking a point upon which to converge for the exchange of traffic, find the southern end of Lake Michigan the natural place of meeting. Had it not been for the little harbor at the mouth of the Chicago River, the extreme southern end of the lake would be the most favorable point for the city. A very small part of the traffic which enters and leaves Chicago, however, makes any use of the lake.

The same conditions hold true in a smaller way of Fond du Lac at the southern end of Lake Winnebago. In the lumbering



TOPOGRAPHIC MAP OF FOND DU LAC AND ADJACENT REGION

From Fond Du Lac Sheet, U. S. Geological Survey

The brown lines (contour lines) and numbers in brown indicate elevation in feet above sea level; all points on the same contour line have the same elevation; the difference in elevation represented by the successive contour lines is 10 feet

Scale: 1 inch = about 1 mile

days Fond du Lac derived a large advantage from the water transportation afforded by the lake. While its recent growth has but little connection with lake transportation, yet the lake is the main natural factor, though an indirect one, in the city's development. This comes about through the influence which the lake exerts upon the railway routes. The steep bluff of limestone along the eastern shore of the lake renders that side less suited to the growth of towns and hence less attractive to railroads, and so the north-and-south railways follow the west side of the lake. Lake Winnebago is a barrier to east-and-west lines, and any such lines must bend north or south around the lake. This causes Fond du Lac to be something of a converging point for railway lines, and that is why it belongs to the Chicago type of cities—the commercial type—in spite of its manufacturing interests. At certain times of the day the North Western station at Fond du Lac has all the bustle and activity which is expected only in cities of large size. We have entered somewhat at length into this matter because Fond du Lac is a *type city* in its location and in its development; it is a representative of a class, and not an exceptional case. It will be found that a city or village of some consequence has grown up at the end of nearly every lake of any size in settled regions where railroads exist. Note the Finger Lakes of New York, for example.

THE GROWTH OF THE CITY

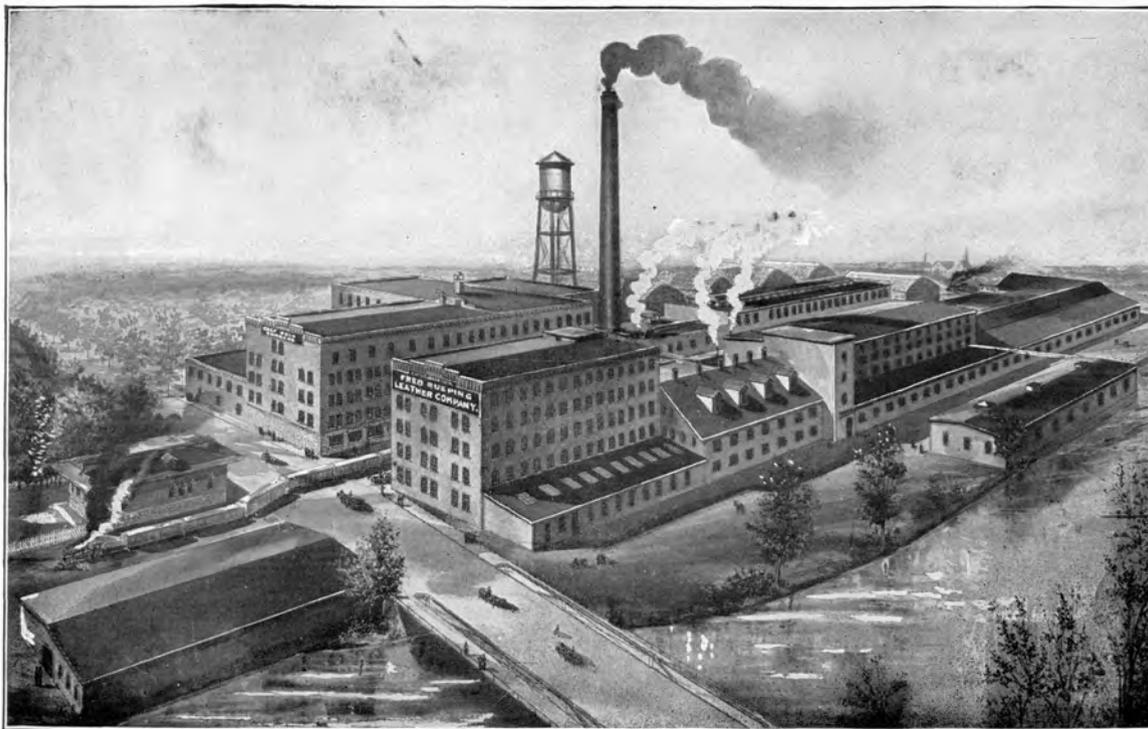
While a trading post existed at the forks of the Fond du Lac River before 1787, the first white settler within the present city limits came in 1836. By 1840 there were 139 white settlers in what is now Fond du Lac County, and at least ten times as many Indians. Down to 1844, when Dr. Mason gave the land for the county court house at Fond du Lac, Taycheedah was the larger place. Still earlier, even Calumet was a more important village than either Fond du Lac or Oshkosh, largely because the early government road ran along the east side of the lake. The first mill in Fond du Lac, a saw-mill, was built in 1845 and two years later the settlement was organized into a village. The population had already passed 500. In 1848 Wisconsin became a state, and Fond du Lac County was organized. Four years later the city was incorporated; it grew rapidly and in 1852 contained over 2000 people. During the late '40's and the '50's there was an influx of settlers, especially from the eastern states and from Germany. It was during these years that the

great lumbering operations began in this part of Wisconsin. In the early '50's came the first railroads, crude affairs with wooden rails upon which strap iron was spiked. The earliest railroad extended from Fond du Lac to Oakfield (about 1852). A little later it was extended to Chester and about 1859 it reached Milwaukee. In 1854 began what is at present the city's greatest manufacturing industry, the Rueping tannery, now the largest one in the state outside of Milwaukee and almost the sole survivor of scores of tanneries which, like saw-mills and flour-mills, existed in nearly every village. (Plates X and XI.)

During the earlier years of the development of a region, two conditions almost wholly control the lines of manufacturing which are entered upon: one is—What sort of manufactures do the people most use? The other: What raw materials for use in manufacturing have we at hand? In Wisconsin the main answer to the second question has ever been "timber from our forests." From the beginning of manufacturing in the state down to the present, the woodworking industries have led all others.

In Fond du Lac the lumber business which began in the '50's reached its zenith in the early '70's and rapidly declined after the great panic of 1873. In the location of the lumber mills and shingle mills, the city's position on the lake—or, more strictly speaking, on a stream flowing into the lake—was a matter of large importance. Most of the logs cut in the region north of the Upper Fox River, especially along the Wolf and Little Wolf, were brought down the rivers in drives, and, near Oshkosh made into rafts, and towed to Fond du Lac by way of Lake Winnebago and the Fond du Lac River. At the height of activity there are said to have been 18 lumber and shingle mills in the city, cutting 67,000,000 feet of lumber and 88,000,000 shingles in a year. There were also four sash and door factories. The one survivor of these mills, the Moore & Galloway Lumber Company, began in 1864 and is yet one of Fond du Lac's large industries, doing a half-million-dollar business yearly; all of the logs are now brought in by rail.

For 15 years following 1875 the saw-mills gradually disappeared and the city marked time, in fact lost population, as nearly every lumbering center has done when its mills, no longer able to get logs and saw them at a profit, had to close down. Since 1895, however, the city has been steadily growing. Its manufacturing still shows the dominating influence of lumber, for of Fond du Lac's nine large manufacturing plants, six are wood-using factories, engaged in making lumber, doors, sash, and other finished



THE PRESENT RUEPING TANNERY AT FOND DU LAC
See cut of original tannery, Plate XI

products, caskets, refrigerators, and furniture. The seventh and largest plant was originally built for tanning leather for the immediate neighborhood, and used hemlock bark for the tanning. The tannery no longer depends upon tan bark, and the furniture factories depend only partially upon wood from Wisconsin, yet the fact that 7 out of 9 large factories either now have or have had in the past an intimate connection with the forest resources of the state indicates how strong an influence those forests exerted in shaping lines of manufacturing. As time passes, and the Middle West grows in population, a greater diversification of industries will follow. In this change Fond du Lac is already sharing, as is shown by the establishment of a typewriter factory, steel working plants and others which do not use wood as their chief raw material.

The city's principal advantage in location is its position in a region of which it is the natural center. What Chicago is to

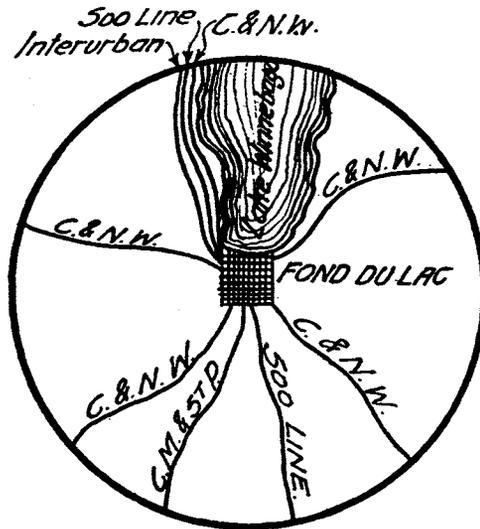


FIG. 8. DIAGRAM SHOWING THE HUB-LIKE POSITION OF FOND DU LAC WITH REFERENCE TO RAILWAY LINES

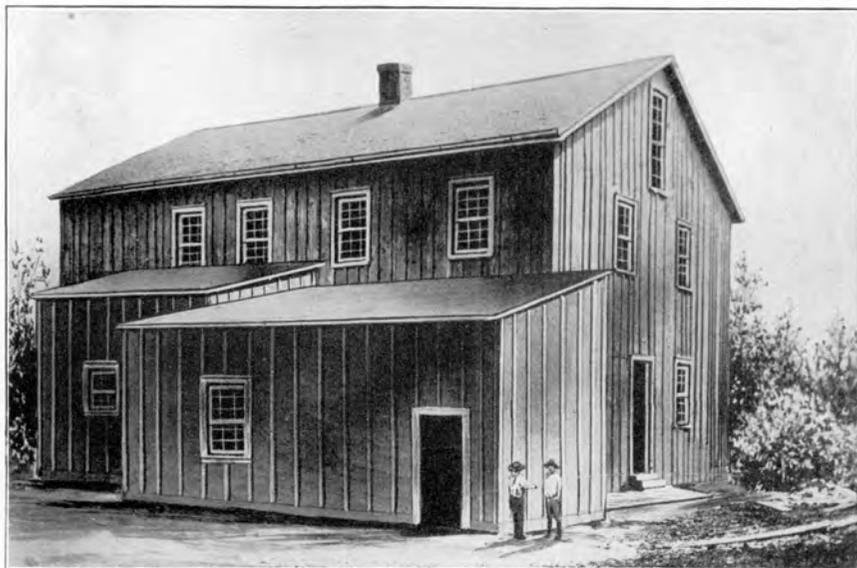
the Middle West, Fond du Lac is to the rich farming region around it, a collecting and distributing point. Southward radiate four railway lines; northward reach two main railway lines and an interurban, while branch lines extend both east and west from the city. Its business emblem might properly be

a wheel with Fond du Lac as the hub, and eight railway lines as spokes. (See Figure 8). The United States census of 1910 gives Fond du Lac 97 manufacturing establishments, most of which are small. In 1914, there were 40 manufacturing concerns employing from 25 to 500 persons each, including eight which employed upwards of 75 persons, and four of the eight employed 300 or more persons. A canvass made by the Business Men's Association indicated over 4000 employees in manufacturing plants. All of the plants are owned and controlled by local men, most of them long-time residents of the city; this is a condition highly favorable to the stability and permanence of the industries. The city takes some pride in the fact that it has never had a boom. Its present growth is normal and it seems assured of continuance.

One fact quite apart from the industrial life of the city seems deserving of note—it is the number and character of the city's excellently housed institutions. The architectural quality of several of these structures is unusual for a city of 20,000 people. St. Paul's Cathedral (Church of England) and the Grafton School buildings in connection with it, the Public Library, St. Mary's Church, and two of the recently built protestant churches are structures whose architectural dignity would attract notice in a city of any size. The buildings of the convent and hospital of St. Agnes, occupying practically two city squares, the Masonic Temple, and several other buildings, give the city a certain atmosphere which is expected only in communities of greater maturity.

NORTH FOND DU LAC

Just beyond the city limits is one of the largest industries connected with Fond du Lac. Here the Soo Line has established one of its large groups of repair shops, and a little city of nearly 2500 people has grown up in a few years. The Chicago & North Western Railroad also has shops here, though much less extensive than those of the Soo Line.



A.—THE FIRST RUEPING TANNERY (1854), FOND DU LAC
Compare with Plate X.



B., C.—TWO PORTIONS OF THE MOORE-GALLOWAY LUMBER MILLS AND
YARDS, FOND DU LAC





OSHKOSH

ITS SITUATION

It has been pointed out that because of Fond du Lac's situation at the head of Lake Winnebago, it belongs to the class of cities of which Chicago, at the head of Lake Michigan, may be taken as the type. Oshkosh has been above all else a lumber manufacturing city, and that places it in the manufacturing, rather than in the commercial class. Nearly all of the lumber centers from Maine to Minnesota have grown up at sites which are essentially similar; some of the mills made use of waterpower, but usually that was a minor consideration, because the waste wood furnished fuel for making steam. White pine is a light wood and readily floated on the rivers; this is the least expensive method of transporting logs from the woods to the mills. Lumbering in eastern Wisconsin reached its height before railroads were numerous, and hence when river transportation was more important than now in all lumbering operations.

The ideal place for a saw-mill center was at some point on a river down to which the logs might be driven, and from which point the lumber would find ready transport to the city markets. If this point had transportation facilities by both rail and water, that was an added advantage and increased the importance of the place. A third consideration was the boomage capacity of the river. When logging is done on a large scale and several companies are driving logs on the same river, the logs get mixed, and at some point above the mills they must be held in quiet water, like a pond or lake, and sorted. Such a place constitutes a boom, and the enormous number of logs driven down the Wolf demanded a boom of exceptional size. Now let us see how many of these essential features the city of Oshkosh possessed.

1. It was built at the mouth of the Upper Fox River whose main tributary, the Wolf, penetrated one of the largest and most magnificent white pine forests in Wisconsin*. It was therefore favorably placed for securing the logs.

* The U. S. census of 1880 (Vol. 9, p. 555) says, "The timber originally on the Wolf and Oconto rivers was especially fine. This has been largely cut (1880). On the Wolf river the timber was very heavy. Instances are known of 10 to 12 million feet of pine lumber having been cut from one section in the Lower Wolf region. The principal points of lumber manufacturing were on Lake Winnebago, at Oshkosh and Menasha, which take the product of the Wolf and Fox River pineries, and at Green Bay and Oconto, which drive logs from the Oconto River." H. C. Putnam estimated 600,000,000 feet of standing timber in the Wolf River basin in 1880. The forests had been well cut 25 miles back from Fox and Wolf rivers and Lake Winnebago by that time.

2. The city lies in the main valley of eastern Wisconsin through which important lines of railroad were sure to be built. There was also transportation by water south, west, and north.

3. It had unequalled boomage capacity. At one time Bay Boom, off Lake Winneconne, was the greatest log boom in all the northern lumber country, when eight tugs were required to sort and assemble the logs belonging to the various companies. Clearly, the city at the mouth of the Upper Fox could scarcely escape becoming a lumber center of the first magnitude, for it possessed each of the three essential qualities—*access to the pineries by river, ample boomage capacity, and convenient access to markets by both rail and water.* Not less than forty places in Northern Wisconsin have been important saw-mill centers—Marinette, Oconto, Green Bay, Wausau, Stevens Point, Grand Rapids, Merrill, Black River Falls, Eau Claire, Chippewa Falls, La Crosse, Ashland, and others—yet the situation of Oshkosh has made it one of the foremost cities of the group. La Crosse, with its highly favorable position on the Mississippi, is the only one of the old lumber centers which was and still remains a close rival of Oshkosh in size and industries.

OTHER CITIES OF THE SAME TYPE

In its situation and its history, Oshkosh belongs to the type of cities of which Bangor and Augusta in Maine, Albany in New York, Grand Rapids and Saginaw in Michigan, and Minneapolis in Minnesota, are representatives. All of them have been white-pine centers for reasons similar to those which made Oshkosh. All grew into importance at points on rivers where the assembling of logs was easy, and from which the lumber could be advantageously shipped away both by rail and by water.

EARLY HISTORY OF THE CITY

The first white settlers came in 1836, but Indian villages and fur traders' posts had existed in the vicinity long before. The canoes of Nicolet, Perrot, Marquette, La Salle, Radisson, Du Luth, Hennepin, Allouez, and a half score other noted Frenchmen had passed and repassed the point; in the vicinity councils had been held, treaties made, and battles fought for nearly two centuries before a permanent white settler made his home on the site where Oshkosh now stands.



Compare with Plate XII.

OSHKOSH IN 1863

Courtesy Castle-Pierce Printing Co.



By a vote of the few people in the immediate region, the name of Oshkosh, a Menominee Chief, was selected in 1840, and in 1842 Winnebago County with a population of 135 was organized. Ten years later the village had grown to nearly 2500 population and was incorporated as a city (1853). The rival village of Algoma was absorbed three years afterwards. In 1859 the first railway train (on the present Chicago & North Western) reached Oshkosh and awakened great enthusiasm and high hopes. Between this date and 1875 no less than five fires swept away large parts of the city, but each disaster was followed by a prompt rebuilding. While this bespoke a remarkable faith and determination on the part of the people, the repeated rising of a new city from the ashes of the old, was a tribute unconsciously paid to the site upon which the city stood. There simply had to be a city here in those days when the Wolf River pineries were pouring their wealth down to the shores of Lake Winnebago. The same cause which made the first city, made the second and the third and so on to the sixth. It probably would have made a seventh and an eighth, for the pine logs continued to come down the river until the '90's. By 1860, the population had passed 6000, and five years later had risen to 10,000.

In 1871 a branch of the present Chicago, Milwaukee & St. Paul Railroad entered the city and in 1882 the Wisconsin Central, now the Soo Line, came. Following the great fires of 1874 and 1875 the city lost population. The census of 1880 showed over 1000 less than that of 1875, but a gain was again shown in 1885 and the city has had a steady but not rapid growth since. The establishment of the State Normal School in Oshkosh has made the city an educational center for a large surrounding region.

THE DEVELOPMENT OF THE MANUFACTURING INDUSTRIES

From first to last Oshkosh has been a wood-working center. Its position with reference to the forests of eastern and northern Wisconsin has made this the one logical industry, and in it the capital and energy of the city have found their chief employment. The first saw-mill was built in 1847 and the first grist mill a year later (in Algoma). In 1849 the industries had expanded to include a steam saw-mill, a shingle mill, and a small sash and door factory. Lumbering in the up-river pineries had begun as early as 1839-40. A notable expansion came during the '50's and still more during the '60's. In 1856 the founder of the present Paine Lumber Company, now the largest industry in

the Fox River Valley, began operations. The early saw mills were small, and the muley saw was in use. This gave way to the more efficient circular saw, as it in turn gave way to the band saw. By 1867 there were seven logging companies driving logs down the river to Oshkosh; between 1500 and 2000 men were employed in these operations and the lumber output of the city was rising toward 100,000,000 board feet a year—practically all white pine. This was the period of many small mills. In 1857 the *Daily Courier* says there were 18 saw mills running nearly 100 saws, and the Oshkosh city directory of 1868 says there were then 22 saw mills, 14 shingle mills, 6 planing mills and sash and door factories, a stave and barrel factory, a match-splint factory, a match factory, and two broom handle factories.

It was also a period of very active boat-building along the water front. In 1866, 25 barges and two steamers were built and taken to the Mississippi River. In the 20 years between 1850 and 1870 forty steamboats were built on the Fox and Wolf rivers and Lake Winnebago, the major part of them at Oshkosh. The rapid growth of the city's industries led the optimistic compiler of the city directory to predict in 1868: "Within another decade by the western shore of beautiful Lake Winnebago, will stand the second city in the State of Wisconsin with 75,000 population." Flour mills, so important in Neenah and Appleton, were never important in Oshkosh. The water power of the Lower Fox favored these mills and left Oshkosh to its lumber interests.

By 1870, 150,000,000 feet of logs were being handled in Oshkosh, some of which went to the mills at Fond du Lac and some to Neenah and Menasha. It is said that half of the working men of Oshkosh worked with logs and lumber. The *Wisconsin Lumberman* of December, 1873, gives the names of 58 manufacturers and dealers in lumber in Oshkosh. The same authority (Feb. 1875) gives the names of 80 lumber camps on the Upper Wolf and its branches. Barr, in his chapter on Oshkosh in Lawson's *History of Winnebago County*, says there were "nearly 30 saw mills in the city at one time." He says, "The most important industries of this thriving community, the leader in the manufacture of lumber, are located on the marshes of its village days, which have become solid earth through fifty years' accumulation of slabs and sawdust." It is said that between 1850 and 1875, sailing schooners were engaged in carrying lumber and other commodities not only on Lake Winnebago, but even on the rivers. Occasionally rafts of logs and lumber were towed



LOGS IN THE FOX RIVER AT OSHKOSH

At the height of the lumber industry in the Wolf and Fox Valleys (around 1870), 150,000,000 feet of logs were handled annually in Oshkosh. There were 25 or more saw mills, and 40 lumber manufacturers and dealers had offices in the city.



to the Mississippi by way of the Fox and Wisconsin rivers. The first mills cut only rough lumber, and nothing but the choice timber was used. The waste was enormous, but scarcely avoidable under the conditions that then existed.

Gradually the timber near the rivers was cut away; logging operations pushed farther and farther up the Wolf and its tributaries. After the Civil War the Wolf above Shawano was improved by clearing the channel and building dams to store the water to be released when needed to float the logs down the river. Over 40 such dams were built. The increasing scarcity of pine forced many mills out of business; only a few were able to continue in Oshkosh, and those underwent a steady evolution from mere lumber and shingle mills to mills in which the work was carried to more and more refined stages. The logs were sawn in the saw mill, planed in the planing mill, and worked into sash, blinds, doors, moulding, and all of the forms required for interior and exterior finishing. White pine was the chief wood used, and it is still used, though it now enters into but a minor part of the products of the mills. Wisconsin had and still has a wealth of hardwood forests, including oak, birch, maple, ash, and elm. Gradually the surviving mills turned to hardwood, and now the making of hardwood flooring, doors, furniture, and an endless variety of ornamental "mill-work" constitutes the leading type of wood-working in the city.

PRESENT INDUSTRIES

There are (1914) about 120 manufacturing establishments—large and small—in Oshkosh; 80 of these employ less than 25 persons each; 24 mills employ between 25 and 100 persons each, and 12 mills employ numbers ranging from 100 to 2000. The largest mill is that of the Paine Lumber Company, whose most valuable products are of hardwood, though a great deal of pine is still used. This company is one of the largest manufacturers of veneered doors in America. Their logs now come by rail from their own timber lands (150,000 acres) in the northern part of Wisconsin. Their plant includes over 30 buildings and their yards and docks extend a mile along the water-front of the Fox River.* (Plate XV).

* Their dry kilns have a capacity of a million board-feet of lumber. The saw mill has a capacity of 100 million board-feet of lumber a year. This is nearly equal to the output of the entire city in the days when Oshkosh had 26 mills. The veneer mill can turn out 45 million feet a year, and the facilities for making doors of all grades permit of an output of a

There are many other mills, foundries, and factories engaged in the manufacture of a variety of products, but they are all overshadowed by the magnitude of the wood-using industries. The almost complete devotion of the city's large industries to the use of wood as the principal raw material may be seen from the fact that only one of the 12 factories which employ 100 or more persons does not belong to the wood-working class. This one makes grass matting, rugs, etc., using a grass which grows along the marshy banks of the Upper Fox River. Of the 11 other large mills, 6 make sash, doors, etc., 2 make furniture, 1, carriages, 1, trunks, and 1, matches; the last named is the second largest manufacturing industry in the city, employing about 700 people and having a capacity of 5 or 6 carloads of matches daily.

TRANSPORTATION

The situation of Oshkosh on the Fox-Winnebago waterway has been of material benefit to the city in the past and is still of benefit, though considerably less so than it was formerly. The only commodity which is now brought in in large quantities by way of the Lower Fox and Lake Winnebago is coal. A line of coal barges runs between Oshkosh and Green Bay; the barges, towed by tugs, carry 200 or 300 tons of coal at a freight rate about one-third less than the railroad charges.

Two main lines of railway—the Chicago & North Western and the Soo Line—also a branch of the Chicago, Milwaukee and St. Paul, and three interurbans running north, south, and west, serve the city.

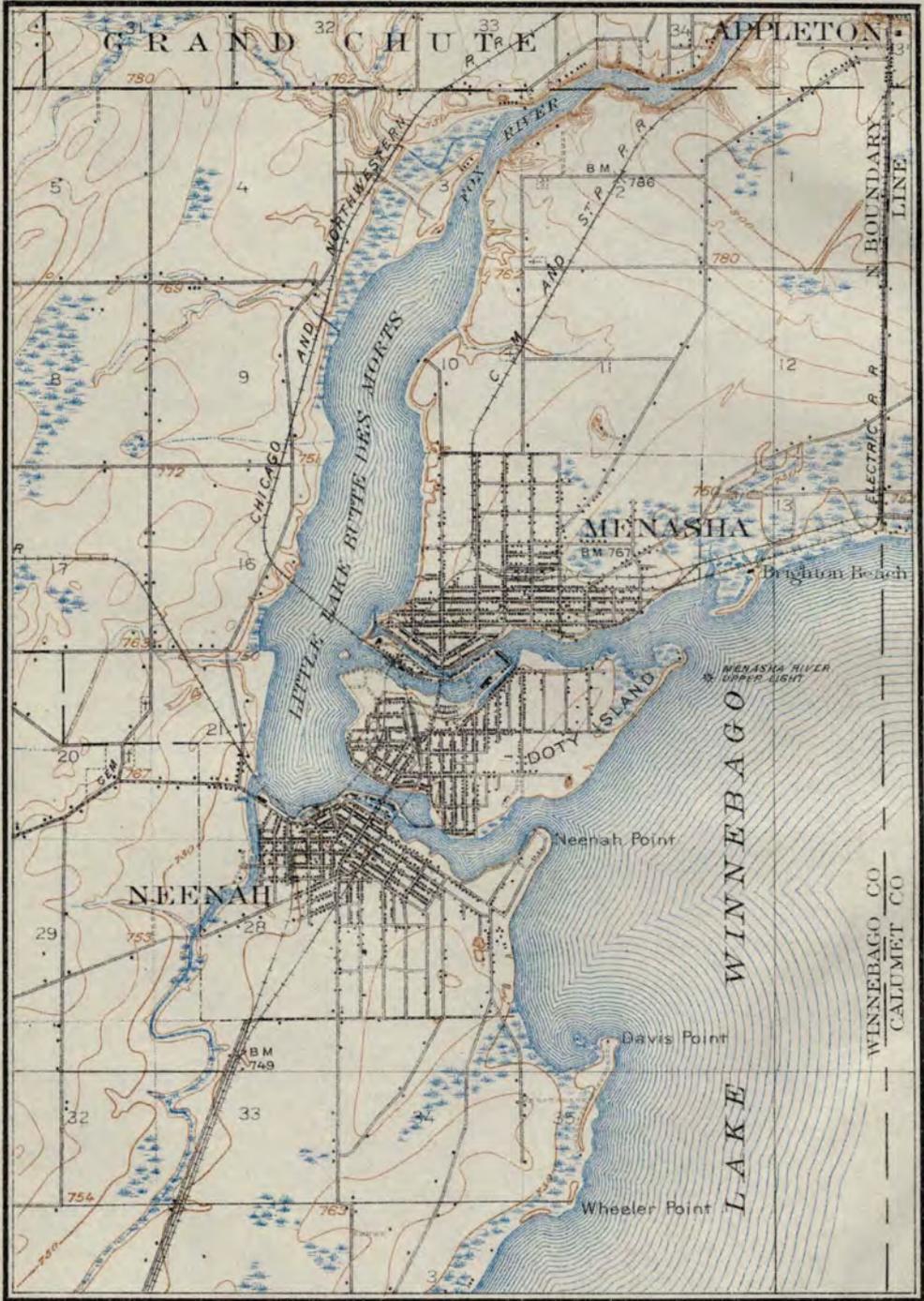
Oshkosh is the largest city in the Fox River Valley, having in 1910 a population of 33,000. During the past 20 years it has grown steadily at the rate of about 500 a year, or 5000 a decade. Both the State Factory Inspector and the U. S. Census of 1910 give approximately 7000 as the number of persons engaged in manufacturing; the value of manufactured products in that year was \$15,000,000, giving the city fourth rank among the cities of Wisconsin (Milwaukee, Racine, Kenosha, Oshkosh).

million and a half doors annually. In addition, the sash and moulding mills have a capacity of a million sash, and 25 million feet of moulding a year.

The principal pine products of the mill require the best of material and this leaves a quantity of less valuable wood to be used in some way. This is largely used for making wooden packing-boxes. The company maintains branch offices and display rooms in ten cities from New York and Atlanta to Dallas and Portland.



PLANT OF THE PAINE LUMBER COMPANY, OSHKOSH
One of the largest manufacturing establishments in the Fox River Valley.



TOPOGRAPHIC MAP OF NEENAH AND MENASHA AND ADJACENT REGION

From Neenah Sheet, U. S. Geological Survey

The brown lines (contour lines) and numbers in brown indicate elevation in feet above sea level; all points on the same contour line have the same elevation; the difference in elevation represented by the successive contour lines is 20 feet

Scale: 1 inch = about 1 mile

NEENAH AND MENASHA

From a business and industrial standpoint, Neenah and Menasha are one city. Only an arbitrary line separates them. The larger part of Menasha lies on the north side of the Fox River, and the smaller part on Doty Island. (Plate XVI). Neenah occupies the balance of the island and the south side of

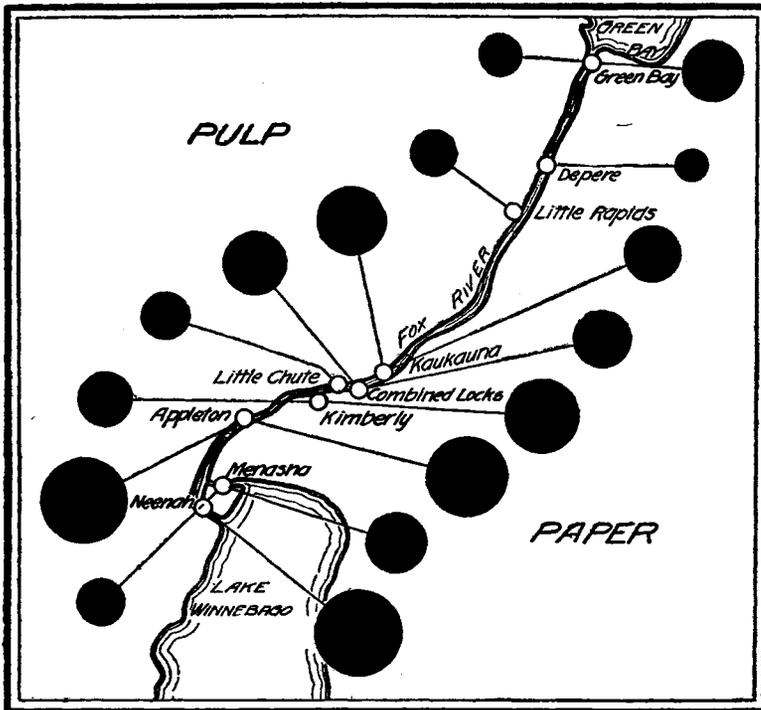


FIG. 9. DIAGRAM SHOWING THE RELATIVE CAPACITY OF THE PULP AND PAPER MILLS IN THE VARIOUS PLACES

The mill at Depere, for example, has a capacity of 32,000 pounds a day. Weight, not value, is the basis of comparison. See table XIII, p. 81. (From Post's Directory 1913).

the river. The principal railroad station (C. & N. W.) is on the island, and is called Neenah and Menasha. Unsuccessful efforts to unite the two cities have been made; the rivalry, once strong, is disappearing on account of the inevitable interweaving of business interests. In 1910 Menasha was the larger city, having a population of 6,081 against 5,734 in Neenah; in 1900 and 1890 Neenah was slightly the larger.

NEENAH-MENASHA AS A TYPE CITY

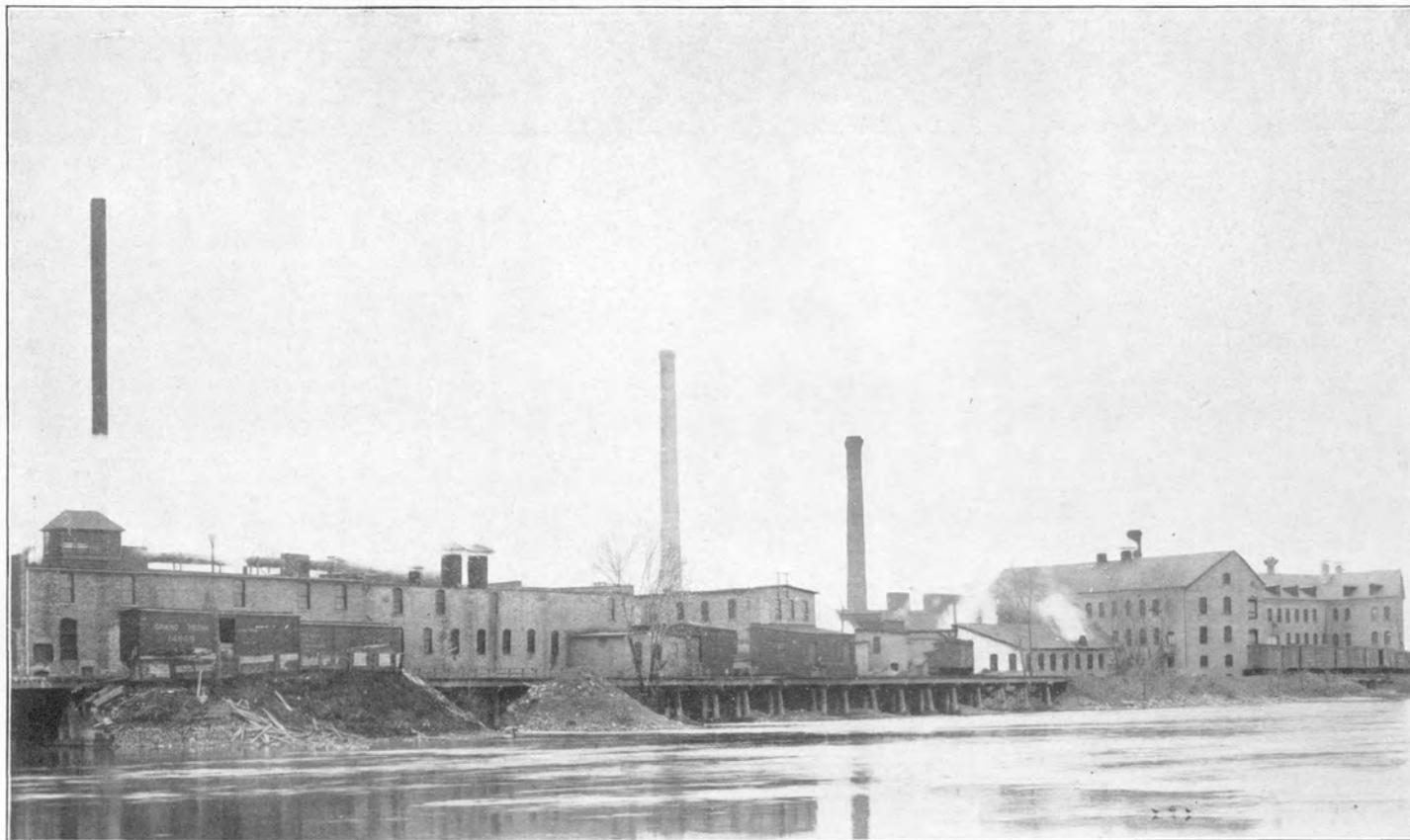
Geographically the two cities should be considered together. It is not so easy to assign them to a single type as it is Oshkosh or Fond du Lac. In one important particular they belong to the type of which Detroit is an example—that is, a city situated at the outlet of a navigable lake, and at a point where land and water routes naturally cross. The island at the outlet of Lake Winnebago makes a convenient place for railways to cross the river, a natural “cross roads of traffic.” Three railroads—the Chicago & North Western, the Chicago, Milwaukee & St. Paul, and the Soo Line, and also two interurbans—focus upon the island and reach out north, south, east, and west. The Fox River is maintained as a government waterway between Lake Winnebago and Green Bay. This is now of minor importance but it was a factor in the making of the cities in earlier days. The situation of Detroit, practically at the outlet of Lake Huron, is not unlike the situation of Neenah-Menasha. At Detroit, important land routes and water routes cross for reasons similar to those which exist at Neenah-Menasha.

Though less well known than Detroit, Sault Ste. Marie, (“Soo”) at the outlet of Lake Superior, is a nearly perfect type of the group of cities to which Neenah-Menasha belongs. The Soo, besides being an important cross roads of land and water traffic, has great waterpower. Canals with locks take boats around the rapids as they do at Neenah-Menasha.

The importance of the great city of Constantinople, for centuries the political and commercial center of the Eastern Roman Empire, was due to like causes on a larger scale, namely to the converging of land and water routes upon a point where the crossing of the water was easiest. It is evident that the site of Neenah-Menasha is a perfectly natural one for a city, that the city is typical of a certain class of cities, and that it is illustrative of a law of city location and of city growth.

THE WATER POWER AND INDUSTRIES

In the making of Neenah-Menasha, the waterpower of the Winnebago rapids has been the main *natural* factor. As early as 1835-6, and before any regular white settlement had been made there, the U. S. government attempted a mission station for the Indians on the south side of the river. A grist mill and a saw mill using the water power were built, but the project came to



SCENE ALONG THE FOX RIVER IN THE PAPER MILL DISTRICT OF NEENAH
Neenah has six paper mills with a combined daily capacity of 240,000 pounds.

naught the following year through the purchase of the Indian lands by the government and the removal of the Indians.

Flour-Milling. The first private mill was built in Neenah in 1848, the year of the building of the first house on the Menasha side of the river. Two years later the Menasha dam was built as a part of the Fox-Wisconsin improvement work. At this time the surrounding region was a dense hardwood forest. Between 1865 and 1885, when Wisconsin was growing wheat in enormous quantities, and before paper-making had reached large proportions, flour-milling was the great industry in Neenah. In his *History of Winnebago County*, Harney names ten flour and grist mills which were built between 1852 and 1868. In 1879 there were seven flour mills in Neenah and four in Menasha. The Neenah mills are said to have ground 1400 barrels of flour a day or 400,000 barrels a year, and the cooper shops of the city to have made 1500 flour barrels a day. It was here that the roller process of flour-milling was perfected and the roller machines patented. Neenah was the chief market and milling center for a considerable territory—especially that lying to the west and southwest, and was referred to as the Rochester of the West. Minneapolis had not yet attained fame as a milling center.

When wheat failed, flour-milling declined and the substitution of some other line of manufacturing had to come. The presence of the waterpower, with Lake Winnebago as a storage reservoir, is a guarantee of the permanence of manufacturing at Neenah-Menasha, although steam power is used increasingly.

Pulp and Paper. It has already been indicated that the manufacturing industries of all northern Wisconsin, and of the Fox River Valley in particular, have been to a remarkable degree wood-using industries. At one time there were eight saw mills operating in Neenah. The demonstration in the '60's that paper can be made from wood was followed in 1871 by the establishment of a wood pulp mill in Appleton.

Neenah's first paper mill was built in 1865-6 (The Old Red Neenah Mill). In 1872 the firm of Kimberly, Clark & Company was organized and became the nucleus of the vast industry which has been built up by that company, now the largest paper manufacturers in the West, with eight mills in the Fox River Valley and several elsewhere. In the same year that company built the Old Globe Paper Mill, which is still in operation. When built it made 3,000 pounds a day and employed 40 hands. In 1874 Kimberly, Clark & Company purchased the Old Red Neenah

Mill from Smith & Van Ostrand. This mill was torn down in 1890; the present Neenah mill was built on the same site. The present Kimberly-Clark mills in the valley produce nearly one-half million pounds of paper and 200,000 pounds of pulp a day.

There are now six paper mills in Neenah with a combined capacity of 240,000 pounds of paper daily. All but one use water power, supplemented by steam. An endless variety of papers are made, nearly all of the higher grades, including book, writing, ledger, bond, crepe, and tissue.

Menasha has five paper mills with a combined daily capacity of 250,000 pounds of paper and one sulphite fibre mill with a daily capacity of 50,000 pounds. All but one of these use water power supplemented by steam.

Factories in Neenah. The State Factory Inspector in 1910 reported 35 mills and factories in Neenah; 28 of these employed less than 25 persons each, four employed between 25 and 100 persons each, and three employed between 100 and 200 persons each. The three Kimberly-Clark paper mills together employ over 200 persons and constitute the largest plant in the city. Paper-making is the predominating industry. There are four other factories of considerable size engaged respectively in the manufacture of woolen goods, shoes, stoves, and hardwood products,—especially veneered doors. The Bergstrom Stove Works began as an iron foundry more than 50 years ago.

Neenah is a city of considerable wealth and there are more fine homes with beautiful grounds than are usually seen in a city of its size.

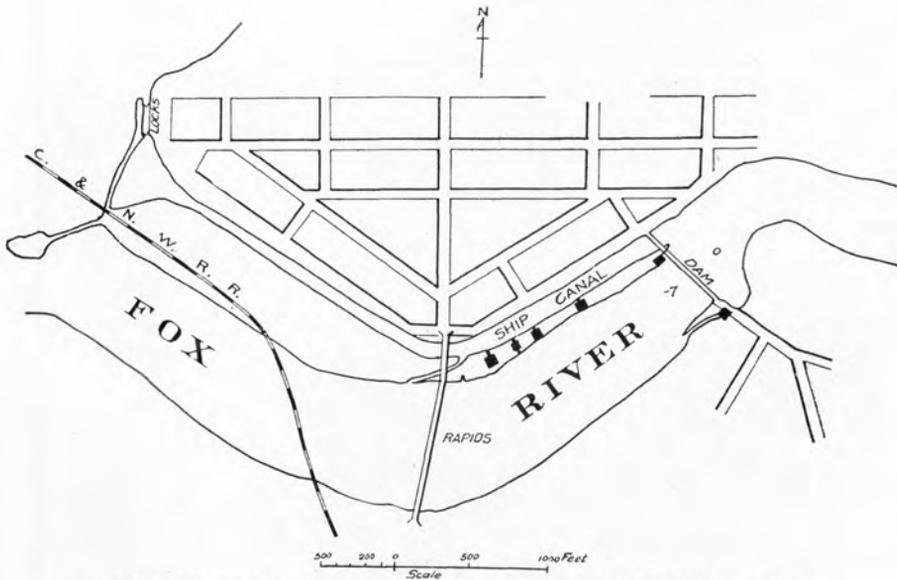
MENASHA

Manufacturing in Menasha is larger in the aggregate than in Neenah. Of the 28 mills and factories, 17 are small and employ less than 25 people each; six employ between 25 and 100 people, four employ between 100 and 200 each, and one employs about 1,300. It is a notable fact that nearly every manufacturing industry of importance in Menasha is connected directly or indirectly with either the paper or the wood-working industries. The only large metal-working establishment specializes in work for the paper mills.

A rapidly growing industry of Menasha represents a third step in the evolution of the wood-using industries of the Valley. Wood is the raw material for the paper mills, and paper is the raw material for plants such as the Menasha Printing Company; its specialty is the printing of great quantities of soap wrappers, gum



A.—GOVERNMENT DAM ACROSS THE FOX RIVER AT MENASHA
Head, about 9 feet; 2400 horsepower developed at ordinary flow.



B.—MAP SHOWING RIVER, GOVERNMENT DAM, SHIP CANAL AND
LOCKS AT MENASHA
(A and B from Bulletin XX, Wis. Geol. and Nat. Hist. Survey).

wrappers, and bread wrappers. A half million bread wrappers and a million soap wrappers a day; 2 to 4 carloads of gum wrappers in a month, 12 carloads of daily-date calendar pads for one year, and single orders involving a billion wrappers, are indicative of the output of this one plant. The recent purchase of a paper mill by this company illustrates a principle of expansion of an industry, namely the advantage gained by controlling its own supply of raw material. In the same way, paper companies frequently own pulp or fibre mills and these in turn frequently own their own timber lands. The Menasha Wooden Ware Company goes a step farther in another direction and owns 140 specially built cars for shipping its products, and has warehouses in Chicago, St. Louis, New York, and Milwaukee for storing and distributing its wares.

The Wooden Ware Industry. The largest manufacturing concern in the Valley, with the exception of one in Oshkosh, is the Menasha Wooden Ware Company, whose buildings, yards, side tracks, etc., cover 65 acres bordering the Fox River. It uses over fifty buildings besides the drying houses. The industry began practically with the founding of Menasha and has grown to be the largest wooden ware plant in the world. The founder of the company (Mr. E. D. Smith) commenced with a single lathe, made his own tubs, pails, etc., and peddled them with a one-horse wagon. Now the plant uses yearly six thousand cars of material, including 300 to 400 cars of wire and hoop iron; 75 per cent of the wood used is basswood cut from the company's 125,000-acre tract of timber lands in northern Wisconsin. All of the logs are now received by rail. No waterpower is used; the great quantity of wood waste resulting from the manufacturing processes supplies fuel. The following partial list of items indicates the magnitude of the operations. Its shipments aggregate a train-load a week.

The plant uses 25,000,000 feet of timber annually; each year it makes

enough candy pails to hold 120,000,000 lbs. of candy;

enough fish pails to hold 12,000,000 lbs. of fish;

enough pickle kits to hold 1,800,000 gallons of pickles;

enough tierces to hold 50,000,000 lbs. of lard;

enough lard half-barrels to hold 30,000,000 lbs. of lard, and

enough lard pails and tubs to hold 60,000,000 lbs. of lard.

APPLETON

EARLY HISTORY

Although the Lower Fox River was one of the most used rivers of the old Northwest, it was 214 years after Nicolet landed at its mouth before the first white settler's house was built at the site of the present city of Appleton (1848). To those who during two centuries used the river for travel, the Grand Chute was only an annoyance and a source of danger; the river was merely a highway along which boats passed, nothing more. The rapids were a cause of delay, and under the conditions which prevailed in that period, they had no economic value, and offered no inducement to men to settle permanently by them; and so the water power, afterward the main cause of the city's growth, was not a factor in the original adoption of the site. Other settlements had already been made farther down the river, when in 1848, the first rude house was thrown together on the bluff overlooking the Grand Chute, as the 4-foot perpendicular fall was long called, and as the township is still called. It was the selection of this spot in 1848 as the site of the Lawrence Institute, now Lawrence College, that drew attention to Appleton in the early days, and aided in attracting to it the high grade of New England and New York people who settled there. While the water power has made an industrial Appleton, the college has been keeping it an intellectual Appleton. The purpose of this report requires a discussion of the industrial development of the city, and hence of the part which the available water power has played in that development. The no less valuable part which the college has played in the city's cultural life must be left all but untouched.

It was the gift of \$10,000 by Amos Lawrence of Boston for an institute of learning to be built on the Fox River, in Wisconsin, and the selection of the present site for that institution, that gave Appleton its start. When ground was broken for the first building, the place was an utter wilderness; 10,000 feet of lumber used in the construction of the first building is said to have been brought from Deer Creek, 30 miles away.

In 1849 the first mail was received, but there was neither flour mill nor saw mill. Neenah was the nearest place where either existed. In 1850 a wooden wing-dam was built into the river and a little saw mill was constructed. Three years later the first grist mill followed. The settlement grew rapidly; in 1853, five



BIRDS EYE VIEW OF APPLETON IN 1881

The original drawing appeared as a large sized wood cut in the Appleton Post of Dec. 29, 1881.

years after the building of the first home, the community was organized into a village and had in the neighborhood of 1,000 population, 275 dwellings, 10 stores, 5 hotels, 3 saw mills, a sash factory, a lath mill, a cabinet shop, and a paper mill. Thus early did the New England mechanics turn to account those talents which had already made New England the manufacturer for the rest of the United States.

By 1856 the river had been sufficiently improved to permit steamboats to pass with difficulty from Green Bay to Lake Winnebago, and the *Aquila*, already referred to (p. 31) had made the trip from Pittsburgh to Green Bay by way of the Ohio, Mississippi, Wisconsin, and Fox rivers. For a few years following this date, and before a railway had traversed the length of the valley (which was accomplished in 1862), the river was actively used for navigation and was of great value to the struggling communities near it. The railroad soon became a competitor and it is doubtful if, so far as navigation is concerned, the waterway has repaid the money spent upon it.

WATER POWER

On the other hand, the improvements which have made the water power available, have paid for themselves, and will do so, many times over. There are three dams at Appleton. Before improvement the total fall was considered to be 38 feet. The government profile gives a present fall of 36.7 feet in a distance of 1.2 miles and the total estimated power which may be developed at ordinary flow is 8,400 horse power.* The upper dam is built of stone and gives an average head of 14 feet and a total power of about 4,350 H. P., of which the Green Bay and Mississippi Canal Company controls 2,000 H. P.

The middle dam is built of timber and is neither a part of the government work nor the property of the Green Bay and Mississippi Canal Company. West's Hydraulic Canal, one of the most valuable of the earlier improvements, receives water from the middle dam. The head at various mills ranges from 7 to 14 feet and at ordinary flow, about 2,050 H. P. is developed.

The lower dam is U. S. government property, and is located three quarters of a mile below the middle dam. The average head is $8\frac{1}{2}$ feet and the ordinary flow of the river gives somewhat over

* Smith, L. S., *Water Powers of Wisconsin*, Wis. Geol. & Hist. Survey, Bull. XX, p 43.

2,000 H. P., which is controlled by the Green Bay and Mississippi Canal Company. Four locks enable boats to pass the various dams.

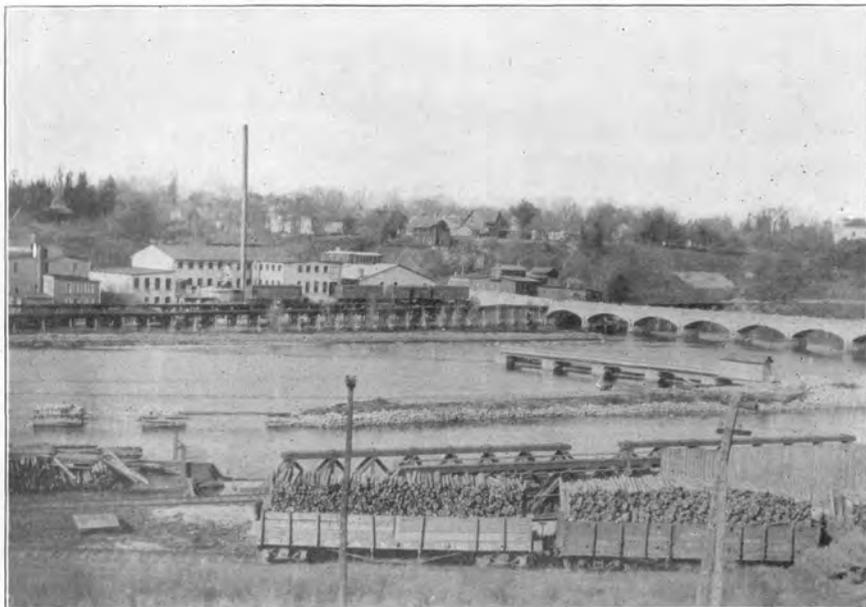
Appleton is a type of the water power city. To this it owes most of its industrial growth and prosperity. The water power leased to the manufacturers by the Green Bay and Mississippi Canal Company—somewhat less than one-half of the water power used at Appleton—is charged for at an average rate of five or six dollars a horse power a year. This does not represent the full cost of the power to the users, yet the saving is undoubtedly large, as it costs in the neighborhood of \$40.00 a horse power a year to produce steam from coal in Appleton. The price paid by the users of the canal company's water power is said to be materially less than that charged in most parts of the country.

The manufacturers who use the power have found it necessary to install steam as an auxiliary power; for the Fox River, while much more uniform in its flow than most rivers, is nevertheless subject to considerable fluctuations, and at low stages of the river the water does not supply the needs of the mills. As a rule the period of low water does not exceed 60 to 90 days in a year. Although the U. S. government allows the waterpower users to take only the surplus water available after the needs of navigation have been met, so few boats pass through the locks that the needs of navigation are not large and most of the water may be used by the mills.

Engineers have placed the annual saving from the use of water power at \$20.00 per horse power in Wisconsin as a whole. On this basis, Appleton manufacturers are benefited \$170,000 a year by the water power which they use, and this is equal to 5% on \$3,400,000. Whatever the actual saving is, the fact remains that it is the advantage due to cheap power that has attracted to Appleton a score of manufacturing establishments, many of which probably would not have been there except for the water power.

EARLY MANUFACTURING

As is the case in most places, early manufacturing in Appleton was dependent upon raw materials produced in the vicinity, and to quite an extent the products were sold nearby. Poor transportation facilities make this condition necessary in any new country. The one raw product which early Wisconsin had in almost unlimited quantity was wood—pine, hemlock, and the hard



A.—LOWER PAPER MILL DISTRICT OF APPLETON

Cars of pulp wood in the foreground; Fox River and the John Street Bridge in the middle ground; Wisconsin Tissue Paper Co.'s mill on opposite side of the River.



B.—LIMESTONE QUARRIED IN THE FOX RIVER CHANNEL AT KAUKAUNA

The River flows on a rock bed nearly all the way from Menasha to Green Bay.

woods—and it naturally followed that wood was used in manufacturing far beyond any other raw material. The Richmond paper mill was running in 1854. In 1858 there were five saw mills in the city and in 1861, 60,000 barrels of flour were shipped from Appleton. A woolen mill was in operation in 1862. By the '70's the manufacturing had attained considerable magnitude, using waterpower almost entirely. The following summary, published in the Annual Review number of the Appleton Post, shows approximately what the manufactures consisted of in 1880, 35 years ago. The values given were estimates, and are probably somewhat generous.

TABLE XI

APPLETON MANUFACTURES IN 1880 (Estimates)

	Dollars		Dollars
Farming implements.....	70,000	Furniture.....	75,000
Flour (6 mills).....	890,000	Hubs and spokes.....	86,000
Iron.....	355,000	Lumber.....	80,000
Leather (2 tanneries).....	85,000	Lime, brick, etc.....	30,000
Machinery.....	38,000	Paper (4 mills).....	850,000
Staves and heading.....	110,000	Sash, doors, and blinds.....	75,000
Woolen goods.....	200,000	Wood pulp.....	140,000

It will be noted from the above table that the manufacture of flour exceeded that of paper in 1880. At this time, the Fox River counties, and for that matter, all of the farming counties in Wisconsin, were raising wheat as the main crop. In the years around 1880, more land in Outagamie County was sown to wheat than to all other crops combined; 700,000 bushels a year were produced, or 70 times as much as is now grown in the county. Appleton was not only a flour-milling center, but it was also a wheat market, and old residents remember when the streets of the city were lined with farmers' teams hauling wheat. It is stated that at the height of the flour-milling activity, more than a million dollars worth of flour was ground annually. By the '90's wheat growing was declining very rapidly, mainly on account of the ravages of pests, and the exhaustion of the soil through the growing of the same crop year after year. Most of the flour mills gave place to pulp and paper mills. Kimberly, Clark & Company, now the largest paper manufacturers in the Valley, were the owners of the large Genesee Flouring Mills.

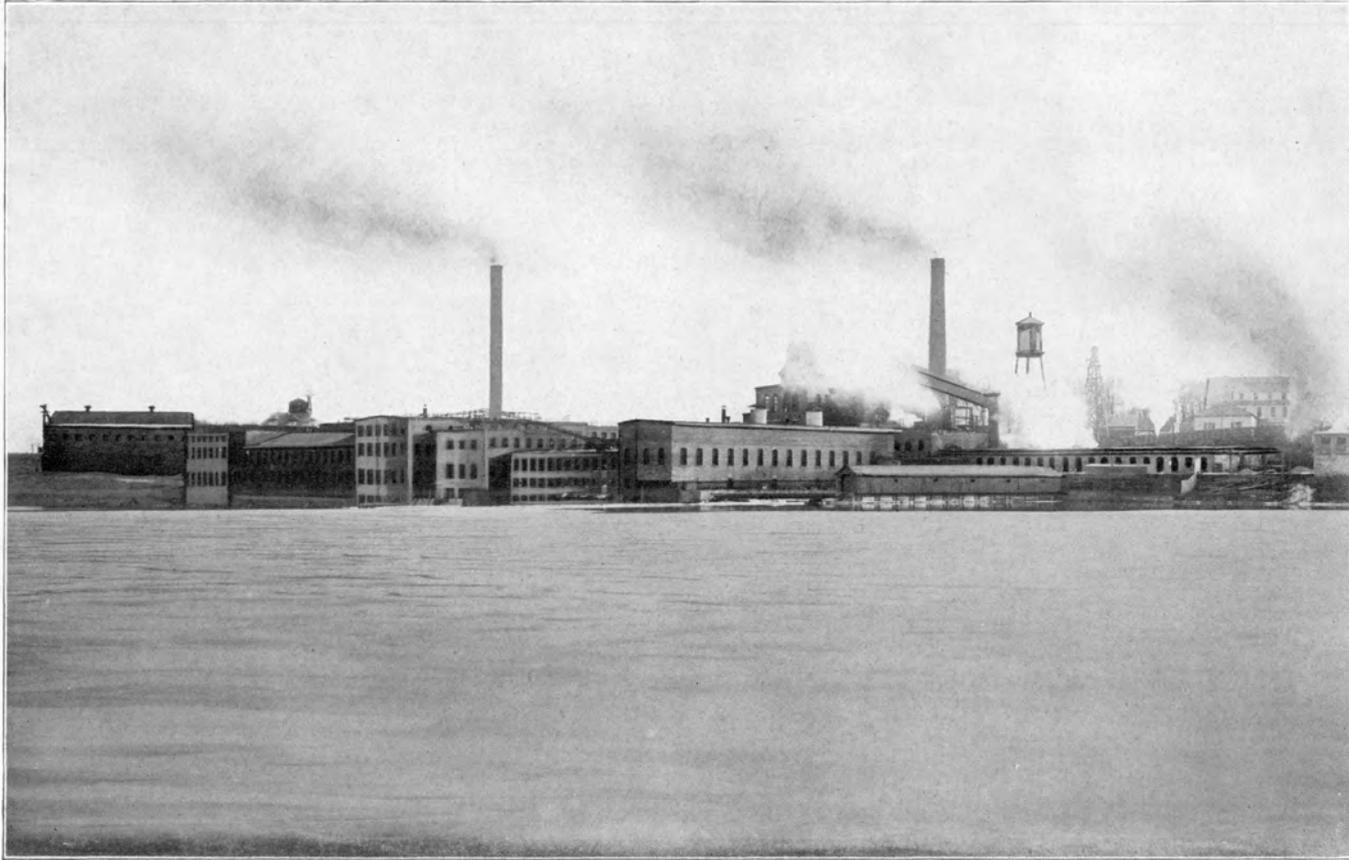
The shifting from flour-milling to paper-making in Appleton

presents an example of an economic principle of wide application, *the readjustment of manufacturing in response to changing raw materials*. It goes on in every city and in every section as changes come which deprive manufacturers of their accustomed raw material and compel them to employ their capital, power, and experience in new lines. The presence of the great water power at Appleton is a guarantee that if one kind of manufacturing is driven out of the Valley, another kind will replace it. Thus the basis of the city's industries is a permanent one under almost any conceivable circumstances. In the 14 lines of manufacturing shown in table XI it is interesting to note that wood formed the raw material for eight. Besides, the two tanneries used bark from hemlock and oak trees, and the iron smelter, the third largest industry and the largest plant in point of value of output, used charcoal for fuel. The charcoal was made by charring wood in dozens of kilns scattered all through the surrounding region. Thus, even the iron industry depended upon wood, and when the wood was gone, the iron furnace went too.

PRESENT MANUFACTURING IN APPLETON

According to the census enumeration of 1910, Appleton had 97 manufacturing establishments. The State Factory Inspector listed 73 establishments during the same year. Many of these are small. Fifty of the 73 manufacturing plants named by the Factory Inspector had less than 25 employees each; 18 had between 25 and 100 employees; 3 had between 100 and 300, and 2 had between 300 and 400. The numbers have increased somewhat, though not greatly, since that time.

The Fox River Valley has become the center of the paper-making industry of the West, and Appleton has both the largest number of pulp and paper mills and the largest output of any of the Fox River cities. There are in the city eleven paper and pulp mills, nine of which manufacture pulp or paper, and two of which use paper in further manufacturing, such as coating or enameling. The former make almost every variety of paper including tissue, crepe, wrapping, manila, book, news, writing, envelope, ledger, bond, linen, and scores of special kinds for special uses; two of the pulp mills make ground wood pulp and two make chemically treated pulp, called sulphite fibre. These mills are capable of making 220,000 pounds of pulp and 270,000 pounds of paper every 24 hours. All of the mills which manufacture pulp or paper are located along the river and use water power, (supplemented by



THE KIMBERLY-CLARK PULP AND PAPER MILLS AT KIMBERLY, 3 MILES BELOW APPLETON
Capacity, 120,000 pounds of pulp, and 200,000 pounds of paper a day—enough paper to make 125,000 ordinary books.

steam when necessary). The mechanical process of grinding the wood for making the pulp requires a great amount of power, and it is in this process that the cheap power furnished by water is most in demand.

The following table gives the chief facts of interest about the different pulp and paper mills.* In the column headed "Kind of power used," "W and S" signifies water and steam.

TABLE XII
PULP AND PAPER MILLS IN APPLETON

Name of Mill.	Daily Capacity	Kind of power used	Principal Products
Appleton Coated Paper Co.....	40,000 lbs.		Enamelled papers, covers. Specialize in cover and laid papers.
Boyd Paper Co.....	20,000 lbs.		
Fox River Paper Co.			
Ravine Mills.....	10,000 lbs.	Water.	English bond.
Lincoln Mill.....	20,000 lbs.	W. & S.	Writing papers.
Fox River Mill.....	30,000 lbs.	W. & S.	Linen, bond, writing papers.
Interlake Pulp & Paper Co.....	100,000 lbs.	W. & S.	Sulphite, fibre, also 12,000 lbs. ground wood.
Kimberly-Clark Co.			
Atlas Mill.....	58,000 lbs.	W. & S.	Manila, fibre, etc.
Telulah Mill.....	45,000 lbs.	W. & S.	Book, envelope, writing, manila.
Patten Paper Co.			
Paper.....	35,000 lbs.	W. & S.	Rag, news, book papers.
Pulp.....	10,000 lbs.	W. & S.	Ground wood pulp.
Riverside Fibre & Paper Co.			
Paper.....	30,000 lbs.	W. & S.	Bond, linen, envelope, etc.
Pulp.....	80,000 lbs.	Steam.	Sulphite fibre.
Wisconsin Tissue Paper Co.....	16,000 lbs.	W. & S.	Tissue and light weight papers.

* Data from *Post's Directory of Paper and Pulp Industries*, 1913.

In any city devoted to a special line of manufacturing, such as paper, mills making supplies and machinery for the use of paper mills, and still other mills designed to use paper in further manufacture are always called into existence. A majority of the factories and mills in Appleton which do not themselves make pulp or paper make special machinery or supplies for the use of paper mills, both in the Valley and elsewhere. The Appleton Wire Works makes fourdrinier wires, cylinder moulds, etc., for the paper mills. The Valley Iron Works' chief line is the manufacture of beating engines for the paper mills, and the Appleton Woolen Mills make paper makers' felts and jackets.

Then there are other mills which have been attracted to the city because they use a large amount of paper in further manufacturing and so find it an advantage to be located in a paper-making center. For example, the Tuttle Press Company manufactures many specialties, including plain and decorated crepe paper, paper napkins, and towels, folding boxes and cartons, box-covering papers, printed wrappers for soap, shoes, gum, and bottles, printed tissue paper, milk bottle caps, etc. The Appleton Coated Paper Company does not manufacture the paper which it uses, but coats, enamels and otherwise treats it for special uses. There are a few other factories and mills not connected with paper-making and not all using water power; among these are a chair factory, a toy factory, three knitting mills, and two or more machine shops.

OTHER FEATURES OF APPLETON

The city is the natural banking and mercantile center of a rich farming and dairying region in addition to being the central city in the chain of paper-making towns along the Lower Fox. Through the city run two divisions of the Chicago and North Western Railroad, a main line to Green Bay, Ashland and the Northwest; and a branch line, connecting Appleton with Manitowoc and other cities along the Lake Michigan shore. A branch of the Chicago, Milwaukee and St. Paul also enters the city, and an interurban connects it with towns as far down the river as Green Bay, and southward with Neenah, Menasha, Oshkosh, and Fond du Lac.

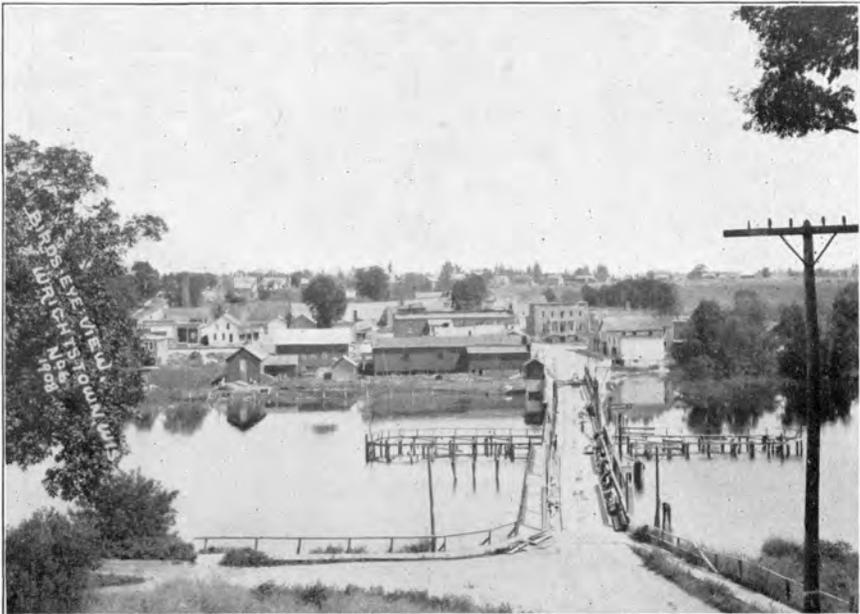
APPLETON AS A TYPE CITY

Appleton belongs pre-eminently to the class of industrial or manufacturing cities. A better example of a city whose industrial life is based upon a single resource—water power—and whose ac-



A.—VIEW IN 1882

From a drawing and wood cut made for the Appleton Post, and published Dec. 21, 1882. Government dam at left; navigation canal across the river.



B.—WRIGHTSTOWN, THE ONLY TOWN ON THE LOWER FOX RIVER NOT AT A WATER POWER SITE

Founded in 1834.



tivities center around a single industry—paper-making—could scarcely be found. Cities of this type, while frequent, are in the small minority. Among the older cities of the East such cases are found. For example, Gloversville and Johnstown, twin cities in eastern New York, are almost wholly devoted to the manufacture of leather gloves and mittens. Troy, N. Y., makes more than 80 per cent of the collars, cuffs, and dress skirts made in the United States. Similar cases are found in Brockton and Lynn, shoe-making centers near Boston; in Fall River, Mass. (cotton), Paterson, N. J. (silk), and South Omaha, Neb. (meat packing). The city of Niagara Falls is one whose manufacturing industries rely almost wholly upon water power, and scores of cities in New England owe their location and early growth to it. Many of the recently built cotton mills in North Carolina, South Carolina, and Georgia are the beginnings of cities of the waterpower type.

KAUKAUNA

EARLY HISTORY

Kaukauna is one of the oldest settlements on the Fox River. In 1790 or 1793 a trading post was established there by a French Canadian who is recorded as having bought a tract "40 acres in length and 40 acres in width for 2 barrels of rum." After 1818, the place became one of the best known on the river. In that year Augustine Grignon settled at the Lower Rapids, built a house, and cultivated land; he maintained a trading post for a long period and gradually attained a widespread reputation for his generous hospitality to travelers along the river. The country was still an almost unbroken wilderness. It is said that for some years prior to 1824 Grignon's house was the only one between Green Bay (Fort Howard) and Lake Winnebago. In 1827 the region about Grand Kakalin, as it was long called, contained 31 people.

The town of Kakalin was organized in 1839, in which year Mr. George W. Lawe, one of the most widely known men in the entire Valley and often referred to as the Father of Kaukauna, came there to live. Ten years later the place was spoken of (in the *Green Bay Advocate*) as "famed for its beauty, prominence and bountiful hospitality." After a bitter contest between the two villages, Ledyard and Kaukauna, on opposite sides of the river, they were incorporated into the single city of Kaukauna in 1885. The first dam across the river was built in 1850 and a four-story mill was erected in 1861.

WATER POWER AND INDUSTRIES

At Grand Kaukauna (the spelling legally adopted in 1861), the Fox has a descent of slightly over 50 feet in less than one mile, and affords the largest water power of any rapids along the river though only a little over half of this is used. The original paper mill was erected in 1873-74. There are now five mills, all of which make either ground-wood or fibre; one mill makes sulphate fibre, a more recent product than the sulphite fibre which is made in many mills in the Valley; three mills make paper. In all, the capacity of these mills is over 200,000 pounds of pulp or fibre and 150,000 pounds of paper in 24 hours, making Kaukauna one of the important pulp and paper centers of the Fox River group.

Power is developed on both sides of the river. It is distributed along the north side by a navigation canal over a mile in length, containing five locks, and on the south side by a private canal. Another dam has also been built, for power purposes, some distance below the government dam. There are excellent conditions for a much larger manufacturing development than has yet taken place.

In 1880 the shops of the Milwaukee, Lake Shore and Western Railroad were placed at Kaukauna and the city experienced a boom of some magnitude. For many years these shops employed a large force of men and gave life to the city, especially to the south side where the shops are located. The Lake Shore Road has since become a part of the Chicago and North Western system, the railroad shops have declined in importance and Kaukauna has suffered a set-back. The population in 1910 was 4,700, four hundred less than at the previous census. The additional water power which might be developed here holds out the prospect that the city may sometime take a large part in the manufacturing industries of the Valley.

KIMBERLY, LITTLE CHUTE, WRIGHTSTOWN, LITTLE RAPIDS

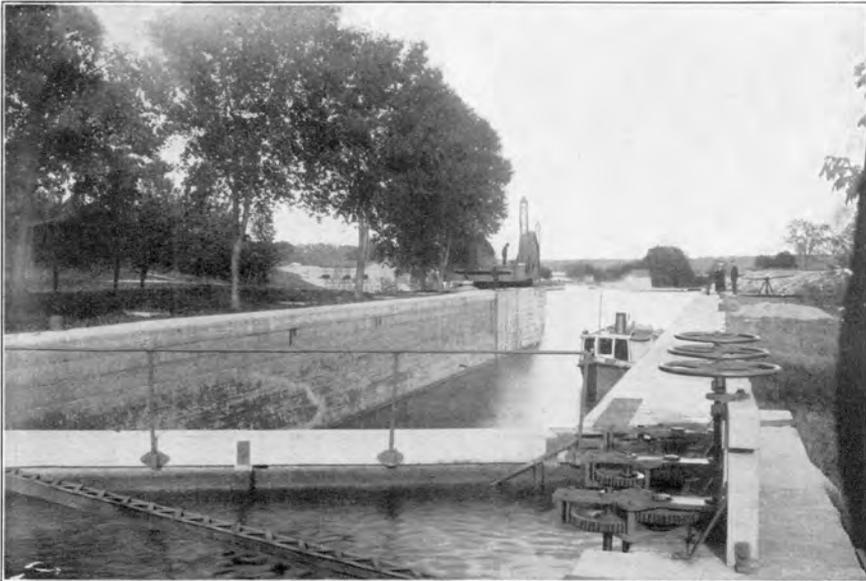
KIMBERLY

The Kimberly-Clark pulp and paper mill, one of the largest paper mills in the West, is situated about 3 miles below Appleton on the south side of the river. In recent years the company has been aiding in the development of a model village, peopled mainly



A.—DAM AND NAVIGATION CANAL AT KAUKAUNA

Kaukauna has the largest Water power (13,400 H.P.) on the river; 6,900 H.P. is not yet developed.



B.—LOCK IN NAVIGATION CANAL AT KAUKAUNA

About 600 boats pass through the lock annually.

by its own employees. The company owns the entire water power developed by the Cedars Dam. The paper mill has a capacity of 200,000 pounds a day, and the sulphite fibre mill a capacity of 120,000 pounds a day.

A medium sized book weighs from a pound to a pound and a half. Every week this one mill produces enough paper for nearly a million such books. It could supply to each family in a city of 8,000 people, a hundred books every day.

Across the river, at the place known as the Cedars, a great convocation of Indians was held (in 1836) for the purpose of selling to the United States government a tract of Indian lands extending from Fond du Lac west to Portage and north to Green Bay.

LITTLE CHUTE

The rapids here were called by the French *La Petite Chute* as distinguished from the Grand Chute, where Appleton now is. The place began as a Catholic mission, established by Father Theodore Van den Broek, a Hollander, in whose honor the township was afterwards named. He began his work among the Indians in 1837 and soon had a parish of two hundred people, all Indians, a majority of whom he taught to read, write, and till the soil. In 1843 the congregation is said to have numbered 600. A little later Father Van den Broek returned to Holland and induced a large number of his countrymen to come to Wisconsin. Little Chute has been, from the beginning of white settlement, mostly peopled by Hollanders and their descendants. In 1910 the population was 1,354.

At Little Chute the river descends 36.2 feet in two miles; the rapids are passed by a canal over a mile in length, with a lock near the upper end and a double lock at the lower end. About 4,000 H. P. is developed by the dam and is used by the Little Chute Pulp Company, whose mill has a daily capacity of 100,000 pounds of ground wood.

At the Combined Locks Dam, a mile below Little Chute, is one of the largest pulp and paper mills in the Valley, that of the Combined Locks Paper Company, with a reported capacity of 200,000 pounds of paper, 100,000 pounds of ground wood, and 80,000 pounds of sulphite fibre daily. Six thousand horse power is used.

WRIGHTSTOWN

Between Kaukauna and Depere are Wrightstown and Little Rapids. The former was settled in 1833 and thus is older than

Appleton, Neenah, Menasha, or Oshkosh; yet it has reached a population of only 700. It has no water power and is the only city or village on the river without manufacturing industries. It gained importance in an early day (1836) as the point where travelers on the Fort Howard-Fort Winnebago Military Road ferried across the river. A bridge which now crosses the river is largely responsible for making the village a trading center for the neighboring region. (Plate XXII, B).

At *Little Rapids* is a dam and canal developing 2,000 horse power, which is used by a wood pulp mill of 64,000 pounds daily capacity.

DEPERE

The city takes its name from the old French *Rapides des Peres*, or Rapids of the Fathers, so-called because of the Jesuit Mission established there by Father Claude Allouez in the winter of 1671-72. The first rapids, as you ascend the river, are here, and they led to the selection of the place for the famous old mission. The rapids made a natural stopping point for canoes, both ascending and descending the Fox, and hence was a favorable place for the mission. It has been the scene of many interesting and some thrilling events. For 18 years Father Allouez labored there, but with many disappointments; the mission was finally destroyed by the Indians. During the fur trading days, Depere shared with Green Bay in the unique life and activities of the Valley, but with the decline of this trade, the place became all but deserted. In 1837 it was made the county seat of Brown County, though it had but a handful of people. A year later it had grown to a place of 28 dwellings, and in 1857 it was incorporated as a village. During the Civil War the village was a live manufacturing center, but declined after the War. In the early seventies West Depere was the most stirring place along the river and is said to have eclipsed Green Bay. It was consolidated with the east side in 1890.

In the early seventies, iron smelting was a large industry at the Deperes and also at other places on the river. The surrounding country was still partly covered with hardwood timber, and this must be removed before the land could be cultivated. The iron furnaces furnished a market for this wood which was made into charcoal and used as fuel for the blast furnaces. In fact the industry was primarily a wood-using industry, and was a boon to the farmers who thus found an additional profit in clearing their land.



DEPERE. LOOKING WESTWARD, NAVIGATION CANAL IN FOREGROUND; POWER CANAL AND PAPER MILL ACROSS
THE RIVER

This dam is the last one in the series of twelve from Lake Winnebago and Green Bay.

Two of the furnaces in Depere using ore from Upper Michigan consumed from 40,000 to 50,000 cords of wood a year. It was an important industry while it lasted, but when the wood was gone the furnaces soon passed out of service. During these same years there were several saw mills on the water power. In the '80's flour milling was a large industry.

At present the largest mill in the city is the fine paper mill on the west side. It was built by the Kimberly-Clark Company expressly for making high-grade writing papers, but was sold to the American Writing Paper Company. It has a capacity of 32,000 pounds daily, using the water power developed by the government dam. The river is so deep that lake steamers drawing 16 feet of water bring coal to the Depere docks. Metal working is, next to paper making, the chief line of manufacturing. Boiler works, machine shops, boat works, and brick yards are industries of some magnitude. Excellent brick and tile clays are obtained on both sides of the river. Two trolley lines connect the city with Green Bay and one with up-river cities. The Chicago and North Western Railroad is on the west side of the river and the Chicago, Milwaukee and St. Paul reaches the eastern portion of the city.

GREEN BAY

ITS LONG HISTORY

No city of the Old Northwest has such a long and interesting history as Green Bay.* It is now approaching 300 years since Jean Nicolet with his mandarin gown and pistols astonished the Winnebagoes at the mouth of the Fox (1634), and enacted the first chapter in the romantic history of the Fox River Valley. In these years Miles Standish was Captain of Plymouth and Wouter van Twiller was governor of New Netherland; Philadelphia was yet undreamed of and Boston had scarcely begun its history. Thirty years after Nicolet's visit came Nicholas Perrot, and began the fur-trading enterprise which was for two centuries the magic influence to attract the hardy and the adventurous *Coureur de Bois*, the penniless *Voyageur*, and the fortune-seeking noble into the pathless wilds of New France. From the beginning of the French regime down almost to the middle of the last century, Green Bay was one of the chief centers of the fur trade

* This has been admirably written up in *Historic Green Bay, 1634-1840*, by Ella H. Neville, Sarah Green Martin, and Deborah Beaumont Martin. Green Bay, 1893.

of the Northwest. Thither each summer came the fleets of canoes and French batteaus from Montreal and Mackinac, bringing arms and cloth and ornaments, and thence each spring went the fleets laden with the furs of the beaver and otter, the bear, wolf, fox, and deer, the lynx, marten, and badger. A score of interior posts at Kaukauna, Buttes des Mortes, Oshkosh, Fond du Lac, Calumet, Portage, Prairie du Chien, and points farther west, were tributary to Green Bay. When all traffic was by water, Green Bay was a strategic point with only two or three peers in the western country. "For 200 years Wisconsin's all important interest was the fur trade. This traffic stimulated exploration, by making it profitable; transformed Indian society politically and economically; brought the Indian into complete dependence upon the trader, and paved the way for the peaceful agricultural settlement of the State."*

HISTORICAL SYNOPSIS, GREEN BAY

Arrival of Nicolet, the first white man to visit Wisconsin, 1634.

Arrival of Radisson and Groseilliers, famous traders and forest rangers, 1654.

Beginning of the fur trade by Nicholas Perrot, 1666.

Arrival of Father Allouez (1669) who later established the first Christian mission in the Valley (St. Francis Xavier) five miles above Green Bay, 1671-2.

Arrival of Joliet and Marquette, discoverers of the Upper Mississippi, 1673.

Nicholas Perrot made first Governor, or commandant, of the territory, 1685.

The first establishment of a garrisoned French post at the mouth of the Fox River, 1721.

Arrival of Augustin and Claude de Langlade, the latter said to have been one of the bravest and most resourceful of the men who made New France, 1745 (?).

Final surrender of Wisconsin, with the rest of New France, to England (1760) and the placing of the first English garrison at Fort Edward Augustus, as the English called Green Bay, (1761).

Withdrawal of English garrison on account of danger from Indians, 1763.

Seven white families at Green Bay, 1780.

Nominal but not actual beginning of United States sovereignty, 1783.

* Turner, F. J., *The Character and the Influence of the Fur Trade in Wisconsin* in *Proc. Wis. Hist. Soc.* 1889, pp. 52 to 98.



A.—GRAIN ELEVATOR AT GREEN BAY



B.—UNLOADING EASTERN COAL AT GREEN BAY

More than 600,000 tons of coal are received by boat at Green Bay annually. This coal is brought from Lake Erie ports at 30 to 40 cents a ton.

Population of Fox River settlement about 50, in 1785.

Actual cession of Wisconsin to the United States by Great Britain, and its incorporation into Indiana Territory, 1800.

First assertion of the authority of the United States; Charles Reaume made a Justice of the Peace, 1803.

Wisconsin becomes part of Illinois Territory, 1809.

Stationing of the first American garrison, and the building of Fort Howard, 1816. Green Bay then had between 45 and 50 families.

First regular school opened in Green Bay, 1817.

Green Bay made part of Michigan Territory, and Brown County organized, 1818.

First arrival of settlers from the Eastern States and the decline of the old French regime, about 1820.

Arrival of the first steamboat, "Walk in the Water," 1821.

Green Bay's first post office, Jan. 2, 1822.

Building of the military roads from Green Bay to Fond du Lac and to Manitowoc, 1832-3.

Father Van den Broek writes that Green Bay has 9 or 10 houses, 1834.

Large immigration of eastern settlers and excited land speculation, 1835-40.

Territory of Ouisconsin created (named by Jas. D. Doty, from the Ouisconsin River), 1836.

Borough of Green Bay formed by the union of the villages of Navarino and Astor, 1838.

Wisconsin admitted to statehood, 1848.

Green Bay incorporated into a city, 1854.

Large immigration of Hollanders, Belgians, and Germans, 1854-57.

First railroad train runs to Green Bay, 1862.

The Civil War, 1861-64.

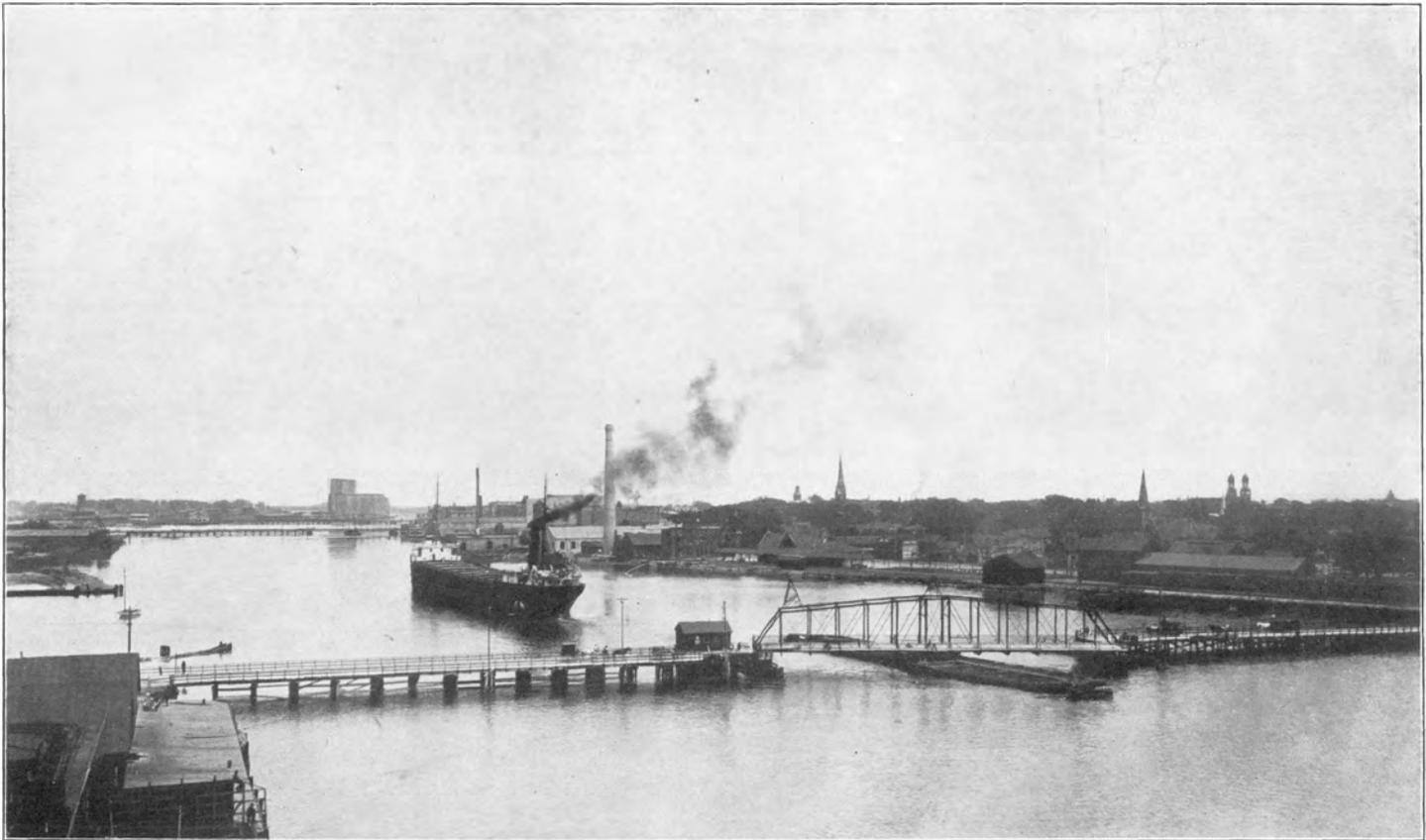
"The war ended, and Green Bay nodded, slept. Wharves along the river shore rotted to the water's edge and on the sandy waste of Washington street, cows dozed on summer days. Gradually from 1866, Green Bay showed a marked awakening in business interests. Elmore and Kelly's elevator was built. Railroads pushed through to this desirable port. The Chicago and North Western was pushed northward to the copper and iron country. The Milwaukee and Northern cut a short line between Milwaukee and Green Bay, and the Green Bay and Lake Pepin road opened up a direct route to the Mississippi. Between 70 and 80 saw mills were erected in Brown County, and in 1870

it is recorded as being the largest shingle market in the world, the market product in that year being one-half billion. Backward lay its romantic past, the part played in the foundation of a new state, the days of the fur trade, of *coureur de bois* and *voyageur*, forward pushed Green Bay of the future, Greater Green Bay.”*

GREEN BAY AS A TYPE CITY

In every city from Fond du Lac to Depere, the manufacturing industries bear the strong impress of a single dominant influence—the influence of Wisconsin’s forests. In all of them, one raw material, wood, overshadows all others. Fond du Lac and Oshkosh still continue engaged in the wood-shaping industries, while the water power cities on the Lower Fox specialize in pulp and paper made from wood. In the case of Green Bay an opposing influence enters and diversifies the industries to an extent at once noticeable. It is an influence which inevitably arises from the city’s commercial life. Green Bay is, like all cities, an industrial center, but an industrial center modified by its commanding position at the head of Green Bay and at the watergate of the Fox River Valley. Because of this commanding position the city belongs to that type of city which is today the leader in the world’s affairs, cities which may be called watergate cities. They are more than seaports, for they sit where two waterways meet—where rivers meet the sea. The river may or may not be in itself important, but the valley that leads up from the sea into a rich, populous hinterland becomes in the very nature of the case a conduit of commerce. A city so situated is fed through two funnels: the one receives the converging lines of trade from the sea; the other brings to a focus railroads from the interior. Such a city is New York at the mouth of the Hudson, and Montreal on the St. Lawrence. Such is London and Rotterdam, Hamburg and Marseilles, Buenos Aires and Calcutta. Lake Michigan is not the ocean nor is the Fox River the Rhine or the St. Lawrence; and correspondingly, Green Bay is not Rotterdam or Montreal, but it belongs to their type—the type of the watergate city. The diversity of its industries, the column of Marine News in the daily paper, the big elevator that looms up at the head of the Bay, the coal docks that line the river, the wholesale houses that turn their fronts to the street and their rear doors to the water, and the office of the collector of customs, are all marks of the port city.

* From “A Historical Sketch of Green Bay,” by Deborah B. Martin, in *A Souvenir of Green Bay*. Milwaukee, 1903.



THE FOX RIVER AT GREEN BAY

The U. S. Government maintains a channel approximately 20 feet in depth. Boats carrying 10,000 tons of coal may reach the coal docks at Green Bay.

GREEN BAY AS A LAKE AND RIVER PORT

The channel at the mouth of the Fox River is kept dredged for vessels drawing 19 or 20 feet of water, but this is not sufficient for the largest boats on the Lakes, and an effort for its further deepening is being made. The present depth permits the entrance of

TONNAGE OF VESSELS ARRIVING AT GREEN BAY

1880		100,000 TONS
1887		132,000 "
1902		200,000 "
1908		415,000 "
1913		464,000 "

FIG. 10

boats carrying 10,000 tons of coal. A few years ago such boats were the monsters of the Lakes. Many an ocean-going vessel is smaller. Between 500 and 600 vessels a year, mostly steamers, enter and clear the harbor. Their total tonnage reaches nearly 500,000 tons. This is not the tonnage of freight received, but the registered capacity of the vessels. The coal receipts alone in 1913 reached 650,000 tons—500,000 tons of soft, and 150,000 tons of hard coal. The fact that this coal is brought from Lake Erie ports, nearly a thousand miles, for 30 cents to 40 cents a ton, while the railroads charge double that amount for hauling it a hundred miles inland, gives some suggestion of the enormous saving made possible by the water shipment of heavy commodities like coal. The Great Lakes save Wisconsin in freight charges on coal alone millions of dollars a year. The densest population of Wisconsin is in the southeastern quarter and it follows that the lake traffic to points south of Sheboygan will be heavier than to points north of that city. With the development of the northern half of Wisconsin, Green Bay's volume of waterborne trade will continue to increase. There are large, but declining receipts of pulp wood (30,000 to 40,000 cords) from points in the Upper Peninsula of Michigan. This is mostly brought in rafts of 3,000 to 4,000 cords, towed by tugs. No Canadian pulp wood reached at this port in 1913; most of this now goes to Ashland and thence is taken by rail to the pulp mills. The receipts of foreign merchandise are now about \$100,000 a year, yielding a duty of \$6,000. In 1902 the duty collected amounted to \$20,000. A regular line of steamers, The Mutual Transport Line, brings some merchandise from the lower lake

ports. The passenger and freight boats of the Goodrich Line no longer touch at Green Bay. Coasting steamers ply between the city and other points on the Bay. The tonnage of vessels entering and leaving the port has steadily increased. This increase is due to the growing receipts of coal. The Reiss Coal Company docks (Plate XXVII.) alone are now (1914) receiving 500,000 tons a year. Their unloading facilities enable them to unload a 7,000 or 8,000 ton boat in 24 hours.

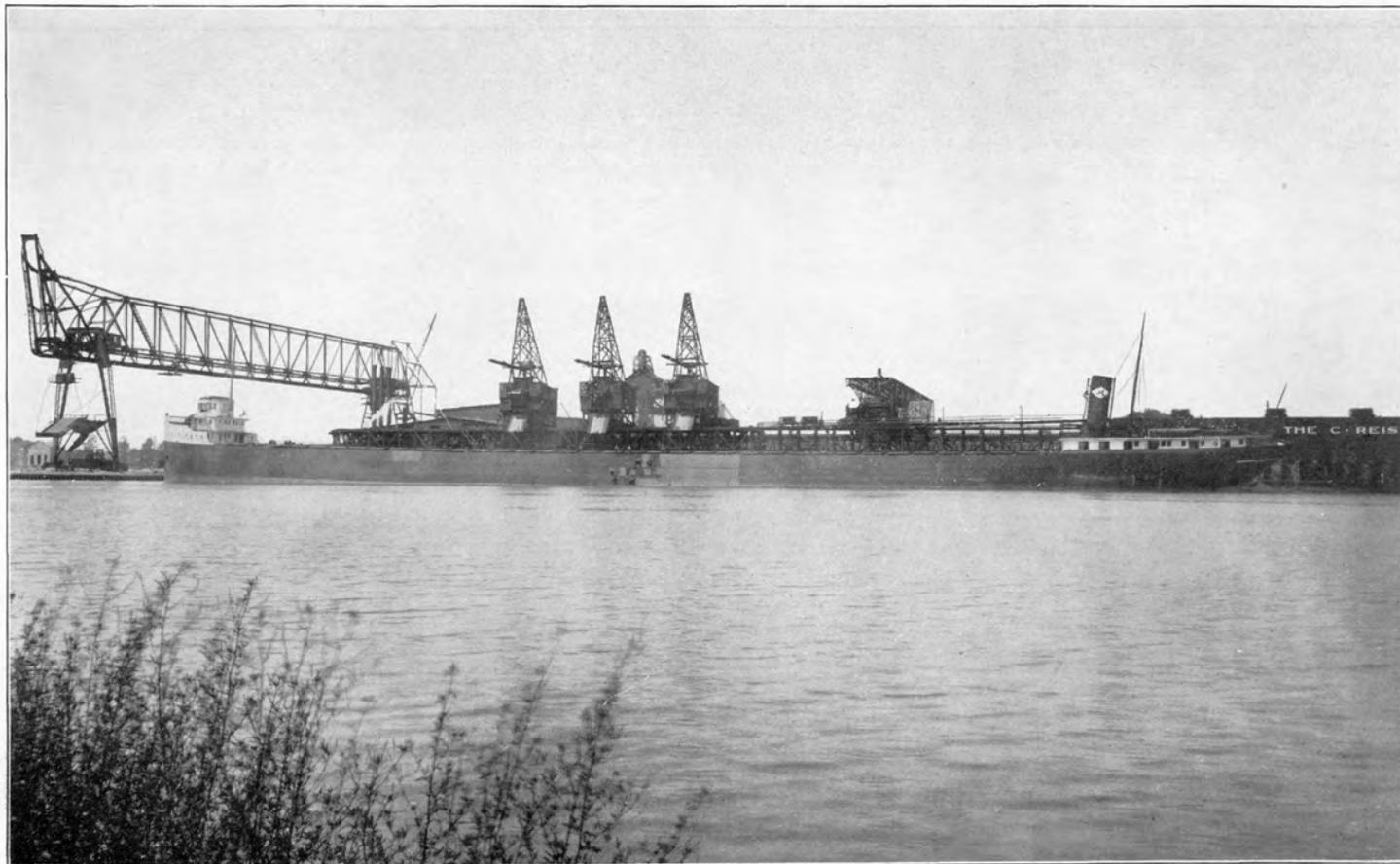
Shipments by water fluctuate. In 1902 more than 23,000,000 feet of lumber were shipped by one company and in that year the Cargill Elevator handled 8,000,000 bushels of grain; not all of the grain went by water, however. In recent years, railroads have carried an increasing proportion of the city's shipments.

MANUFACTURING INDUSTRIES

Green Bay has practically 100 manufacturing establishments, over one-half of which employ less than 25 people. There are 23 plants which employ between 25 and 100 people each, nine that employ between 100 and 300 people, and two that employ over 300 each. There is greater diversity in the character of the industries than is found in any other of the Fox River Valley cities. The wood-using industries are less prominent, yet they lead. In the years around 1870, Green Bay was a great lumber and shingle market. There were over 60 lumber mills in the county,* and the city handled 100,000,000 feet of lumber and 500,000,000 shingles a year. There were five lumber mills in the city and at Mill Center, 9 miles away, there are reported to have been 19 mills. Two large lumber mills and three planing mills, a box factory, a furniture factory, and other wood-using plants now operate in the city. A combined sulphite fibre and paper mill produces about 60,000 pounds of fibre and an equal amount of paper. Two other paper mills produce respectively 50,000 and 40,000 pounds, chiefly colored tissue, crepe napkins, toilet, fruit wrappers, and paper towels. The Green Bay paper mills are among the few in the state that do not use water power.

The manufacture of cooperage has long been an industry of importance; 1,200 carloads of cooperage are said to have been shipped in 1889. The industry is still flourishing. Three flour mills are operating and one of them has a capacity of 500 barrels a day. The great increase in dairying in the region tributary to Green Bay has tended to reduce the grain shipments.

* In the *History of Brown County*, by Deborah B. Martin, it is said that in the fifties there were well toward 150 saw mills in the county.



COAL DOCKS AT GREEN BAY

Unloading a 10,000-ton cargo of eastern coal at the Reiss Coal Company's docks at Green Bay. Note the length of the boat.

It is noticeable that the iron and steel working industries—except those which serve the paper mills—are not prominent in any of the cities between Lake Winnebago and the city of Green Bay. At that city, however, these industries are among the foremost, due in part at least, to the cheap coal, cheap transportation, and the marine activities of the city. There are nine establishments which operate either as foundries or machine - building plants, or both, and the products of several of these are widely sold. In addition there are three railroad shops, that of the Chicago, Milwaukee and St. Paul employing upwards of 500 men. The widely diversified character of manufacturing is seen in the following partial list of factories, large and small:

Glove factories.....	2
Knitting mills.....	3
Harness and saddlery.....	2
Overall factories.....	2
Candy factories.....	2
Canning and pickle factories.....	3
Brick yards (nearby).....	3

There are also wholesale and jobbing houses, a large seed company, and seven coal companies with coal docks; 1,300 business concerns are listed in the city directory.

GENERAL SUMMARY OF CITIES AND INDUSTRIES

The existence of a chain of eight cities in 60 miles, from Fond du Lac to Green Bay, is evidence of the operation of some unusual geographical influence. The cities and their population are:

Fond du Lac.....	18,797	Appleton.....	16,773
Oshkosh.....	33,062	Kaukauna.....	4,717
Neenah.....	5,734	Depere.....	4,477
Menasha.....	6,081	Green Bay.....	25,236
		<hr/>	
		Total, 1910.....	114,877

These are not large cities and in the East would not occasion any comment, yet there is only one more important chain of cities in Wisconsin (the one along Lake Michigan), and few equally important from an industrial standpoint in the states of the Middle West. All of these cities are actively engaged in lines of manufacturing in which wood is the principal raw material. This is a direct outgrowth of the great supply of timber which naturally gravitated into the Fox River Valley. In the quarter century following 1860, about 100 saw mills were operating in the Valley at one time; Oshkosh, Fond du Lac, and Mill Center, near Green Bay, were the main centers. The pineries of the Wolf and Oconto rivers supplied the logs, and the rivers and lakes were used for transporting them. Rough lumber and shingles were the principal products until the supply of white pine began to decline; then planing mills, sash, door, and blind factories, and other mills for the further finishing of the lumber became relatively more and more important. Gradually the smaller mills and those at less favorable sites were abandoned. Many of them burned. The mills situated at especially favorable locations, or those which were backed by larger capital and business ability continued longer, and a few continue to the present. Fond du Lac still has one large mill, Oshkosh has three, and Green Bay has two. One or two smaller mills continue in most of the other cities. The white pine is practically all gone, and the rivers are used scarcely at all for transporting logs or lumber. The mills of Fond du Lac County have cut as high as 100,000,000 feet of lumber annually; those of Brown County, somewhat more than that, and those of Winnebago County, nearly 200,000,000 feet.* In all of the centers except Oshkosh, most of the mills had been closed down by the end of the seventies. Owing

* A medium sized frame dwelling requires about 15,000 feet of lumber; hence 200,000,000 feet would build between 12,000 and 14,000 houses, or enough to house a city of 50,000 to 75,000 people.

to its exceptionally favorable location, Oshkosh continued active operations on into the eighties, but with increasing emphasis upon

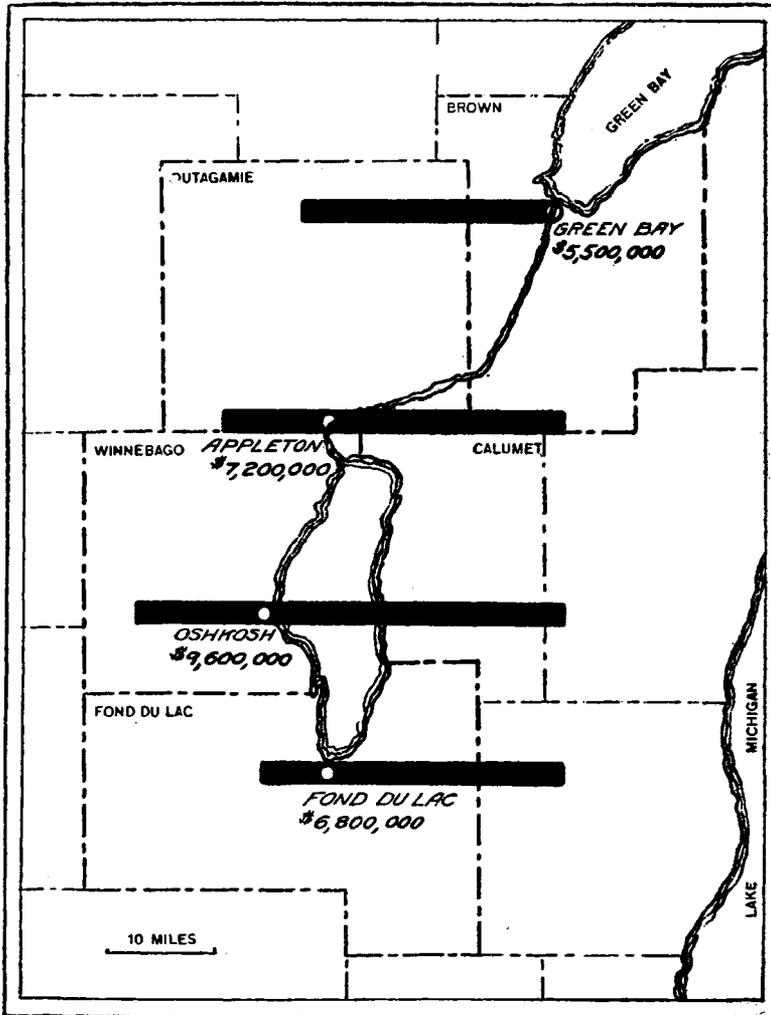


FIG. 11. DIAGRAM SHOWING THE AMOUNT OF CAPITAL INVESTED IN MANUFACTURING IN 1910 IN EACH OF THE CITIES HAVING A POPULATION OF OVER 10,000. (U. S. Census 1910).

Compare Appleton and Oshkosh in this diagram with the same cities in Fig. 12.

finished products and a diminishing output of rough lumber. After the white pine had been cut, enormous quantities of hemlock, basswood, and the hard woods still remained, and these have become the basis of the present wood-working industries of the Valley. Furniture factories are using large quantities of oak, birch,

and maple; carriage and other vehicle factories are using hickory, elm, ash, and oak; cooperage mills are using elm, basswood, oak,

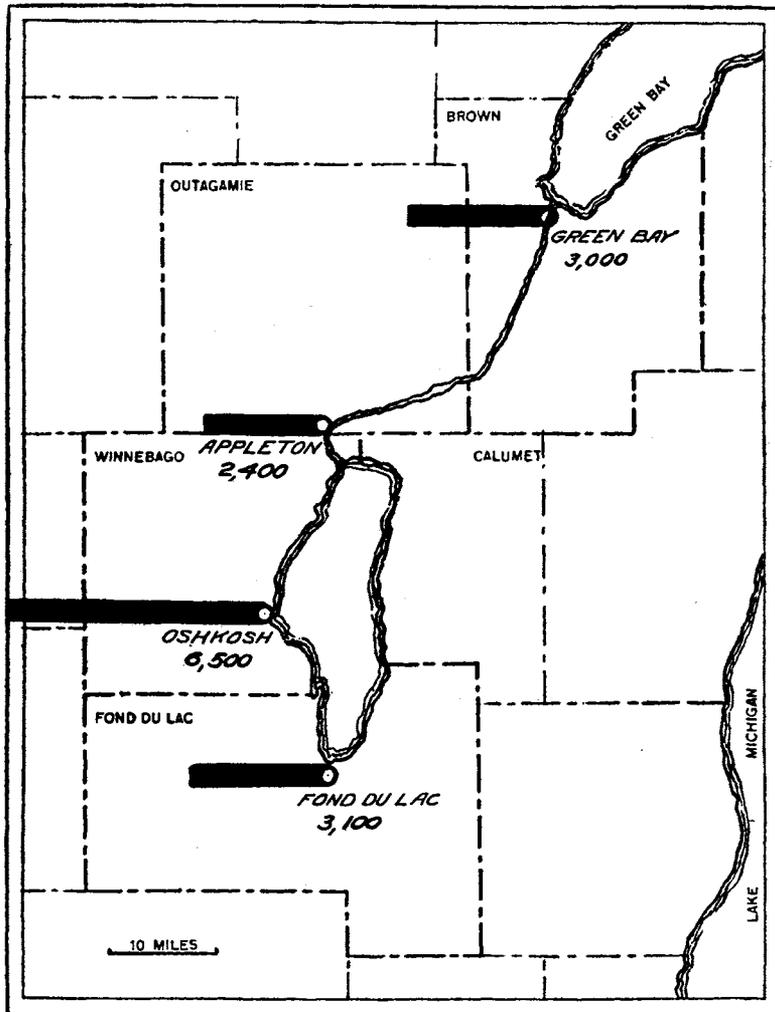


FIG. 12. DIAGRAM SHOWING THE NUMBER OF PERSONS ENGAGED IN MANUFACTURING IN EACH OF THE CITIES HAVING A POPULATION OF OVER 10,000 IN 1910. (U. S. Census 1910).

Note by comparison with Fig. 13 that the wood-working industries of Oshkosh use a much larger force of men than do the paper industries of Appleton, but that Appleton uses much more mechanical power.

and a variety of other woods; single factories in Neenah and Oshkosh have a capacity of 800 and 1,500 doors a day, using both hard and soft woods; the wooden ware factory at Menasha makes annually several million pails and tubs, mainly from basswood.

Then there are box factories using inferior grades of pine, excelsior mills, shingle mills, and a long list of other mills engaged in nearly every variety of wood-working.

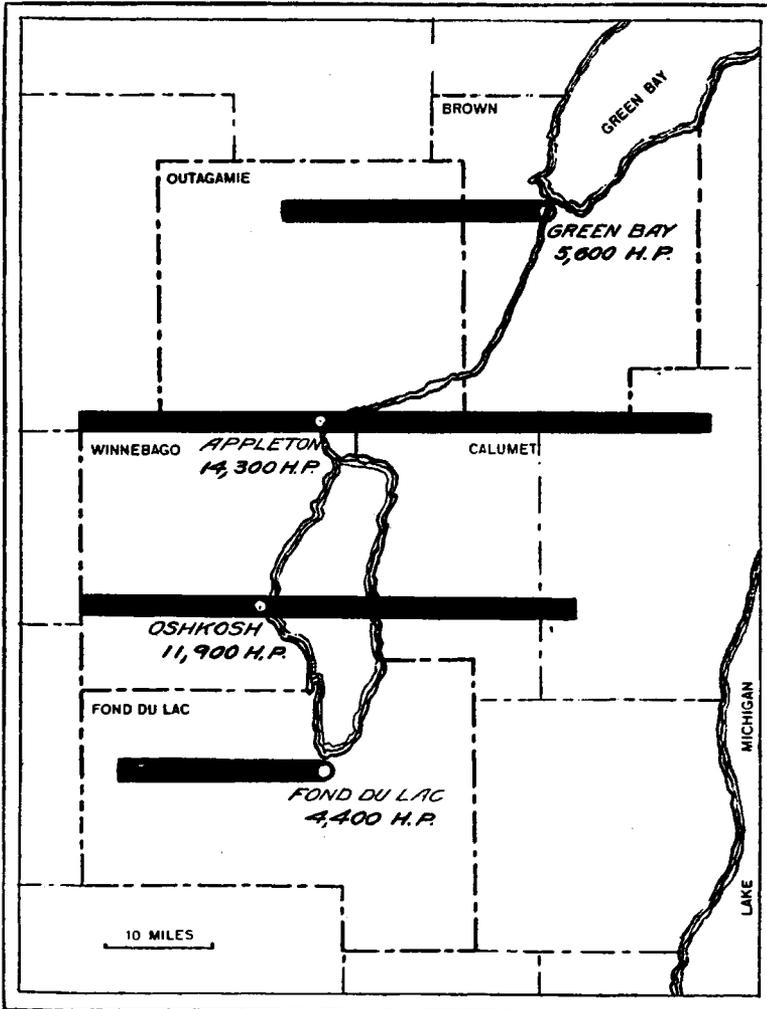


FIG. 13. DIAGRAM SHOWING THE PRIMARY HORSE POWER EMPLOYED IN MANUFACTURING IN EACH OF THE CITIES HAVING A POPULATION OF OVER 10,000 IN 1910. (U. S. Census 1910).

Pulp and paper manufacturing requires a larger use of power than the other lines of industry. Note Appleton, for example.

Thirty or forty years ago there were many small tanneries using the hemlock and oak bark. Only one of these survives in the Valley, the one at Fond du Lac, and it has far outgrown its

early local character and now buys its hides and tanning extracts and sells its four million dollars' worth of leather in the markets of the world.

At one time the making of charcoal (from wood) was an industry of importance, and iron furnaces used this charcoal in smelting iron ore which was brought in from Mayville, Dodge County, or from the Upper Michigan mines. Appleton and Depere had smelters of large capacity.

From 1860 to 1885, wheat was the principal crop grown in Wisconsin and flour mills flourished in every city in the Fox-Winnebago Valley, notably in Neenah and Appleton. In about 1870 there were seven flour mills in Neenah, four in Menasha, and six in Appleton, all using water power. As wheat growing declined, most of these flour mills were either converted into paper mills, or were replaced by them, and these now form the one dominant industry along the Lower Fox.

This vast industry is the outgrowth of two geographical factors—(1) the pulp-wood of the northern forests, and (2) the water-power of the Fox River. The wood pulp which is used in cheaper grades of paper is made by grinding wood, mainly spruce. The grinding process requires a great deal of power, and since water-power is the cheapest kind, these mills naturally locate at places near the forests and at points where water power is available. The Fox River Valley met these two requirements, and has become the greatest pulp- and paper-making district in the West.

As the Wisconsin forests have been culled of their spruce, the making of ground-wood pulp has been shifting away from the Fox River to the Upper Wisconsin, and into Canada. Now the manufacture of sulphite pulp, made by treating chipped wood with chemicals, is replacing the manufacture of ground wood and is bringing about a corresponding change in the kind of paper which is made in the Valley. Some years ago print, or newspaper, was the kind most largely made. This has given way to the manufacture of better and better grades, such as book, ledger, and bond papers. At present, nearly every variety of paper known to the market is made in the Valley. The output is enormous. Appleton, for example, has 13 pulp and paper mills with a combined daily capacity of 220,000 pounds of pulp, and 230,000 pounds of paper. The location, number, and capacity of the mills are shown in the following table (see also Fig. 9):

TABLE XIII

LOCATION, NUMBER AND CAPACITY OF PULP MILLS AND PAPER MILLS IN THE
FOX RIVER VALLEY, (1913)

(Data from Post's Directory)

City	Number of mills.		Daily capacity in pounds	
	Pulp	Paper	Pulp	Paper
Neenah.....	.....	6	.....	260,000
Menasha.....	1	4	60,000	170,000
Appleton.....	5	8	220,000	230,000
Kimberly.....	1	1	120,000	220,000
Little Chute.....	1	.....	100,000	.....
Combined Locks.....	1	1	180,000	200,000
Kaukauna.....	5	3	200,000	140,000
Little Rapids.....	1	.....	64,000	.....
Depere.....	.....	1	.....	32,000
Green Bay.....	1	3	60,000	150,000
	16	27	1,004,000	1,402,000

Many of the other industries in these cities depend directly or indirectly upon the paper mills. Some of them manufacture machinery, screens, felts, etc., for the use of the paper mills, while others use the products of these paper mills for further manufacturing; such, for example, as the making of paper napkins and towels; gum, soap, and bread wrappers, and paper specialties of great variety. Some of the mills handle orders reaching a billion printed wrappers of a single kind. From Neenah to Green Bay the traveler is seldom out of the sight of a paper mill or its tall chimney. (See Plate XXI.) Nearly all use water power, but a few of the newest mills are using steam or electricity only. More than four-fifths of the water power used along the Fox River is used by the paper and pulp mills.

Green Bay is distinctively a lake port, and its widely varied industries show a smaller proportionate use of wood than those in any of the other cities, yet the wood-using industries are larger

than any other single group. The iron-using industries are more important in Green Bay than in any other city in the Valley, due to cheap coal and the natural activities of a port. A list of the

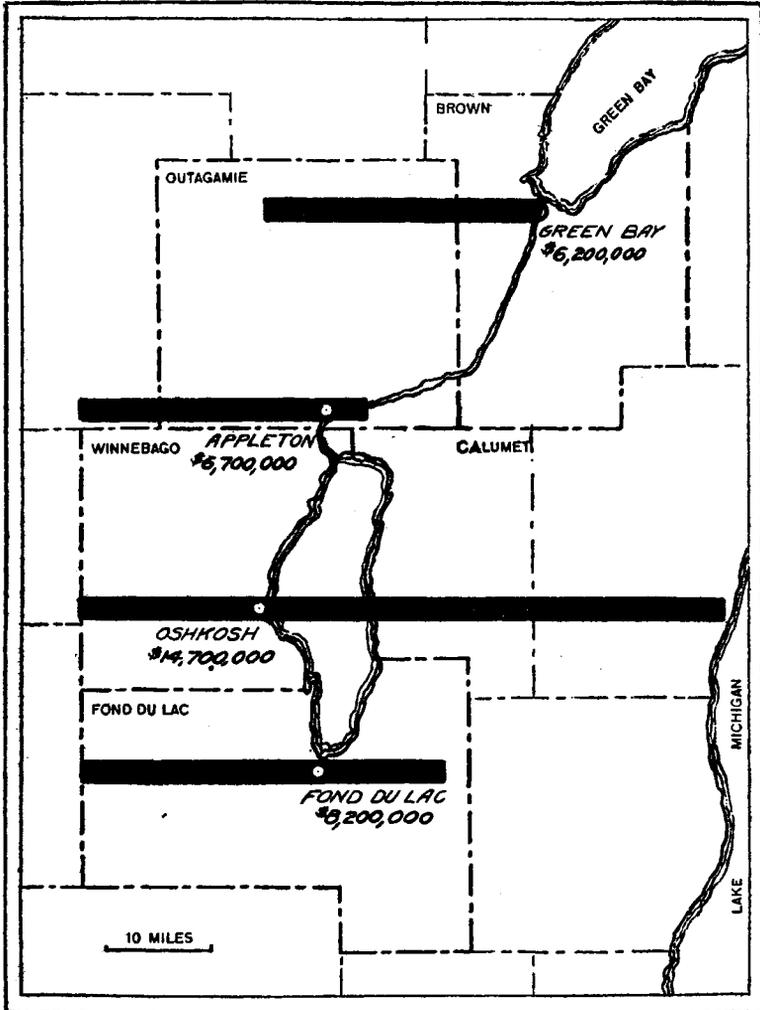
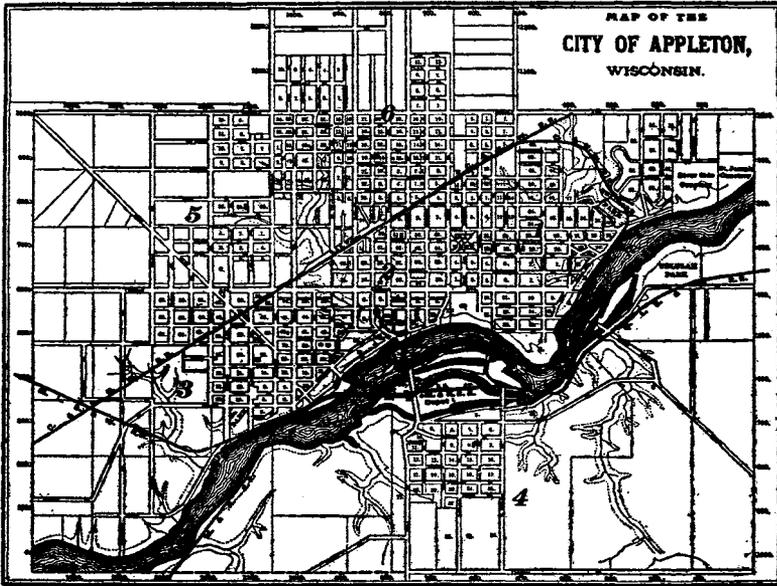


FIG. 14. DIAGRAM SHOWING THE VALUE OF MANUFACTURED PRODUCTS MADE IN EACH OF THE FOUR CITIES HAVING A POPULATION OF OVER 10,000 IN 1910. (U. S. Census 1910).

cities and their leading lines of manufacturing shows how largely the wood-using industries predominate:

Fond du Lac.....	Leather, furniture
Oshkosh.....	Lumber, doors, matches
Neenah.....	Paper, hardwood products
Menasha.....	Woodenware, paper
Appleton.....	Paper, pulp
Kaukauna.....	Pulp, paper
Depere.....	Paper, iron products
Green Bay.....	Iron products, paper, lumber

A widely distributed phase of manufacturing exists in the creameries and cheese factories, which are sprinkled over the entire Valley and whose products reach a larger sum than is generally supposed.



CHAPTER VI

AGRICULTURE

FOND DU LAC COUNTY

The Land. Originally the larger part of the area now included in the county was covered with hardwood forest, but very little timber now remains. The wooded area does not exceed one-twelfth of the whole. Almost the entire county (96 per cent.) is farm land, and an average of seven acres in every ten are improved land, that is, have been brought under the plow. The waste land, relatively small in amount, is due for the most part to marshes. In some cases these are the last stages of shallow lakes which are slowly disappearing. At one time, shortly after the close of the Glacial Period, a quarter of the present land of Fond du Lac County was covered with shallow lakes which gradually changed into swamps as vegetation grew inward from the shore; some of the swampy areas have passed into rich black loam. By artificial drainage, most of the marsh land still remaining can be reclaimed.

CONDITION OF AGRICULTURE

Judged by the American standard, agriculture is in a high state of development throughout the county. In the proportion which farm land bears to the total area, Fond du Lac County ranks with the leading four counties of the state, and is one of a group of ten counties which lead the state in average value of land. Four-fifths of the farms are occupied and worked by their owners, one of the evidences and one of the causes of agricultural prosperity.

REASONS FOR THE HIGH AGRICULTURAL DEVELOPMENT

There are four main natural causes for the high development of farming in the county. The same reasons would apply to many of the farming counties of eastern and southeastern Wisconsin.

1. *The land is essentially a plain. Very little of it is too hilly to be cultivated. Aside from the escarpment of Niagara limestone,*

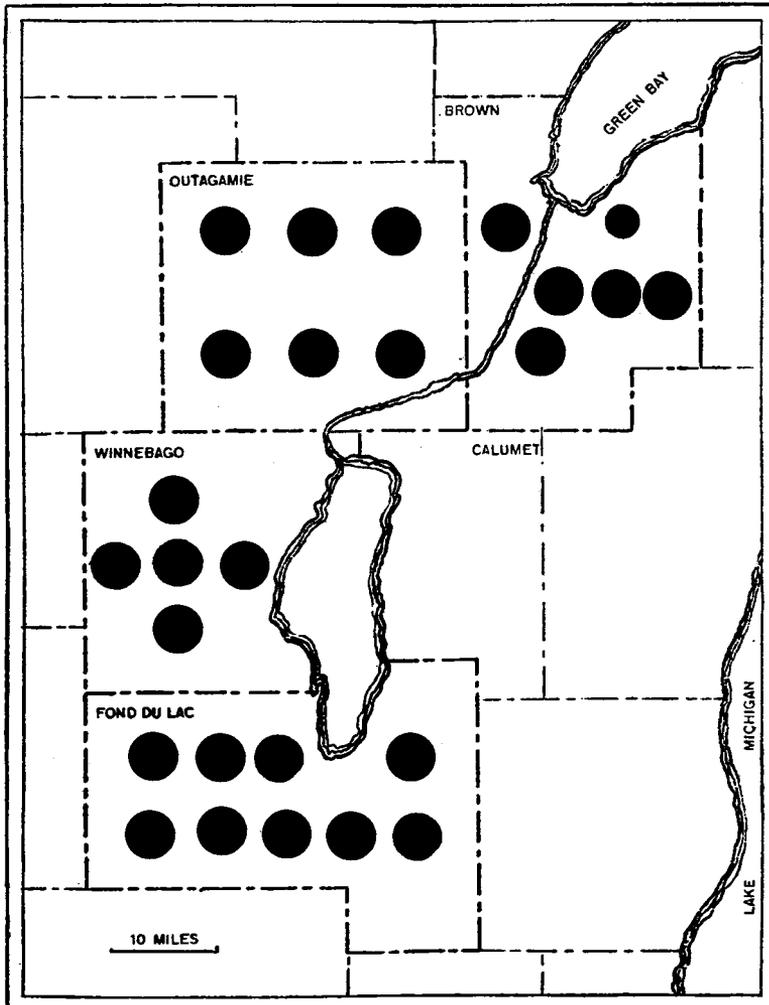


FIG. 15. MAP SHOWING THE RELATIVE VALUE OF FARM PROPERTY IN FOUR COUNTIES. EACH FULL-SIZED CIRCLE REPRESENTS \$5,000,000. (U. S. Census 1910).

almost the only hills are due to glacial deposits, and none of these are high.

2. *Much of the soil is derived from decayed and pulverized limestone, a kind of rock which yields a strong, fertile soil.*

3. *The slope of the land insures reasonably good drainage, thus limiting the area of swamps.*

4. The average rainfall (over 30 inches) and the length of the growing season* (nearly 150 days) are favorable conditions. Besides these four *natural* causes there are others which are due to man's work in producing favoring conditions for agriculture. Some of these are:

1. Good railroad facilities.
2. Farmers of more than average industry and progressive-ness.
3. The widespread practice of dairying, a type of farming which maintains the fertility of the land.

THE SOIL

The entire county has been over-ridden a number³ of times by glaciers, and all of the soil is either directly or indirectly of glacial origin, or it is formed of deposits of till laid down in former

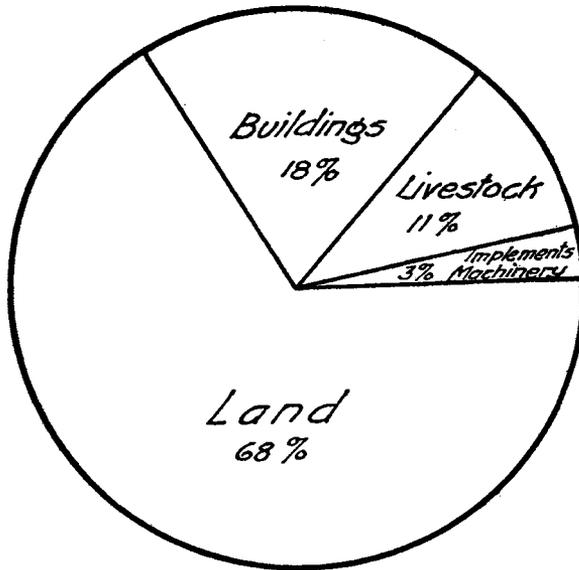


FIG. 16. THE VALUE OF ALL FARM PROPERTY IN FOND DU LAC COUNTY IS ABOUT 45 MILLION DOLLARS, DISTRIBUTED OVER FOUR ITEMS AS SHOWN IN THE ABOVE DIAGRAM

glacial lakes. At times Lake Winnebago has extended farther south and west than it does now as has already been explained in Chapter III. During one or more of these stages red clay was deposited, and upon the withdrawal of the lake from the previously submerged area, this lake-clay mixed with some coarse material

* The growing season extends from the last severe frost in spring to the first in autumn.

became the basis of the soil of the region (see fuller discussion, p. 16). The red color is due to the oxidized iron or iron stain in the soil. About one-eighth of the soil of Fond du Lac county is of this lake-bed origin, derived from deposits of the larger Lake Winnebago.

The fact that the soil is directly or indirectly of glacial origin does not mean that it is uniform in character. The Geological and Natural History Survey has made a soil map of the county; this shows eight different soil series, including 17 soil types. The most important one of these covers 38 per cent of the county. It is a silt loam, grayish brown, soft, smooth to feel of, and contains 95 per cent of very fine sand, silt, and clay. Peat and muck, composed of partially-decayed vegetation which grew in swamps, cover an eighth of the surface, and a dark-colored loam, rich in decayed vegetable matter, occupies the low ground in many places. This soil covers about 11 per cent of the county.

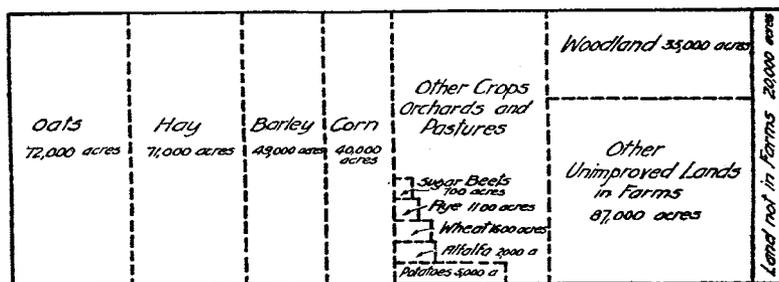


FIG. 17. THE DIAGRAM REPRESENTS THE 465,000 ACRES OF LAND IN FOND DU LAC COUNTY. THE SUBDIVISIONS SHOW HOW MANY ACRES ARE DEVOTED TO THE VARIOUS CROPS AND USES

THE LEADING FARM PRODUCTS

The farmers of Fond du Lac County are engaged in three main lines of production—cattle, hay, and grains. The value of all of the crops of the county is about five million dollars a year, and the grains—mainly oats, corn, and barley—make up nearly two-thirds of this amount. Wheat, once the leading crop, has ceased to be important, due in part to the ravages of pests and in part to the fact that other crops and dairying are more profitable. In America, wheat is primarily a crop for new lands.

In a broad sense, dairy farming prevails; there are nearly as many cows in the county as there are people (about 50,000), and nearly 50,000,000 quarts of milk are produced annually, the greater part of which is made into butter and cheese. In 1913 the

30 creameries and 40 cheese factories in the county made 5,600,000 pounds of butter and 3,400,000 pounds of cheese. Nearly a million pounds of butter were also made on the farms, giving a total of six and one-half million pounds a year, worth nearly two million dollars.

In dairy farming, a major part of the land is devoted to the growing of feed for the cattle—pastures for summer feeding, meadows for hay, and corn both for the grain itself and for ensilage. A large part of the oats and practically all of the corn are fed to farm animals. The barley is both a money crop, and a food crop for the farm animals.

The development of dairy farming has been of great value to the county. Where the farmer produces only the usual farm crops, he must wait for his money until the crops are harvested and sold. During the larger part of the year he has but little money coming in. The dairy farmer receives his check every month or perhaps every two weeks, and he is in a position to "pay as he goes". Moreover, the dairy farmer feeds out the major part of his crops on his farm and returns to the land the fertility which the crops have taken out. The silo and the Babcock milk test are benefiting dairy farming very materially. The raising of hogs is a profitable side line, but is not carried to any such extent as it is in the "Corn Belt" of Illinois and Iowa. For example, the average number of hogs per farm in Fond du Lac County in 1910 was about ten, while in Pottawattamie County, Iowa, it was 48.

Sugar beets are raised, though not to a large extent. In the entire state, only Sheboygan and Manitowoc counties produce as much fruit as Fond du Lac; 140,000 bushels of apples are grown in an average year. Potatoes are much less important in the grain-growing counties than they are in the sandy soils of the central part of the state. The difference may be seen by comparing such counties as Portage, Waupaca, and Waushara, each producing from 2 million to 3 million bushels of potatoes a year, with Fond du Lac County which produces less than one million bushels. On the other hand, Fond du Lac County raises 6 million bushels of grain a year against less than 2 million bushels in the counties with the sandy soil. Grass and most grains require a large amount of water, and clay soils hold water much better than sandy soils.

WINNEBAGO COUNTY

GENERAL CONDITIONS OF FARMING

Nearly 90 percent of the land area of Winnebago County is farm land; in this particular it ranks high among the counties of Wisconsin. Originally most of the land was covered with hardwood forests, but the virgin timber has all been cut, and scatter-

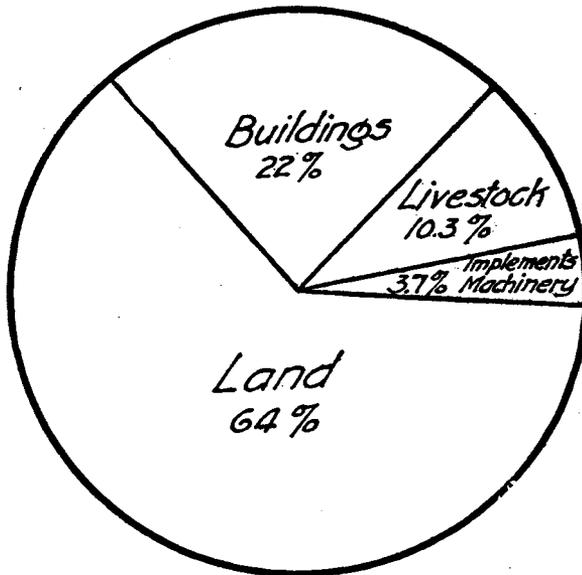


FIG. 18. THE VALUE OF ALL FARM PROPERTY IN WINNEBAGO COUNTY IN 1910 WAS \$25,000,000, DIVIDED AS SHOWN IN THE ABOVE DIAGRAM

ing pieces of woods of second growth occupy 7 per cent of the 294,000 acres in the county. The improved land constitutes about two-thirds of the entire land area. The surface is so nearly flat that drainage is imperfect and there are nearly 50,000 acres of marsh land, mainly along the streams and lakes. The well drained land is of excellent quality. Two thirds of the farmers are American-born and 4 farms in every 5 are worked by their owners. As a rule the farms are not large; the average size is 95 acres.

THE WORK OF GLACIERS

The entire county, in common with all of eastern Wisconsin, was covered by the great continental glaciers which came from the north and northeast, spread over our northern states, and

when they melted left a mantle of glacial drift spread over the surface of the ground. If the mantle of drift were removed, bedrock would everywhere be revealed. This rock surface would be considerably less plain-like than the present surface; the glacial drift tends to smooth the irregularities, because it is usually thicker in the valleys than on the hills. Winnebago County is unquestionably more plain-like than it was before the mantle of glacial drift was spread over it. There is now hardly a hill of any size in the county. Much of the drift is composed of decayed and pulverized limestone combined with clay and a moderate mixture of sand and boulders which are totally unlike the bed rock of the region where they are now found; these boulders are known as *erratics*, or wanderers.

THE RED TILL AND CLAY

Almost all of the county was once covered by a portion of larger Lake Winnebago which is discussed on page 16. In this lake the water of the melting glacier deposited red clay which a later advance of the glacier changed to red glacial till. Some of this till seems to have been again worked over by the waves and currents of the lake and spread out so as to fill the depressions and transform the area which it covers into a remarkably level plain. The red soil is rich in plant food and grows excellent crops. At the surface it is often gray or black in color, due to the action of vegetation.

CROPS

The soil of the county is notably uniform in quality. Drainage is one of the most important considerations. There is little sandy or gravelly land; the red clay is very similar in composition wherever found. Clay soils are particularly well adapted to grass and grains, which require much water. Hay, pastures, and oats make up half of the total acreage (See Fig. 19); corn and barley are large but not major crops. Wheat has all but disappeared and potatoes are grown only a little in excess of the requirements of the population of the county. The difference between the crops on clay-loam and sandy-loam soils is well shown by a comparison of Winnebago County with Waushara County, which joins Winnebago County on the west, but which is underlain by a sandstone rock and has a relatively high percentage of sand in its soil. In 1909 Winnebago County produced

375,000 bushels of potatoes, but Waushara produced 2,250,000 bushels, or six times as many. Winnebago produced 18,000 bushels of rye, but Waushara produced 230,000 bushels,

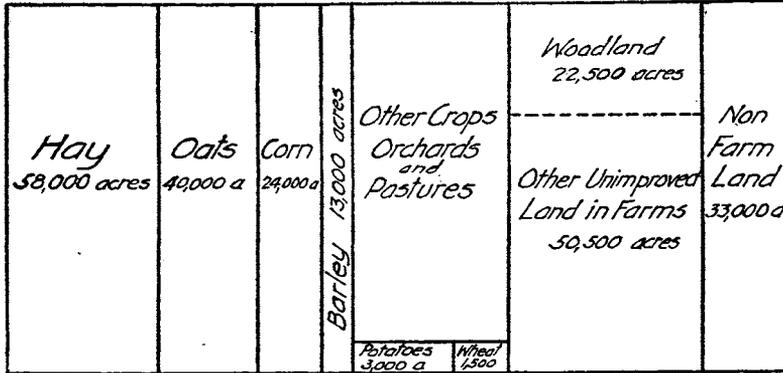


FIG. 19. DIAGRAM SHOWING THE USE WHICH IS MADE OF THE 294,000 ACRES OF LAND IN WINNEBAGO COUNTY. (Census of 1910.)

Non-farm land is that used for roads, railroads, villages, cities, etc.

12 times as much. Potatoes and rye are crops which do well on sandy loams. On the other hand, Winnebago County produced twice as much hay, three times as much oats, and 15 times as much barley as Waushara County; these are the characteristic products of clay-loam soils. The difference also comes out in a comparison of the value of farms in the two counties. According to the U. S. census of 1910, farm land in Winnebago County has an average value per acre more than double that in Waushara County. This is undoubtedly due in part to the presence of cities and to better railroad facilities in Winnebago County.

DAIRYING

Like so many parts of Wisconsin, Winnebago is a county of dairy farms—and in Wisconsin this has come to mean prosperity. The making of cheese is particularly concentrated in the northern half of the county. In the eastern tier of townships, cheese factories and creameries are mingled, while in the western tiers of townships creameries have almost a monopoly. There are less than 20 creameries and skimming stations, but nearly 40 cheese factories. A comparison of the quantity of milk produced in the different counties of the Valley is shown in Fig. 20. Winnebago County has the largest number of cattle in proportion to area of any of the four counties with which we are dealing.

Outagamie and Brown counties have one cow to every seven acres; Fond du Lac County, one to every six acres; and Winnebago, one to every five acres. In this particular, the county

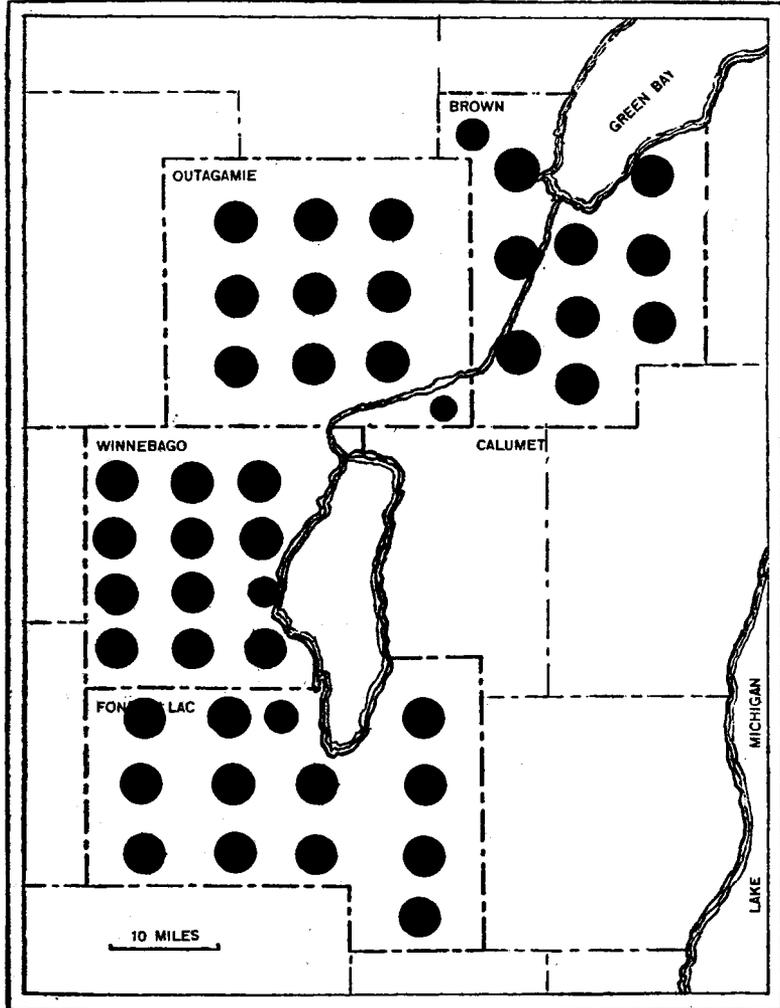


FIG. 20. AVERAGE ANNUAL PRODUCTION OF MILK

Each full sized circle represents one million gallons or 8 million pounds.

stands with the foremost in Wisconsin. There are nearly 30,000 dairy cows in Winnebago County, which is more than the entire number in the state of Arizona. As is commonly the case in a region of dairy farms, the farm buildings are excellent. It is not unusual to find barns with the attached silo which are worth \$3,000 to \$4,000.

OUTAGAMIE COUNTY

THE SOIL

Several factors besides the climate and the inherent quality of the soil have a part in determining the value of farm land and the profitableness of farming. Some of these are

- (1) railroad facilities,
- (2) nearness to large cities, and
- (3) the length of time during which the region has been undergoing improvement or development.

Two quite different kinds of soil, each including many variations, are found in the county. The whole county was covered by the

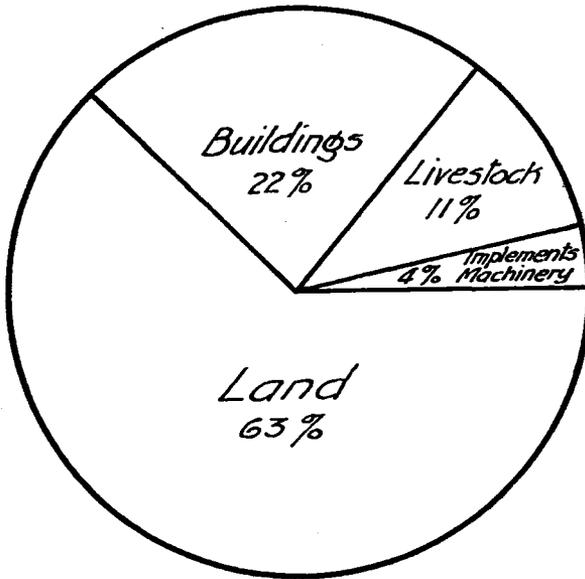


FIG. 21. THE VALUE OF ALL FARM PROPERTY IN OUTAGAMIE COUNTY IS ABOUT 30 MILLION DOLLARS, DISTRIBUTED OVER FOUR ITEMS AS SHOWN IN THE ABOVE DIAGRAM

great ice sheet of the Glacial Period, and so the soil is all of glacial origin, made up of clay, sand, gravel, and some boulders, mixed in varying proportions. Most of the boulders were transported a long distance, many of them from Canada; but the major part of the drift of which the soil is made, was transported only a short distance, and is sandy or clayey in character according as the underlying rock of the region is sandstone or limestone.

The glaciers which overspread Outagamie County came from a northerly and northeasterly direction; they had, therefore, been moving over and eroding limestone rocks which are the predominant rocks of eastern Wisconsin. The eastern half of the county is itself underlain by limestone, but the western half is partly underlain by sandstone. This is mentioned because of

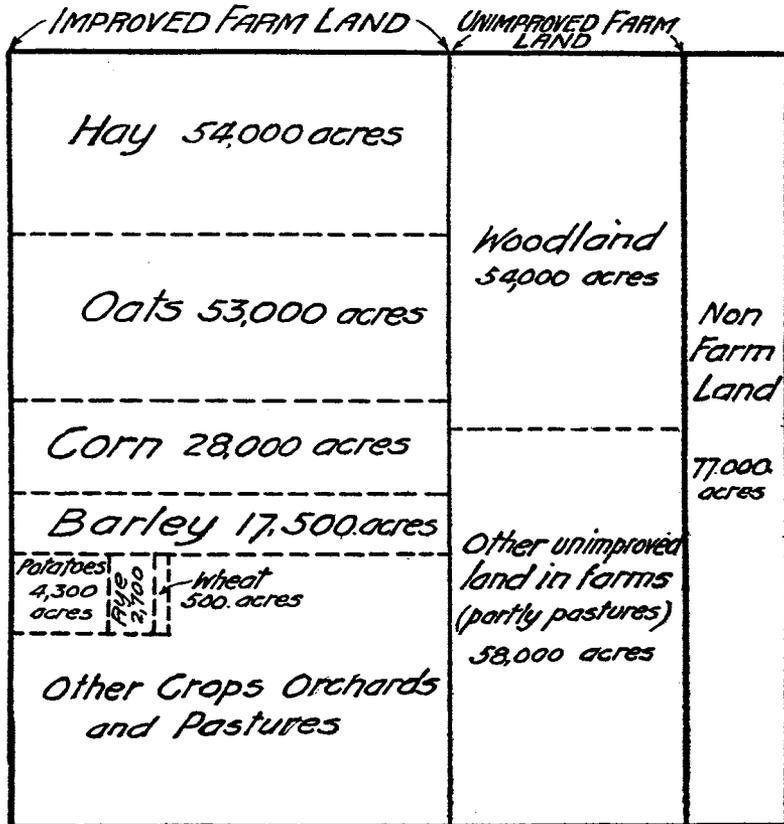


FIG. 22. DIAGRAM SHOWING THE USE THAT IS MADE OF THE 413,000 ACRES OF LAND IN OUTAGAMIE COUNTY. (Census of 1910).

Non farm land is that used for roads, cities, railways, etc.

the great difference in the character of the soil which is derived from limestone and from sandstone. Soil derived from limestone is very largely clay and silt,—fine grained, and rich in plant foods; while soil derived from sandstone is mostly sand, which is deficient in plant food and hence is less productive. This difference is plainly apparent in different sections of Outagamie County. Eight townships in the western and northwestern part

of the county, while containing many good farms, also contain a high proportion of sandy and swampy land. This inferior land is in the sandstone belt previously mentioned. The eastern and southern townships are underlain by limestone and their soil is mainly derived from this rock or similar rock a little further east.

A considerable area in the southeastern part of the county was covered by the glacial lake which occupied the whole Fox River Valley from Green Bay southward beyond Fond du Lac, and in which was deposited the red clay which is so noticeable throughout the Valley.

VALUE OF FARM PROPERTY

The difference between the sandy and poorly drained land which is common in several of the northern and western townships, and the clay loam soil which predominates in the southern and eastern half of the county, comes out in the value placed upon these lands for assessment purposes; all of the property in the former 10 is given a "true value" of a little less than 11 million dollars, while about an equal area in the 10 southern and eastern townships is valued at over 20 millions; city and village property is not here included. Nearly two-thirds of the value of all farm property is in land. Outagamie County is a dairy county and that means good buildings, and especially, good barns; 22 per cent of the value of all farm property in the county is in the buildings; this is well above the average for the state as a whole, even though Wisconsin is a dairy state and ranks high in the average value of its farm buildings.

Cattle are the leading farm animals; hogs and sheep are raised but not in large numbers. The average value of farm property per acre for the county as a whole in 1914 was about \$80, as compared with \$83, for Brown County, \$90 for Winnebago, and \$100 for Fond du Lac. The poorer showing made by Outagamie County is mainly due to the sandy and swampy character of the land in certain townships, previously referred to. The eastern and southern part of the county (and some sections in the rest of the county) rank with the best farm lands of the state and sell for as high as \$150 per acre.

The proportionate value of the four main items of farm property is shown in the diagram (Fig. 21).

PRINCIPAL CROPS

The total land area of the county is a little over 400,000 acres, of which two-thirds is improved. The unimproved land is partly in the former Oneida Reservation tract, which is now organized under township government and is being brought under cultiva-

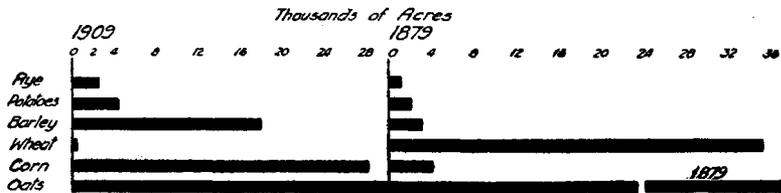


FIG. 23. DIAGRAM SHOWING THE CHANGE IN THE CROPS GROWN IN OUTAGAMIE COUNTY IN 1879 AND IN 1909, THIRTY YEARS LATER

Note wheat particularly.

tion; and partly in the undrained lands in the western and north-western half of the county. The magnificent pine forests which once existed are all gone and only about 85 square miles of scattered timber remains and that is largely second growth.

All of the usual grains are grown, but oats lead, with corn second. Barley is not a leading crop, rye is unimportant, and wheat, once all important, is grown only on a small scale. Hay actually leads in acreage, as is shown in Fig. 22; potatoes are grown much in excess of local demand. The extensive practice of dairying requires that a considerable area be devoted to pastures, probably not less than 20 per cent of the total farm land.

DAIRYING

Outagamie County stands high in dairying, ranking 13th or 14th among the 71 counties of the state in total number of dairy cows (40,000). There are thirty creameries, about fifty cheese factories, and (in 1913) one large milk condensing factory in New London, which is on the western boundary. There are produced annually in the county the enormous quantity of 38 to 40 millions quarts of milk, one half of which is made into cheese. The general advance in the value of farms and the increasing rural prosperity are in a large degree due to the practice of dairy farming.

BROWN COUNTY

GENERAL CONDITIONS OF FARMING

The soil of about three-fourths of the county is red till or clay loam. The remaining quarter, mainly the old Oneida Reservation and the townships bordering on Green Bay, is more or less sandy. In the vicinity of the city of Green Bay this

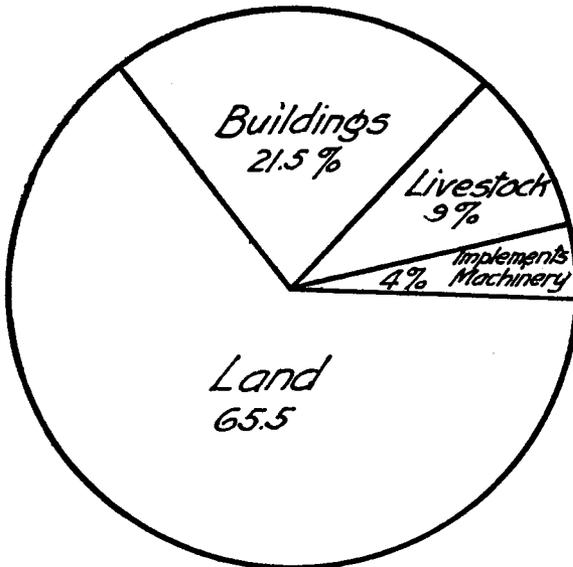


FIG. 24. THE VALUE OF ALL FARM PROPERTY IN BROWN COUNTY IN 1913 WAS \$26,600,000, DIVIDED AS SHOWN IN THE ABOVE DIAGRAM

sandy loam is ideal for truck gardening and this type of farming is more generally practiced than in any other part of the Fox River Valley. Two other factors combine to stimulate truck gardening in this region: (1) the high proportion of Belgians* in the population, a people who are trained in this kind of farming, and (2) the excellent market for garden products in the mining regions of the Upper Peninsula of Michigan. Thousands of acres near Green Bay are devoted to the raising of peas, beans, beets, tomatoes, etc., for the canning factories, to cucumbers for the pickle factory, to sugar beets for the beet sugar factory at Marinette, and to cabbage. The soil is of glacial origin; most of the county is nearly level; a part of the eastern tier of townships

* There are about 1,800 Belgians in Brown County, nearly half of the total number in the state.

is on the Niagara limestone upland and here is found the prize farming township of the county, Morrison. Though there is no railroad or city in this township, its farms have the highest average value of any strictly rural township in the county. There is a somewhat higher percentage of unimproved land in Brown County than in any other of the four counties here considered.

THE SOIL AND CROPS

The land area of the county is about 340,000 acres, of which 60 per cent is improved farm land. Scattered woodland amounting to 50,000 acres still remains. The largest number of acres (63,000) devoted to any one crop is given up to hay; this is due both to the high percentage of clay soil, which is best suited to the grasses, and to the large number of cattle which are kept. Only three of the grains are grown to a large extent, oats, barley and rye (See Fig. 25). Rye is a crop which thrives in sandy soil, and over 10,000 acres of this crop are raised annually on the sandy areas.

The decline in corn-growing as we go northward from Fond du Lac County to Brown County is rather striking. Fond du Lac

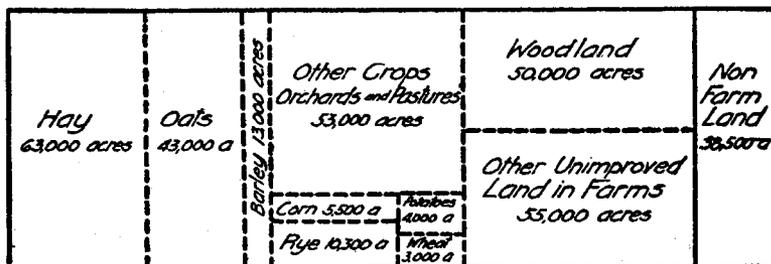


FIG. 25. DIAGRAM SHOWING THE USE THAT IS MADE OF THE 338,000 ACRES OF LAND IN BROWN COUNTY. (Census of 1910).

Non farm land is that used for roads, railroads, cities, villages, etc.

raises 40,000 acres of corn, Outagamie County 28,000 acres, and Brown County only 5,500 acres. This is not wholly due to climate, for the growing season (period between the last killing frost in spring and the first one in fall) is practically as long in Brown County as it is in the other three counties, namely 140 to 150 days. Evidently the farmers of the county can raise corn if they so desire. The relation of corn-growing to hog-raising is shown in the fact that Brown County raises only one-fourth as many hogs as Fond du Lac County.



A.—THRESHING OATS IN BROWN COUNTY

Each of the Fox River Valley Counties produces from 1,500,000 to 3,000,000 bushels of Oats annually.



B.—TYPICAL FARM SCENE ON THE LEVEL LAND WHICH WAS FORMERLY COVERED BY LARGER LAKE WINNEBAGO (NEAR DEPERE)

DAIRYING AND STOCK RAISING

The agricultural interests center around dairying. The big red barn and the silo are everywhere in evidence. Cheese making is more in favor than butter making; there are 20 creameries and skimming stations, but nearly twice as many cheese factories; 40,000,000 quarts of milk are produced yearly. Many farmers are acquiring herds of blooded Guernseys and Holsteins. As is true throughout the dairy section of the state, so in Brown County, the dairy cow is making prosperity, for she is adding a million dollars every year to the wealth of the county. Relatively few sheep are raised; in fact poultry have four times the value of sheep in the county.

A fact deserving of comment is the exceedingly high percentage of farms that are operated by their owners. For example, in Rock and Green counties in the southern part of the state, from 30 to 35 percent of the farms are operated by tenants, while in Brown County only seven per cent are so operated.

OWNERSHIP AND SIZE OF FARMS

The large proportion of small farms is noticeable; only one-third of the farms exceed 100 acres in size, and the average for the county is 83 acres, the lowest in the state except Milwaukee County and its neighbor, Ozaukee. In Grant County, in the extreme southwestern part of the state, the farms average 170 acres in size, and in Adams County in the middle of the state the average is 183 acres. This condition of small farms is closely related to the high proportion of Belgians, Danes, Germans, and Hollanders who have settled in the county and who in their own country were accustomed to small farms, intensively cultivated. Nearly half of the farmers of the county are foreign born; they are industrious, thrifty, and conservative. The second generation is said to be more progressive than the first and to make the best of farmers.

BIBLIOGRAPHY

- Appleton *Crescent*, Feb. 10, 1853, Vol. 1, No. 1.
A somewhat detailed account of the city as it was then. The issue of Mar. 27, 1909, (Vol. 19) gives a History of the Green Bay and Mississippi Canal Company.
- Arndt, John Wallace, "Pioneers and Durham Boats on Fox River," *Proc. Wis. Hist. Soc.* 1912, p. 180.
- Arndt, John Wallace, *The Early History of Green Bay and the Fox River Valley; Personal Reminiscences*; (Depere, 1894) Paper, 57 pp.
Contains detailed description of the Durham Boats, their use and construction. Gives an account of a boat trip up the Fox River in 1830.
- Art Publishing Co. (no author), *The Valley of the Lower Fox: Historical, Descriptive, Picturesque*.
A collection of superb views along the Valley and in the cities. A descriptive and historical sketch accompanies the views. Best collection of large sized views of the Valley, (1887).
- Barber, Charles, "History of Oshkosh" in Lawson's *Hist. of Winnebago County*, Chap. XLI. Chicago, 1908.
- Barr, Edward Balch, "Manufacturing in Oshkosh" in Lawson's *History of Winnebago County*, Chap. XLII. Chicago, 1908.
- Birge, E. A. and Juday, Chancey, *The Inland Lakes of Wisconsin*, Bulletin XXVII, Wis. Geol. & Nat. Hist. Survey, 1914, 137 pp.
Many excellent maps; Chap. VIII deals with the lakes of the Fox and Wolf rivers.
- Buckley, E. R., *Building and Ornamental Stones of Wisconsin*; Bulletin IV, Wis. Geol. & Nat. Hist. Survey, 1898.
Chap. V deals with quarries in the Fox River Valley.
- Buckley, E. R., *Clays and Clay Industries of Wisconsin*. Bulletin VII, Wis. Geol. & Nat. Hist. Survey, 1901.
Includes chapters on the clays of the Fox River Valley.
- Chamberlin, T. C., "Geography of Eastern Wisconsin," Vol. II, Part II. *Geology of Wisconsin*, 1873-1879.
- Cunningham, C. A., *History of Neenah* (to 1878). Neenah, 1878.
Gives rather complete account of the industrial side of the city's history.
- Durrie, Daniel S., *Early Outposts of Wisconsin, Green Bay for 200 years; 1639-1839*.
Chronological account of leading events. A paper read before the Wisconsin Historical Society, 1872; paper, 12 pp.
- Gary, George, *Studies in the Early History of the Fox River Valley*. Oshkosh, 1901, 267 pp.
Includes events down to about 1830. More carefully done than local histories sometimes are.

- Geib, W. J., Conrey, Guy, and others, *Soil Survey of Fond du Lac Co.*, U. S. Dept. of Agr., Bureau of Soils, Washington, 1913, 43 pp., and large folded map.
- Glaze, A. T., *Incidents and Anecdotes of Early Days in the City and County of Fond du Lac*. Fond du Lac, 1905, 368 pp.
Gives many details and personal reminiscences regarding business and other features of the local history.
- Griffith, E. M., The Intimate Relation of Forest Cover to Stream Flow. Exhibit 28, p. 723 in *Rept. of the Com. on Water Powers, Forestry, and Drainage of the Wis. Legislature*, Part II. Published by the State of Wisconsin, Madison, 1910.
- Harney, Richard J., *History of Winnebago County*, Oshkosh, 1880.
Includes histories of Oshkosh, Neenah, and Menasha.
- Kellogg, Louise Phelps, "Organization, Boundaries and Names of Wisconsin Counties," *Proc. Wis. Hist. Soc.* 1909, p. 184; "The Fox Indians during the French Regime," *Proc. Wis. Hist. Soc.* 1907, p. 142.
- Lawson, Publius V., *History of Winnebago County*. Chicago, 1908.
Contains much industrial history and also chapters on special topics by other writers.
- Lawson, Publius V., "Paper-making in Wisconsin," *Proc. Wis. Hist. Soc.* 1909, p. 273.
- Martin, Elizabeth Smith, "A Visit to Fort Howard in 1836," *Proc. Wis. Hist. Soc.* 1911, p. 181.
- Martin, Deborah Beaumont, *History of Brown County, Past and Present*, Chicago, 1913. Volume I by Miss Martin is an excellent record of the county's history, economic as well as political.
- Martin, Lawrence, *The Physical Geography of Wisconsin*. Includes chapters on Eastern Wisconsin and Fox River Valley, Bulletin 36. Wis. Geol. & Nat. Hist. Survey, 1915.
- McKenna, Maurice, Editor, *Fond du Lac County, Past and Present*, 2 vols., Chicago, 1912.
Contains much interesting material but is not critical in selecting matter.
- McLenegan, Annie Susan, "Pioneer Life in the Fox River Valley," *Proc. Wis. Hist. Soc.* 1905, p. 265.
Gives facts and names connected with the settlement of towns in the Fox River Valley.
- Mead, D. W., Exhibit 29, p. 737, *Report of the Committee on Water Powers, Forestry, and Drainage of the Wisconsin Legislature*, 1910, Part II. Published by the State of Wisconsin, Madison, 1910.
Discussion of value of water powers, forests and stream flow, water power trust, state regulation and control, stream flow and measurements. Contains an unusually full treatment of factors governing stream flow.

- Neville, Arthur C., "Historic Sites about Green Bay." *Proc. Wis. Hist. Soc.* 1905, p. 143. (map).
- Perry, Ernest J., "An Address on the Industrial Development of Fond du Lac," delivered at the Home-coming of 1912. Reproduced in *The History of Fond du Lac County*. Maurice McKenna, Editor. Chicago, 1912.
- Reid, A. J., *Illustrated Annual Review of the Appleton Post*.
 Devoted to the city of Appleton, Wis., its water power and industries; also an historical sketch of the Fox River Valley. Appleton, 1879, 74 pp.
The Resources and Manufacturing Capacity of the Lower Fox River Valley. Appleton, 1874. 55p.1
 Written to attract industries to the Valley. Contains detailed map of the power sites and factories of Appleton in 1874. Very optimistic.
- Ries, Heinrich, *The Clays of Wisconsin and their Uses*. Bulletin XV. Wis. Geol. & Nat. Hist. Survey, 1906.
 Includes discussion of clays of the Fox River Valley.
- Roche, Thomas, "Steamboating in the Early Days on Lake Winnebago, The Fox and Wolf Rivers," in Lawson's *History of Winnebago County*, pp. 588-609.
 Gives list of boats built and used on Lake Winnebago and the Fox River.
- Smith, L. S., *Water Powers of Wisconsin*. Bulletin XX, Wis. Geol. & Nat. Hist. Survey, 1908. Fox River System, pp. 26-54.
 Gives details regarding dams, locks, waterpower, flow, etc.
- Thwaites, Reuben Gold, *Down Historic Waterways*. Chicago, 1902.
 Contains a delightfully written account of a canoe trip down the Fox River in 1887. Many historical events are woven into the narrative.
- Thwaites, Reuben Gold, "Oshkosh, Menominee Sachem," *Proc. Wis. Hist. Soc.*, 1911, p. 170.
 An address at the unveiling of the bronze statue of Oshkosh, June 21, 1911, at Oshkosh.
- Turner, Frederick J., "The Character and Influence of the Fur Trade in Wisconsin," *Proc. Wis. Hist. Soc.*, 1889, pp. 52-98.
 Nothing better on the subject.
- Warren, Major G. K., *Report on the Transportation Route along the Wisconsin and Fox Rivers*, Executive Document No. 28, 44th Cong., 1st session, Gov't Printing Office, 1876.
 Best U. S. Government document on the subject. Contains review and summary of many earlier official reports. Detailed maps.
- Whitbeck, R. H., *The Geography & Industries of Wisconsin*. Bulletin XXVI, Wis. Geol. & Nat. Hist. Survey, 1913. Includes discussion of the industries of the Fox River Valley.

U. S. GOVERNMENT DOCUMENTS

The following documents are devoted to reports, recommendations, and information concerning the Improvement of the Fox and Wisconsin Rivers:

- 1839. House Document 102, 25th Cong., 3d session.
- 1839. House Document 175, 25th Cong., 3d session.
- 1839. Senate Document 208, 25th Cong., 3d session.
- 1844. Senate Document 28, 28th Cong., 1st session.
- 1846. Senate Document 551, 29th Cong., 1st session (maps).
- 1872. Executive Document 176, 42d Cong., 2d session.
- 1872. Executive Document 185, 42d Cong., 2d session.
- 1872. Executive Document 236, 42d Cong., 2d session.
- 1873. Executive Document 111, 42d Cong., 3d session.
- 1874. Executive Document 256, 43d Cong., 1st session.
- 1875. Executive Document 74, 43d Cong., 2d session.
- 1876. Executive Document 28, 44th Cong., 1st session.*
- 1880. Executive Document 49, 46th Cong., 2d session.
- 1881. Executive Document 26, 46th Cong., 3d session.
- 1882. Executive Document 53, 47th Cong., 1st session (maps).
- 1882. Executive Document 93, 47th Cong., 1st session.
- 1882. Executive Document 153, 47th Cong., 1st session.

Each year since 1872, the U. S. engineer in charge of the Waterway has issued a report giving details of the progress of improvement, cost, navigation, etc. This is printed as an appendix J. J. to the Annual Report of the Chief of Engineers to the Secretary of War. It is also printed as a separate.

The Report of the Select Committee of the Wisconsin Assembly, Mar. 1856, gives a detailed history of the Improvement to that date.

*This is Major G. K. Warren's Report. It gives a complete documentary history of the proposed Fox-Wisconsin Waterway down to 1870.

REFERENCES TO EXAMINATION OR SURVEY REPORTS AND MAPS OR PLANS
(INCLUDING PROJECT DOCUMENTS)*

Section covered	Congressional documents				Annual reports of Chief of Engineers		
	House or Senate	No.	Congress	Session	Year	Part	Page
Entire river (Pettival).....	House.....	102	Twenty-fifth	Third			
Entire river (Cram).....	Senate.....	318	Twenty-sixth	First			
Report of arbitrators.....	House.....	185	Forty-second	Second			
Entire river (Houston).....	House.....	111	Forty-second	Third			
Entire river (Warren).....	Senate.....	228	Forty-fourth	First	1876	II	189
Flowage damages.....	Senate.....	117	Forty-fourth	Second			
Money expended by Government.....	Senate.....	181	Forty-fifth	Second			
Excessive flowage damages (Attorney General)	House.....	451	Forty-fifth	Third			
Wolf River, Lake Poygan to mouth of Red River.....	Senate.....	223	Forty-fifth	Third	1879		1552
Wolf River.....	House.....	119	Forty-sixth	Second	1880		1978
Flowage damages.....	House.....	128	Forty-sixth	Third	1881		2148
List of awards, flowage.....	Senate.....	1120	Forty-eighth	First			
Wolf River to Semples bridge.....					1880		1978
Lake Winnebago.....	Senate.....	253	Forty-seventh	First			
Menasha Dam.....	House.....	293	Forty-seventh	First			
Lake Winnebago.....					1882		2182
Flowage damages.....	Senate.....	292	Forty-eighth	First	1884		1882
Entire river.....					1884		1899
Project of 1884.....					1885		2041
List of flowage claims.....	Senate.....	2181	Fiftieth	First			
Fond du Lac Harbor and Lake Winnebago.....	House.....	294	Fifty-first	First	1890		2389
Rules and regulations.....	House.....	1152	Fifty-first	Second			
Protection wall, Kaukauna Canal.....	House.....	128	Fifty-second	Second	1893		2779
Stockbridge Harbor, Lake Winnebago.....	House.....	178	Fifty-second	Second	1893		2782
Calumet Harbor, Lake Winnebago.....	House.....	1117	Fifty-second	Second	1893		2783
Entire river.....					1897		2750
Stockbridge Harbor, Lake Winnebago.....					1898		2349
Entire river—United States property (Bragg).....	House.....	2389	Fifty-fifth	Second	1898		2353
High Cliff Harbor, Lake Winnebago.....	House.....	1356	Sixty-first	Second			
Waupaca River.....	House.....	120	Sixty-second	Second			
Fox River—Portage levee.....	House.....	231	Sixty-third	First			
Retaining wall along Fox River at Kaukauna.....	House.....	2815	Sixty-third	Second			

¹No maps²Contains maps.³Basis of project adopted by Congress.

*From Ann. Report Chief of Engineers 1914, Appendix J. J.

MAPS

The United States Geological Survey publishes a special map of Lake Winnebago, showing by contour lines the topography of the country immediately around the lake, including maps of Fond du Lac, Oshkosh, and Neenah-Menasha; size 18x36 inches; price 20 cents. Also the same in two separate maps; the *Fond du Lac sheet* includes the southern half of the lake and the adjacent country, and the *Neenah sheet* includes Oshkosh, Neenah-Menasha, and the northern half of the lake; price 10c each. Address Director U. S. Geological Survey, Washington, D. C.

The U. S. Lake Survey publishes a map of Lake Winnebago, giving details of depth, and character of shore line, etc. Price 15 cents. Address U. S. Engineer's Office, Oshkosh.

The Wisconsin Geological and Natural History Survey, Madison, issues a large geological and road map on the scale of 6 miles to the inch. Mounted on cloth, with rollers, price \$1.00. Address Supt. of Public Property, Madison.

The Wisconsin Railroad Commission, Madison, publishes a Railroad Map of the State on the scale of 10 inches to the mile, distributed free to citizens of the state.

INDEX

- Agriculture, 84.
Brown county, 97.
Fond du Lac county, 84.
Outagamie county, 93.
Winnebago county, 89.
Alden, Wm. C., quoted, 16, 17.
American Fur Company in Wisconsin, 29.
Appleton, 58.
birdseye view of, plate XIX.
early manufacturing, 60.
fall of river at, 18.
history, 58.
lower paper mill district, plate XX.
manufactures in 1880, 61.
manufactures, present, 62.
map of, 83.
pulp and paper mills, list of, 63.
type city, 64.
views at, plates VI, VII
water power at, 22, 59.
Arndt, J. W., quoted, 29.
Astor, John Jacob, in Wisconsin, 27.
Astor and Navarino united, 71.
Barr, Edward, quoted, 50.
Bay Boom, 48.
Berlin, Wisconsin, 14.
Bibliography, publications dealing with
Fox-Wisconsin Valley, 100.
maps, 105.
U. S. government documents, 103, 104.
Brick-making, near Depere, 69.
Brown county, agriculture, 97.
crops of, 98, figure 25.
dairying in, 99.
farming conditions in, 97.
farm property of, figure 24.
organized, 71.
size of farms, 99.
soils of, 98.
stock-farming in, 99.
value of farm property, map, 85.
Calumet, 43.
Canoe travel, early importance of, 25.
Canoes and batteaus on Fox River, 28.
Capital invested in manufacturing, Fox-Winnebago Valley, map, 77.
Carver, Jonathan, in Wisconsin, 27.
Cedars Dam, 67.
Charcoal, importance in early iron smelting, 68.
Counties of Fox-Winnebago Valley, population, 41.
Cities of Fox-Winnebago Valley, principal industries of, 83.
Cities and industries of Fox River Valley, summary of, 76.
Cities of Wisconsin, population, 41.
Coal, carried on Fox River, 34.
Combined Locks dam, 67.
water power at, 22.
Coureurs de bois, 25.
Depere, 68.
clay beds near, 16.
fall of river at, 18.
historical facts, 68.
industries, 68.
river scene, plate XXIV.
water power at, 22.
Doty, James D., state named by, 71.
Doty Island, plate XVI.
Durham boats on Fox River, 29.
Erie Canal, 5.
gives impetus to canal building in Wisconsin, 29.
Erosion, factors affecting, 6.
slowness of, 6.
Falls and rapids, cause of, 6.
Farm scenes, plate XXVIII.
Flour-mills in Fox-Winnebago Valley 55, 61, 69, 74, 80.
Fond du Lac, 42.
architectural quality of buildings, 46.
early industries, 43.
first railroad into, 44.
growth of, 43.
historical facts, 43.
lumber mills and yards, plate XI.
manufacturing in, 45, 46.
map of region, plate IX.
present industries, 44.
railroad center, 43, figure 8.
Reuping tannery, plate X.
saw-mills of, 44.
strategic situation of, 42.
transportation, importance of, 42.
type city, 42, 43.
Fond du Lac county, agriculture, 84-88.
farm products, 87.
farm property, 85, 86.
saw-mills of, 76.
soil of, 86.
Fort Howard, built, 71.
Fox Indians, war with, 26.
Fox River
average fall of, 14.

INDEX

- catchment basin of, 22.
 - close approach of, to Wisconsin River, 14.
 - commercial waterway, 27.
 - drainage map, plate IV.
 - early canoe routes, 26.
 - early navigation on, 28, 29.
 - exploration of, 24.
 - freight carried on, 35.
 - history of improvement, 29.
 - historic events connected with, 26.
 - importance in fur trade, 28.
 - increase of lockages on, 35.
 - list of locks, 36, table, p. 36.
 - maximum flow of, 23.
 - navigation of, past and present, 24, 28, 35.
 - opened to steamboat navigation, 31, 32.
 - peculiarities of, 13.
 - survey of, 30.
 - uniformity of discharge, 22.
 - upper course, 14.
- Fox River waterway
- average yearly cost of improvement, 39.
 - average yearly cost of operation, 39.
 - expenditures for operating and maintaining, 39.
 - list of articles carried on (1890), 37, (1913), 38.
 - U. S. appropriations for, 40.
- Fox-Winnebago Valley,
- capital invested in manufacturing, map, 77.
 - causes of, 8, 10, 11.
 - cities of, 41.
 - cross section of, fig. 1.
 - drainage map, plate IV.
 - erosion of, 10.
 - forests of, 12.
 - geological map, plate III.
 - glaciation in, 9.
 - glacial lake in, 14.
 - industries, summary of, 76.
 - manufacturing, persons engaged in, map, 78.
 - natural resources of, 12.
 - origin of, 7.
 - physical features of, 7, 11.
 - power employed in manufacturing, map, 79.
 - principal towns of, figure 5.
 - pulp and paper industries, cause of growth, 80.
 - red till and clay in, 16.
 - relative size of cities in, figure 5.
 - relief map, plate II.
 - trading posts in, 26.
 - value of manufactured products, map, 82.
- Fox-Wisconsin waterway
- period of government control, 34.
 - period of greatest use, 33.
 - sold on foreclosure, 32.
 - taken over by U. S. government, 32.
- Freight carried on Fox River, (1890), 37, (1913), 38.
- Freight rates, influenced by water transportation, 34.
- French, the, interest in fur trade, 28.
- French explorations, 24.
- Fur trade, importance of, 25.
- Fur trading posts of Wisconsin, 70
- Gatun Dam, Panama, 15.
- Geographical environment, man and his, 1.
- Geography, applied, aim of, 2.
- content of, 1.
- Geography, physical, content of, 1.
- Glacial lobes in Wisconsin, 9, figure 2.
- Glacial period, the, 9.
- Glaciation of Fox-Winnebago Valley, 9.
- Glaciers, deposits left by, 6, 15, 16.
- effect upon rivers, 6, 14, 15, 17.
- Grand Kaukauna, fall of river at, 18.
- Great Lakes, importance of to Wisconsin, 26.
- Green Bay, 69.
- commanding position of, 72.
 - diversified industries of, 72, 74, 75.
 - early industries, 71.
 - early settlement of, 24.
 - first railroad, 71.
 - fur trading post at, 69, 70.
 - harbor scenes, plates XXV, XXVI, XXVII.
 - history, 69, 70.
 - Nicolet at, 69.
 - paper mills, 74.
 - port, 73.
 - saw-mills, 71.
 - tonnage of vessels arriving at, 73.
 - type city, 72.
- Green Bay and Mississippi Canal Co., water rights of Fox River, 32.
- Green Bay lobe of Wisconsin glacier, 17.
- Groseilliers, in Wisconsin, 26.
- Ground moraine, origin of, 15.
- Harney, Richard J., quoted, 55.
- Ice age, the, 9.
- Illinois territory, Wisconsin part of, 71.
- Improvement of Fox-Wisconsin waterway begun, 30.
- opened to navigation, 30.
 - turned over to private company, 30.
- Indian trails, importance of, 25.
- Industries and cities, summary of, 76.

INDEX

- Interglacial periods, 9.
Iron smelting in Fox River Valley, 68.
Iron-using industries, in Green Bay, 82.
- Joliet, in Wisconsin, 26.
- Kaukauna, 65.
 birdseye view, plate XXII.
 dam, canal and lock, plate XXIII.
 early history, 65.
 limestone quarry, plate XX.
 water power and industries, 22, 66.
- Kimberly, 66.
 fall of river at, 18.
 mill at, plate XXI.
 water power at, 22.
- LaCrosse, as a lumber center, 48.
Lawson, P. V., quoted, 34.
LeSueur, in Wisconsin, 26.
Little Chute, 67.
 fall of river at, 18.
 water power at, 22.
- Little Lake Butte des Mortes, 18.
Little Rapids, 68.
 fall of river at, 18.
 water power at, 22.
- Lockages on Fox River, number of
 (1890) 36, (1913) 37.
- Lower Fox River,
 channel of, 18.
 characteristics of, 17.
 concentration of fall, 19, cause of,
 20.
 length of, 18.
 only important north flowing river
 in state, 13.
 profile of, plate VIII.
 rapid fall of, 17.
 rapids of, statistics, 18.
 total descent of, 18.
- Mann, Capt. L. M., statistics furnished
 by, 34.
- Manufactured products of Fox-Winne-
 bago Valley, value, map, 82.
- Manufactures, in Wisconsin cities, value
 of, 35.
- Manufacturing, persons engaged in,
 Fox-Winnebago Valley, map, 78.
- Marquette, in Wisconsin, 26.
Martin, Doborah B., quoted, 72.
Menasha (see also Neenah-Menasha)
 manufacturing in, 56.
 paper mills in, 56.
 sketch map of river, plate XVIII.
 U. S. government dam, plate XVIII
 Wooden Ware Company, 57.
- Michigan, Lake, origin of, 9.
Michigan territory, Wisconsin part of,
 71.
- Military roads, from Green Bay, 71.
- Navarino and Astor united, 71.
Neenah, as a flour-milling center, 55.
 capacity of paper mills, 56.
 Kimberly-Clark Co., 55, 56.
 manufacturing in, 56.
 mill scene in, plate XVII.
 paper and pulp making, 55.
- Neenah and Menasha, 53.
 favorable location of, 54.
 flour-milling in, 55.
 historical facts, 54.
 industrial unit, 53.
 type city, 54.
 U. S. contour map of, plate XVI.
 water power at, 22, 54.
- New France, relation of Wisconsin to
 5, 24.
- Niagara limestone, 8, 15.
Nicolet, Jean, 24.
North Fond du Lac, 46.
- Oshkosh, 47.
 boat-building in, 50.
 development of manufacturing, 49
 fires in, 49.
 first railroad, 49.
 growth of, 49.
 history, 48.
 logging scene at, plate XIV.
 lumber center, 47, 50.
 organization as village, 49.
 origin of name, 49.
 Paine Lumber Co., 51, plant, plate
 XV.
 panoramic view, plate XII.
 present industries, 51.
 present railways of, 49, 52.
 saw-mills in, 50.
 transportation facilities, 52.
 type city, 48.
 rank as manufacturing city, 52.
 view in 1863, plate XIII.
 wood-working center, 49.
- Outagamie county
 agriculture, 93.
 crops of, 96, figure 22.
 dairying, 96.
 farm property, 95, figure 21.
 glacial drift in, 94.
 livestock in, 95.
 soil of, 93.
 value of farm property, map, 85.
- Paper mills of Fox River Valley, list of,
 81, capacity of, 81.
- Paper and pulp centers, map, 53.
Pineries of Wolf River, 12.
Plank roads, public interest in, 30.
Population of Fox River counties,
 growth, figure 6.
Portage, canal at, 14.
Power employed in manufacturing, Fox-
 Winnebago Valley, map, 79.

INDEX

- Pulp mills of Fox River Valley, list of, 81, capacity of, 81.
Pulp and paper centers, map, 53.
- Race factor in geography, 2.
Radisson, in Wisconsin, 26.
Rainfall of eastern Wisconsin, 22.
Rapide Croche, fall of river at, 18.
 U. S. gaging station at, 34.
 water power at, 22.
- Rapids and falls, cause of, 6.
Red clay in other parts of Wisconsin, 17.
Red till, origin of, 16.
Relief map of Wisconsin, plate I.
Rivers, importance of in history, 24.
Roach, Thomas, quoted, 34.
Rocks, the differing character of, 8.
 influence upon topography, 8.
 uplift of, 7.
- Rocks of Wisconsin, origin of, 7.
- Saw-mill centers of Wisconsin, 48.
Schooners, sailing, on Lake Winnebago, 50.
- Stage of development, a factor in geography, 3.
- Steamboats built on Fox River, list of, 34.
 early, on Fox River, 31.
- St. Francis Xavier, mission of, 26.
St. Lawrence River, relation to exploration of Wisconsin, 24, 26.
- Summary of cities and industries, 76.
- Taycheedah, 43.
Terminal moraine, 9, 15.
Thwaites, Dr. R. G., quoted, 29.
Till sheet, origin of, 15.
Turner, Prof. F. J., quoted, 25, 28.
- Upper Fox River, 13, 14, plate VIII, 35.
 locks and lockages, 36, 37.
- Valleys and mankind, 4.
 in American history, 5.
 due to erosion, 5.
 of the old world, 4.
- Van den Broek, Theodore, founder of Little Chute, 67.
- Voyageurs, 25.
- Warren, Maj. G. K., reports on Fox-Wisconsin waterway, 18, 33.
- “Walk in the Water”, arrival of at Green Bay, 71.
- Water power of Fox River, 19, 21, 22, figure 4, table II (p. 22), 54, 59, 60, 64, 66, 67, 69.
- Water powers of Wisconsin, map, plate V.
- West Depere, 68.
- Wheat growing in Fox-Winnebago Valley, 80.
- Whitman, Daniel, quoted, 29.
- Winnebago county
 agriculture, 89.
 crops of, 90.
 dairying, 91.
 soil of, 90.
 value of farm property, 88, 89.
 saw-mills of, 76.
- Winnebago, Lake.
 considered for U. S. Naval station, 33.
 dimensions of, 14.
 effect upon floods, 22.
 evaporation from, 22.
 former extent of, 17.
 height above sea level, 17.
 importance of position of outlet, 21.
 maps, plates II, III, IV.
 origin of, 15.
 outlet of, 16.
 past and present, 14.
 relation of red clay to, 16.
 shallowness of, 15.
 steamboats built on, 34.
- Winnebago, Fort, 29.
- Winnebago Indians, met by Nicolet, 24.
- Winnebago rapids, fall of river at, 18.
- Winnebago Valley, cross-section of, figure 1.
- Wisconsin River improvement, cost of, 40.
- Wisconsin territory created, 71.
- Wooden ware industry in Menasha, 57.
- Wood-using industries, change in, 51.
- Wolf River, course of, 14.
 dams on, 14, 51.
 log driving on, 14.
 lumber camps on, 50.
 navigation of, 12.
 pineries, 12, 47.
 proposed storage reservoirs in upper course, 23.
- Wrightstown, 67.