Atlas of Minnesota

Resources & Settlement

by

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Introduction

The geographical boundaries of Minnesota, finally set at the beginning of statehood in 1858, today enclose one of the most variegated parts of America's land and a large piece of the seamless fabric of America's society and economy.

Within those boundaries, the people of Minnesota must carry out the functions of state government — not only the insurance of law, order, and justice but also the operation of a large public enterprise that helps to provide roads, education, resource management, water and sewer utilities, housing, and many other goods and services. The people of the state must determine the needs for those goods and services and raise the taxes to pay for them. The operation of that public enterprise requires most of the management and planning in state government.

What is done in the operation of the state enterprise depends largely upon the condition of the state — the condition of the resource base, the productive system, and the people. That condition determines the need and demand for state services and goods, and it determines the collective ability to pay. The condition of the state varies from place to place and from time to time; it depends in large part upon global and national forces.

One important reflection of the state condition is the changing pattern of settlements, resource use, and population, portrayed through maps and accompanying graphs, tables, and text. In this atlas, a selected sampling from the kaleidoscopic variety of settlements and land features is portrayed on 349 maps, grouped under four main headings. Together these maps are a composite reflection of the forces that both determine the state of the state at any given time and keep it in a process of continuous change.

Like the first two editions, this edition of the atlas is an outgrowth of classroom needs and related research at the University of Minnesota. It will help to meet a wide variety of educational needs in the ongoing democratic formulation of state government policies and actions. Although important preparation for that work occurs in classrooms, the process is carried on more importantly in a great variety of other places, by other organizations and agencies. Hence the State Planning Agency has again been a major contributor in the production of the atlas, as a part of the state's developing planning information system.

This edition of the atlas also continues to reflect the vast and growing stream of data from which to map the major spatial dimensions of Minnesota's resources and settlement. The acknowledgements on page xiii show the range and variety of sources. The Atlas provides one way to synthesize and display this mass of information so it can be comprehended and interpreted for both general background and strategic planning. It should continue to be updated regularly as part of the state's information system. Meanwhile, new decisions by individuals, business firms, and government will continue to change the geography and the condition of the state, and the data will continue to pour in.
Chapter 1. The Natural Resource Base
Minnesota lies astride several major boundaries or sharp transition zones on the map of the world. Most of the zones cross the state from the northwest to the southeast. The greatest contrasts are visible, then, as one travels across these zones, from the northeast to the southwest.

Rocky, rough, mineral-rich, glacier-scoured uplands dominate the Arrowhead region. They are typical of much of central Canada and the northern Great Lakes region. In sharp contrast, the southwestern half of the state is a large part of the fertile, level plains and deep glacial deposits typical of the Lower Midwest. At the time of white settlement, northern coniferous forests dominated the northeast; open prairie grasslands covered the west and south. There is an accompanying transition from acid, infertile soils in the northern forest to the world's richest upland soils in the prairies; from abundant water resources, high runoff, dependable streams, and clear lakes in the northern forest to significant drought risk, low runoff, and unsteady rivers in the southwest.

All of these contrasts reflect a regional climatic transition zone that has shaped natural environments in this part of the world for millennia. It is a transition from deep winter snows and cool summers in the northeast to relatively dry winters and hot summers in the southwest. Furthermore, today the state lies astride the northern climatic boundary zone of a number of major middle-latitude food and fibre crops; and energy requirements for winter heating are among the nation's highest while energy requirements for summer cooling are among the lowest. But the far-northern image for which Minnesota is so well-known among Americans hardly applies uniformly to the entire state. For the north-south distance across the state is more than one-quarter of the distance from Hudson Bay to the Gulf of Mexico; and the summer climatic heat for growing crops in the southern Minnesota corn belt is more than double that on the cool north shore of Lake Superior.

These contrasts in the natural resource base have affected the course of frontier expansion and the eventual development patterns of farms, mines, logging camps, towns, and cities. The same contrasts account for regional variations in the clarity of lakes, the hardness of water supplies, the size and dependability of rivers. And they underlie some important regional variations in wealth, tax base, and the need for public services.

The maps in this chapter portray many of the vivid regional differences in resources, and suggest the accompanying variety of scenery on which the Minnesota drama has unfolded.

LAND

ELEVATION

The surface of Minnesota's land ranges from 602 feet above sea level at Lake Superior to 2,301 feet above sea level at Eagle Mountain, just thirteen miles from the North Shore of Lake Superior (page 5). Despite its relatively low elevation, Minnesota straddles three major watersheds of North America, with waters flowing northward through the Red and Rainy Rivers to Hudson Bay via Lake Winnipeg and the Nelson River, eastward through the Great Lakes and the St. Lawrence River to the Atlantic Ocean, and southward through the Mississippi River System to the Gulf of Mexico.

Areas of the state lying below 1,000 feet elevation are in the Minnesota and Mississippi river valleys in eastern and southeastern Minnesota and in the Red River valley along the state's western edge. Highest elevations in the state are in the hills above Lake Superior which divide the Lake Superior-St. Lawrence River watershed from the Rainy River-Hudson Bay watershed. Other high areas are in Clearwater County, between the Mississippi and the Red River-Hudson Bay flowage, and the Prairie Coteau, which divides the Minnesota River watershed from the Missouri River watershed in the southwest corner of the state.

MAJOR LANDFORMS

Glacial activity has given the land surface great variety by leaving behind a mantle of sand, gravel, boulders, and clay up to several hundred feet thick. Terminal moraines mark the zones where the rate of glacial movement was approximately equal to the rate of melting, resulting in especially thick deposits of sand, pebbles, clay and boulders (page 7). These coarse materials were left in rough, disorderly piles creating today's patchwork of steep hills, lakes, ponds, and bogs. Terminal moraines generally make in-
ferior cropland because of their coarse soils, steep slopes, and poor drainage, though these limitations are less significant in the area south of the Twin Cities. The moraines also include some of the state's most scenic areas. The greatest terminal moraine development in Minnesota extends from Albert Lea northward to the Twin Cities, westward toward Willmar, northwestward toward Glenwood and Detroit Lakes, eastward toward Park Rapids and southeastward toward Brainerd forming the shape of a large reverse question mark.

Outwash plains are composed of finer materials washed away from the terminal moraines by the flow of glacial meltwater. Their surfaces are generally level and the material sandy, with coarse sand and gravel beneath the surface. Hence they are dry and good for agricultural use. Outwash plains are most extensive north of the Twin Cities in Anoka and Sherburne Counties and in conjunction with the major terminal moraine belt in central Minnesota, such as in Wadena County.

Ground moraines (or glacial till plains) were deposited during periods of rapid, widespread melting; surfaces are gently rolling and the material is a mixture ranging from fine clay to boulders. This is the major landform type of Minnesota's most productive agricultural areas.

Lake plains are the bottoms of former glacial lakes commonly composed of heavy clay, with sand ridges at the former lake edges or beach lines. Their soils retain moisture and their surfaces are level and poorly drained. The most extensive of Minnesota's lake plains was formed by glacial Lake Agassiz in northwestern Minnesota. The western, deepest part of the lake is now the flat, agriculturally productive Red River valley. But earlier, higher stages of the lake extended to the east across northern Minnesota. Some of the eastern areas have remained poorly drained, allowing the growth of marshland vegetation that has decayed slowly over several thousands of years, creating Minnesota's most extensive peat lands.

Along the north shore of Lake Superior, in the border lakes region, and on the Mesabi Range, glaciers scoured away much of the surface material and exposed the underlying bedrock, leaving only thin and scattered patches of glacial drift behind. In this ice-scoured region of northeastern Minnesota, hilltops and upper slopes are often bare rock and many intervening basins are filled with deep clear lakes or shallow bogs.
LANDFORMS

Source: Minnesota Geological Survey
The older ground moraines, in extreme southwestern Minnesota, were not covered in the most recent glaciation and have had time for natural stream channels to form. Because of a better developed drainage system, this area has few natural wetlands in comparison to the newer ground moraines.

Mature stream dissected topography is seen in Minnesota's unglaciated southeast, with its steep valley walls and rocky bluffs rising up to 500 feet above the valley flood plains. The stream dissected flanks of the Minnesota and Upper Mississippi River valleys are also included in this category.

SURFACE MATERIALS

Soils are the products of the original rock materials, climatic conditions that have eroded them and plants that have grown and decayed, adding organic matter. Consequently soils vary widely in texture and chemical composition.

Loam is a soil of mixed sand, clay, and organic material that exhibits great differences in its suitability for agriculture (page 9). Loam soils range from the deep, dark colored topsoils formed under the prairie grasslands of southwestern Minnesota, rich in organic matter and high in soluble mineral plant food, to the thin, light colored, low fertility soils that developed beneath the coniferous forests of central and northeastern Minnesota. Sandy soils and clay soils are directly related to the location of outwash plains and lake plains, respectively. Peat, composed of slowly decaying post-glacial vegetation, is concentrated in the area north and east of the Red Lake, in St. Louis and Aitkin Counties and in other smaller locations scattered across the state, mostly north of the Twin Cities area. Rock outcrops predominate in the ice-scoured areas of northeastern Minnesota and in areas where soils have been eroded away leaving the underlying bedrock exposed, as for example in unglaciated southeastern Minnesota. Other surface materials in Minnesota include alluvium, spread across the flat floodplains of present-day streams; loess (wind-blown soil), found in southwestern Minnesota and parts of southeastern Minnesota; and the growing mass of mine tailings generated on the iron ranges.

SURFACE SLOPE

The average slope of local terrain, shown on page 10, is based upon ninety-four geomorphic regions in Minnesota. The steepest topography is found in the stream dissected southeast and the ice-scoured rocky highlands of the northeast where local relief reaches 500 feet or more. Hills can be steep in the terminal moraine belts of central Minnesota though local relief is less. At the other extreme, the glacial lake plains, particularly in the Red River valley, are among the most extensive nearly-flat areas in the world.

MINERALS

BEDROCK GEOLOGY

While the preceding maps portray mainly the work of the glaciers and later events, the map on page 11, shows the legacy from geologic times that preceded the Ice Ages. For the purposes of the map, those older rocks are divided into six general categories based partly on the period in which they were formed and partly on the type of rock.

Shale, sandstone, and clay consist of sediments left by ancient seas that covered much of Minnesota in the Mesozoic period (60 to 225 million years ago). Remnants of these deposits extend from southwestern to northwestern Minnesota, with thin patches in other scattered locations.

During the Paleozoic period (225 to 570 million years ago) the land that is now Minnesota subsided beneath the sea for long intervals, and sediments of marine fossils formed dolomite limestones, sandstones, and shales which comprise the layers of bedrock in southeastern Minnesota and extreme northwestern Minnesota.

Precambrian rocks were formed before the profusion of marine life (or before about 570 million years ago). During a major period of volcanic activity about 1.1 billion years ago, known as the Keweenawan period, a massive displacement in the earth's crust created the basin of Lake Superior, and lava flows formed the basalt and rhyolite rocks above Lake Superior and the harder, heavier copper and nickel-bearing gabbro and granite rocks of
northeastern Minnesota. Sediments consisting of older rock fragments were deposited in and near the rift zone as subsidence followed geologic activity. These rocks, shown as Keweenawan sandstones, have been quarried near the town of Sandstone, where they are only thinly covered by glacial deposits.

Older sedimentary rocks deposited roughly between 1.4 and 2.0 billion years ago include quartzite (consisting of rock segments tightly cemented with quartz — such as the pipestone and jasper rocks of southwestern Minnesota), siltstone (a fine-grained sandstone), iron formation (containing the ore of the Cayuna, Mesabi, and Gunflint ranges), argillite and graywacke (a dark sandstone containing larger rock fragments).

Granites from two relatively short periods of intensive geological activity are combined on this map (page 11). During the Penokean period of about 1.7 billion years ago, a sedimentary basin of central Minnesota was intruded by volcanic rock, providing the granite building stones quarried in the St. Cloud area. During the Algoman period between about 2.6 and 2.7 billion years ago, sedimentary rocks of north-central and northwestern Minnesota were intruded by granitic rocks along northeast-southwest trending belts. These granites are near the surface at their southern extremity and are quarried at several locations in the Minnesota River valley.

Minnesota rocks formed before 2.7 billion years ago have been changed repeatedly by heat and pressure. Labelled on the map as metaigneous, metavolcanic and metasedimentary rocks, they include the “greenstone” sedimentary, volcanic, and igneous rocks and the even earlier and coarser gneisses, which are among the oldest rocks yet found on earth.

DEPT TO BEDROCK

Above the underlying rock foundations are deposits and accumulations of millions of years of weathering from ice, water, wind, and temperature variation, together with glacial deposits. The result is a mantle or overburden of sand, gravel, boulders, and clay. This mantle generally is less than five feet thick in northeastern Minnesota, where surface materials were scraped away during the latest glaciation, and in southeastern and in some parts of southwestern Minnesota, where surface materials have been washed away by water (page 13). Mantle thickness ranges up to more than 500 feet in a large area of the west-central Minnesota terminal moraine belt, in smaller areas in the south-central Minnesota terminal moraines and in the Prairie Coteau area of southwestern Minnesota.

ORE DEPOSITS

Minnesota’s iron ore deposits, which have been among the richest in the world, were formed during two separate geologic periods. Iron-bearing deposits formed from about 1.8 to 2.0 billion years ago host the ores found on the Cayuna, Mesabi, and Gunflint ranges (page 14). The ores of the Soudan iron formation, formed about 2.6 to 2.7 billion years ago, have been mined underground in the Vermillion Range. Duluth gabbro, a hard volcanic rock formed during the Keweenawan period of about 1.1 billion years ago, contains copper-nickel and titanium-vanadium resources which are currently being studied for commercial production. The Keweenawan sedimentary deposits underlying Carlton and Pine Counties are being explored currently for uranium, with expressed public concern for potential contamination of underground water supplies.

BUILDING STONE AND AGGREGATES

Rocks have been quarried for construction and decorative value in locations where they occur close to the surface. There are granites in the St. Cloud area and in the Upper Minnesota River valley, limestones, in various locations in southeastern Minnesota and the Lower Minnesota River valley, and harder sandstones of the Keweenawan period near Sandstone, Minnesota. The loosely structured sandstones of southeastern Minnesota are from the more recent Paleozoic period and are not useful as building materials. Sand and gravel, which are abundantly available in Minnesota’s outwash plains, river valleys, and terminal moraines, are quarried in many locations throughout the state and used in construction.

PEAT

Minnesota’s more than seven million acres of peat comprise over half the known peat deposits in the contiguous forty-eight states
DEPT TO BEDROCK

Thickness of soil and glacial overburden in feet:
- Less than 5
- 5 to 100
- 100 to 300
- 300 to 500
- 500 to 700
- 700 or more

Source: Minnesota Geological Survey
Peat is an early stage in coal development and consists of decaying plant material that has accumulated during the post-glacial period in the poorly drained areas of the state. Large deposits are found in the area known as the "big bog," north and east of Red Lake in Beltrami, Lake of the Woods, and Koochiching Counties. Peat also is found in substantial quantities in St. Louis and Aitkin Counties and in other smaller scattered locations in the state. Peat bogs occupy ancient lake beds where drainage was inhibited. Lake Agassiz, in northwestern Minnesota, is an example. There the receding lake left successive beach ridges that created shallow, poorly drained areas with level clay bottoms where plant growth could thrive.

Peat is generally classified in three types: fibric, hemic, and sapric, distinguished by the degree of decomposition. Of these three, fibric peat is least decomposed, consisting largely of recognizable plant fiber. Minnesota's fibric peat is primarily sphagnum moss. It often lies as a shallow cap on northern peat bogs. Sphagnum moss is used in horticulture as a surface mulch, a component in commercial potting soils, and as a soil conditioner. Hemic peat is intermediate in decomposition and is derived largely from sedges, rushes, reeds, and woody plants. Hemic peat is the best type for energy production and agricultural use. Sapric peat is the most decomposed and lies as a thin layer at the base of peat deposits. It is derived partly from lake bottom plants, but also from more completely decayed fibric and hemic peats.

In their natural state, peat bogs are important for their ability to retain water and as habitats for wildlife. Many of Minnesota's northern peat bogs support stands of tamarack, white cedar, and black spruce. Black spruce is an important source of pulpwood for Minnesota. Southern peat bogs, such as those in Anoka County, just north of the Twin Cities, are important in agriculture, including the production of specialty vegetable crops and lawn sod. About one-third of the nation's radish crop is grown on the peatlands of Anoka County.

Peat offers an important fuel source for the future. When dry, peat can be burned to produce electricity, or when gasified it can replace natural gas. The cost of producing manufactured gas from peat is expected to become more competitive as the cost of natural gas continues to rise. Prospective demands for Minnesota's peat because of its energy value are now raising the question of how to manage its development in the most efficient way, in the best long-range interests of the state, and with minimal environmental damage.

SOILS

Soil is perhaps Minnesota's most important natural resource, the base upon which the state's agricultural economy is built. Soil consists mostly of rock materials which have been weathered and worn over long periods of time. Except in southeastern Minnesota, most of these rock materials have been brought into the state by glaciers and deposited in piles of gravel and sand or smoothed out in the gently rolling glacial till plains. As the glaciers gradually melted and receded, and before much vegetation had developed, the finer soil materials were moved about and deposited on outwash plains, in stream valleys (alluvial soils) and glacial lake bottoms (lacustrine soils) by water, and on upland slopes in many parts of the state by wind (loess soils).

The weathering effects of temperature and precipitation gradually broke down the minerals in the parent material and established an environment suitable for vegetative growth. Vegetation, in turn, responding to the varying climatic conditions, has had an important influence on soil development. Where there has been sufficient moisture trees grew; less moisture resulted in prairie grasslands. This tree-grassland boundary occurs at about the 25 inch average annual rainfall line in southern Minnesota and at about 22 inches in northwestern Minnesota because of the differences in heat resources and evapotranspiration. Trees also occur in the prairie area along stream bottom lands where soil moisture is available.

The development of organic material in the soil is directly related to the type of vegetation. In forested areas organic material is derived primarily from the falling leaves or needles and from decaying wood. In prairie areas many of the stalks and roots of grasses decay each year, supplying the soil with an abundance of organic matter. As a result the prairie soils are the richest and the most productive soils for agriculture in Minnesota. Soils that have developed under the hardwood forests are intermediate in fertility, while those developed under the coniferous forests of north-central and northeastern Minnesota tend to be acidic, least fertile, and likewise least suitable for crop pro-
duction.

Topography, too, affects soil formation. Steep slopes that encourage rapid runoff retain less moisture for plant growth, which in turn, retards soil development. Flat, poorly drained, continuously moist areas result in abundant plant growth, but slow deterioration — as in Minnesota's peat bog areas. Slope also influences the rate of evapotranspiration with south-facing slopes receiving more direct sunlight than north-facing slopes. For example, the north-facing bluff of the Minnesota River valley as far west as about Redwood Falls is wooded, whereas the south-facing bluff is predominately grassland because of the higher rates of evapotranspiration. Thus the soils of Minnesota have developed over many thousands of years.

FERTILITY

A method developed to evaluate the natural fertility of the soil in Minnesota considers four basic and four secondary physical characteristics that are important to crop production.* The soil characteristics used include: 1) soil texture more than five feet below the surface, 2) soil texture in the top five feet, 3) natural drainage conditions, and 4) color, which is generally an indication of organic content. The secondary characteristics considered are slope, rooting zone thickness, available phosphorus and potassium, and the potential for artificial drainage. The weighing of these factors is shown in the map on page 18.

Group 1 soils are naturally well-drained or artificially drained deep loams and clay loams, rich in organic matter on nearly level to gently rolling terrain. These soils have been formed on the prairie grasslands from south-central Minnesota to northwestern Minnesota. Soils in groups 2 and 3 are generally loams and sandy loams where crop production is limited by slope or by lower levels of organic matter in their rooting zone than soils in group 1. These soils were commonly formed under a deciduous forest and extend from southeastern Minnesota to west-central Minnesota and in other scattered areas of the state. Soil groups 4 and 5 have a wide range of characteristics and limiting factors. These soils include wet clays and loams without artificial drainage, shallow soils over bedrock, soils on very steep slopes, sands and sandy loams low in organic matter, and peatlands.

PRODUCTIVITY

In considering the productivity of soil for agricultural purposes, heat and moisture conditions need to be taken into account as factors that modify natural soil fertility. The result is a wide range of crop growing conditions in Minnesota, shown on page 19.

Productivity Group 1 is comprised principally of deep, well-drained, organically rich loam and clay-loam soils with at least sixteen inches of precipitation (page 45) and 2,400 growing degree days (page 43) during the crop production season. This area of south-central Minnesota which poses few limitations on crop selection and production, includes the state's most valuable agricultural land (page 103).

Productivity Group 2 is comprised of deep, well-drained, organically rich, sandy to clay loams. But in comparison to Group 1, it has somewhat less and more variable precipitation toward the west and less heat resources toward the north.

Productivity Group 3 includes soils that are further modified by heat and moisture availability, and to some extent, by topography. This group includes the organically rich loams and sandy loams of the terminal moraines, that extend from Dakota County to Otter Tail County where crop production is limited by steep slopes. Also included are the shallow and sandy loams, low in organic matter, that stretch from Mille Lacs County to east Otter Tail County; the rich clay loams of the Lower Red River valley; and the deep, naturally well-drained, low-organic loams in southern Beltrami County, that are limited in production by a short growing season.

Productivity Group 4 includes the shallow sandy and gravelly loams extending from Pine County to eastern Stearns County with northeasterly and northwesterly extensions. Productivity is modified by declining heat resources and soil fertility toward the northeast and by both declining heat resources and declining precipitation toward the northwest.

Productivity Group 5 includes a variety of conditions, from the shallow, droughty soils of the Anoka Sand Plain and the steep bluffs and shallow soils of the stream dissected region of southeastern Minnesota, to the shallow and sandy loams of north-
central Minnesota that lack organic matter and have a short growing season. Also included in this group are the poorly drained clay soils, peat lands, and marshes in the north (also handicapped by a short growing season) and the areas of shallow soils, steep slopes, and short growing season in the extreme northeast.

MOISTURE RETENTION

The ability of soil to hold and release moisture to plant roots is mapped on page 21. Soil moisture is measured in terms of the number of inches of water contained in the top five feet of soil. This is indicated in the map legend as the range, in inches, of water available. For example, 0 to 12 indicates that the moisture-holding capacity of the soil is 12 inches and the wilting point (the soil water content below which plants are unable to draw moisture) is 0. Where the first number is 0, it indicates that plants are able to extract virtually all the moisture available. The ability of soil to hold or release moisture depends on the combined soil characteristics of the rooting zone (up to about four feet) and the stratum below. For example, if both the rooting zone and substratum are sand, as in many stream bottoms, soils may hold up to 12 inches of moisture, entirely extractable by plants.

Heavier soils, ranging from loams to clays, are able to hold more moisture than is sand under similar drainage conditions. But these heavier soils retain some moisture that plants are unable to extract. Soils with a loam to sandy loam rooting zone and with sandy to sandy loam substratum, fall into the 4 to 12 inch category, depending upon their drainage characteristics. These soils, which comprise nearly 14 percent of the state’s land area, have the best soil conditions for irrigation (page 22). The 8 to 12 inch category contains silty loams, clay loams, or clay and loam mixtures in both the rooting zone and substratum that are found in well drained areas, and sandy loams found in poorly drained areas. Soils with these moisture retention characteristics make up 58 percent of the total land area in the state, including the most fertile and productive soils. The constantly wet, lowlying peatlands comprise the category of 12 or more inches moisture retention and are severely limited for agricultural use, even with extensive drainage.

SOILS MOST SUITED FOR IRRIGATION

While drainage is a more common water management need in Minnesota, the addition of irrigation water to supplement rainfall can also increase crop production where soils are suitable. The greatest potential for supplemental irrigation is in those areas where soils have low moisture retention, or there is high variability in growing season precipitation, or both. Generalized soil types within geomorphic regions that are most suited for irrigation are shown on page 22. These include the sandy outwash soils of central and east-central Minnesota and the sandy alluvial deposits along stream bottom lands, each identified by characteristics of the rooting zone and substratum. Most irrigation water used in Minnesota is pumped from wells 30 to 150 feet deep in glacial deposits and distributed by sprinkler systems. Deeper wells, that draw water from bedrock sources 200 to 400 feet down, are more common in Sherburne and Dakota Counties. Groundwater contains more minerals in the western part of the state, but this does not limit irrigation potential except in the extreme northwest and southwest (see pages 29 and 37). The four most commonly irrigated crops in Minnesota are corn, potatoes, soybeans, and alfalfa. Irrigated land in Minnesota, estimated at 140,000 acres in 1975, may reach 200,000 acres or more in 1980, still accounting for less than one percent of the state’s total cropland. Of Minnesota’s eight million acres of predominantly sandy soils, as much as one million acres are estimated to be potentially irrigable.

VEGETATION

PRE-SETTLEMENT VEGETATION

The map of pre-settlement vegetation in Minnesota (page 23) is based on information compiled by Francis J. Marschner, of the U.S. Department of Agriculture, from field notes, descriptions, and maps taken from the original land surveys of Minnesota. The surveys were done for the U.S. General Land Office between about 1850 and 1905. Land surveys were usually made just ahead of settlement, beginning in southeast Minnesota before the Civil
SOILS MOST SUITED FOR IRRIGATION

Sources: Minnesota Geological Survey
Agricultural Experiment Station, University of Minnesota
*dark refers to the high content of organic material in the surface soil
War and completed in the extreme northeast shortly after the turn of the century. Thus, the map shows vegetation before it was directly altered by commercial logging, cultivation, or urban development.

During the pre-settlement centuries, the state's vegetation was gradually and constantly changing as a result of climatic changes, fires, windstorms, insect infestations, plant disease outbreaks, and the gradual modification of lakes and wetlands by bog and swamp forming processes. Fires were significant in their influence on the unstable prairie-forest border and were necessary to maintain the pine forest ecosystem. The general patterns of vegetation were relatively stable, but the details of the mosaic were continually shifting.

Tall grass prairie dominated southern and western Minnesota. Among the more common species were big bluestem, little bluestem, Indian grass, prairie clover, goldenrod, pasque flower, and shrubs such as roses and wolfberry. Prairie marshes included blue jointgrass, sedges, reeds, cattails, bull rushes, and wild rice. The mixed grassland and hardwood area shown on page 23 represents the prairie-forest transition zone, consisting of grassland, with trees or brush scattered or in small clusters. Oak, with some elm, ash, and basswood dominated in the southeast and east-central areas of the state. Aspen was an associate species toward the central and northern parts of this area. Burr oak, scattered and in groves, was typical of the Anoka Sand Plain, with the oak gradually giving way to jack pine toward the sandy outwash plains of north-central Minnesota.

The hardwood forest or big woods extended from southeastern Minnesota to west-central Minnesota and included red, white, and burr oak as the dominant species, with secondary species varying from black walnut, butternut, hickory, and wild cherry in the southeast, to maple and basswood in central Minnesota, and elm, ash, and cottonwood along the river lowlands. Oak dominance gradually gave way to aspen and birch in the north.

The pine forest included some nearly pure stands of white and norway pine, the basis for Minnesota's early lumber industry. But mixtures of pine with balsam fir, white and black spruce, and northern white cedar were more typical. Also in this category are the transition areas between the conifers and mixed hardwoods, where, for example, post-fire aspen and birch dominance was being gradually overtaken by under-stories of white and norway pine, balsam fir, and spruce.

In areas of the state classified as bogs and swamps, the vegetation developed over peat and acid groundwater and included black spruce, tamarack, heaths, and sphagnum mosses. The less acidic areas included, in addition, balsam fir, northern white cedar, and birch. This category includes, as well, the nearly treeless muskeg or floating bog areas, north of Red Lake and in parts of St. Louis and Roseau Counties, which have been dominated by sedges, reeds, grasses, bog birch, mosses, and stunted tamarack.

Much of the pre-settlement pine and spruce was cut and replaced by the natural regrowth of aspen, which has become the dominant species in Minnesota, covering nearly one-fifth of the state's total land area. The hilly moraine and stream dissected lands, once heavily forested with hardwoods such as oak, maple, and elm, have been selectively cleared for cultivation over the past century. Woodlands that remain through these areas tend to be on the steeper slopes that are less desirable for cultivation, but suitable for pasture. Almost all the virgin prairie lands, with their rich soils, were converted to cropland before the turn of the century.

MAJOR FOREST TYPES

The major forest types in Minnesota in the late twentieth century are shown on page 25. Forest types represent groups of tree species which commonly grow in association with one another. A spruce-fir forest, for example, consists of balsam fir, white spruce, black spruce, tamarack, and northern white cedar. The pine forest shown on this map consists predominantly of white pine, red pine, or jack pine. The maple-basswood forest type consists primarily of sugar maple, basswood, yellow birch, upland elm, and red maple. Oak forests are predominantly red oak, white oak, or burr oak. The elm-ash-cottonwood forest type includes lowland elm, black ash, cottonwood, and red maple. Unproductive forest lands are those incapable of producing industrial wood under natural conditions, which in most cases consists of poorly drained peatlands with scattered or stunted tamarack or black spruce. Unforested areas include parcels of land and water where less than one-sixth of the land area has tree cover.
MAJOR FOREST TYPES
1977

Source: Minnesota Land Management Information System
The map on page 25 is based upon aerial photographs, most of which were taken between 1968 and 1974. One county was photographed in 1964 and three Twin Cities metropolitan area counties as recently as 1977. These aerial photographs were divided into forty-acre segments, which in turn have been compiled into larger parcels, five kilometers on a side (approximately 154 forty-acre segments). A larger parcel was classified as forested if at least one-sixth of the forty acre segments it contains are dominantly forested.

WATER

SURFACE WATER

Annual water runoff is the excess of average annual precipitation (page 44) over evapotranspiration (combined annual evaporation from land and structures and transpiration from plant surfaces). Runoff represents the average annual depth of water which runs off the land, either directly (surface runoff) or indirectly (ground water movement), into streams that lead eventually to the sea. Runoff may be thought of as Minnesota’s basic water supply or the water available after evaporation losses and the needs of vegetation have been met. It is the water available to replenish the state’s lakes, streams, and underground basins and to tap for cities, industries, and farms.

Runoff is greatest in the areas of relatively high precipitation, low temperature, and less frequent sunshine, as in the northeast; and least in the areas of relatively lower precipitation, higher temperature, and more frequent sunshine, as in the southwest (Table 1). The estimated average annual direct and indirect runoff is shown on page 27; and stream flow, or direct runoff only, is shown on page 28.

The distribution of lakes in Minnesota was determined largely by the surface-shaping forces of glacial activity. The greatest concentration of lake basins is found in the terminal moraine belt of central Minnesota and the ice scoured northeast (page 7). In these regions, lake basins cover at least 10 percent of the total surface area (page 29). The rate of water flow through these lakes (water turnover or natural replenishment) is dependent on the amount of runoff, which ranges from more than ten inches in the northeast to less than one inch near the South Dakota border. As a result, a lake of a given volume in northeastern Minnesota may have an average turnover time of ten years, while a lake of equal volume in west-central Minnesota may have a turnover time of 50 to 100 years, making it much more vulnerable to contaminants.

At least one-fifth of Minnesota’s more than 15,000 lake basins of 10 or more acres have become dry as a result of the natural processes of filling and vegetative growth and, more importantly, drainage projects to expand cropland. Most extensive installation of drainage ditches and tiles is found on the gently rolling glacial till plains of southern and southwestern Minnesota (page 29). Drainage ditches, generally without tributary tile systems, are extensive in the moisture-retentive clay soils of the Red River valley and in the marshland and bog areas of northwestern Minnesota and St. Louis County. These efforts to convert the northeastern areas into productive agricultural use have met limited success because of soil infertility and climatic handicaps. While drainage facilities have increased agricultural production, side effects have been a local reduction of water fowl breeding areas and increased stream flow during periods of heavy precipitation or snow melt.

The development of natural drainage systems, or stream densities, is highest in those areas of the state where the topography has been shaped by stream erosion over a long period of time (page 30). These areas are most prominent in the stream-dissected unglaciated lands of southeastern Minnesota and in

<table>
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<th>County</th>
<th>Rainfall</th>
<th>Evapotranspiration</th>
<th>Runoff</th>
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<tr>
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<td>Cook</td>
<td>29</td>
<td>18</td>
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the older ground moraines in the Prairie Coteau region of southwestern Minnesota.

WATER FROM BEDROCK SOURCES

The water-bearing capabilities of Minnesota's bedrock formations are generalized in the map on page 31. Aquifers, or water-bearing strata, consist of one or more geologic formation that forms an hydraulically continuous unit, separated from formations above and below it by layers of rock that do not permit water readily. For example, the important Prairie du Chien and Jordan formations of southeastern Minnesota function as a single major aquifer.

Page 31 shows only the bedrock aquifer nearest the surface; other aquifers lie below it. For example, in the sedimentary bedrock layers of southeastern Minnesota, aquifers alternate with confining, impervious layers such as shale. These bedrock layers generally slope toward the south but appear on the map only where they are exposed at the surface or just beneath the glacial overburden. The Prairie du Chien-Jordan aquifer, then, lies in a "bowl" that is tilted generally toward the south, with its north, east and west edges exposed. Within the northern end of that larger "bowl," known as the Hollandale Embayment, lies a smaller one known as the Jordan Basin, which surrounds and underlies the Twin Cities area and provides much of the metropolitan ground water supply. (See the generalized cross sections on page 33).

The Prairie du Chien-Jordan aquifer, with its northern extension underlying the Twin Cities area, is about 470 feet thick and is the most productive bedrock aquifer in the state, yielding typically 500 to 1,000 gallons of water per minute from deep wells. Also included in the highest yielding category in the map on page 31 is the Mount Simon-Hinckley-Fond du Lac aquifer, consisting of fine to coarse grained sandstone formed during three distinct Precambrian periods, but functioning essentially as a single water-bearing stratum. The Mount Simon-Hinckley-Fond du Lac aquifer out-crop area averages between ten and twenty miles in width and extends from near Duluth to near Glencoe; typical yields from individual wells range from 400 to 700 gallons per minute.

Bedrock formations yielding from 250 to 500 gallons per
WATER YIELD FROM BEDROCK SOURCES

Typical water yield of wells
in gallons per minute

- None*
- Less than 25
- 25 to 100
- 100 to 250
- 250 to 500
- 500 to 1000

Source: Minnesota Geological Survey

*Little or no primary porosity; water found sporadically in zones of secondary porosity resulting from faulting or leaching
minute include the Cedar Valley-Maquoketa-Dubuque-Galena aquifer with its almost horizontal beds of limestone, dolomite, sandstone, and shale which, in effect, fill the southward-plunging Hollandale Embayment, reaching a thickness of about 640 feet at the Iowa border. This aquifer yields water mainly from channels, joints, and fissures which tend to be more prevalent in the upper layers. Subsurface caverns and drainage systems (known as karst development), are common, including sinkholes where surface water may enter rapidly into underground channels forming caverns and underground streams. The natural quality of this water is good, but it is sensitive to contamination because of the direct flow of surface waters into underground streams.

The Franconia-Ironton-Galesville aquifer is about 330 feet thick and lies beneath the St. Lawrence confining bed. It consists of sandstones formed during three different periods, with some interbedded shale, and dolomite. The Franconia-Ironton-Galesville aquifer is exposed in some places along the Mississippi River valley and is the upper layer of bedrock west and north of the Twin Cities area beyond the edges of the Jordan Basin. This aquifer typically yields from 250 to 500 gallons per minute.

The St. Peter aquifer consists of light yellow or white, fine to medium-grained sandstone and lies above the Prairie du Chien-Jordan aquifer, separated from it by thin beds of siltstone and shale. Average thickness is about 100 feet; yield typically ranges from 100 to 250 gallons per minute.

The Cretaceous aquifer, formed more recently than the water-bearing formations of southeastern Minnesota, consists of sandy, silty, and shaly remnants deposited in a shallow sea which spread from the west across most of Minnesota. This aquifer is nearly continuous in large areas of southwestern Minnesota; it underlies the Red River valley and includes two large outliers just south of the Mesabi Range.

The Cretaceous aquifer thickens toward the west, from a few feet in the eastern outliers to a maximum known thickness of about 600 feet in Lincoln County near the South Dakota border. Water yields typically range up to 50 gallons per minute, but in the extreme southern part of the state some wells are capable of producing 250 gallons per minute. Wells in cretaceous beds commonly draw supplemental water from the overlying quaternary deposits in order to provide sufficient amounts. Most of the waters in this aquifer are mineralized with dissolved solids reaching as much as 6,000 parts per million in the extreme western part of the state.

The Red River-Winnipeg aquifer of extreme northwestern Minnesota includes the Red River formation, consisting of limestone and dolomitic limestone above, and the Winnipeg formation, consisting of fine to medium-grained sandstone below. This aquifer is covered by several hundred feet of glacial till and sediments from former Lake Agassiz. Recorded yields from this aquifer range from 5 to 60 gallons per minute, but yields ranging from 100 to 250 gallons per minute would be possible if wells penetrated the full thickness of the aquifer. The water is highly mineralized, having concentrations of dissolved solids from 5,000 to 60,000 parts per million.

Bedrock formations with low or highly variable yields include the Keweenawan rocks of northeastern Minnesota, the Sioux Quartzites of southwestern Minnesota and the Biwabik iron bearing formation of the Mesabi Range. Within the Keweenawan formations, water is found in fractured and weathered zones which occur irregularly within the upper 300 to 400 feet. Likewise, in the Sioux Quartzites, water bearing zones occur only near the weathered and eroded upper surface of the formation, where the rock is fractured and friable because of decomposition. The Biwabik iron formation, the host rock of the Mesabi Range, lies along the northern edge of a large basin of Proterozoic rocks extending from southern St. Louis County to Crow Wing County. Typical water yields in each of these three formations are usually less than 25 gallons per minute, though yields of individual wells in the Biwabik formation have ranged as high as 500 gallons per minute.

The harder Precambrian rocks generally do not function as aquifers except where porosity has been developed by fracturing or leaching. In these areas ground water is generally taken from the overlying, unconsolidated quaternary deposits of glacial drift and alluvium.

Water quality from bedrock sources is measured by the concentration of dissolved solids in parts per million (page 34). Generally, the sedimentary aquifers of southeastern Minnesota provide both the greatest yields and the best quality of water, though their water is susceptible to contamination from surface sources. By comparison, the Precambrian and volcanic rocks of northern Minnesota produce little water and its quality is highly
WATER QUALITY
FROM BEDROCK SOURCES

Dissolved solids
in parts per million

- Widely variable or data not available
- Less than 500
- 500 to 5,000
- 5,000 or more

Source: Minnesota Geological Survey
variable. The quality of bedrock water generally decreases with surface precipitation and increasing rates of evaporation. The poorest quality of water from bedrock sources is found along the western edge of the state.

WATER FROM GLACIAL AND FLOODPLAIN DEPOSITS

The water yield ratings of Minnesota’s quaternary deposits are shown on page 36. These deposits have accumulated over the past two million years or so and include glacial drift and more recent flood plain deposits. The sustained yield rating is based on estimates of the permeability and thickness of an aquifer and the rate of ground water recharge. This rating represents a hypothetical perpetual yield that could be obtained by continuous pumping from an isolated well penetrating the full thickness of the aquifer without irreversible depletion of the ground water supply.

The highest yield ratings, over 500 gallons per minute, are in areas of alluvial deposits in major river valleys where the ground water is sustained by seepage from the stream. This rating applies only to the lower Minnesota River valley and the Mississippi River valley below the Twin Cities. Yields between 100 and 500 gallons per minute are possible from other alluvial deposits and from outwash plains of sand and gravel. Outwash materials that include some silt and clay, and heavier alluvial materials along smaller streams, might yield from 25 to 100 gallons per minute. The finest outwash and alluvial materials in combination with low recharge are estimated to yield from 5 to 25 gallons per minute. The beach ridges along the edges of glacial Lake Agassiz are rated at 1 to 5 gallons per minute. Most of the state’s surface deposits yield less than 1 gallon per minute. Those include the ground moraines or till plains of mixed sand, silt, and clay; the clay and silt soils of glacial lake deposits, as in the Red River Valley; the loess, or wind-blown deposits of southeastern Minnesota; and the peat deposits primarily in the north. In these areas of low water yield from quaternary deposits, water may be available from the underlying bedrock (page 31).

The water quality of quaternary deposits is measured in terms of total dissolved solids; it does not include suspended sediments, colloids, or dissolved gases (page 37). In general, dissolved solids in quaternary deposits tend to increase from east to west in Minnesota. The gradation is primarily related to increasing evapotranspiration in the western areas.

Calcium-magnesium bicarbonate is the dominant dissolved salt in recharge areas and is the most common ground water solute in Minnesota, occurring in the eastern three-fourths of the state. Sodium-potassium-sulfate and sodium-potassium-chloride occur commonly in combination with calcium-magnesium bicarbonate in various locations in western Minnesota. For most domestic and industrial uses, water should contain less than 1,000 parts per million of these dissolved solids and for most agricultural uses less than about 3,000 parts per million.

WATER QUALITY MANAGEMENT

Maintaining the water quality of the state is a responsibility of the Minnesota Pollution Control Agency (PCA). This state government agency is charged with providing for the prevention, control, and abatement of pollution of all waters of the state. The agency has classified all interstate and intrastate waters according to their natural water quality, their volume of flow (or rate of recharge) and "considerations of best use in the interest of the public." Based on these factors, the PCA has set standards for the amount and quality of wastes that may be discharged into the state’s lakes and streams. The standard for discharge varies with each body of water. Secondary treatment is the minimum required for discharge of all biological and chemical wastes. Secondary treatment is defined as effective sedimentation, biochemical oxidation, and disinfection to meet specific standards for oxygen demand, coliform bacteria, suspended solids, pathogenic organisms, oil, phosphorous, turbidity, acidity/alkalinity, and toxic or corrosive substances. Primary treatment is treatment at levels below these standards; tertiary treatment is at levels that are more stringent.

The major municipal, industrial, and utility waste water dischargers in the state and their status as of October 15, 1978 are shown on page 38. Construction complete indicates that the required treatment plant to meet water quality standards has
WATER YIELD FROM QUATERNARY DEPOSITS

Gallons per minute

Less than 1
1 to 25
25 to 100
100 to 500
500 or more

Source: Minnesota Geological Survey
WATER QUALITY FROM QUATERNARY DEPOSITS

Dissolved solids in parts per million

- Less than 500
- 500 to 1000
- 1000 or more

Source: Minnesota Geological Survey
MAJOR WASTE WATER DISCHARGERS
1978

Construction status of treatment facilities as of Oct. 15, 1978
- Construction complete
- Under construction or reconstruction
- Awaiting federal grants for construction

<table>
<thead>
<tr>
<th>Municipal</th>
<th>Industrial</th>
<th>Power plants</th>
<th>Million gallons per day flow</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Less than 1</td>
</tr>
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<td></td>
<td>1 to 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5 to 20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20 to 100</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100 to 500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>500 or more</td>
</tr>
</tbody>
</table>

Source: Minnesota Pollution Control Agency
*complete, except for lift station
been constructed and is operational. *Under construction or reconstruction* indicates that the required treatment facilities are being built and are not yet operational. *Awaiting funds* indicates that required construction or reconstruction will commence as soon as funds become available. Of the ten major power plant dischargers in the state, nine were complete and one was under construction as of October 15, 1978. Of the eighteen major industrial dischargers in the state, eleven were complete and seven under construction. Major industrial facilities under construction at that time included sugar beet plants, paper processing plants and a taconite processing plant. Of the forty-four major municipal waste water dischargers, twenty-one were complete and had met water quality standards, one was under reconstruction (the state’s largest, serving much of the Twin Cities area), while twenty-two were awaiting funds.

While the PCA is responsible for preventing and combating the contamination of water in the state, it is just one of more than a dozen state and federal agencies that have some jurisdiction over water. The Minnesota Department of Natural Resources is responsible for granting permits to use water for any purpose, except domestic, including agriculture, industry, and recreation. The Minnesota Department of Health is responsible for regulating the use of drinking water and monitoring its quality.

**CLIMATE**

**TEMPERATURE**

Minnesota extends over 400 miles from the sub-arctic forest to the heart of the corn belt and encompasses a great range of climatic conditions. Mean daily maximum temperatures for July range from less than 70 degrees along the shore of Lake Superior in extreme northeastern Minnesota to more than 86 degrees in parts of southwestern and southeastern Minnesota (page 40). During July, the angle of the sun is more nearly overhead in southern Minnesota than it is at the equator, providing the heat to produce Minnesota’s most important crops. Summer temperatures in northeastern Minnesota are tempered by the effect of cool and deep Lake Superior and to a lesser extent by the smaller lakes and trees in that part of the state. Average daily temperature ranges during July are also affected. They vary from a range of less than 20 degrees in the northeast to near 30 degrees in the southwest, where there are few lakes and trees to moderate summer temperatures.

Mean daily maximum temperatures in January range from about 10 degrees above zero Fahrenheit in northwestern Minnesota to 25 degrees in the Mississippi River valley in extreme southeastern Minnesota (page 40). The generally increasing temperatures from north to south are noticeably modified by Lake Superior which seldom freezes over. January daily temperature ranges of approximately 20 to 25 degrees are found throughout the state, except along the shore of Lake Superior where daily ranges may be 5 to 10 degrees less than in others of the state.

The average last spring frost is on May 1 or earlier in the Lower Mississippi River valley and as far north as the Twin Cities; but on June 1 or later in southern St. Louis and central Koochiching Counties (page 41). Most of the southern half of Minnesota experiences its last spring frost by mid-May.

The first fall frost occurs in early September in those same areas of St. Louis and Koochiching Counties, while the first fall frost does not occur at least until early October along the Mississippi River as far north as the Twin Cities and along the Iowa border in south-central Minnesota (page 41). In an average year, most of the southern half of Minnesota does not experience its first frost until late September. Again, the modifying effect of Lake Superior delays the first frost along its shores by two weeks or more.

The number of days between the last frost in spring and the first frost in fall is shown on page 42. The frost-free season ranges from less than 100 days in certain areas of northern and northeastern Minnesota to 160 days or more in extreme southeastern Minnesota and in the Twin Cities area. In the southern half of Minnesota the frost-free season generally exceeds 140 days, except for an area in and near Olmsted and Dodge Counties in southeastern Minnesota. Normal frosts can be influenced by local air drainage patterns, as in central Koochiching and southern St. Louis Counties, and the Zumbro and Upper Minnesota river valleys. Urban areas, too, have a modifying effect on the frost-free season. The Twin Cities area, particularly, generates and reflects heat, thus contributing to a slightly earlier
spring and later fall. Lakes, which cool more slowly than the surrounding land areas, tend to delay the first fall frost and to remain frozen longer than the surrounding land areas, thus cooling spring temperatures. Lake Superior, which seldom freezes, has a moderating effect on its shore lands throughout the year, delaying fall's first frost and discouraging late frost in the spring.

While the length of the frost-free season in some parts of Minnesota is nearly twice as long as in other parts, the differences in heat available for plant growth are even greater. Growing degree-days represent the cumulative total of degrees by which average daily temperatures exceed 50 degrees Fahrenheit during the growing season. The 50 degree base represents the minimum daily temperature needed for significant growth of field corn or soybeans. If the average temperature on a given day is 51 degrees (or one degree above the base temperature), one growing degree-day is accumulated; on a day when the average is 61 degrees, eleven degree-days are accumulated. When the average daily temperature is 50 degrees or less, zero growing degree-days are accumulated. By this measure, the heat resources available for crop growth in Minnesota range from less than 800 growing degree-days in the extreme northeast to more than 2,800 growing degree-days in the extreme southeast (page 43).

The southern half of the state generally exceeds 2,000 growing degree-days, which is considered to be a guideline for adequate corn and soybean maturation, though some corn hybrids with shorter growing seasons extend the limits of corn production farther north (see page 70). In considering the potential for wheat production, a 40 degree base is usually used in calculating growing degree-days because wheat is better adapted to cooler temperatures than are corn and soybeans.

PRECIPITATION

Minnesota receives about two-thirds of its annual precipitation during the five-month growing season. Source of the moisture is the tropical part of the Atlantic Ocean and Gulf of Mexico. During winter months, Minnesota moisture comes more frequently, though in small amounts, from the Pacific Ocean. Annual average precipitation in Minnesota ranges from more than 30 inches in the extreme southeast to less than 22 inches in the extreme northwest (page 44). That part of the state closest to the source of
summer moisture receives the greatest amount of precipitation.

Annual snowfall ranges from 70 inches in the northeast near the dominant winter storm track to less than 40 inches in parts of southwestern Minnesota (page 44). Not only is there more snowfall in northeastern Minnesota, but it lasts longer because of an earlier fall and later spring. On the average, northeastern Minnesota experiences at least 140 days with one inch or more of snowcover, while much of southern Minnesota has 95 days or less (page 45). The amount of snow and the duration of snowcover vary widely from year to year.

Precipitation is most critical during the growing season from May through September. Differences in growing season precipitation are shown on page 45. Precipitation ranges from less than 14 inches in parts of northwestern Minnesota to more than 20 inches in some places in southeast Minnesota.

CLIMATIC ZONES FOR CROP PRODUCTION

The agricultural climate zones shown on page 46 were determined by combining moisture (precipitation) and heat (growth degree-days). Other variables, such as soil and terrain, were not considered. Zone one represents the area with the greatest combined heat and moisture resources during the growing season. This zone imposes few limitations on choice of crops or crop production. Zone two is limited by lower levels of growth degree-days or precipitation or both. Both zones one and two are predominantly corn/soybean production areas, but productivity in zone two will generally be lower than in zone one. Zone three is a transitional area between small grain and corn/soybean production, where lower levels of both heat and moisture begin to limit crop choice and productivity. Heat is the principal limitation in zone four. In this zone crop choice is limited to small grains and forage crops. Heat resource is the limiting factor in zone five, with crop choice being very limited and productivity marginal.

NATIONAL HEAT AND MOISTURE RESOURCES

The percentage of possible sunshine across the United States ranges annually from more than 90 percent in the southwestern deserts to less than 50 percent in parts of the cloudy northern
Pacific Coast, in the Appalachian Mountains, and on the eastern shores of the Great Lakes (page 47).

Minnesota lies astride the transition zone between the dry, sunny southwest and the cloudier Great Lakes region, in the main storm path across North America. Annual average precipitation for the United States is shown on page 47.

The national map of growing degree-days underscores the importance for Minnesota farmers of quick-maturing crops such as corn and small grains, or cool-summer crops such as potatoes (page 47). In order for field corn or soybeans to reach their full maturity, a minimum of about 2,500 growing degree-days (on the scale used in this map*) are needed. This effectively limits the production of these two crops to the southern half of Minnesota. The natural heat resource available in central Minnesota is about two-thirds as great as in southern Iowa, half that of the Mississippi River bottomlands in Arkansas and Tennessee, and less than half that on the coastal plains of Georgia and South Carolina.

Minnesota also lies in the zone of near-minimum cooling requirements and maximum heating requirements for the United States. Summer and winter temperatures can be used to calculate the amount of winter heating and summer cooling necessary to maintain temperatures at comfort level. Heating degree-days are determined by the cumulative deficiency of average daily temperatures below a base temperature of 65 degrees Fahrenheit during the year (page 48). Conversely, cooling degree-days are the cumulative number of degrees by which the average daily temperatures exceed 65 degrees Fahrenheit (page 48). Heating degree days, being related to winter temperatures, range from near zero in the extreme south of Florida to 10,000 or more in parts of the Rockies and along the Canadian border in northern Minnesota. Cooling degree-days, which are related to summer temperatures, range from near zero along the north Pacific Coast, the northern Cascades, and higher parts of the Rocky Mountains to more than 4,000 in parts of the desert Southwest, south Texas, and south Florida.

*Unlike the Minnesota map of growing degree-days (page 43), the degree-days here were calculated by counting all maximum values over 96 degrees as 96, and all minimum values below 50 degrees as 50.
Chapter 2. The Production System
The people of Minnesota, through their farms, mines, industries, and trade and service organizations, produce approximately 1.9 percent of the American gross national product. Minnesota’s share of national production has a distinctive composition because of the state’s unique location on the maps of America’s natural resources and settlement. One finds great economic variety within the state boundaries. But the dominant theme has been vigorous adaptation to a continuing barrage of technologic, social, and economic changes that have repeatedly altered both the meaning of the natural resource base and the relative location of state production within the world’s markets.

GROWTH, VARIETY, ADAPTATION

In the northeast the world’s largest iron mining district shifted from small, underground mines in pioneer days to the vast, open pits that fed American industrial growth during the automotive age and that ultimately exhausted the easily recovered, high-grade ores. Since the 1950s the same region has been converted again, this time to the world’s foremost producer of taconite pellets.

In the southern and western two-thirds of the state, farmers have performed in a remarkable drama. They created a large part of the agricultural Midwest in the pioneer period. They created the nation’s first major hard spring wheat region and from that crop earned the first surge of agricultural income to start the upward spiral of farm mechanization and improvement. They created a major part of the nation’s commercial dairying region during the heyday of butter and milk consumption in American society and thus laid the foundation for a continuously evolving system of dairy farms, milk processing plants, farm-to-market roads, and financial institutions.

In the twentieth century in the southern half of the state, farmers have thrust the traditional corn-hog system farther north than it has ever been before. Through changes in farm organization and development of specialized sub-regions, farmers have subsequently adapted the Minnesota corn belt to hybrid seeds, shifts in the national diet, introduction of new crops, fluctuations in world-wide demands, and revolutionary changes in machinery, fertilizer, pest-control, tillage, labor costs, life-style, and environmental awareness.

In the northwest the bonanza farms of the Red River valley have been converted to family-operated enterprises with the flexibility to shift enormous acreages dramatically within a wide range of cash crop options in quick response to changes in world-wide needs.

Other generations of entrepreneurs have built, rebuilt, and continuously expanded Minnesota’s industrial plants, despite their location well beyond the edge of the historic American manufacturing belt and removed from today’s New York-California axis of American commerce.

The first factories were small, aimed at local markets, driven by water power and firewood. They processed local clay deposits, lumber, grain, and cream. They forged iron hardware and turned out wood products ranging from washboards to wagon wheels for the region. Marketing of Minnesota flour and butter quickly reached out to national and European markets.

By the turn of the century Minnesotans were combining the inflow of capital and new technologies into developing local industries to make tractors and plows, automobiles, electric motors, refrigeration and central heating equipment, mechanical controls, light bulbs, and printing machinery, and to develop a large domestic printing and publishing industry. In many fields Minnesota industries were pioneers. Some disappeared to other parts of the country, nearer the major markets and major sources of financing. Most remained, many grew, and some became national leaders in their fields.

By the mid-twentieth century the industrial base had become far more sophisticated — oil refineries, petrochemicals, aircraft and spacecraft guidance equipment, computers, information systems, lasers, scientific testing equipment, paper, seeds, and countless other items for the national and export markets. Meanwhile, the early food-processing industries had evolved into a broad variety of canning, packing, freezing, and drying operations supplying the Midwest and the nation.

Still other entrepreneurs have organized the transportation and communication networks that energize the region and link it to the rest of the world. Pioneer wagon roads and a few thin rails reinforced the settlement frontier as it advanced inland from the Mississippi river ports. By the 1880s Minnesota-based railroads had spanned and built the “Northwest Empire” from Lake
Superior to Puget Sound. Major airline, trucking and car-leasing headquarters have joined the legacy of railroad headquarters.

Meanwhile, large scale, thermal electric generating stations and long-distance transmission lines have grown from the small, pioneering hydroelectric system that went on-line at St. Anthony Falls in 1882. Coal, oil, petroleum products, and natural gas come by barge, unit-train, and pipeline from distant parts of central North America.

In the fields of trade and service, change and adaptation have also been the central theme. Country general stores and small-town main streets dotted the state as the farming frontier advanced. Wholesalers of harnesses, hardware, groceries, and drygoods supplied the small towns from Minneapolis, St. Paul, Duluth, and the smaller regional railroad centers. From that beginning evolved the giant warehouses of the Twin Cities and Duluth, later to become extinct fossils of the railroad age, and still later rehabilitated as offices, boutiques, studios, museums, or condominiums. But from the accumulated base of experience and capital has flowered today’s diversity of Minnesota-based chains and franchising organizations in retailing, restaurants, vehicle leasing, hotels, and other fields, with regional, national, and international service areas. From the seedbed of small, pioneer banks, county insurance societies, and farmer cooperatives, have grown some of the nation’s largest financial institutions and the first two farm cooperatives to appear in the “Fortune 500” list of America’s largest industrial organizations. Throughout this evolutionary process thousands of small new businesses have continued to emerge, and the lengthening spectrum of business firms reflects continuing adaptations to changing conditions.

The pattern of urban settlements on the map of the state reflects this process of change and adaptation in the production of goods and services. In the era of the tractor, the truck, the auto, and growing farm productivity, the trend has been inexorably toward bigger centers, bigger markets. The result has been exponential growth in the selection of goods and services and in the number and variety of jobs at the modern, diversified, multi-county out-state trade centers. Those cities have spawned a full array of retail stores, educational facilities, banks, newspapers, and radio and television stations. Meanwhile, the remaining general-store hamlets have become specialized. There has been a continuous adaptation of towns and cities to the changing technologies of transportation, communications, agriculture, and new living standards.

Now the whole productive system stands at the brink of a new era, as the age of cheap fossil fuel draws to a close. Significant changes appear inevitable in the technology and the organization of transportation, building construction, and basic energy supply. New energy supplies may be either more centralized or more dispersed, and conflicting trends will run for a long time. In the face of perhaps one or two generations of experimentation, trial, and error, the historic adaptive abilities that have characterized the Minnesota productive system will be needed more than ever. To meet that need, the vital resources of diversified, technologically advanced industries and capital are large and in place. The maps in this section show how those resources are distributed across the state and how they have evolved.

MINING

Iron ore mining accounts for more than 90 percent of the value of all minerals produced in Minnesota. Historically, iron ore has been extracted from three iron ranges: the Vermillion, the Mesabi, and the Cayuna Ranges (page 52).

The state’s first iron mine opened at Soudan on the Vermillion Range in 1884. Six years later iron ore was discovered on the Mesabi Range and the first mine opened at Mountain Iron in 1892. The Mesabi Range was destined to become the nation’s largest, at one time producing as much as one-fourth of the world’s iron ore and during World II reaching annual production of nearly 50 million tons of natural ore from its open pit mines. Iron mining began on the Cayuna Range in 1911 with an open pit mine northeast of Brainerd (pages 53 to 58).

A NEW ERA

In the late 1970s iron ore was no longer mined from the underground deposits of the Vermillion or from the open pits of the Cayuna and most of the natural ores of the Mesabi had been depleted (pages 59 and 60). Depletion of the Mesabi’s natural ores brought rising unemployment and the prospect of economic hardship to northeastern Minnesota in the late 1950s and 1960s.
THE TACONITE PROCESS

Whereas the natural ores are merely scooped from the ground after stripping off the glacial overburden, taconite must be drilled and blasted to shatter the hard rock, which is then hauled to processing plants where it is crushed and ground to the consistency of powder. The finely ground powder, suspended in water, then passes through magnetic separators to extract the particles rich in iron. Finally, the black, flour-like powder is partly dried, combined with a clay bonding agent, and formed into pellets about one-half inch in diameter that contain about 60 to 65 percent iron. The taconite plants are enormous and expensive engineering feats, representing a capital investment of more than a billion dollars.

<table>
<thead>
<tr>
<th>Years</th>
<th>Natural Ore in millions of gross tons</th>
<th>Improved Natural Ore in millions of gross tons</th>
<th>Taconite in millions of gross tons</th>
<th>Taconite as percent of total</th>
<th>Minnesota Shipments as percent of U.S. shipments</th>
</tr>
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<tbody>
<tr>
<td>1891-1900</td>
<td>4.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25(^c)</td>
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<tr>
<td>1901-1910</td>
<td>20.8</td>
<td>0.1</td>
<td>0</td>
<td>0</td>
<td>50(^d)</td>
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<tr>
<td>1911-1920</td>
<td>32.5</td>
<td>3.6</td>
<td>b</td>
<td>b</td>
<td>59(^d)</td>
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<tr>
<td>1921-1925</td>
<td>27.3</td>
<td>5.5</td>
<td>0.03</td>
<td>0.1</td>
<td>62</td>
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<td>1926-1930</td>
<td>34.1</td>
<td>5.9</td>
<td>b</td>
<td>b</td>
<td>62</td>
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<tr>
<td>1931-1935</td>
<td>11.1</td>
<td>3.1</td>
<td>b</td>
<td>b</td>
<td>60</td>
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<tr>
<td>1936-1940</td>
<td>24.8</td>
<td>7.1</td>
<td>0.01</td>
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<tr>
<td>1941-1945</td>
<td>52.0</td>
<td>15.7</td>
<td>0</td>
<td>0</td>
<td>70</td>
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<tr>
<td>1946-1950</td>
<td>44.3</td>
<td>16.6</td>
<td>0.02</td>
<td>b</td>
<td>68</td>
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<td>1951-1955</td>
<td>46.0</td>
<td>22.4</td>
<td>0.6</td>
<td>0.8</td>
<td>67</td>
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<tr>
<td>1956-1960</td>
<td>26.0</td>
<td>19.3</td>
<td>7.9</td>
<td>14.8</td>
<td>67</td>
</tr>
<tr>
<td>1961-1965</td>
<td>11.0</td>
<td>19.4</td>
<td>16.8</td>
<td>35.6</td>
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<tr>
<td>1966-1970</td>
<td>7.9</td>
<td>17.3</td>
<td>28.7</td>
<td>53.3</td>
<td>63</td>
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<td>1971-1975</td>
<td>2.5</td>
<td>13.5</td>
<td>38.2</td>
<td>70.6</td>
<td>67</td>
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<tr>
<td>1976-1978</td>
<td>0.1</td>
<td>6.6</td>
<td>38.4</td>
<td>85.1</td>
<td>63</td>
</tr>
</tbody>
</table>

a) Some non-iron particles are washed or screened away to improve the ore content before shipping.
b) Insignificant.
c) Estimated.
d) Minnesota production as a percent of U.S. production.
Sources: Mineral Resources Research Center, University of Minnesota; American Iron Ore Association; Historical Statistics of the United States.

Fortunately, University of Minnesota minerals scientist Edward Davis, had been working for nearly half a century on a process to extract iron from the much harder and leaner taconite rock. The first experimental taconite plant had been built near Babbitt in 1922, but the process had not been adequately developed and the plant closed in 1924. The first taconite pellets were produced in a pilot plant at Mountain Iron in 1953. Two years later Minnesota's first large taconite plant was completed by the Reserve Mining Company at Silver Bay, followed by the Erie Mining Company plant at Hoyt Lakes in 1957.

To stimulate taconite development in Minnesota, the Taconite Amendment was approved by the voters of the state in 1964. The constitutional amendment guaranteed taconite developers a 25 year period free from tax increases. This turning point in Minnesota taconite development led to the construction of taconite plants at Eveleth, Nashwauk, Keewatin, Hibbing, and Minnesota's largest plant at Mountain Iron. By the late 1970s taconite concentrates accounted for more than 85 percent of all ores shipped from Minnesota (Table 2).
Source: University of Minnesota Bulletin, Mining Directory Issue
IRON RANGE POPULATION AND IRON ORE SHIPMENTS, 1890

Population

Unincorporated places

Five persons

Incorporated places

- 100
- 250
- 500
- 1,000
- 2,500
- 5,000
- 10,000
- 15,000

Shipments

(Mean annual shipments, 1889 to 1891)

Thousands of long tons, by individual mine

- 1 to 50
- 150 to 200
- 400 to 450
- 750 to 800
- 1200 to 1250
- 1750 to 1800
- 2400 to 2450

Population change from 1885 to 1890

(see inset)

- <1000 or more
- 1500 to <1999
- 2000 to >1999
- 250 to <1999
- 150 to <199
- 149 to <49
- 50 to <199
- 200 to <49
- 100 to <999
- >1000 to <49

Sources: Mining Directory of Minnesota
U.S. Census of Population
J. Webb, 1918
IRON RANGE POPULATION AND IRON ORE SHIPMENTS, 1905

Population
Unincorporated places
- Five persons
- 100
- 250
- 500
- 1,000
- 2,500
- 5,000
- 10,000
- 15,000

Incorporated places
- 1 to 50
- 150 to 200
- 400 to 450
- 750 to 800
- 1,200 to 1,250
- 1,750 to 1,800
- 2,400 to 2,450

Shipments
(Mean annual shipments, 1904 to 1906)
Thousands of long tons, by individual mine

Population change from 1900 to 1905
- +1,000 or more
- +500 to +999
- +250 to +499
- +50 to +199
- +49 to -49
- -50 to -199
- -200 to -499
- -500 to -999
- -1,000 or more

Sources: Mining Directory of Minnesota
U.S. Census of Population
J. Webo, 1958
IRON RANGE POPULATION AND IRON ORE SHIPMENTS, 1960

Population
- Unincorporated places
  - Five persons
- Incorporated places
  - 100
  - 250
  - 500
  - 1,000
  - 2,500
  - 5,000
  - 10,000
  - 15,000

Shipments
(Mean annual shipments, 1959 to 1961)
- Thousands of long tons, by individual mine
  - ≤ 1000 or more
  - < 500 to +999
  - < 200 to +499
  - < 50 to +199
  - < 49 to ≤ 49
  - < 50 to ≤ 19
  - < 200 to ≤ 49
  - < 500 to ≤ 999
  - < 1000 or more

Population change from 1950 to 1960
- Use inset

Sources: Mining Directory of Minnesota
U.S. Census of Population

MESABI AND VERMILLION RANGES

CLAYUNA RANGE

Population change from 1950 to 1960

0 2 Miles

57
HIGH GRADE IRON ORE RESERVES, 1956

Iron ore reserves
in millions of long tons,
by square mile section

- Less than 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- 5 to 6
- 6 or more

Source: Mining Directory of Minnesota
HIGH GRADE IRON ORE RESERVES, 1978

Iron ore reserves in millions of long tons, by square mile section:
- Less than 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- 5 to 6
- 6 or more

Source: Mining Directory of Minnesota
dollars, a replacement cost probably in excess of three billion at 1980 prices (page 61).

For every ton of taconite pellets produced, at least two tons of residue, or tailings, are left over which must be disposed of. Until this year, seven of Minnesota's eight taconite plants disposed of their tailings on land: tailings are carried to an on-land disposal area in a water slurry with the water being recycled. Tailings disposal sites are filled to a designated height and planted with grass and trees to prevent erosion. The one exception to this process was Reserve Mining Company at Silver Bay. As the first of the large, commercial taconite plants, it was granted a permit by the state to discharge tailings directly into Lake Superior. An on-land tailings disposal site a few miles inland from Silver Bay with a closed water cycle opened in early 1980.

MINING COMMUNITIES

The first communities on Minnesota's iron ranges grew conveniently within walking distance of the mines. Gradually, with changes in transportation and depletion of the natural ores, the patterns of settlement have changed considerably (pages 54 through 58). Automobiles provided greater individual mobility and contributed to the beginning of a suburbanization or spreading out of population on the Mesabi Range as early as the 1920s. Following World War II, population dispersal increased rapidly and communities assumed more specialized functions. Retail trade and services became concentrated in Virginia, Hibbing, and Grand Rapids. The smaller towns — such as Gilbert, Mountain Iron, Buhl, Keewatin, and Nashwauk — lost in the competition with the larger centers, their commercial areas deteriorated, and they began to function more as bedroom communities. As the taconite industry developed at new locations, highway transportation improved, providing iron range workers with good access to the new locations. Population on the Mesabi Range today is about 100,000, almost the same as it was three-quarters of a century ago. This region today functions much like a spread-out metropolitan area, held together by a heavily-used highway corridor. In 1979 Minnesota's iron mining industry employed about 15,000 persons, shipped about 45 million tons of ore and pellets with a value of more than 1.6 billion dollars.

AGRICULTURE

EXPANSION OF FARMLAND

The first permanent white settlement in Minnesota was at Fort Snelling in 1819, but agricultural settlement did not begin significantly until the 1850s. Agricultural settlement started in southeastern Minnesota, the sector of the state most accessible to those settlers who arrived by river from the south and the east (page 63). While the first settlement preceded the railroads, railroad construction during the 1860s, 70s, and 80s stimulated settlement and fixed townsite locations across the state. During the last decade of the nineteenth century, the cultivated area advanced rapidly westward and northward to western Minnesota and the Red River valley. After 1900 the frontier of cultivation advanced more slowly for the area most suitable for cultivation had already been settled. The state's cropland reached a limit during World War I. During the 1920s the agricultural frontier retreated, advancing again in the 1930s and early 20s and retreating again in the post-World War II years, fluctuating in response to changing technology and economic conditions. A third advance has been seen in the last decade as new crops (such as sunflowers) and new foreign markets for small grains have brought new land under cultivation in northwestern Minnesota. Since World War II, urban dispersal and encroachment on agricultural lands has brought localized reductions in cultivated lands in eastern Minnesota, particularly within the Twin Cities commuting zone.

To the south and west of the line showing maximum cultivation advance (page 63), lies the major area of crop production in Minnesota. To the north and east of that line is the marginal agricultural sector of the state and the area where forestry, mining, and recreation are the most important economic activities.

Changes in the distribution of agricultural production in Minnesota occurred in conjunction with new agricultural methods, increasing mechanization, and rising economic pressures that began during the 1920s. This led to an increase in average farm size and a decline in the number of farms — a process that was inhibited during the depression years and World War II, but accelerated rapidly after the war. The number of farms in Minnesota declined from 179,000 in 1950 to 99,000 by 1974, while the average
Taconite production in millions of gross tons

18.5
10.0
2.0
0.5

1965
1976
1980 (Projected)

Taconite rail line

Source: Skillings' Mining Review
size of farms increased from 184 to 280 acres during that period (Table 3). The development of hybrid crops and the use of fertilizers and other chemicals brought increased crop yields and increased profits, contributing to the process of change by giving the largest farmers the means to become even larger.

AGRICULTURAL REGIONS TODAY

Land in Farms

The proportion of Minnesota's total land area in farms averaged 54.4 percent in 1974, having declined gradually from a peak of 64.7 percent in 1945. Land in farms in 1974 ranged from more than 90 percent in nine western, southwestern, and southern Minnesota counties, with good soil and little competition for land from non-agricultural uses, to about one-tenth of one percent in Cook County in extreme northeastern Minnesota (page 65). Land in farms is closely related to soil quality (pages 18 and 19), with the highest proportion of land area in farms on the rich prairie soils of southern and southwestern Minnesota and the lacustrine soils of the Red River valley. The shallow, acidic, and infertile soils in many parts of northeastern Minnesota are better suited for timber than for the production of field crops.

Land Harvested

The amount of harvested cropland in Minnesota shows even more clearly the significance of soil quality for crop production (pages 65 and 66). The highest proportion of total land area in harvested cropland is concentrated in southern Minnesota between the stream dissected land of the southeast and the Prairie Coteau of the southwest. Though cropland harvested in the state decreased by 8.2 percent between 1954 and 1974, it increased slightly between 1964 and 1974, from 34.5 percent to 35.3 percent of the total land area. At the same time, land in farms decreased, largely as a result of abandoning marginal areas. The increase in cropland was a direct response to increased grain exports in 1973, resulting in higher prices to farmers, which, in turn, encouraged farmers to increase plantings the following year. The overriding trend since World War II has been a decline in cropland along with a decline in the number of farms. Crop production has been increasingly concentrated in the more produc-
Table 3: Farms, Farm Population, and Farm Products Sold

<table>
<thead>
<tr>
<th>Year</th>
<th>Population In thousands</th>
<th>Farms Number in thousands</th>
<th>Farms Average size in acres</th>
<th>Products Sold Value in millions of dollars</th>
<th>Livestock as percent of total</th>
<th>Average per farm in thousands of dollars</th>
<th>Net Income In millions of dollars</th>
<th>Average per farm in thousands of dollars</th>
<th>Average per farm in thousands of 1967 constant dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1920</td>
<td>903</td>
<td>178</td>
<td>169</td>
<td>N.A.</td>
<td>N.A.</td>
<td>N.A.</td>
<td>N.A.</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>1930</td>
<td>898</td>
<td>185</td>
<td>167</td>
<td>361</td>
<td>74.3</td>
<td>2.0</td>
<td>223</td>
<td>1.2</td>
<td>2.4</td>
</tr>
<tr>
<td>1940</td>
<td>915</td>
<td>197</td>
<td>165</td>
<td>301</td>
<td>64.5</td>
<td>1.5</td>
<td>191</td>
<td>1.0</td>
<td>2.3</td>
</tr>
<tr>
<td>1950</td>
<td>740</td>
<td>179</td>
<td>184</td>
<td>961</td>
<td>70.9</td>
<td>5.4</td>
<td>514</td>
<td>2.9</td>
<td>4.0</td>
</tr>
<tr>
<td>1959</td>
<td>671</td>
<td>146</td>
<td>211</td>
<td>1212</td>
<td>69.1</td>
<td>8.3</td>
<td>388</td>
<td>2.7</td>
<td>3.0</td>
</tr>
<tr>
<td>1969</td>
<td>502</td>
<td>111</td>
<td>261</td>
<td>1748</td>
<td>68.0</td>
<td>15.8</td>
<td>659</td>
<td>5.9</td>
<td>5.4</td>
</tr>
<tr>
<td>1974</td>
<td>440</td>
<td>99</td>
<td>280</td>
<td>3470</td>
<td>49.3</td>
<td>35.2</td>
<td>1552</td>
<td>15.7</td>
<td>10.6</td>
</tr>
</tbody>
</table>

a) Not adjusted for inflation.
b) Estimated.

Note: For Census years 1920, 1930, 1940, and 1950, inventory data are for approximately April 1 of those years; data on crop and livestock production, sales and income refer to the previous calendar year.

Sources: U.S. Censuses of Agriculture; Historical Statistics of the United States; Statistical Abstract of the United States; Bureau of Economic Analysis.

The greatest proportion of land in pasture is located in the dairying area, extending from the southeastern counties to west-central Minnesota (page 67). It can be assumed that pastureland in this area is used most intensively as well. The variation in intensity of use across the state makes a comparison of pastureland difficult.

Pastureland, according to the Census of Agriculture, includes land used exclusively for pasture, woodland which is pastured, and cropland used only for grazing; data are available only for those farms with $2,500 or more in agricultural sales during 1974. According to this definition, 8.5 percent of Minnesota's total land area is used for pasture. Farms with $2,500 or more in sales accounted for 99 percent of all dairy cattle, 93 percent of all beef cattle, 90 percent of all sheep and lambs, and 76 percent of all horses and ponies in Minnesota in 1974. A relatively small number of part-time and recreational farms account for a small additional amount of pastureland used at low intensity. Changes in the definition of pastureland make 1974 census data not directly comparable with earlier censuses. Based upon changes in the numbers of grazing animals, the amount of pastureland in Minnesota has probably decreased by one-fourth to one-third between 1954 and 1974.

CROP SPECIALIZATION

Crops occupy more than one-third of Minnesota's total land area and are usually grown in areas most suited for their production. Corn and soybeans, for example, are concentrated on the rich prairie soils of southern and southwestern Minnesota where sufficient heat and moisture are available during the growing season. Small grains and other cash crops are concentrated in the Red River valley with its deep, rich, lacustrine soils, but where heat and moisture are less than in southern Minnesota.

Shifts in crop production are often a response to changing market conditions. Increasing demands for soybeans, both in the domestic and national markets, have elevated them from insignificance to the state's second most important crop. Increas-
ed production of sugar beets and sunflowers has been a response to expanded market opportunities. Wheat, in long-term decline, expanded again in 1973 when international market opportunities brought unexpected profits to wheat farmers. Flax production has dropped steadily over the past three decades as latex-based paints have replaced oil-based paints, reducing the need for linseed oil. Oats, too, has declined in production as it has been replaced by corn as a feed crop and by wheat as a cash crop (Tables 4 and 5).

**Corn**

Corn is Minnesota's most valuable crop and occupies more acreage than any other crop. In 1974, the value of Minnesota's corn crop was approximately 1.1 billion dollars, which accounted for more than 40 percent of the value of all crops in the state. Corn requires hot, humid weather for maximum production and is therefore most highly concentrated in southern Minnesota (page 70). Corn acreage ranges from 41 percent of the total land area in Martin County to none in Cook County. Over the past half century, new hybrids have adapted corn to drier conditions and a shorter growing season; other hybrids have substantially increased corn production per acre. While the corn frontier has pushed westward and northward to southern Manitoba, corn remains concentrated in the most suitable growing areas of the corn belt, from western Ohio through southern Minnesota to eastern Nebraska and South Dakota. Corn is used primarily as a feed crop, but is also sold as grain for the production of oil, syrup and starch, used in a wide variety of edible and non-edible products.

**Soybeans**

Soybeans are Minnesota's second most valuable crop, worth close to half a billion dollars and accounting for about 18 percent of the value of all crops in 1974 (page 70). The climatic and soil requirements of soybeans are similar to, but slightly more restrictive than, those of corn. As a result, soybean production is less extended toward the north and west. Their production ranged from none in seven northeastern counties to more than 37 percent of the total land area in Faribault County. Since 1939, when information on soybean production was first recorded in the cen-
sus, soybean acreage in Minnesota has increased eighteen and one-half times (page 71). Soybeans are the nation's most important source of vegetable oil and are used as a basic ingredient in a variety of food products. The residue or meal remaining after oil is extracted is used for animal feed and in some food and industrial products. Approximately 40 percent of the United States' soybean crop is exported.

Wheat

The changing patterns of wheat production in Minnesota over the past century are shown on pages 72 and 73. In 1879, wheat production was highly concentrated in the southeastern Minnesota counties. At that time, it was the major crop in the settled portion of the state, with the proportion of total land in wheat ranging up to more than 41 percent in Goodhue County (page 72).
Table 5: Rank in Value and Acreage of Major Crops

<table>
<thead>
<tr>
<th>Crops</th>
<th>Rank in Total Value</th>
<th>Rank in Acreage</th>
<th>Rank in Value per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Soybeans</td>
<td>7</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Wheat</td>
<td>5</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Hay</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Oats*</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Sugar Beets</td>
<td>11</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Barley*</td>
<td>6</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Potatoes</td>
<td>8</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Vegetables</td>
<td>9</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Flax*</td>
<td>4</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Sunflower Seeds*</td>
<td>14</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>Nursery Products*</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Field Seed Crops*</td>
<td>10</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>Tree Fruits &amp; Berries</td>
<td>13</td>
<td>13</td>
<td>14</td>
</tr>
</tbody>
</table>

* 1974 data only for farms with $2,500 or more in agricultural sales.
Source: U.S. Censuses of Agriculture.

Wheat acreage increased from 6.0 percent of Minnesota's total land area in 1879 to 7.5 percent in 1920 and, like the patterns of settlement, moved west and northwest toward the Red River valley where the drier climate was more suitable for the production of the hard red spring wheats. Wheat production continued to shift westward to North Dakota, Montana, and the Canadian provinces of Saskatchewan and Alberta, while winter wheats from Kansas, Oklahoma, and Texas assumed a greater portion of the American wheat market. As a result, Minnesota wheat production declined and by 1969 occupied only 1.6 percent of the total land area of the state, concentrated in the Red River valley. Foreign demand for United States wheat resulted in major wheat exports in 1973 and in higher prices for farmers. The following year other cropland (and some pastureland) in western Minnesota was converted to wheat production.

Prospects are that wheat will be an important commodity in international trade in the future, with Minnesota producers supplying a share of the growing, unstable international market.

Hay

Hay was produced on nearly 2.8 million acres or 5.5 percent of Minnesota's land area in 1974 (page 74). Nearly two-thirds of the hay acreage was alfalfa, Minnesota's most valuable hay crop. Timothy, clover, wild hay, and other hay crops make up the balance of Minnesota's hay production and tend to be grown on
CHANGE IN SOYBEANS
1939 to 1974

Land in soybeans, 1974
as multiple of 1939

- See footnotes
- 1 to 10 times
- 10 to 100 times
- 100 to 285 times

State average: 18.5 times

Source: U.S. Census of Agriculture

Legend:

\( ^a \) no soybean production in either 1974 or 1939
\( ^b \) no soybean production in 1939; data not available for 1974
\( ^c \) no soybean production in 1974; 11 acres in 1939
\( ^d \) 225 acres of soybeans in 1974; no production in 1939
\( ^e \) 1021 acres of soybeans in 1974; data not available for 1939
\( ^f \) 660 acres of soybeans in 1974; data not available for 1939
\( ^g \) 61 acres of soybeans in 1974; 134 acres in 1939
the poorer soils. In northeastern Minnesota, non-alfalfa hay is the largest crop in acreage.

Hay production is closely correlated with the dairying areas of the state. Carver County, for example, the state’s most intensive dairying county, has 15 percent of its land in hay, three-quarters of which is alfalfa. Hay is most commonly fed to livestock on the place where it is produced, but some hay is grown as a cash crop.

Oats

Oats are used primarily as feed for livestock, usually consumed on the farm where they are produced. Oats have been an excellent feed grain in areas too cool for corn production. With the development of hybrid corn, adapted to a shorter growing season, corn has gradually replaced oats as a livestock feed along the margins of the corn belt (page 75). The increase of wheat exports encouraged a shift from oats to wheat as a cash crop, particularly in the Red River valley and west-central Minnesota on the margins of the wheat-producing area. As a result of these two factors, oats acreage in Minnesota dropped by two-thirds between 1954 and 1974 and Minnesota dropped to the nation’s second ranking oats producer, behind South Dakota. Estimates since the 1974 census indicate that Minnesota has regained its top rank. Nearly half the 1954-74 decrease in oats acreage occurred between the 1969 and 1974 censuses, largely as a result of the shift from oats to wheat.

Sugar Beets

Sugar beet production in Minnesota is confined to those areas of the state that are most accessible to processing and marketing facilities. Sugar beet processing plants are located at East Grand Forks, Crookston, Moorhead and Renville (page 75). Production is highest in Polk and Clay Counties, the location of the three older plants. In 1974 Minnesota ranked second to California in sugar beet production, with about one-sixth of the nation’s sugar beet acreage.

Potatoes

Potato production is common throughout the state, with a high percentage of farms producing some potatoes for home use or
local sale. The four areas of intensive production are: just north of the Twin Cities area, in Pope County, the Red River valley, and in Freeborn County (page 76). The area to the north of the Twin Cities—Sherburne, Isanti, Anoka, and the northern Hennepin Counties—has produced potatoes for the Twin Cities market for many years. Pope County production, likewise, has been oriented toward the state market for whole unprocessed potatoes. Potato production, processing and marketing facilities in the Red River valley and at Hollandale in Freeborn County have been based on the increased consumption of processed potatoes such as potato chips, french fries, and dehydrated potatoes. In 1974 Minnesota ranked fifth among the states in potato acreage.

**Vegetables**

Vegetables are grown widely across the state, but commercial production is most concentrated in south-central Minnesota (page 77). Minnesota is the nation's leading producer of sweet corn for the canning industry and is also a leader in the production of peas, beans, and other canned vegetables. The production of these crops reflects, in part, the location of an optimal combination of soil, climate, and rural culture; but the pattern has been reinforced by the building of vegetable canning and freezing plants located in Fairmont, Glencoe, LeSueur, Rochester, Montgomery, Owatonna, Arlington, Blue Earth, Caledonia, Cokato, Faribault, Kenyon, Olivia, Ortonville, Plainview, Waseca, Wells, Winnebago and Winsted (page 123).

**Sunflower Seeds**

The cultivation of sunflower seeds has increased rapidly in Minnesota in recent years, with growing use of sunflower seeds for oil and as nuts in confectionary foods. Production in Minnesota is concentrated in the Upper Red River valley, particularly Wilkin and Traverse Counties (page 77), where there are nearby processing and marketing facilities. In 1974, Minnesota produced 62,000 tons of sunflower seeds, one-fourth of the nation's production, ranking second behind North Dakota.
Grass Seeds

The production of grass seeds, including bluegrass, timothy and clover, is highly concentrated in Roseau County (page 77). In 1974, Minnesota led the nation in timothy seed production (46 percent) and in sweet clover seed production (44 percent) and ranked fourth in bluegrass seed production.

Wild Rice

Minnesota’s nation-leading production of wild rice was about four and one-half million pounds in 1977, one-third gathered from natural wild rice stands and two-thirds cultivated. The leading area of cultivation in Minnesota is just west of Lower Red Lake, located mostly in Clearwater County (page 78). Aitkin County leads in total production with both domesticated and natural stands of wild rice. Contrary to what its name suggests, wild rice is not related to rice at all. It is an annual grass that requires very specific growing conditions, including low-sulphate fresh water of three to four feet in depth (without much fluctuation) on an organic lake bottom. These conditions are well met in parts of north-central Minnesota. University of Minnesota wild rice experts estimate that the potential for domestic wild rice production in Minnesota is great, but requires substantial capital investment in equipment and water management, refinement of production methods, skilled producers, and improvement of processing and marketing facilities.

LIVESTOCK

As a source of income to Minnesota farmers, livestock and livestock products have outranked crops in value and sales over the past half century, except in 1973 and 1974 (Table 3). Estimates since that time indicate that livestock sales have again exceeded crop sales. It should be emphasized, however, that many of the crops grown on Minnesota farms are not sold directly, but are fed to livestock and marketed indirectly as meat, milk, eggs, and other livestock and poultry products. Dairy production in Minnesota retains a slim lead over beef in the value of sales. Hog production ranked third in 1974, a decline in its relative importance in Minnesota’s overall livestock industry. Turkey production has
grown rapidly, ranking fourth in 1974, while other poultry production and sheep and lamb production lagged far behind (Table 6).

**Dairy Cows**

Minnesota ranks fourth nationally behind Wisconsin, California, and New York in whole milk production, first in dry milk production, second in butter, and second in cheese production. Minnesota's dairy belt extends from southeastern Minnesota, to west-central Minnesota, being closely associated with the hilly, deciduous woodland and somewhat less fertile soils of that area in comparison to the prairie lands. This is an area well suited for grazing and closely related to the state's pastures (page 67). Carver County, on the southwest edge of the Twin Cities metropolitan area, is Minnesota's most specialized dairying country, with more than sixty dairy cows per square mile (page 80).

Between 1929 and 1974 the number of dairy cows in Minnesota decreased by 43 percent, from about 1.4 million to .8 million. Although the consumption of dairy products per capita declined slightly during this period, the most important factors influencing the decline were increasing cattle specialization (rather than dual-purpose beef-dairy cattle) and increasing milk

<table>
<thead>
<tr>
<th>Table 6: Livestock and Livestock Products Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Total sales</strong> (in millions of dollars(^a))</td>
</tr>
<tr>
<td>Dairy Products</td>
</tr>
<tr>
<td>Cattle and</td>
</tr>
<tr>
<td>Calves</td>
</tr>
<tr>
<td>Hogs and Pigs</td>
</tr>
<tr>
<td>Turkeys</td>
</tr>
<tr>
<td>Chickens</td>
</tr>
<tr>
<td>Eggs</td>
</tr>
<tr>
<td>Sheep and</td>
</tr>
<tr>
<td>Lambs</td>
</tr>
</tbody>
</table>

\(^a\) Not adjusted for inflation.

\(^b\) Estimated.

Source: U.S. Censuses of Agriculture.
production per cow. The largest decline in dairy production occurred in the south-central counties which are better suited for corn, soybeans, hog and beef production (page 80). Dairying, like most types of agriculture, has become more mechanized, allowing one operator to manage a larger number of cows. As a result, the average number of dairy cows per farm in Minnesota increased from less than ten in 1929 to twenty-seven in 1974, with less than one-sixth the number of farms keeping dairy cows. Dairying has become larger scale, more specialized, and concentrated in the areas of the state best suited for it. Like the small dairy farm, the small creamery has given way to fewer but larger creameries concentrated in the major dairying area. Dairy production requires large amounts of energy, used in milking, storage, transport, processing, packaging, and delivery to the consumer. In recent years American per capita consumption of all dairy products except cheese and dry milk has decreased. These factors suggest that Minnesota's dairy industry will probably continue to concentrate in the present major areas of production.

**Beef Cattle**

The census inventory of December 31, 1974 recorded 657,260 beef cattle on Minnesota farms. Distribution ranged from less than one per square mile in northeastern Minnesota to forty-four per square mile in Fillmore County in southeastern Minnesota (page 81). Between 1929 and 1974, beef cattle increased more than ten times, while dairy cows decreased about 43 percent (page 81). The net change in the combined total of dairy and beef cattle during that period was less than 16,000, a decline of about 1 percent. In the past it was common to keep dairy cattle first for milk and later for meat, but farmers found that they are able to provide better quality dairy and meat products with higher profits through specialization. Specialization has been a major factor in the decline in the number of dairy cows and the increase in beef cattle in Minnesota.

Dairying uses land and labor more intensively and is oriented more to the market than is beef production. For these reasons dairying has become more concentrated near the state's urban areas while the southeastern margins of the dairy belt have shifted to beef grazing and the northwestern margins have been shifted to cropland or left to reforestation. Beef production, on the other hand, has become concentrated in the southeast and southwest areas of the state, where good grazing lands are available along with the production of feed crops. Beef processing facilities have become increasingly decentralized, moving away from South St. Paul toward the areas of production.

**Horses**

Horses today are seldom used as draft animals as they were in the pre-tractor era. The 40,000 horses and ponies in Minnesota in 1974 were kept almost exclusively for sports and recreation. Their location is related to the general distribution of pastureland (page 67), but also to the commuting range of the state's major employment centers. The largest number of horses are found on the west and east edges of the Twin Cities metropolitan area and near Rochester in Olmsted County (page 82).

**Sheep**

Sheep and lambs in Minnesota numbered 359,000 in 1974 — less than half the number recorded in the census ten years earlier. While sheep production has declined in Minnesota, there has been a noticeable increase in southwestern Minnesota (page 82). Declining production in northern Minnesota has been attributed in part to an increasing timber wolf population in recent years.

**Hogs**

Minnesota's hog population is most heavily concentrated in the southern tier of counties, declining gradually toward the north (page 83). Hog production is closely tied to corn production, the principal feed. Outside the corn growing areas of the state, oats and barley are used as feed for hogs. The nearly three million hogs in Minnesota in 1974 were about 10 percent less than the number in 1929 although both the average weight and total meat production were substantially greater (page 83). Annual variation in hog production, often exceeds 10 percent, as the relatively short gestation period allows hogs producers to be more responsive to market fluctuations than are beef producers. Hog production has spread into the central and north-central parts of the
state along with the northward movement of corn production. As in other types of agriculture, hog production has become more specialized, changing from many farms with a few hogs in 1929 to a few farms with many hogs by 1974. The decentralization of both markets and processing facilities has further encouraged geographic concentration and farm specialization. In 1977, Minnesota ranked third among the states in hog production, behind Iowa and Illinois.

*Turkeys*

Minnesota leads the nation in turkey production, accounting for about one out of every six turkeys produced. Between the censuses of 1939 and 1974, turkey production in Minnesota increased by more than nine times. As a result of effective marketing, turkey consumption has changed from a once-a-year occasion to a year-round occurrence. Turkey has become a familiar component of the American diet. Turkey production in Minnesota is concentrated with a small number of large producers; sixty-two farms, each with at least half a million dollars in sales, sold over 14 million turkeys in 1974, accounting for 63 percent of Minnesota's total production.

Comparison of the maps on page 85 indicates the increasing concentration of turkey production in a few counties, particularly in west-central Minnesota. At least thirty of Minnesota's eighty-seven counties decreased in production between 1939 and 1974, in spite of the overall state increase. High concentrations of turkey production are reflected in the withholding of information by the census for certain counties in 1974 so as to avoid disclosing information about individual turkey producers. For this reason, the maps on page 85 have a large number of counties for which data is not available.

*Chickens*

Chickens are kept for either egg or meat production. Most meat chickens are *broilers*, raised as meat and sold before three months of age (page 86). Laying hens (or those over three months of age) are represented on page 87 as *chickens on hand*. The number of chickens on hand declined by 43 percent between 1939 and 1974; information on the actual number of eggs produced is not available. Egg production in Minnesota probably increased during the same period. It has become highly scientific, with precise diets and mass production. Hens are kept only as long as they produce eggs profitably. Between 1939 and 1974 egg production shifted from a few chickens on most farms across the state to a few large-scale egg producers in scattered locations. Though the number of laying hens in Minnesota decreased, fourteen counties realized increases, most notably Clearwater County (550 percent) and Clay County (154 percent). Minnesota egg production is estimated to exceed egg consumption in the state by at least 50 percent.

The number of chickens raised as meat in Minnesota in 1974 was less than half the number produced in 1939, but eight counties increased in meat chicken production, most notably Benton County (by more than twenty-one times) and the nearby counties of Morrison, Stearns, and Wadena, thus making central Minnesota the major broiler producing area of the state. Even so, Minnesota produces less than half the meat chicken it consumes.

**FARM OPERATIONS**

*Size of Unit*

The 1974 Census of Agriculture reported average farm size in Minnesota to range from 747 acres in Kittson County in the northwest to 36 acres in Ramsey County (the only county where average farms size has decreased). In general, farm size depends on the productivity of the land, the type of farming, and the amount of part-time farming.

In the main agricultural region of the state, farms tend to be larger toward the west, where it is drier, and toward the north, where the growing season is cooler and shorter. In both cases, larger farm size tends to compensate for lower productivity.

Dairy farms are smaller and have grown more slowly than other types of farms. Mechanization has been slower and more limited than in crop farming. The size of the herd is harder to change so dairy farms have not enlarged rapidly. Within the traditional dairy region, the greatest change in farm size has come in the rural southeast, central, and west-central counties, where many individual farms have been converted from dairying to beef,
hogs, and especially cash crops since World War II.

Another factor influencing farm size is the availability of non-agricultural employment to supplement farm income. This is an important influence especially where farms are within commuting distance of the Twin Cities area or in the relatively urbanized southeast. Where other employment options are accessible, there is less pressure to increase farm size.

Hennepin County farms increased 81 percent in size, on the average, between 1920 and 1974, but this represents an exception to the general pattern, and is probably the result of residential subdivision of small farms on the urban fringe and consolidation of farms in rural western Hennepin County. Ramsey County experienced a decrease in average farm size during the same period, while the number of farms also decreased from 983 to 80, being squeezed out by the expanding urban area within the state's smallest county.

All types of agriculture in the state have experienced a continuing increase in average farm size for at least the past half-century (pages 89 through 91). Between the censuses of 1920 and 1974, farm size in Minnesota increased on the average by 111 acres (or 66 percent) to an average of 280 acres in 1974. The farms of northeastern Minnesota, already the largest in 1920, increased most, both in acreage and percent. The farms of northeastern Minnesota, somewhat smaller than those in the Red River valley in 1920, increased rapidly in size, while the number of farms and amount of farmland declined more quickly than in other parts of the state.

In the thirty year period between 1920 and 1950 average farm size in Minnesota increased by 15 acres or 9 percent; in the twenty-four year period between 1950 and 1974, average farm size increased by 96 acres or 52 percent. The acceleration in farm size increase in the post-World War II period was facilitated by rapid mechanization of agriculture, allowing a single family to manage a much larger farm operation. Increased mechanization has also encouraged specialization and a movement away from growing food for home consumption. In competition with one another, the larger, more efficient and more productive farms, those with the most capital, have had an advantage.

Tenant Operators

Farmers who do not own land, but operate on land they rent from others (for cash or share) are defined by the census as tenant farmers. In 1974, 9.9 percent of Minnesota's 98,537 farms were tenant-operated, with a high of nearly 27 percent in Martin County (page 92). Tenant farms tend to be the areas of higher land value and high productivity in southern and southwestern Minnesota. Whereas higher land values probably discourage land purchase, the good soils also offer a potentially greater return to the operator. Tenant farmers are usually young, aspiring farmers without the means to purchase their own land. For these persons, tenancy serves as a transition or trial period preceding ownership. Typically, the length of tenancy is only a few years, before the result is realized in farm ownership or alternative employment.

Since 1945 there has been a continuous decline in the number and proportion of farms that are tenant-operated (pages 91 and 92). During this period the actual number of tenant-operated farms has declined from over 50,000 to less than 10,000; down 81 percent, as compared to a decline of 36 percent in the number of owner-operated farms. This suggests that there are fewer opportunities than ever for aspiring but non-capitalized farmers to break into agriculture.

Part-time Operators

Families on about one in five farms in Minnesota in 1974 had a greater income from non-agricultural sources than from operation of the farm (page 99). In northeastern Minnesota and near the state's major urban areas, families on small farms are able to survive by supplementing farm income with non-agricultural employment. In areas of the state that do not have nearby employment opportunities, the small farmer faces the difficult choice of staying in business and struggling or selling out entirely. Where soil productivity is high, farm income is also high and there is generally less need for supplemental income. Farmers receiving a majority of their income from non-agricultural sources are thus most common in marginal agricultural areas.
and in the most urbanized areas of the state. Conversely, part-time farms are least common in the state's most productive and least urbanized areas.

**Tractors**

The average Minnesota farm had 2.6 tractors in 1974. The fewest per farm were found in the far northeast and around the urban areas. The largest number per farm were found in the Red River valley with its large, full-time crop farms, and in south-central Minnesota with its high income and full-time crop-livestock farms.

On a square mile basis, the counties of Minnesota's dairy belt have the highest density of tractors (page 94). Carver County, for example, with its small, prosperous dairy farms, had an average of 9.2 tractors per square mile, compared to a state average of 3.3. Where crops are auxiliary to livestock production, as in the dairy regions, tractors are generally smaller than those in the major cash crop producing areas of the state.

**Fertilizer**

Fertilizer use in Minnesota is shown on page 94. Fertilizers are used most where the soil is most productive and where major cash crops are being grown, such as soybeans, corn, vegetables for canning, sugar beets, potatoes, wheat, and sunflowers. In areas of the state where soils are naturally productive, the measured application of fertilizers and water adds significantly to the efficiency of crop production. Thus, commercial fertilizer use is most concentrated in south-central Minnesota. This area also happens to be in the Minnesota River drainage basin, with its relatively low level of runoff (page 27). The combination of these factors contributes to a high level of chemical nutrients that contaminate the water of the Minnesota River and its tributaries.

**Water Management**

The removal of excess water is a problem in many parts of Minnesota where potentially productive lands are flat and low-lying with poor natural drainage. Tiles, ditches, or other means of water removal have been constructed on an average of 8.6 percent of Minnesota's total land area. Land drained for agriculture reaches 39 percent on the rich, rolling prairie soils of Faribault County (page 95). Sixteen southern Minnesota counties and two Red River valley counties exceed 20 percent. Investment per acre in land drainage is highest in the southern region, where virtually all of the tiling is concentrated.

While the removal of water is a much more common management need, the addition of water through irrigation is found in many Minnesota counties. Though not yet commonplace, the use of supplemental water is expanding, particularly in areas where drought risk is high, such as on the sandy outwash plains in Sherburne and Dakota counties, with 3.9 and 1.4 percent of their total land areas, respectively, in irrigation (page 95). Irrigation is provided mostly through overhead sprinkler systems, using underground water sources.

**Value of Farm Products Sold**

The value of farm products sold per acre of farmland is directly related to soil productivity, the intensity of agricultural development, and the market value of particular products. The highest value per acre is in southern Minnesota along the Iowa border, while the lowest is in northeastern Minnesota (page 96). The Twin Cities metropolitan area has a relatively high value of production per acre because of the intensity of agricultural development. Ramsey County, for example, with only eighty farms, averaging thirty-six acres in size and with 3 percent of its land in farms, had an average value of farm products sold per acre of $1,085 — nearly five times the next highest county, or nearly nine times the state average.

The value of farm products sold per farm reflects not only soil productivity, intensity of development, and type of product, but also the size of farm (page 96). Crop value remained high in 1974 following unexpected foreign demands for wheat the preceding year. As a result, the area from the Red River valley to south-central Minnesota was significantly above the state average of $35,200 per farm (Table 3). Wilkin County, with an average of $76,040, was the highest in the state.

The total value of agricultural products sold in 1974 was 3.47 billion dollars, of which 49.3 percent or 1.71 billion dollars was
TRACTORS 1974

Tractors per square mile of total land area
- Less than 2
- 2 to 4
- 4 to 6
- 6 to 8
- 8 or more

State average: 3.3

Source: U.S. Census of Agriculture

FERTILIZER 1974

Tons of commercial fertilizer used per square mile of total land area
- Less than 5
- 5 to 10
- 10 to 20
- 20 to 30
- 30 to 40
- 40 or more

State average: 16.2

Source: U.S. Census of Agriculture
from the sale of livestock and livestock products and 50.7 percent or 1.76 billion dollars was from the sale of crop (including nursery and forest products). Cash crops are generally concentrated on the more productive soils in the state. Livestock tends to be more important than crops where there are rough or rocky areas more suited for grazing as in the area from southeastern to west-central Minnesota, extending northward and eastward, and in the Prairie Coteau of southwestern Minnesota. Crops are relatively more important in the south-central and Red River valley areas — the areas where land is most nearly flat and investment in drainage is greatest. The value of crop production as a percent of total production reaches a peak of 93.2 percent in Kittson County in extreme northwestern Minnesota, while livestock production reaches a high of 92.0 percent of all products sold in Mille Lacs County in the east-central Minnesota dairying area.

Livestock production was relatively more important in 1939 than in 1974, when nearly two out of three farm dollars came from the sale of livestock and their products (pages 97 and 98). In 1939 farmers in only four counties received less than 40 percent of their income from livestock. Kittson was the lowest at 29.7 percent and Kanabec the highest at 94.9 percent. Livestock remained more important than crops in Minnesota until 1973 when foreign crops sales increased significantly. In response to the higher prices, cropland acreage (in wheat, particularly) increased the following year. Much of the change in western and northwestern Minnesota, shown on page 98 occurred within a single year, when Red River valley counties increased their specialization in crop production. Some south-central Minnesota counties experienced a more gradual shift from livestock to crop production during the 1939 to 1974 period as a result of the expansion of vegetable crops and processing plants at certain locations. The map also suggests an expanding ring of high intensity agricultural land use within the metropolitan area and a shift from livestock to crop production. A growing emphasis on the production of market-oriented fresh vegetables in the metropolitan area has pushed dairying a little farther away.

In central and east-central Minnesota, two additional factors have been operating to increase the importance of livestock: a decline in crop production on the relatively poor soils north of the Twin Cities has increased the importance of livestock production, and a rapid growth in the poultry industry has occurred —
turkeys in Kandiyohi and Swift Counties; broilers in Stearns, Benton and Morrison Counties; and eggs in Clearwater County. The relative increase in livestock production in southwestern Minnesota is the result of increased specialization in beef cattle. Livestock has remained more important than crop production in southeastern Minnesota as dairying has shifted to beef production in recent years.

Value of Land and Buildings

The value of land and buildings is presented in two ways: per farm, and per square mile of total land area. The average value per farm in Minnesota increased from $4,300 in 1900 to $39,000 in 1964 and to $120,000 in 1974 (pages 100 and 101). Part of that increase was a result of the growing size (page 90) and declining number of farms (Table 3). The highest values per farm are found in south-central Minnesota and the lowest in the northeastern part of the state. Recent increases in the concentration of high value farms in the most productive soil areas were the result of crop export increases in 1973, which in turn were reflected in land values the following year (page 101). Competition for land from non-agricultural uses also influences land values, as in Dakota and Ramsey Counties.

Changes in dollar value of farms between 1900 and 1974 are shown on page 101. Highest increases were in south-central Minnesota, the Red River valley, and, to a lesser extent, on the fringe of the Twin Cities metropolitan area.

The amount of land in farms reached a peak (33.1 million acres) in Minnesota in 1945, declining to 27.6 million acres by 1974. Farmland decreased most rapidly in the marginal agricultural areas of north-central and northeastern Minnesota. The average census value of farmland in Minnesota increased from $26 per acre in 1900 to $166 per acre in 1964 and $429 per acre in 1974, the largest increases being in south-central Minnesota and around the Twin Cities metropolitan area.

The value of land and buildings per square mile of total land area is shown on pages 102 and 103. These four maps are arranged by quartile (four equal numerical groups) to allow comparison of locations from one map to another.

In 1900 the highest quartile lay south and east of a line between the Twin Cities and Fairmont. By 1964 the highest quartile
had shifted slightly to the west and by 1974 it had moved to south-central and southwestern Minnesota, with a high of $540,000 per square mile in Martin County. Thus the highest investment in farm improvements gradually shifted from the areas developed first to the areas of highest natural productivity.

FORESTRY

At the time of the first permanent white settlement, about 40 percent of Minnesota was covered by pine, spruce, and fir forests and an additional quarter of the state was covered by hardwoods such as maple, oak, elm, and basswood, with cottonwood and ash in the river valleys of southern and southwestern Minnesota (page 23). Most of the hardwoods were gradually cut and the land converted to crop or pasture uses. The state’s dairy region now comprises much of the former hardwood belt of the state. The commercially valuable softwoods of central and northeastern Minnesota were the base of Minnesota’s lumbering industry in the late nineteenth and early twentieth centuries. Following clear-cutting, much of the former softwood area was replaced by the natural regrowth of aspen and birch. Today aspen and birch occupy nearly one-fifth of the state’s total land area, while pine, spruce and fir together and other hardwoods each occupy about 9 percent.

In 1977, 27 percent of Minnesota’s total land area was commercial forests (page 105). The proportion of land area in commercial forests ranged from near zero in southwestern Minnesota to more than three-fourths in Itasca County. An additional 10 percent of Minnesota’s land area is forested, but not of commercial value (page 25). Commercial forest land is defined as land which does or can produce crops of industrial wood and which is not withdrawn from such use by statute or administrative regulation.

Between 1962 and 1977 the amount of commercial forest land in Minnesota declined from 30.4 percent to 27.0 percent. Only five of the state’s eighty-seven counties increased in acreage of commercial forest land — Itasca, Sherburne, Hubbard, Wabasha and Winona — largely as a result of improved forest management techniques (page 105). The greatest percentage declines in commercial forest land were in other northeastern Minnesota counties. Cook, Lake, and St. Louis had an average net loss of 14 percent of their commercial forest land, or a total of some 640,000 acres over that fifteen year period. While total acreage declined in most areas of the state, the volume of growing stock increased by an average of 25,000 cubic feet per square mile (page 106). Commercial forest lands increased at the greatest rate in the marginal agricultural counties where some cropland and pastureland were left to natural reforestation. Except for Koochiching and Lake Counties, the heavily wooded counties increased in growing stock volume between 1962 and 1977. Differences from county to county are apparently the result of varying forestry practices. Increases in timber volume were seen in the major hardwood forest areas of the state, but decreases continued in most prairie counties of southern and southwestern Minnesota.

The timber stock on commercial forest lands in Minnesota was valued at approximately 253 million dollars in 1977 (page 107). Itasca and Cook Counties had the highest values; 10.7 and 11.5 thousand dollars per square mile, respectively. Though the volumes of timber are lower, the higher value of southeastern Minnesota hardwoods is apparent (page 107).

In 1975, 133 million cubic feet of timber was cut in Minnesota, valued at 40 million dollars (page 108). Of this amount, 72.6 percent was used for pulpwood production, 20.8 percent for saw timber, and 6.6 percent for other purposes such as veneer logs, posts, poles, and pilings. Timber cutting by county ranged up to 6.7 thousand cubic feet per square mile of total land area in Itasca County and 7.2 thousand cubic feet in Koochiching County (page 108). The cutting patterns are unstable, however. Cutting in Koochiching County exceeds the rate of reforestation, whereas the replacement of growing stock exceeds the cutting rate in Itasca County.
MANUFACTURING

In the past, most of Minnesota's manufacturing industry has been based on natural resources, on the processing of agricultural, timber, and mineral products. But industry has gradually changed until the largest corporate employers in the state are now no longer directly related to Minnesota's natural resources, but to new technologies. Minnesota's economy has become more diversified, similar to the national economic structure. Though manufacturing employment has been growing at a greater rate in Minnesota than nationally, the proportion of Minnesota's labor force engaged in manufacturing remains slightly below the national average. Manufacturing accounted for 20 percent of Minnesota's total employment in 1976, compared to a national average of 23 percent.

The majority of Minnesota's industries are now located here for reasons other than materials or market. Many draw supplies from distant and widely scattered places and manufacture products for regional, national and foreign markets. These industries are in the state because they started here and choose to remain. Most of the state's manufacturing industries are homegrown - products of local ideas and entrepreneurship that through ingenuity and hard work have overcome the disadvantages of Minnesota's location. As a result, many of these industries have remained in the home communities of their founders. They stay and prosper in Minnesota by choice. In 1974, thirteen of the nation's 500 largest corporations were Minnesota-based and all but one were originally established in Minnesota by Minnesotans. Among metropolitan areas of one million or more, the Twin Cities was second only to Boston in the number of ten million dollar corporations per capita.

GEOGRAPHIC DISTRIBUTION OF MANUFACTURING

Like the patterns of settlement in Minnesota, manufacturing employment started in the southeast and spread throughout the state. From the small-scale, locally based enterprise with a local market (such as bakeries, blacksmith shops, print shops, and breweries) manufacturing has grown into large scale interdependent corporations with world-wide marketing and distribution. The growth in scale has brought a concentration of manufacturing employment to the Twin Cities area. There the amount of manufacturing employment increased from 52 percent of the state total in 1870 to 66 percent in 1929 and 68 percent in 1947 (Table 7 and pages 110 and 111).

Changing Patterns

Manufacturing employment in the seven county Twin Cities area reached 207,000 persons in 1967, more than 69 percent of the state's total. But the rate of manufacturing growth in the Twin Cities area dropped sharply between 1967 and 1977, increasing by only 3 percent and 5,000 employees, while its share of the state total manufacturing dropped from 69 to 64 percent. Increasingly manufacturing has been moving to locations beyond the Twin Cities area, within what is called the state's industrial triangle (that area south of a line, roughly, from Eau Claire to Brainerd to Sioux Falls). Manufacturing employment increased in that area (excluding the seven metropolitan counties) by 36 percent and more than 23,000 employees between 1967 and 1977 (Table 7). During the same period, the balance of the state continued to grow slowly in numbers of employees and its share of the state total continued to decline slightly.

Table 7: Manufacturing Employment by Area

<table>
<thead>
<tr>
<th>Year</th>
<th>Twin Cities Seven County Area</th>
<th>Remainder of Industrial Triangle</th>
<th>Remainder of Minnesota</th>
<th>Minnesota Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Employment in thousands</td>
<td>Percent of state total</td>
<td>Employment in thousands</td>
<td>Percent of state total</td>
</tr>
<tr>
<td>1929</td>
<td>68.2</td>
<td>65.9</td>
<td>20.5</td>
<td>19.8</td>
</tr>
<tr>
<td>1939</td>
<td>51.3</td>
<td>64.3</td>
<td>17.2</td>
<td>21.5</td>
</tr>
<tr>
<td>1947</td>
<td>122.8</td>
<td>68.2</td>
<td>34.6</td>
<td>19.3</td>
</tr>
<tr>
<td>1958</td>
<td>136.8</td>
<td>65.4</td>
<td>47.7</td>
<td>22.8</td>
</tr>
<tr>
<td>1967</td>
<td>207.1</td>
<td>69.1</td>
<td>65.1</td>
<td>21.7</td>
</tr>
<tr>
<td>1977*</td>
<td>212.4</td>
<td>64.3</td>
<td>88.4</td>
<td>26.8</td>
</tr>
</tbody>
</table>

* Preliminary.

Source: U.S. Censuses of Manufactures.
Dispersal of Production

Distinguishing between two elements of manufacturing employment — production employees and nonproduction employees — is helpful in understanding these patterns of change. Following World War II, manufacturing production employment* began to decentralize to rural Minnesota: the seven county Twin Cities area proportion dropped to 59 percent by 1972 (page 112). The largest numerical increase in manufacturing production employment during that post-war period occurred in the metropolitan fringe and in McLeod, Stearns, and Olmsted Counties, all within eighty miles of the Twin Cities area. The largest percentage increases during the post-war period were widely dispersed around the state and included Roseau, Kittson, Clay, Mille Lacs, and other counties. During the 1947-1972 period, manufacturing production employment in the Twin Cities area increased by 25,600 while the remaining eighty counties of the state, with about an equal population, increased by 38,900 (page 112).

Many industries found it profitable to locate production operations in rural Minnesota, taking advantage of the productivity and relatively low cost of rural labor (page 113). Exceptions to this growth trend are seen in St. Louis, Scott, Beltrami, Dakota Carlton, Cass, and Cook Counties. There decreases are related to the production and processing of minerals, timber, and agricultural products, where increased mechanization has reduced labor requirements in processing.

Concentration of Offices

Meanwhile, manufacturing non-production employment** has become more concentrated in the Twin Cities area (page 113). In fact, supportive or non-production employees have increased in greater numbers than have production employees. In 1972, more

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*Production employment includes workers engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packaging, warehousing, and shipping, as well as those who provide maintenance, repair, janitorial services, guarding services, product development, power production, record-keeping and other services closely associated with production operations. Supervisory employees above the working foreman level are excluded from this category. This definition, which is used on pages 111 and 112 is not strictly comparable with the data for 1970 and 1972 shown on page 110. Data available for these census years include certain administrative, distribution, and construction personnel.

**Non-production employment includes those in factory supervision above the working foreman level, sales, delivery, advertising, credit, collection, installation and servicing of products, clerical, executive, purchasing, financing, legal, personnel, professional, and technical functions.
than 74 percent of Minnesota's non-production employees were located in the Twin Cities metropolitan area. This centralization provides opportunities for efficient administration, communication, and interaction with other industries. The same relationship between production and non-production employees can be seen at the national scale (page 151). Non-production employees have been retained in the eastern urban centers while production employment has grown rapidly in the south and west.

Capital Expenditures

The Census of Manufactures reported an increase in new capital expenditures from 159 million dollars in 1963, to 231 million in 1967, 301 million in 1972 and 579 million dollars in 1977 (pages 114 and 115). New capital expenditures include those for manufacturing plants in operation and plants under construction but not yet operating. Allowing for inflation, the actual increase in new capital expenditures between 1963 and 1977 amounted to about 80 percent. New capital expenditures for manufacturing plants in the seven county Twin Cities metropolitan area accounted for 64 percent of the state total in 1963 and 1967, dropping to 54 percent in 1972, and increasing to 61 percent in 1977. New capital expenditures were widely distributed throughout the state, with most noticeable increases in southeastern and northeastern Minnesota, and particularly in the Rochester, Hutchinson, and St. Cloud areas.

Specialization

Durable goods manufacturing includes primary and fabricated metals; electrical and non-electrical machinery; transportation equipment; instruments; clay, glass, and stone products; lumber; furniture; and fixtures. Durable goods manufacturing accounted for 11.4 percent of all wage and salary employment in Minnesota in 1976. While 69 percent of the state's durable goods manufacturing is concentrated in the Twin Cities area, it accounts for a higher percentage of local employment in many other communities in the state, such as Owatonna, Waseca, and Roseau (page 117).

Non-durable goods manufacturing includes food, textiles, apparel, leather goods, paper products, printing and publishing,
chemicals, petroleum, rubber, and plastics. Non-durable goods manufacturing accounted for 8.4 percent of all wage and salary employment in Minnesota in 1976 and is more widely dispersed throughout the state than is durable goods manufacturing (page 117). The processing of agricultural and forestry products accounts for much of the non-durable goods manufacturing in non-metropolitan Minnesota, including vegetable canning and freezing in south-central and southeastern Minnesota, meat-packing across southern Minnesota, dairy products from southeastern to west-central Minnesota, sugar and potato processing in the Red River valley and paper production in north-central and northeast Minnesota. The seven county Twin Cities metropolitan area accounted for 57 percent of non-durable goods manufacturing in Minnesota in 1976.

Industrial Location Factors

The location of a particular manufacturing industry depends upon a combination of factors. Most businesses were initiated by a local entrepreneur with an idea, the basic materials, and a small amount of capital. If conditions were right, the business survived and flourished. The right conditions include accessible and reasonably priced raw materials, adequate and skilled labor, and access to markets and related industries. For example, the location of the paper products and vegetable processing industries in Minnesota are closely tied to the supply of the resources they process. Manufacturers of apparel depend to a large extent on productive low cost labor while manufacturers of precision instruments depend on highly skilled labor. Metal fabricators and chemical manufacturers are closely related to other industries that use their products and thus influence their locations. The location of petroleum refining in Minnesota is closely related to the transportation of petroleum (by either pipeline or barge) and the market for its products.

As industries have become less railroad oriented and more highway oriented, they have moved to locations with highway access, leaving the more densely developed areas and moving to suburbs and outlying areas of the state, where single-story buildings can spread out on cheaper land. These trends are more characteristic of the manufacturing production than of administrative functions, which tend to remain in the Twin Cities area. Between 1947 and 1977 manufacturing employment in Minnesota increased from 180,000 to 330,000 (Table 8), while the value added by manufacturing increased more than nine times (Table 9).

MAJOR TYPES OF PRODUCTION

Minnesota's largest manufacturing category in 1947, foods and beverages, decreased from 46,600 to 42,700 employees by 1977 and from 25.9 percent to 12.9 percent of total manufacturing employment as the foods processing industry became more mechanized and more dispersed throughout both the producing and market areas. Employment in textiles and apparel manufacturing also declined over that three decade period, as imported items produced by developing nations with lower labor costs increasingly replaced Minnesota products. Greatest employment increases were in non-electrical machinery (including the computer industry), with a rise from 24,100 to 62,500 employees and in fabricated metal products which increased from 11,200 to 32,100. Most rapid rates of increase were in precision instruments and in rubber and plastic products, each increasing by more than ten times in the number of employees between 1947 and 1977. Growth in plastics came from increased production in more than 300 small plants scattered across the state.

Food Processing

The sites of poultry, and egg-processing in Minnesota are shown on page 120. Meat packing has moved toward the source of supply and into smaller plants in recent years, a shift made possible by fast, refrigerated, truck transport. Poultry and egg processing has likewise shifted toward the source of supply. Meat processing remains close to its market area.

Processors of feeds for hogs, poultry, cattle, and pets are shown by location on page 121. Most feed processors are very small. Only eleven of the more than 300 across the state are shown on this map. Three of the eleven are located in the Twin Cities area. Two produce pet foods exclusively. Feed processors are strongly oriented to the source of supply and to the market, using soybean and corn by-products, alfalfa, sunflower seeds, and meat scraps — all of which are available and marketable in
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<tbody>
<tr>
<td></td>
<td>Employment</td>
<td>Percent of</td>
<td>Employment</td>
</tr>
<tr>
<td></td>
<td>in thousands</td>
<td>total</td>
<td>in thousands</td>
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<tr>
<td>2000 Food and Related Products</td>
<td>46.6</td>
<td>25.9</td>
<td>42.7</td>
</tr>
<tr>
<td>2200 Textile Mill Products</td>
<td>4.6</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>2300 Apparel and other finished</td>
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<td></td>
</tr>
<tr>
<td>cloth products</td>
<td>9.0</td>
<td>5.0</td>
<td>5.8</td>
</tr>
<tr>
<td>2400 Lumber and Wood Products</td>
<td>6.3</td>
<td>3.5</td>
<td>12.8</td>
</tr>
<tr>
<td>2500 Furniture and Fixtures</td>
<td>3.2</td>
<td>1.8</td>
<td>4.0</td>
</tr>
<tr>
<td>2600 Paper and Allied Products</td>
<td>8.9</td>
<td>5.0</td>
<td>16.4</td>
</tr>
<tr>
<td>2700 Printing and Publishing</td>
<td>18.1</td>
<td>10.1</td>
<td>28.3</td>
</tr>
<tr>
<td>2800 Chemicals and Allied Products</td>
<td>5.0</td>
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<td>6.2</td>
</tr>
<tr>
<td>2900 Petroleum Refining and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Related Industries</td>
<td>1.6</td>
<td>0.9</td>
<td>1.1</td>
</tr>
<tr>
<td>3000 Rubber and Plastic Products</td>
<td>0.6</td>
<td>0.3</td>
<td>10.1</td>
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<tr>
<td>3100 Leather and Leather Products</td>
<td>1.6</td>
<td>0.9</td>
<td>2.1</td>
</tr>
<tr>
<td>3200 Glass, Stone, Clay and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete Products</td>
<td>3.6</td>
<td>2.0</td>
<td>9.0</td>
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<tr>
<td>3300 Primary Metals</td>
<td>7.0</td>
<td>3.9</td>
<td>7.5</td>
</tr>
<tr>
<td>3400 Fabricated Metals</td>
<td>11.2</td>
<td>6.2</td>
<td>32.1</td>
</tr>
<tr>
<td>3500 Machinery, except electrical</td>
<td>24.1</td>
<td>13.4</td>
<td>62.5</td>
</tr>
<tr>
<td>3600 Electrical Machinery</td>
<td>15.1</td>
<td>8.4</td>
<td>27.6</td>
</tr>
<tr>
<td>3700 Transportation Equipment</td>
<td>3.4</td>
<td>1.9</td>
<td>8.2</td>
</tr>
<tr>
<td>3800 Precision Instruments</td>
<td>1.1</td>
<td>0.6</td>
<td>13.7</td>
</tr>
<tr>
<td>3900 Miscellaneous Manufacturing</td>
<td>8.9</td>
<td>4.9</td>
<td>7.6</td>
</tr>
<tr>
<td>Central Administrative Offices,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auxiliaries</td>
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</tr>
<tr>
<td>Minnesota TOTAL</td>
<td>180.0</td>
<td>100.0</td>
<td>330.3</td>
</tr>
</tbody>
</table>

a) Preliminary.
b) In 1947 employees in this category were included with the industry that employed them.
Note: Column figures may not equal Minnesota total due to rounding.
Source: U.S. Censuses of Manufactures.
### Table 9: Value Added by Manufacturing

<table>
<thead>
<tr>
<th>Standard Industrial Classification</th>
<th>1947</th>
<th>1977b</th>
<th>Increase 1947-1977</th>
<th>Rate of change as percent of state mean&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Millions of dollars&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Percent of total</td>
<td>Millions of dollars&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Percent of total</td>
</tr>
<tr>
<td>2000 Food and Related Products</td>
<td>279.3</td>
<td>27.3</td>
<td>1,437.7</td>
<td>15.6</td>
</tr>
<tr>
<td>2200 Textile Mill Products</td>
<td>15.5</td>
<td>1.5</td>
<td>33.3</td>
<td>0.4</td>
</tr>
<tr>
<td>2300 Apparel and other finished cloth products</td>
<td>33.7</td>
<td>3.3</td>
<td>99.6</td>
<td>1.1</td>
</tr>
<tr>
<td>2400 Lumber and Wood Products</td>
<td>24.3</td>
<td>2.4</td>
<td>330.7</td>
<td>3.6</td>
</tr>
<tr>
<td>2500 Furniture and Fixtures</td>
<td>13.2</td>
<td>1.3</td>
<td>90.7</td>
<td>1.0</td>
</tr>
<tr>
<td>2600 Paper and Allied Products</td>
<td>61.9</td>
<td>6.1</td>
<td>713.6</td>
<td>7.7</td>
</tr>
<tr>
<td>2700 Printing and Publishing</td>
<td>105.3</td>
<td>10.3</td>
<td>684.6</td>
<td>7.4</td>
</tr>
<tr>
<td>2800 Chemicals and Allied Products</td>
<td>68.2</td>
<td>6.7</td>
<td>385.0</td>
<td>4.2</td>
</tr>
<tr>
<td>2900 Petroleum Refining and Related Industries</td>
<td>11.8</td>
<td>1.2</td>
<td>49.1</td>
<td>0.5</td>
</tr>
<tr>
<td>3000 Rubber and Plastic Products</td>
<td>—</td>
<td>—</td>
<td>231.1</td>
<td>2.5</td>
</tr>
<tr>
<td>3100 Leather and Leather Products</td>
<td>8.0</td>
<td>0.8</td>
<td>54.9</td>
<td>0.6</td>
</tr>
<tr>
<td>3200 Glass, Stone, Clay and Concrete Products</td>
<td>15.7</td>
<td>1.5</td>
<td>294.0</td>
<td>3.2</td>
</tr>
<tr>
<td>3300 Primary Metals</td>
<td>29.4</td>
<td>2.9</td>
<td>202.6</td>
<td>2.2</td>
</tr>
<tr>
<td>3400 Fabricated Metals</td>
<td>60.8</td>
<td>5.9</td>
<td>916.4</td>
<td>9.9</td>
</tr>
<tr>
<td>3500 Machinery, except electrical</td>
<td>128.9</td>
<td>12.6</td>
<td>1,992.2</td>
<td>21.5</td>
</tr>
<tr>
<td>3600 Electrical Machinery</td>
<td>68.5</td>
<td>6.7</td>
<td>821.3</td>
<td>8.9</td>
</tr>
<tr>
<td>3700 Transportation Equipment</td>
<td>21.1</td>
<td>2.1</td>
<td>287.2</td>
<td>3.1</td>
</tr>
<tr>
<td>3800 Precision Instruments</td>
<td>—</td>
<td>—</td>
<td>426.7</td>
<td>4.6</td>
</tr>
<tr>
<td>3900 Miscellaneous Manufacturing</td>
<td>70.0</td>
<td>7.0</td>
<td>173.8</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>Minnesota TOTAL</strong></td>
<td><strong>1,022.6</strong></td>
<td><strong>100.0</strong></td>
<td><strong>9,245.3</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

<sup>a</sup> Not adjusted for inflation.
<sup>b</sup> Preliminary.
<sup>c</sup> State percent increase 1947-1977 divided by each category percent increase 1947-1977.

Note: Column figures may not equal Minnesota total due to rounding.

Sources: U.S. Censuses of Manufactures.
ANIMAL FEEDS*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown.

*Includes Standard Industrial Classifications 2047 and 2048

Source: Dun and Bradstreet, May 1, 1978
rural Minnesota.

Processed foods include a wide variety of products (page 123). Butter and cheese are produced near the source of milk supply; few are located in the Twin Cities area. On the other hand, whole milk and ice cream tend to be processed close to large markets, such as the Twin Cities area. Vegetable canning and freezing plants are located near their source of supply (page 77). Most of the state's flour and cereal production uses the less expensive land and labor outside the Twin Cities. With the long term gradual decline in wheat production in Minnesota until 1974, much of the flour and cereal production has left Minnesota, while the administrative offices of General Mills, Pillsbury, International Multifoods, Cargill, Peavey, GTA, Genex, Midland, and others remain in the Twin Cities area. Bakeries, too, are included in the category of processed foods and range in size from very small to large. They are scattered across the state in close proximity to their markets. Sugar beet processing plants are located in Crookston, East Grand Forks, Moorhead, and Renville, near the source of supply. Soybean oil processing plants are located in Dawson, Mankato, and Savage, accessible to the areas of production. A sunflower oil processing plant is located in Gonvick in Clearwater County, also near the growing area. Linseed oil processing, on the other hand, is located in the Twin Cities and Red Wing, near paint, chemical, and leather processing industries; while flax (the source of linseed) is grown in western and northwestern Minnesota. Plants that render animal fats and oils are usually in close proximity to meat packing plants. Other processed foods, such as confectionary and specialty foods, tend to be market-oriented in their locations.

Beverage production in Minnesota is shown by locations on page 124. Only four breweries remain in the state; two in St. Paul and one each in Cold Spring and New Ulm. Malting plants are in Minneapolis, Red Wing, Shakopee, Cannon Falls, and Winona. One small distillery is located at Long Prairie. Licensed commercial wineries are near Hastings and Maple Lake. Soft drinks, syrups, and extracts are produced in locations widely scattered throughout the state. The larger plants tend to be located in the Twin Cities area. Coffee is roasted in both the Twin Cities and Duluth. The processing of foods and beverages employed 42,700 persons in Minnesota in 1977.

Textiles and Apparel

Textile mill products made in Minnesota include cloth, yarn, thread, rope, twine, batting, and fill which are made of wool, cotton, flax, and synthetic fabrics. Wool and flax straw processing tends to be located in rural areas near the source of supply (page 125). Rope and twine production, too, tends to be located in rural areas to serve rural markets. Textile producers that serve the apparel industry have historically been located in the Twin Cities, but are now dispersing within and beyond the state. A very limited supply of raw materials and a relatively high cost for labor have made textiles a small and declining industry in the state. Textiles employed 2,500 persons in Minnesota in 1977.

Apparel produced in Minnesota includes a wide variety of clothing — suits, coats, shirts, trousers, underwear, neckties, hats, furs, gloves and belts (page 125). Also in this category are draperies and other cloth house furnishings, cloth bags, tents, awnings, automobile trim, and bedding. Minneapolis has a small garment district on the north edge of the downtown area. In recent years there has been a dispersal of apparel production into the rural areas of the state, where labor is less expensive. Often women, as second wage earners in a family, are employed at minimum wages. It has been difficult for Minnesota's apparel industry to compete with the even lower cost of labor in parts of the southern United States and in the developing nations. As a result, the number of apparel employees has declined gradually to 5,800 in 1977.

Wood Products and Furniture

Lumber and wood products industries in Minnesota include logging companies, pole yards (producing poles, posts, pilings, and railroad ties), and sawmills and planing mills (that produce lumber). Logging companies, pole yards, and sawmills are usually small operations located near the source of timber in northcentral and northeastern Minnesota, but also scattered in the hardwood forest areas (page 127). Wood products tend to be produced near major markets, as for example the Twin Cities area. They include millwork, boxes, baskets, barrels, crates, and pallets. Mobile homes and pre-fabricated wooden buildings are also included in this category. Their production facilities are
**PROCESSED FOODS**

1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown.

*Includes dairy, bakery and confectionary products; canned, frozen and dehydrated foods; fats and oils; fish; specialty foods (Standard Industrial Classifications 2021 2045, 2041, 2079, 20991 2094 and 2098-20999)*

Source: Dun and Bradstreet, May 1, 1978
TEXTILES*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown

*Includes Standard Industrial Classifications Group 22

Source: Dun and Bradstreet, May 1, 1978

0 20 40 60 Mls
0 20 40 60 km

0 5 10 15 Mls
0 5 10 15 km

0 3 Mls
0 3 km

125
LUMBER AND WOOD PRODUCTS*
1978

Plants with fewer than 25 employees are not shown

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

*Includes Standard industrial Classification Group 24

Source: Dun and Bradstreet, May 1, 1978
widely scattered across the state, particularly in areas of population expansion. The modest growth of this sector is largely due to these last two industries. The lumber and wood products industries employed 12,800 persons in Minnesota in 1977.

The category of furniture and fixtures includes both household and business furniture (wood, metal, and upholstered) and fixtures of all kinds as well as mattresses and bedspreads (page 129). This industry employed approximately 4,000 persons in 1977, widely distributed across the state. Over the past three decades the industry has experienced a modest growth, largely due to increases in the production of metal and plastic furniture and fixtures.

**Paper Products**

The location of manufacturers of paper and allied products in Minnesota is shown on page 130. Mills are located in Cloquet, International Falls, Grand Rapids, Bemidji, Little Falls, Sartell, Duluth, and St. Paul and range in size from 150 to 700 employees. These mills produce a wide range of coated and uncoated printing and specialty papers, along with wallboard and insulation. The manufacture of packaging materials — such as corrugated boxes, paper bags, paper board, and food containers — is located near the markets for these products, particularly in the Twin Cities area with its concentration of retailing and wholesaling that serves the entire region. Minnesota’s growing paper industries employed 16,400 persons in 1977. In late 1979 up to six new aspen wafer board plants were planned or under construction at a cost of approximately 150 million dollars. They will employ nearly 700 people at sites near Bemidji, Grand Rapids, Cook, and Brainerd. In addition, a major expansion has been announced for the paper mill at Sartell.

**Printing and Publishing**

Printing and publishing include newspapers and small print shops that are spread across the state (page 131). More specialized publishing — such as periodicals and books, large scale commercial printing, lithography, and engraving — is heavily concentrated in the Twin Cities area, with notable additions in Duluth, St. Cloud, Long Prairie, Sleepy Eye, and Waseca. This concentration of specialized printing results from the interdependence of various facets of the publishing industry. The printing and publishing industries have experienced moderate growth, employing 28,300 persons in 1977.

**Chemicals, Petroleum, Plastics, and Rubber**

Chemicals and allied products include paints and varnishes, plastics and resins, soaps and detergents, ink, adhesives, polishes, sanitation products, embalming fluid, Insecticides, and aerosols, all of which tend to be concentrated in the Twin Cities area (page 132). Plastics are also produced in Winona. Agricultural chemicals such as fertilizers, fungicides, and herbicides tend to be produced in the rural areas of the state, along with livestock pharmaceuticals. Human pharmaceuticals and vitamins are produced in Winona, Mankato, and Baudette, along with the Twin Cities area. Employment in this moderately growing industrial category reached 6,200 in 1977.

Petroleum refineries in Minnesota are located at Wrenshall, St. Paul Park, and Pine Bend (page 133). The Wrenshall plant receives almost all its crude oil by pipeline from Alberta. The St. Paul Park and Pine Bend refineries receive crude oil by pipeline from Canada and by pipeline and barge from Texas, Louisiana, and Oklahoma. This category also includes about two dozen small bituminous surfacing plants (each with less than twenty-five employees) scattered across the state. Roofing materials and lubricating oils tend to be produced in the Twin Cities area. A recently closed coke plant was located in St. Paul; a charcoal manufacturing plant is located near Isanti. Petroleum refining and related industries employed 1,100 persons in Minnesota in 1977.

Plastic, rubber, and leather products are shown on page 134. Over the last three decades there has been a near-explosive growth in the number of plastic products on the market; likewise in the production of plastic products in Minnesota. In 1978 there were over 300 plants producing plastics scattered across the state, three-quarters with fewer than twenty-five employees; the larger plants tend to be located in the Twin Cities area. Plastic products produced in Minnesota include film, sheeting, tubing, and a wide variety of molded products such as boxes, trays, cases, plumbing fixtures, machinery components, gears, ar-
FURNITURE AND FIXTURES*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown.

*Includes Standard Industrial Classifications Group 25

Source: Dun and Bradstreet, May 1, 1978
PAPER AND ALLIED PRODUCTS
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown.

*Includes Standard Industrial Classifications Group 26

Source: Dun and Bradstreet, May 1, 1978
PRINTING AND PUBLISHING*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown

*Includes Standard Industrial Classifications Group 27

Source: Dun and Bradstreet, May 1, 1978
CHEMICALS AND ALLIED PRODUCTS
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown.

Source: Dun and Bradstreet, May 1, 1978

* Includes Standard Industrial Classifications Group 28
PETROLEUM REFINING
AND RELATED INDUSTRIES*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown

*Includes Standard Industrial Classifications Group 29

Source: Dun and Bradstreet, May 1, 1978
RUBBER, PLASTIC, AND LEATHER PRODUCTS*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown.

*Includes Standard Industrial Classifications Groups 30 and 31

Source: Dun and Bradstreet, May 1, 1978
tificial flowers, bottles, louvers, tableware, tool handles, credit cards, and badges. Plastic products also include septic tanks, agricultural drain tile, doors, windows, frames, foam packaging, protective covers, ornaments, and novelties.

Rubber products made in Minnesota include gloves, gaskets, straps, rings, hose, mats, belts, moldings, snowmobile treads, and tire retreads. Industries manufacturing rubber and plastic products employed 10,100 persons in Minnesota in 1977. Leather products are manufactured largely in the Twin Cities area and in southeastern Minnesota, most notably Red Wing and Winona. They includes shoes, boots, moccasins, gloves, mittens, jackets, belts, luggage, purses, briefcases, saddles, and halters. Employment in Minnesota’s leather goods industries totaled 2,100 persons in 1977.

**Stone, Clay, and Glass**

The distribution of stone, clay and glass products in Minnesota is shown on page 136. The largest number of processors in this group are more than 200 small concrete mix plants scattered across the state. Most produce other concrete products as well, such as blocks and various precast items including drain tile, culverts, septic tanks, and burial vaults. Only thirty-nine of this group have as many as twenty-five employees. Large glass container manufacturers are located in Shakopee and Rosemount. Optical lenses are produced in St. Cloud and Long Prairie. Producers of flat glass, automobile glass, stained glass, mirrors, neon tubing, bottles, and jars tend to be concentrated in the Twin Cities area, with Owatonna and Marshall as notable non-metropolitan production sites. Monuments, building stone, crushed rock, and lime are usually processed near the granite or limestone quarrying sites (page 14). The manufacture of abrasive products, vermiculite, fiberglass insulation, and acoustical board tend to be concentrated in the Twin Cities area. Manufacturers of stone, clay, glass, and concrete products employed 9,000 persons in Minnesota in 1977.

**Metals**

Primary metals include a wide range of ferrous and non-ferrous metals. Manufacturers serve and are located near industries that require metals, such as those in the Twin Cities area (page 137). Products include a wide range of iron castings, aluminum castings, brass castings, refined precious metals, and heat-treated metals. In 1977, 7,500 persons were employed in Minnesota’s primary metals industries.

Fabricated metals are heavily concentrated in the Twin Cities area, but there is a strong trend toward dispersal within a range of about 100 miles of the Twin Cities (page 138). This industry’s products include sheet metal, prefabricated metal buildings, aluminum doors and windows, ladders, furnaces, incinerators, structural steel, posts, fencing, chains, railings, stairs, automobile parts, ornamental iron, tanks, drums, cans, pails, hardware, tools, cutlery, nuts and bolts, bearings, gears, hoseshoes, stampings of various kinds, small arms and small arms ammunition, military ordnance, pipes, wire, and wire products (such as cables and springs). Between 1947 and 1977 the fabricated metals industry in Minnesota grew from 11,200 to 32,100 employees in conjunction with the rapid growth of the machinery industry in the state.

**Machinery**

Machinery manufacturing (excluding electrical) is Minnesota’s largest category of manufacturing employment. The locations of 333 machinery manufacturers (with twenty-five or more employees) are shown on page 139. There are, in addition, more than 200 machinery manufacturers in the state with fewer than twenty-five employees that are not shown on this map. The production of farm-related machinery tends to be scattered across the agricultural areas of the state, while mining-related machinery is made in northeastern Minnesota. Machinery such as turbo-generators, internal combustion engines, computers, construction machinery, welding equipment, elevators, conveyors, hoists and cranes, and lawn and garden equipment tend to be made in the Twin Cities areas, with larger companies often establishing assembly branch plants outside that area. Minnesota manufacturers also produce industrial lifting and loading equipment, machine tools for metal cutting and metal forming, dies, jigs, fixtures, power driven hand tools, food products machinery, woodworking machinery, paper industries machinery, printing trades machinery, pumps, air compressors, blowers,
STONE, CLAY, AND GLASS PRODUCTS*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown.

* Includes Standard Industrial Classifications Group 32

Source: Dun and Bradstreet, May 1, 1978
PRIMARY METALS*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown

*Includes Standard Industrial Classifications Group 33

Source: Dun and Bradstreet, May 1, 1978
FABRICATED METAL PRODUCTS
(except machinery and transportation equipment)*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown.

*Includes Standard Industrial Classifications Group 34

Source: Dun and Bradstreet, May 1, 1976
MACHINERY
(except electrical)
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown

*Includes Standard Industrial Classifications Group 35

Source: Dun and Bradstreet, May 1, 1978
fans, heating and air conditioning machinery, transmissions, typewriters, computing equipment, laundry equipment, and general industrial machinery. Non-electrical machinery manufacturing in Minnesota increased from 24,100 employees in 1947 to 62,500 employees in 1977, with the computer industry accounting directly for perhaps two-thirds of the growth.

Electrical machinery produced in Minnesota includes transformers, electrical switching equipment, electrical motors and generators, industrial controls, welding apparatus, storage batteries, battery chargers, refrigerators, freezers, electrical housewares such as vacuum cleaners and sewing machines, lighting fixtures, vehicular electrical equipment, radio and television receiving and communication equipment, telephone apparatus, X-ray apparatus, and various electronic components. Electrical machinery manufacturers tend to be concentrated in and near the Twin Cities, with notable additions in the Mankato/St. Peter/New Ulm area, Red Wing, St. Cloud, and Waseca (page 141). As with other metals industries, there is a trend toward dispersal to the outlying suburbs and to rural areas of the state. This category has experienced modest growth between 1947 and 1977, increasing from 15,100 to 27,600 employees.

Transportation Equipment

Manufacturers of transportation equipment include the Ford Motor Company assembly plant in St. Paul with over 2,000 employees (page 142). The production of motor vehicle parts and accessories and truck and bus bodies and equipment is scattered in many locations across the state. Motorcycle accessories are produced in seven small plants (six of which have fewer than twenty-five employees). Railway maintenance equipment is produced in Fairmont, Winona, and other locations; aircraft equipment is manufactured in Alexandria and the Twin Cities. Tractor cabs are produced in Mankato and Litchfield; components for the aerospace industry are made in the Twin Cities area; travel trailers and campers are produced at several locations. Boats are produced at Little Falls, St. Peter, New York Mills, Pipestone, Mora, St. Cloud, and other locations; major snowmobile producers are located at Thief River Falls and Roseau (and Crosby in 1978), with component parts manufactured at several other loca-

tions. In the three decades from 1947 to 1977, Minnesota's transportation equipment industry increased in employment from 3,400 to 8,200 persons.

Precision Instruments

Precision instruments manufactured in Minnesota include engineering instruments; testing and analysis instruments (including those for environmental, sanitation, and laboratory use); wind tunnel, aircraft, and missile instruments; and meteorological instruments. Also included are temperature controls, liquid controls, meters and counting devices, fire detectors, clocks, compasses, electronic measuring instruments, hearing aids and accessories, surgical and medical instruments and supplies, optical lenses, artifical limbs and organs, dental instruments and supplies, dentures, photographic equipment and supplies, microfilm, microfiche, and related products. The production of most of these goods is concentrated in the Twin Cities area with the exception of optical goods which employ some 800 persons in the St. Cloud area (page 143). In addition, medical instruments are produced in the Rochester area, hearing aids in Glencoe, temperature controls in Winona, and remote control handling equipment in Red Wing. Employment in Minnesota industries that produce instruments and related products has increased from 1,100 in 1947 to 13,700 in 1977.

Other Manufacturing

Miscellaneous manufacturing consists of manufacturing industries not elsewhere included in the Standard Industrial Classifications. This category includes Minnesota's largest toy manufacturer, located in Mound; Minnesota's largest jewelry manufacturer, located in Owatonna; and Minnesota's only wooden match manufacturer, located in Cloquet (page 144). Fishing equipment is produced in many small operations (less than twenty-five employees), scattered across rural Minnesota. Soft toys and dolls are produced in Eden Valley, Maple Lake, and Cannon Falls. Staging equipment is produced in Owatonna; hockey sticks in Warroad. Wooden and plastic toys, games and hobbies, skis, skates, golf equipment and supplies, bowling equipment, billiard cues, pool tables, archery supplies, play-
ELECTRICAL MACHINERY
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown.

*Includes Standard Industrial Classifications Group 36

Source: Dun and Bradstreet, May 1, 1978
TRANSPORTATION EQUIPMENT*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25
employees are not shown

*Includes Standard Industrial
Classifications Group 37

Source: Dun and Bradstreet, May 1, 1978
PRECISION INSTRUMENTS*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown.

Source: Dun and Bradstreet, May 1, 1978

*Includes Standard Industrial Classifications Group 38

143
MISCELLANEOUS MANUFACTURING*
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown

*Includes jewelry, tableware, musical instruments, toys, athletic goods, office and artists' materials, brooms, caskets, novelties, motors, etc. (Standard Industrial Classifications Group 39)

Source: Dun and Bradstreet, May 1, 1978
ground equipment, pens, pencils, art goods, marking devices, brushes, paint applicators, signs, advertising displays, and caskets are all produced in the Twin Cities area. This industrial class employed 7,000 persons in 1977.

FOREIGN EXPORTS

About 800 Minnesota manufacturers exported products to 135 foreign nations in 1976, with Canada being the leading market (pages 146 and 147). More than 1.5 billion dollars worth of Minnesota manufactured products were exported that year, representing about 8 percent of Minnesota’s total production. In the preceding decade, the value of Minnesota’s manufactured exports increased by nearly five times. The largest increase was in the category of nonelectrical machinery (mainly computers) which grew from 132 million dollars to 721 million dollars, 46 percent of the value of all Minnesota’s manufactured exports (Table 10).

OUT-OF-STATE OWNERSHIP

A large number of manufacturing plants in Minnesota are owned by out-of-state companies (page 148). These vary from small to large plants, cover the full range of manufacturing functions, and are about equally divided between the Twin Cities area and the balance of the state. In some cases, plants have been merged with, or have been purchased by out-of-state owners. In other cases, out-of-state companies have established branch plants in Minnesota; or companies that have grown up in Minnesota, have left, but retained some operations within the state. Forty-one out-of-state corporations employ 500 or more persons in Minnesota manufacturing plants (not including mining or taconite processing operations). Many of these companies have corporate headquarters located in the industrial east: ten are from New York; nine from Illinois; three from Ohio; two each from Michigan, Connecticut, and Oklahoma; and one each from Arizona, California, Washington, Oregon, Idaho, Texas, Kansas, Indiana, Missouri, Florida, Pennsylvania, New Jersey, and Massachusetts.

NATIONAL TRENDS

Since World War II significant changes have occurred both in the composition and distribution of manufacturing industries in the United States. These changing characteristics are illustrated on pages 149 through 151. Total manufacturing employment between 1947 and 1976 increased by 31 percent from 14.3 to 18.8 million, with most of this increase occurring in southern and western states. The shift of manufacturing employment from the historic center of industrial production in the northeastern states to the South and West has been most pronounced in production

<table>
<thead>
<tr>
<th>Category</th>
<th>Value in millions of dollars&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Percent of Total 1976</th>
<th>Rate of increase 1966-1976&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery, except electrical</td>
<td>132</td>
<td>46.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Food and kindred products</td>
<td>73</td>
<td>14.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Electrical machinery</td>
<td>21</td>
<td>10.5</td>
<td>7.8</td>
</tr>
<tr>
<td>Primary and fabricated metals</td>
<td>12</td>
<td>6.8</td>
<td>8.8</td>
</tr>
<tr>
<td>Transportation equipment</td>
<td>23</td>
<td>6.1</td>
<td>4.1</td>
</tr>
<tr>
<td>Precision instruments</td>
<td>18</td>
<td>5.1</td>
<td>4.2</td>
</tr>
<tr>
<td>Chemicals, petroleum, rubber, plastic, leather, glass, stone, clay, and concrete products</td>
<td>10</td>
<td>5.1</td>
<td>8.0</td>
</tr>
<tr>
<td>Wood products, paper products, furniture and fixtures</td>
<td>12</td>
<td>3.6</td>
<td>4.7</td>
</tr>
<tr>
<td>Printing, publishing and miscellaneous manufacturing</td>
<td>20</td>
<td>1.3</td>
<td>0</td>
</tr>
<tr>
<td>Textiles and apparel</td>
<td>4</td>
<td>0.9</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>326</strong></td>
<td><strong>100.0</strong></td>
<td><strong>4.8</strong></td>
</tr>
</tbody>
</table>

<sup>a</sup> Not adjusted for inflation.

<sup>b</sup> 1976 as a multiple of 1966.

Source: Minnesota Department of Economic Development.
MANUFACTURING PLANTS*
with out-of-state headquarters
1978

Plant employees
- 25 - 49
- 50 - 99
- 100 - 249
- 250 - 499
- 500 or more

Plants with fewer than 25 employees are not shown

*Includes all Standard Industrial Classifications

Source: Dun and Bradstreet, May 1, 1978
U.S. MANUFACTURING EMPLOYMENT
1947

For each state:

Manufacturing employment in thousands
Percent of manufacturing employment in non-production

example: Louisiana

U.S. total manufacturing employment: 14,294,000
U.S. percent of manufacturing employment in non-production: 16.6

Source: U.S. Census of Manufactures
U.S. MANUFACTURING EMPLOYMENT
1976

U.S. total manufacturing employment: 18,753,000
U.S. percent of manufacturing employment in non-production: 30.4

Source: U.S. Bureau of the Census,
1976 Annual Survey of Manufactures
employment: all states from Illinois to Maine with the exception of Indiana and Delaware experienced losses in manufacturing production employment during that period. The shift is accounted for by the attraction of cheaper labor and of new markets that followed population shifts.

While manufacturing production employment increased by 10 percent nationally between 1947 and 1976, manufacturing non-production employment or administrative functions grew by 140 percent. All states increased in non-production employment, but most northern and northeastern states increased at rates slower than the national average. While production functions shifted to the South and West, administrative functions have tended to remain in the urban centers of the northeast.

Minnesota grew more rapidly than the nation as a whole in overall manufacturing employment (68 percent as compared to 31 percent) during this three-decade period. This was due in part to the growth of a number of large national corporations that retain their headquarters in Minnesota. Within Minnesota a similar pattern of geographic change has been occurring, with production functions moving outward from the Twin Cities to the lower cost labor and pleasant environments of rural Minnesota, while the administrative functions are retained in the Twin Cities area.

CENTERS OF TRADE, SERVICES, AND COMMUNICATION

The towns and cities of the state evolved at nodes in the network of transportation routes. To be sure, those nodes were the locations of industrial production, but they also determined the geographic structure of trade, services, and mass communications.

DEVELOPMENT OF THE URBAN PATTERN

The first permanent white settlers arrived by water, and towns emerged along the major routes at points where the settlers ventured inland — from the Mississippi, St. Croix, Minnesota, and Red Rivers and Lake Superior. By far the largest number of settlers entered Minnesota by way of the Mississippi, travelling as far upstream as possible, to the most suitable landing point below the Falls of St. Anthony. Because of the steep river banks, the first good disembarkment point below the falls happened to
be just east of what is now downtown St. Paul. At this location, river travelers transferred their goods to wagons and carts and proceeded ten miles overland to a point just above St. Anthony Falls where they could conveniently cross the river and proceed westward. At that site the village of St. Anthony grew on the east bank and Minneapolis on the west bank. The locations of the state's major cities were thereby anchored by the early modes of transportation.

With railroad development in the 1860s, the growth and dominance of the Twin Cities accelerated. St. Paul became the transportation center, with rail lines extending toward the west and northwest. At St. Anthony, the first bridge spanning the Mississippi was constructed in 1855, and was paralleled by a railroad bridge 300 yards upstream twelve years later. The significance of that location was further enhanced with the lumbering and flour milling functions that emerged about 500 yards downstream at the Falls of St. Anthony.

Not only were the locations of St. Paul and Minneapolis determined by early transportation functions, but a number of other major urban areas in the state were first established on water routes and later linked by the rail system. Important examples include Winona, Red Wing, Hastings, Stillwater, Mankato, and St. Cloud. The majority of major urban centers outside the Twin Cities, however, grew because of their locations at important rail junctions and/or their designation as seats of county government. Notable exceptions are on the Mesabi, Vermillion, and Cuyuna Iron Ranges, where the rich mineral resources served as the major determinants of location. The emergence of small agricultural service centers along the rail lines in nineteenth century Minnesota, was influenced by the distance that could be travelled conveniently in a single day by horse and wagon. The location of Minnesota's natural resources and the arteries of transportation that provided access to those resources strongly influenced where people lived and worked. These patterns were largely established during the latter half of the nineteenth century.

During the first half of the twentieth century, the state embarked on a road building program that has profoundly affected the patterns of settlement in the state. Major impacts of the automobile came in the 1920s, were inhibited during the depression and war years, and exploded after World War II. Highways were reconstructed to improve speed and safety, while affluence and cheap energy made automobiles available to nearly everyone. Improved accessibility brought about the concentration of trade and services in the larger centers across the state, often at the expense of the smaller communities which found the direct competition difficult. In the cities, the streetcar-oriented shops and markets gave way to automobile-dependent supermarkets, shopping centers, and discount stores.

Improved personal transportation and greater affluence enabled an increasing number of Minnesota residents to live in an environment of their choice. Commuting distances extended farther into the countryside from the urban centers, while the older areas of almost all towns and cities experienced population losses. In many cases these trends of urban thinning and spreading stimulated the growth of the former agricultural service centers that were within commuting distance, as they became much like outlying suburban nodes or bedroom communities. With rising energy costs in the 1970s, questions were being raised about the efficiency of this auto-oriented settlement system.

The potential for a major communications revolution offers the prospect of accessibility to many of the services that now require personal transportation. It may be significant to note that the only consumer goods that have been decreasing in cost in a time of inflation are those in the area of communications technology. New communications systems can allow people to live where they wish, but still be tied into the network of employment, culture, and services. Emerging communications technology has the potential for a greater impact on the settlement system over the coming years than highway development did over the past three decades. Meanwhile, today's patterns, shown on the following maps, continue to reflect the steamboat, rail, and auto ages. For a map of today's population service centers see the Appendix, page 304.

TRADE AND FINANCE SERVICES

Minnesota's urban areas with 10 million dollars or more in wholesale sales in 1972, are shown on page 153. The Twin Cities area, as the historic distribution and transportation center of the Upper Midwest, dominates wholesale trade in Minnesota and
WHOLESALE SALES
1972

Wholesale Sales Volume
For urban areas with ten million dollars or more in wholesale sales (in millions of dollars)

State total: 15,054

Wholesale Sales per Capita

Source: U.S. Census of Business

*Includes non-Minnesota portion of urban area
nearby states. Rail and truck distribution systems link Twin Cities wholesalers with retailers from Upper Michigan to Montana and Wyoming. While the Twin Cities area ranks first in wholesale volumes in the Upper Midwest, the Fargo-Moorhead area ranks first in wholesale sales per capita, with the Twin Cities area second. Generally speaking, trade centers within a hundred miles of the Twin Cities fall below the Minnesota average in per capita wholesale sales. Wholesale sales strength tends to increase with distance from the Twin Cities area; urban areas such as Worthington, Pipestone, Fairmont, and Thief River Falls exceed the state average.

Minnesota's urban areas with 10 million dollars or more in retail sales in 1972, are shown on page 155. The volume or retail sales in the Twin Cities area is by far the largest in the state and above the state average in per capita sales, but the Twin Cities area does not dominate retailing in Minnesota to the extent that it dominates wholesaling. The greatest retail strength (in terms of sales per capita) is found in the small to medium-size centers scattered across the state. This retail strength has been the result of good shopping facilities, a variety in choice for the consumer, parking availability, good merchandising, and advertising. It has occurred at the expense of many smaller communities. Communities of less than about 1,000 in population often find it difficult to compete successfully with the larger trade centers which can offer lower prices with higher trade volumes. A nucleation of retailing has resulted over the last thirty years, facilitated by improved highways and cheap energy.

Retail sales and accompanying services, per capita, are noticeably larger in principal trade centers of the northern recreational lake regions. There business is swollen by the tide of seasonal and weekend visitors who trade in those communities but are not counted by the census as residents. Large numbers of visitors also raise per capita sales volumes at other locations in the state, such as along the interstate highway system, near college campuses, in the environs of Rochester's Mayo Clinic, and in the regional business center at the Twin Cities. The pattern is reflected vividly in the map of hotel-motel receipts per capita, page 156.

In fact, tourism and other travel of all kinds contribute substantially to the state's service economy. The state Department of Economic Development estimates that more than 1.5 billion dollars were spent in Minnesota in 1978 for lodging, food, gas, and other tourist goods and services, including amounts spent by Minnesotans in Minnesota (Table 11). According to a travel survey conducted by Von Kuster and Associates, about 31 percent of Minnesota households vacationed in Minnesota in 1978; most out-of-state residents vacationing in Minnesota came from Illinois, Iowa, and Wisconsin. A national study found that Minnesota ranked thirteenth among all states (highest in the Midwest) in travel expenditures as a proportion of gross state product.**

The Twin Cities banks and savings and loan associations draw savings deposits from much of the state, but most heavily from nearby counties, which fall far below the state averages in per capita deposits (page 156). Savings deposits per capita tend to be highest in the high income agricultural areas across southern Minnesota. Aggressive local financial institutions further contribute to high savings deposits per capita in some rural county seat trade centers.

Table 11: Tourist Expenditures

<table>
<thead>
<tr>
<th>Selected Years</th>
<th>Total</th>
<th>Lodging</th>
<th>Food, Gasoline and other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>784</td>
<td>160</td>
<td>624</td>
</tr>
<tr>
<td>1975</td>
<td>1200</td>
<td>245</td>
<td>955</td>
</tr>
<tr>
<td>1978</td>
<td>1587</td>
<td>316</td>
<td>1271</td>
</tr>
</tbody>
</table>

* Not adjusted for inflation.
Source: Minnesota Department of Economic Development.

RETAIL SALES
1972

Retail Sales Volume
For urban areas with ten million dollars or more in retail sales
(in millions of dollars)

State total: 8,352

Retail Sales per Capita

Dollars  Ratio to state average
Less than 2154  Less than 1.0
2154 to 3231  1.0 to 1.5
3231 to 4308  1.5 to 2.0
4308 or more  2.0 or more

State average: $2,154

Source: U.S. Census of Business
*includes non-Minnesota portion of urban area
produce for their tributary areas. Data on public institutions indicate the pattern.

Primary and Secondary Schools and Service Areas

The location and relative size of all public and private high schools in Minnesota are shown on page 158. Enrollment for the three grades from ten to twelve is used for size comparison. The general distribution and size of the high schools in Minnesota is closely related to the patterns of population distribution, with the larger high schools located in the Twin Cities metropolitan area and other major urban areas of the state. Smaller schools tend to be located in smaller communities and the smallest in the most rural school districts, most of which are scattered across western and southern Minnesota. Consolidation of two or more districts was a common response to the high operating costs of small school districts during the 1950s and 1960s, but this trend has slowed noticeably in the last few years.

In the late 1970s as costs were beginning to rise sharply and high school enrollments were beginning to decline, a new wave of consolidation or expanded cooperative arrangements was anticipated. Today, many school districts from northwestern Minnesota to southwestern Minnesota have fewer than 50 students in grades ten through twelve. These same areas are expected to continue a gradual population loss, further reducing enrollments and forcing difficult decisions.

Changes in public school enrollment from the 1971-72 school year to the 1976-77 school year for grades one through twelve are shown on page 159. During this period, elementary enrollment declined, while senior high enrollment increased, both reflecting changing birth rate trends. The greatest enrollment growth during this period occurred in school districts on the Twin Cities metropolitan fringe, particularly to the north, beyond the first two tiers of suburbs and up to about forty miles distance. New home construction and increases in family population characterized this area. Central Minnesota experienced some modest increases in public school enrollment, but much of the population growth in central Minnesota was in non-school age groups (page 217). Greatest public school enrollment declines occurred in the dominantly agricultural areas of southern and western Minnesota, on the Iron Range, and in the Twin Cities metropolitan core area, including some close-in suburban districts.

Collegiate and AVTI Service Areas

Entrance rates for college and area vocational technical institutes (AVTI) in Minnesota are shown by county on page 160. Included are two and four-year public and private colleges in Minnesota and public colleges in Wisconsin and North Dakota under reciprocity agreement with Minnesota. These maps compare high school graduates (based on the location of the high school attended in the spring of 1977) with full time entering college freshmen (based on residence for fall of 1977). In interpreting the map it should be cautioned that some school districts overlap county boundaries. For this reason, certain counties have been combined on the maps in order to avoid excessive distortion.*

The proportions of high school graduates attending college tend to be lowest in the rural areas of the state from southwestern Minnesota to central Minnesota and highest in the southeastern, northeastern, and metropolitan areas of the state. Highest proportions attending AVTIs are from west-central Minnesota; lowest from the southeast and urban areas. The choice of institution is greatly influenced by accessibility. Entering freshmen are inclined to enroll in the institution of higher education that is closest to home.

Service areas for two and four-year public colleges and universities in Minnesota (including those under reciprocity agreements in Wisconsin and North Dakota) are shown on page 161. This map is based upon the college attended by the largest number of entering freshmen in the fall of 1977 from each county in Minnesota. In the case of the Twin Cities campus of the University of Minnesota, entering freshmen are tabulated for the College of Liberal Arts and the General College only.

*For example, a substantial portion of Becker County residents attend high school in adjoining counties. Students are tabulated as high school graduates of those adjoining counties, but as residents of Becker County in college entrance records. For this reason, the percent of college and AVTI entrants in Becker County totals 105 percent of the high school graduates.
HIGH SCHOOL ENROLLMENT
public and non-public, grades 10-12
1977-78 school year*

Source: Minnesota Department of Education
*Public school enrollment is for Fall, 1977;
non-public school enrollment is for Spring, 1978
COLLEGE ENTRANCE RATES
1977

Full-time entering freshmen, Fall 1977, as percent of high school graduates, Spring 1977*

<table>
<thead>
<tr>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 30</td>
</tr>
<tr>
<td>30 to 40</td>
</tr>
<tr>
<td>40 to 50</td>
</tr>
<tr>
<td>50 or more</td>
</tr>
</tbody>
</table>

State average: 42

Sources: Minnesota Department of Education; Higher Education Coordinating Board

- Benton, Sherburne and Stearns Counties combined
- Ramsey and Washington Counties combined
- Dakota and Scott Counties combined
- Blue Earth and Nicollet Counties combined

*Entering freshmen include those at the University of Minnesota, state universities, community colleges and private colleges in Minnesota and those under reciprocity agreement at academic institutions in North Dakota and Wisconsin. These data are available by Minnesota county of residence. Data for high school graduates are based on county location of the high school, rather than county of residence. Because of this disparity, certain counties are combined where school district boundary overlap may have a measurable effect on entrance rates.

AREA VOCATIONAL-TECHNICAL INSTITUTE ENTRANCE RATES
1977

Full-time entering freshmen, Fall 1977, as percent of high school graduates, Spring 1977*

| Percent | |
|---------|
| Less than 30 |
| 30 to 40 |
| 40 to 50 |
| 50 or more |

State average: 30

Sources: Minnesota Department of Education; Higher Education Coordinating Board

- Benton, Sherburne and Stearns Counties combined
- Ramsey and Washington Counties combined
- Dakota and Scott Counties combined
- Blue Earth and Nicollet Counties combined

*Entering freshmen include those at all AVTs in Minnesota and those under reciprocity agreement at the North Dakota State School of Science. These data are available by Minnesota county of residence. Data for high school graduates are based on county location of the high school, rather than county of residence. Because of this disparity, certain counties are combined where school district boundary overlap may have a measurable effect on entrance rates.
PUBLIC COLLEGE SERVICE AREAS
Fall 1977

Public colleges include all branches of the University of Minnesota*, all state universities and all community colleges. Service areas are based on the largest number of entering freshmen from each county. Where there is more than one college in a county, service areas are based on approximate travel time.

- Public college location

Sources: for University of Minnesota, Twin Cities: Office of Admissions and Records, University of Minnesota, Minneapolis
for all others: Minnesota Higher Education Coordinating Board

*for University of Minnesota, Twin Cities' Campus, data include entering freshmen in the College of Liberal Arts and General College only
The largest attendance areas in the state are typical of the older, well established four-year state universities, particularly at Mankato, St. Cloud, and Moorhead. Entering freshmen are inclined to attend the closest school; exceptions are the strong pull of Mankato State in southwestern Minnesota, where students are actually closer to Southwest State, and the pull of Moorhead State and St. Cloud State in west-central Minnesota, where students may be closer to the Morris branch of the University of Minnesota. In all cases, the public two and four-year colleges dominate the enrollment from the county within which they are located and draw strongly from other nearby counties.

Reciprocity agreements with North Dakota and Wisconsin have contributed to an increased enrollment of Minnesota students in colleges in those states. In the fall of 1977, the University of Wisconsin, LaCrosse and the University of North Dakota in Grand Forks attracted the largest number of entering freshmen from two Minnesota counties.

Attendance patterns at Minnesota’s thirty-four AVTIs are directly related to distance (page 163). The North Dakota State School of Science in Wahpeton is also included here. It attracts the largest number of students from nearby Wilkin and Traverse counties. All AVTIs dominate student attendance in the county within which they are located, with the exception of Staples. There, the AVTI draws students from northern Todd County, where it is located, and from nearby Cass and Wadena Counties, but most Todd County students attend the AVTI in Alexandria, which is closer. Since 1960, twenty-six entirely new AVTI campuses have been constructed, resulting in a rapid growth of enrollment.

Students from lower income families usually attend closer to home, while higher income students have a wider range of choices. Minnesota residents attending college in other states have the highest median family income. Families of students attending the University of Minnesota or the four-year private colleges in Minnesota are at the next highest income level; families of students attending state universities or community colleges are at the next income level. Students attending area vocational technical institutes tend to come from families with below median income.*

Full-time students attending all public and private, academic, trade, and business colleges in Minnesota are shown on the map on page 164. Higher education facilities are accessible to residents throughout the state, but the widest choice is found in the Twin Cities metropolitan area. Several colleges draw significantly from outside the state. These include Carlton, Macalester, St. Olaf, St. Mary’s, St. Theresa’s, and certain specialized religious schools and seminaries. The University of Minnesota’s Twin Cities campus attracts the largest number of nonstate residents to Minnesota (17 percent of its enrollment in the fall of 1979). The state universities near the state’s borders (as at Winona and Moorhead) draw from one-fifth to one-third of their students from the adjoining states, which share reciprocity arrangements with Minnesota. Most state community colleges and AVTIs draw entirely from Minnesota residents.

MASS COMMUNICATIONS

The Press

Newspapers, together with radio and television broadcasting, reinforce the ties between trade centers and their trade areas. Hence, thus far, they have reinforced the geographic pattern of settlement that evolved with the development of the rail and highway network.

Newspaper circulation in Minnesota is dominated by a few large daily papers, including those from Minneapolis, St. Paul, and Duluth, plus several others published just outside the state but having a significant penetration in Minnesota, such as the newspapers of Fargo, Grand Forks, Sioux Falls, and LaCrosse (page 165). Dailies (morning and afternoon) published in Minneapolis have the largest daily circulation (464,000) and the widest distribution across the state. Circulation of the St. Paul newspapers (218,400) is dominant over a much smaller area, but penetrates significantly into western Wisconsin. Daily newspapers published in smaller communities have much smaller circulation areas, though some have significant market penetration in terms of total circulation in relation to urban households, as for example, in Willmar and Worthington. At the other extreme are the daily newspapers in Hibbing and Stillwater, with a relatively low market penetration.

Area Vocational-Technical Institute service areas are based on the largest number of entering freshmen from each county. Where there is more than one AVTI in a county, service areas are based on approximate travel time.

AVTI location

Source: Minnesota Higher Education Coordinating Board

*Staples AVTI does not draw the largest number of students from any county
POST-SECONDARY SCHOOL ENROLLMENTS
Fall 1977

Enrollment (full-time, Fall, 1977)

10,000
1,000
100
10

Spring 1979, estimated enrollment

Non-Minnesota residents (not shown when less than 1% of total)

Type of institution
- Public 4-year
- Public 2-year
- AVI
- Private 4-year
- Private 2-year
- Private business or professional

Sources: Minnesota Higher Education Coordinating Board (Fall, 1977)
Individual Institutions (Spring, 1979)
The larger daily newspapers do not replace a need for local papers which emphasize and interpret local news. For this reason most communities with more than a few hundred persons have weekly newspapers with local circulations (page 167). In communities where both daily and weekly newspapers exist, the weekly usually serves in part as a shopper edition.

Television and Radio Broadcasting

Television broadcasting stations are situated in Minnesota's major urban areas, with four commercial and two public stations serving the Twin Cities area and three commercial and one public station serving the Duluth-Superior urban area (page 168). A limited number of VHF broadcast channels and the short effective broadcast distance make careful management of the spacing of broadcast stations important to avoid interference and to provide reception to as many parts of the state as possible. For this reason, broadcast stations are situated at critical intermediate locations between the major urban area broadcast centers. Even so, some areas of southwestern Minnesota and northern Minnesota lack good television reception.

Whereas television and FM radio signals are broadcast in a straight line from the transmitting tower, AM radio signals follow the curvature of the earth and have a much longer effective broadcast distance, directly related to station power. Their power, frequency, and hours of operation vary considerably in response to the Federal Communications Commission regulations. The most powerful AM stations are located in the Twin Cities, where there are three commercial 50,000 watt stations. Two 50,000 watt stations in Winnipeg also reach northwestern Minnesota (page 169).

As a result of the straight line signal characteristics, FM broadcasting has a limited reception range; hence the same frequency may be used repeatedly by different stations in neighboring localities (page 170). For this reason, FM broadcasting has a potential to meet local service needs. With limited broadcasting power and relative low operating costs, areas as small as a city block (or as large as a radius of fifty miles) can be served. Because of these advantages, FM broadcasting is growing rapidly, particularly the very small stations with less than one kilowatt of power (not shown on this map of FM stations). The largest concentration of FM stations is in the Twin Cities area, but like AM stations, they are widely scattered throughout the state. Public and non-profit stations comprise a considerable proportion of the FM broadcasters. For example, there are twenty-three public FM stations within Minnesota, but only nine public AM stations. Additional FM public broadcasters serving Minnesota include four in North Dakota, two in South Dakota, four in Wisconsin, and one in Iowa.

Cable Television

Cable television can offer viewers multiple channels that deliver all commercial networks, public television, selected independent stations, and cover local events, news, and weather. It developed initially to serve isolated markets beyond the range of broadcast reception. From the state's first operational cable system in Peterson in 1954, the number of systems has grown to 128 serving 223 municipalities by January 1, 1980, with an additional five systems under construction (page 171). These ranged in size from five systems with fewer than 100 subscribers each to one system with 18,952 subscribers, in Rochester. Most cable systems in Minnesota have a capacity of twelve channels, but some can receive as many as thirty-five channels. Two systems — Fosston and St. Peter — have operational two-way capability, which allows listener participation; an additional sixty-one systems have the technical capability to activate two-way operations.

On a stationwide average, 13 percent of Minnesota’s households were served by cable television in mid-1979, ranging from 36 percent in Region 9 (south-central Minnesota) to 1 percent in the Twin Cities area. * Past growth of cable television has been concentrated outside the Twin Cities metropolitan area where limited choice has been available from the broadcast media. Only three cities of 10,000 population or more outside the Twin Cities area remain uncabled: Northfield, Owatonna, and Worthington, the first two of which are located so as to receive good broadcast choice. Only two cities in the 5,000 to 10,000 population range do not have cable television: Elk River and Hermantown, which lie within good reception range of Twin Cities and Duluth broadcasters, respectively. Communities with fewer than about 1,200 persons usually do not have sufficient market potential to support

* Minnesota Cable Communications Board.
WEEKLY NEWSPAPER CIRCULATION
1977

Figure indicates the total number of weekly newspapers in a community where the number exceeds one.

Figure in parentheses indicates the number for which circulation data is not available.

Source: Ayer Directory of Publications, 1977
Source: Broadcasting Yearbook

*In Minnesota and within approximately 50 miles of the state border
AM RADIO STATIONS*
1978

Source: Broadcasting Yearbook
*In Minnesota and within approximately 50 miles of the state border
FM RADIO STATIONS*
1978

Source: Broadcasting Yearbook
*stations with one or more kilowatts of power in Minnesota and within approximately
50 miles of the state border
cable television although fifty of Minnesota's nearly 600 municipalities of that size are served by cable.

The effect of cable TV, so far, has been to reduce the advantage of greater choice and diversity of entertainment which would otherwise have accrued to the largest cities. One can only speculate on the degree to which that foreshadows the potential of electronic communications to modify the urban pattern fundamentally in the future.

TRANSPORTATION AND UTILITIES

The state's natural resources and industries are tied to one another, to other regions, and to the entire settlement fabric by the transportation and transmission networks. Raw materials move from farms, mines, and forests to mills. Manufactured products move to warehouses and stores for farms and consumer markets, to other factories as equipment and semi-finished raw materials. Energy flows from mines, wells, refineries, and electric power stations to points of consumption throughout the settlement system. People move between house and job, shop and client, residence and recreation, farm and town in the daily, weekly, and seasonal pulsation of commercial, social, and personal life. Perhaps more than any other human activities, transportation and energy transmission influence the distribution and character of settlement on the landscape.

Early economic activities in Minnesota were oriented to water transportation: the trappers, fur traders, and military personnel arrived and established their outposts along the water courses. In the mid-nineteenth century steamboats multiplied — especially on the Mississippi below St. Paul and later on the Great Lakes waterway to Duluth. Wagon and stage roads penetrated the neighboring wilderness but were simply a brief prelude to the railway lines.

RAILROADS

Minnesota's first railroads extended inland from the principal river and lake ports, following the main wagon and stage routes. By 1880 railroads had become the backbone of the national transportation system, with the Twin Cities the major node on the northern transcontinental route. Virtually all service in Minnesota converged toward the Twin Cities, Duluth, or Chicago. Interstitial movements were tedious and expensive, if not impossible in places. By 1900 Minnesota's basic rail network was in place, though a few more branch lines and iron ore lines were added before 1920 (page 173). At that time freight and passenger movement between cities in Minnesota was almost entirely dependent upon the railroad system, with only an unpaved grid of country roads along certain township and section lines.

The rising influence of the automobile after 1920 led to a shrinking of the rail network. First, a few redundant branch lines were eliminated, and later, in the face of direct competition for freight movement with the trucking industry, many unprofitable lines were left unmaintained and eventually abandoned. State government now provides some modest funds to assist the railroads in maintaining a few of the deteriorated, but needed, rail branch lines. Railroad passenger service began to decline in the 1920s and especially, the 1930s (page 174). Passenger travel by rail declined rapidly during the 1950s and 60s in the face of direct competition with airlines on long runs and automobiles on short runs (page 175). As a result, service was discontinued entirely in the 1970s by the private rail companies operating in Minnesota. The only rail passenger service that remains is operated and heavily subsidized by AMTRAK, a public railroad corporation that offers daily passenger service between the Twin Cities and Chicago, Duluth, Seattle, and intermediate points.

While many of the shorter branch lines have been unprofitable for hauling freight, the main lines, in most cases, have remained profitable with longer trains and longer-distance hauling. In comparison to truck transport, railroads are more suited to hauling bulk commodities, such as coal, which accounts for increasing shipment volumes between sources in Montana and North Dakota and consumers in Minnesota (page 176).

Motor trucks are more flexible, serving most locations in the state via the highway network (limited only by highway weight restrictions). They provide fast door-to-door delivery (page 177). In view of rising energy costs, the greater efficiency of freight movement over long distances should give rail transport a competitive edge over trucking. Trucks, on the other hand, will retain an advantage for the short hauls and to locations where rail service is not available. Rather than being directly competitive, as these
RAILROAD LINES, 1979
(with abandonments since 1920)

In operation
1979
Abandoned
1920-1979

Lines constructed before 1880
Lines constructed 1880-1920
Lines constructed after 1920

Sources: Harold A. Meeks, "The Growth of Minnesota Railroads, 1857-1957," Department of Geography, University of Minnesota; Minnesota Department of Transportation
PASSENGER TRAINS
1934

Number of trains scheduled per day:
- 1 or 2
- 3 or 4
- 5 or 6
- 7 or 8
- 9 or 10
- 11 or more

Source: Official Guide of Railways

Legend:
- National service center
- Metropolitan service center
- Regional service center

Scale: 1 to 20, 40 Miles
1 to 20, 40 Km
MOTOR FREIGHT CARRIERS
1978

Number of Regular Route Common Carriers providing service to communities:
- 1
- 2 or 3
- 4 or 5
- 6 to 9
- 10 or more

Source: Survey of individual companies by Minnesota State Planning Agency
*based on returns from 25 of 37 carriers operating in Minnesota
modes of freight movement have often been in the past, truck and rail transport will likely move toward a more integrated transport system that combines the advantages of each.

The comparisons of hauling freight by rail or by truck extend also to comparing passenger travel by rail or by bus: buses are more flexible, but potentially less efficient over the long haul. Inter-city bus service in Minnesota is provided by thirteen bus lines which radiate outward from the major urban centers, particularly the Twin Cities (page 179).

HIGHWAYS

In the early 1920s the state’s highway system consisted largely of graded section line roads or improved trails that radiated outward from the major urban centers, such as the Twin Cities (page 180). Hard surface routes were limited to urban areas and a few inter-city routes such as between Duluth and the Iron Range; between the Twin Cities, Northfield, and Faribault; and between the Twin Cities, St. Cloud, and Little Falls. By 1940, the overall network of state and federal highways had been greatly expanded, but the paved roads mainly paralleled the major rail corridors outward from the Twin Cities (page 181). At this stage, the effect of highways was largely to reinforce the existing patterns of accessibility and dominance of the Twin Cities area.

After World War II, the county road system, as well as the state and federal systems were upgraded substantially: routes were widened, hard surfaced and designed for increased speed and safety (page 182). This improved access between all points in the state, allowing freedom of movement in all directions, widening settlement choices for individuals and businesses, and contributing directly to the patterns of urban dispersal that developed in the 1950s and 60s. The expanded choice of mobility offered by an improved highway system has brought increasing interdependence among Minnesota’s urban areas. Today they function as new urban forms, much like low-density, spread-out metropolitan areas.

The historic radial routes to and from the Twin Cities area remain the most heavily travelled highway routes in the state for both noncommercial and commercial traffic (pages 183 and 184). The most lightly travelled highways in the state are those interstitial routes in the areas of low population density, particular, from southwestern to northwestern Minnesota. Since these roadways are paid for directly from state highway user taxes, it is possible on the basis of traffic to estimate revenue generating capacity or subsidy (page 278).

General commercial traffic volumes (trucks and buses) tend to be confined more to the heavily travelled routes that radiate outward from the Twin Cities toward Chicago and eastward, Fargo and westward, Mankato and southwestward, and Albert Lea and southward.

AIRWAYS

Minnesota’s airways system includes 142 public airports scattered across the state (page 185). These include eighteen key system airports, seventy-five intermediate system airports and forty-nine landing strips. The key system consists of airports with paved runways of over 5,000 feet in length, that are capable of accommodating heavy, multi-engine aircraft. Intermediate system airports have paved and lighted runways of less than 5,000 feet in length, capable of accommodating all single-engine, most twin-engine, and some light jet aircraft. Landing strips usually have sod surfaces without lighting and are of undetermined length, capable of accommodating single-engine aircraft and some light twin-engine aircraft.

The availability of commercial air service is restricted by the number and spacing of stops technologically feasible and practical with present-day aircraft. The spacing of airport facilities has thereby been a factor contributing to the clustering of activities in Minnesota that benefit from direct and fast access to regional and national activities. Ten certified air carriers serve Minnesota, two are Minnesota-based. Certified air carriers function primarily as a linkage between the Twin Cities and other major urban centers in the United States, Canada, Europe, East Asia, and Latin America (page 186). In addition to the Twin Cities, certified air carriers provided service to Duluth, Rochester, Fargo/Moorhead, Grand Forks/East Grand Forks, Bemidji, Brainerd, Thief River Falls, International Falls, Hibbing, Mankato, Fairmont, Worthington, and LaCrosse/La Crescent. In addition, six commuter air carriers link the Twin Cities with communities not served by the certified air carriers, including Alexandria, Detroit Lakes, Grand Rapids, Marshall, New Ulm, and Winona, in
NONCOMMERCIAL HIGHWAY TRAFFIC
1977

Average number of vehicles per day on Federal and State Routes

- 1,000 to 2,000
- 2,000 to 3,000
- 3,000 to 4,000
- 4,000 to 5,000
- 5,000 or more

Routes with fewer than 1,000 vehicles per day are not shown

- National service center
- Metropolitan service center
- Regional service center

Source: Minnesota Department of Transportation
U.S. AND INTERNATIONAL PASSENGER FLIGHTS ON SCHEDULED AIR CARRIERS
From Minneapolis-St. Paul
July 1979


*Data for Asia, Europe and South America as of August, 1979

†Direct air service less than five days per week

‡Commuter service only
Minnesota, and other communities in Wisconsin, Iowa, Nebraska, and North Dakota. The heaviest air traffic corridor links the Twin Cities with Chicago. In 1979, the Twin Cities International Airport ranked eighteenth among all airports in the United States with 9.3 million passengers. Cargo flights link the Twin Cities with the nation's major industrial centers and selected other locations where rapid delivery of high value commodities is required (page 188).

WATERWAYS

More than 60 million short tons of commodities were shipped from Minnesota's Lake Superior ports in 1976 (Table 12). Most of this tonnage (88 percent) consisted of taconite pellets and natural iron ore shipped from Duluth-Superior, Two Harbors, Silver Bay and Taconite Harbor to Chicago, Detroit, Cleveland, and other Lower Great Lakes ports for steel production (page 189). The remaining shipments consisted largely of wheat, with barley, corn, and sunflower seeds also significant. Wheat moves to Buffalo for milling or directly on to foreign ports, as do most other agricultural commodities. All agricultural and other non-ore commodities were shipped through the Duluth-Superior port. Shipments arriving at Lake Superior ports totaled 3.6 million tons in 1976, and consisted largely of general cargo, coal, and concrete products, most of which were received at Duluth-Superior.

Barge traffic too, is significant in Minnesota commerce, with 7.8 million short tons of commodities shipped to markets down the Mississippi River in 1976. Grain shipments were handled largely from the municipal Port of St. Paul and private ports on the Minnesota River near Savage. The municipal Port of Minneapolis at that time handled much of the coal originating in North Dakota and Montana that moved downriver. Upriver barge traffic totaled 5.1 million short tons in 1976, consisting largely of petroleum products, agricultural fertilizers, and some Illinois coal, with heavy local traffic of sand and gravel (page 189).

Table 12: Water-Borne Transport
(in millions of short tons)

<table>
<thead>
<tr>
<th>Port</th>
<th>Shipments 1976</th>
<th>Receipts 1976</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Iron Ore and Concentrates</td>
<td>Agricultural Products</td>
</tr>
<tr>
<td>Lake Superior</td>
<td>53.2</td>
<td>4.6</td>
</tr>
<tr>
<td>Duluth-Superior</td>
<td>22.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Two Harbors</td>
<td>8.3</td>
<td>0</td>
</tr>
<tr>
<td>Silver Bay</td>
<td>10.8</td>
<td>0</td>
</tr>
<tr>
<td>Taconite Harbor</td>
<td>11.5</td>
<td>0</td>
</tr>
<tr>
<td>Mississippi River</td>
<td>*</td>
<td>2.4</td>
</tr>
<tr>
<td>Port of Minneapolis</td>
<td>*</td>
<td>0.4</td>
</tr>
<tr>
<td>Port of St. Paul</td>
<td>*</td>
<td>2.0</td>
</tr>
<tr>
<td>Minnesota River</td>
<td>0</td>
<td>2.6</td>
</tr>
</tbody>
</table>

* Less than 50,000 short tons.

Note: Figures may not total due to rounding.

Source: U.S. Army Corps of Engineers.
ENERGY USE AND TRANSMISSION

Energy consumption in Minnesota reached 297,000 BTUs per capita during 1977 (Table 13). Petroleum accounted for 45 percent of this total. Natural gas accounted for 23 percent, dropping from a peak of 34 percent in 1971. Coal, about five-sixths of which is used to produce electricity, accounted for 22 percent of Minnesota's energy consumption in 1977, with the proportion increasing in recent years in response to rising demands for electricity. Nuclear energy in Minnesota is used exclusively for electric production, and accounted for 10 percent of the state's total energy consumption in 1977.

Electricity

About 60 percent of the electricity consumed in Minnesota was generated in coal-fired steam plants in 1977 (Table 14). Nuclear steam plants generated another 30 percent, with the remainder produced by gas, diesel, and water power.*

Natural gas, which provided 38 percent of Minnesota's electric production in 1960 had been nearly eliminated as a generating fuel in the late 1970s, being replaced in importance by nuclear sources which did not exist two decades earlier. Three nuclear reactors produce electricity in Minnesota: two at the Prairie Island plant near Red Wing, and one at the Monticello generating plant.

A high voltage electric transmission system links Minnesota's power generating stations with the state's market areas (page 191). Most electric generating plants are located near their market areas, accessible to rail or barge service which delivers coal, and near an adequate source of water to cool the generating equipment. In two cases, Minnesota is supplied by power produced in North Dakota at the coal mining site and delivered by direct current transmission lines to the major market areas of Minnesota. Minnesota is further tied to a multi-state power grid that can provide power where needed should demands exceed the normal peaks or should an emergency arise either from line failure or generating plant breakdown. This linkage system is known as the Midcontinent Area Power Pool.
and includes Minnesota, Iowa, North Dakota, Nebraska, most of South Dakota, eastern Montana, western Wisconsin and northwestern Illinois (page 192).

In 1978, Minnesota consumed 34,871 million kilowatt hours of electricity. The largest amounts were consumed in the state's major population centers and industrial areas. Electricity used per capita is highest in northeastern Minnesota where the taconite plants and paper mills use large amounts of power (page 193). The consumption of electricity in Minnesota more than tripled between 1960 and 1978, while the state's population increased by only 18 percent.

Natural Gas

Natural gas is delivered to Minnesota by pipeline, principally from the midcontinent fields that include the Panhandle areas of Texas and Oklahoma and southwest Kansas. About 10 percent of Minnesota's natural gas supply came from Canada in 1979. Minnesota is also linked indirectly to the major gas fields of the Texas and Louisiana Gulf Coast (pages 194 and 195). Most of Minnesota's urban centers are served by the natural gas distribution system, but large rural areas of the state do not have access to natural gas pipelines and us LP (liquefied propane) for gas appliances. In 1978, piped natural gas was not available in twelve of Minnesota's eighty-seven counties, all of which are dominantly rural with low population densities and little industrial demand. Heaviest natural gas use is in the Twin Cities area and in northeastern Minnesota, where taconite and paper industries are major gas consumers. Natural gas is used principally for space heating in Minnesota; where natural gas is not available, fuel oil is most often provided for space heating. As with electricity, highest consumption rates per capita for natural gas are found in northeastern Minnesota counties (page 196).

Petroleum

Minnesota's three petroleum refineries at Wrenshall, St. Paul Park, and Pine Bend receive most of their crude oil supplies by pipeline from the Canadian province of Alberta. Crude oil and petroleum products are also delivered to Minnesota by pipeline and barge from Oklahoma, Texas, and Louisiana (pages 194 and 195). With limited supplies, Canada is phasing out crude oil deliveries to the United States. Suppliers are involved in a prolonged process of obtaining permits and financing for new pipelines that can deliver petroleum to replace the Canadian supplies. The proposed "northern tier" pipeline would bring Alaskan petroleum from Puget Sound; the "northern" pipeline would link with existing pipelines in Illinois, delivering crude oil from the Gulf states and foreign sources. In early 1980, neither of these two pipeline proposals had been finally approved, with court action pending in Iowa and Washington.

**Table 13: Energy Consumed**

<table>
<thead>
<tr>
<th>Selected Years</th>
<th>Coal</th>
<th>Petroleum</th>
<th>Natural Gas</th>
<th>Hydro-power</th>
<th>Nuclear</th>
<th>Total</th>
<th>Per Capita in thousands of BTUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>140.6</td>
<td>362.4</td>
<td>179.6</td>
<td>9.6</td>
<td>0</td>
<td>692.2</td>
<td>202</td>
</tr>
<tr>
<td>1964</td>
<td>155.4</td>
<td>385.1</td>
<td>237.1</td>
<td>9.1</td>
<td>0.6</td>
<td>787.3</td>
<td>222</td>
</tr>
<tr>
<td>1968</td>
<td>162.8</td>
<td>453.2</td>
<td>311.0</td>
<td>10.2</td>
<td>0.2</td>
<td>937.4</td>
<td>256</td>
</tr>
<tr>
<td>1971</td>
<td>165.4</td>
<td>510.0</td>
<td>360.8</td>
<td>10.2</td>
<td>12.7</td>
<td>1,059.1</td>
<td>274</td>
</tr>
<tr>
<td>1974</td>
<td>183.1</td>
<td>504.8</td>
<td>337.5</td>
<td>*</td>
<td>53.5</td>
<td>1,078.9</td>
<td>276</td>
</tr>
<tr>
<td>1977</td>
<td>260.2</td>
<td>533.2</td>
<td>266.1</td>
<td>*</td>
<td>122.8</td>
<td>1,182.3</td>
<td>297</td>
</tr>
</tbody>
</table>

* Combined with nuclear.


**Table 14: Electricity Produced and Distributed**

<table>
<thead>
<tr>
<th>Selected Years</th>
<th>Coal</th>
<th>Petroleum</th>
<th>Natural Gas</th>
<th>Nuclear and Hydro-power</th>
<th>Total</th>
<th>Electricity Distributed in billions of kilowatt hours</th>
<th>Efficiency Ratio*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>66.0</td>
<td>2.3</td>
<td>48.5</td>
<td>9.6</td>
<td>126.4</td>
<td>10.0</td>
<td>.27</td>
</tr>
<tr>
<td>1964</td>
<td>85.4</td>
<td>2.8</td>
<td>53.1</td>
<td>9.7</td>
<td>151.0</td>
<td>13.3</td>
<td>.30</td>
</tr>
<tr>
<td>1968</td>
<td>112.2</td>
<td>5.1</td>
<td>64.7</td>
<td>10.4</td>
<td>192.4</td>
<td>19.1</td>
<td>.34</td>
</tr>
<tr>
<td>1971</td>
<td>123.5</td>
<td>7.7</td>
<td>59.1</td>
<td>22.9</td>
<td>213.2</td>
<td>23.7</td>
<td>.38</td>
</tr>
<tr>
<td>1974</td>
<td>141.9</td>
<td>8.9</td>
<td>45.9</td>
<td>53.5</td>
<td>250.2</td>
<td>25.3</td>
<td>.34</td>
</tr>
<tr>
<td>1977</td>
<td>220.0</td>
<td>12.6</td>
<td>7.1</td>
<td>122.8</td>
<td>362.5</td>
<td>28.7</td>
<td>.27</td>
</tr>
</tbody>
</table>

* BTUs distributed as a proportion of BTUs consumed.

NATURAL GAS USE
1978

Billions of cubic feet*

Source: Minnesota Energy Agency
*based on natural gas consumption reported to the Minnesota Energy Agency

NATURAL GAS USE PER CAPITA
1978

Thousands of cubic feet*

State average: 67

Source: Minnesota Energy Agency
* based on natural gas consumption reported to the Minnesota Energy Agency
Chapter 3. The People
Individual people, households, and larger organizations are, of course, the basic substance of the whole productive system which makes up so much of the Minnesota landscape represented in the preceding maps. And the well-being of people is the basic purpose of the whole system. But beyond that, many attributes of individuals and families, in themselves, vary from one part of the state to another and add further to the state's regionalism.

**GROWTH, VARIETY, ADAPTABILITY**

When Senator Stephen Douglas introduced the bill to Congress in 1849 to create the Territory of Minnesota, thirty years had passed since the first permanent white settlement at Fort Snelling. At that time, he told his colleagues that eight to ten thousand settlers lived in the territory. Most of this population was located within the protective shadow of Fort Snelling at Mendota, a few miles downstream from Mendota in the emerging village of St. Paul, or a few miles upstream at the Falls of St. Anthony. The few remaining people were scattered in small clusters along the lower St. Croix and Mississippi Rivers. Later in that same year, Governor Alexander Ramsey, addressing the first territorial legislature, estimated the Indian population at 25,000, while the 1849 census counted 5,000. The Indians were spread across what is now Minnesota and the Dakotas east of the Missouri River.

By 1860, two years after statehood and establishment of Minnesota's western border at the Red River, the population had grown and spread, reaching some 172,000 (Table 15). From those early numbers the total population of the state rose to 2 million by 1910 and 4 million today, virtually all the result of immigration and subsequent natural increase of the immigrants.

Meanwhile, geographical differences in the ethnic character of the population evolved rapidly as immigrants entered the state, spread across the land, multiplied, and migrated again. Native American Indians were concentrated on a few reservations as treaty cessions opened most of the land to white settlement in the mid-nineteenth century.

Immigration to Minnesota was first dominated by western Europeans who established themselves on the state's best agricultural lands. Western European immigration slowed and eastern and southern European immigration increased toward the end of the nineteenth century and into the early twentieth century. These people settled on the remaining and poorer agricultural lands, on the state's iron ranges, and in the Twin Cities area. In the mid-twentieth century, black immigrants from the southern United States arrived along with a second wave of eastern European immigrants. More recently newcomers to Minnesota have included those from Mexico and Indochina in particular.

Less colorful but at least equally important have been Minnesota's internal population shifts. Geographical concentrations of young and elderly have evolved as people have migrated in large numbers in response to changing economic and social conditions. There are accompanying large differences in wealth, income, unemployment rates, health care, disease, housing, crime, life expectancy, and needs for welfare aids across the state. Min-

<table>
<thead>
<tr>
<th>Year</th>
<th>Population in Thousands</th>
<th>Percent in Seven County Twin Cities Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1860</td>
<td>172</td>
<td>30</td>
</tr>
<tr>
<td>1870</td>
<td>440</td>
<td>25</td>
</tr>
<tr>
<td>1880</td>
<td>781</td>
<td>24</td>
</tr>
<tr>
<td>1890</td>
<td>1310</td>
<td>31</td>
</tr>
<tr>
<td>1900</td>
<td>1751</td>
<td>28</td>
</tr>
<tr>
<td>1910</td>
<td>2076</td>
<td>31</td>
</tr>
<tr>
<td>1920</td>
<td>2367</td>
<td>32</td>
</tr>
<tr>
<td>1930</td>
<td>2564</td>
<td>36</td>
</tr>
<tr>
<td>1940</td>
<td>2792</td>
<td>36</td>
</tr>
<tr>
<td>1950</td>
<td>2982</td>
<td>40</td>
</tr>
<tr>
<td>1960</td>
<td>3414</td>
<td>45</td>
</tr>
<tr>
<td>1970</td>
<td>3805</td>
<td>49</td>
</tr>
<tr>
<td>1978</td>
<td>4008</td>
<td>49</td>
</tr>
</tbody>
</table>

Sources: U.S. Censuses of Population; Minnesota State Demographer (1978).

---

nesotans have adapted themselves to changing conditions and opportunities. One response is seen in the network of social organization and technology; another in the attention given to health and education — the basic requisites to guiding change.

THE EUROPEAN STOCK

The Minnesotas' first white settlers were New England Yankees of English, Scottish, and Irish stock who cut the trees, established the lumber mills and later the flour mills, became the early managers and professionals, and assumed political leadership in the mid-nineteenth century.

The accelerating population growth of the state in the 1860s, 70s, and 80s (Table 15) consisted largely of non-English-speaking European immigrants who clustered in areas of the state that were opening for settlement when they arrived. Germans, Minnesota's largest ethnic group, settled in the Lower Mississippi valley beginning in the 1850s, moving up the Mississippi and Minnesota valleys in large concentrations to within 80-100 miles of the Twin Cities area (page 199). The Swedes, Minnesota's second largest ethnic group, first arrived in Minnesota at about the same time as the Germans, eventually filling almost solidly several counties immediately north of the Twin Cities area and several smaller areas in west-central and western Minnesota. Norwegians, the third largest group in Minnesota, settled first in Fillmore County at about the same time and gradually moved across the southern counties toward the west and northwest and are now the dominant ethnic group in western Minnesota and the Red River valley.

Arriving slightly later, in smaller numbers and filling the gaps were French Canadians, Bohemians, Irish, Dutch, Flemish, Polish, Danish, Welsh, Swiss, Luxemburgers, and Icelanders. With most of the good agricultural lands in Minnesota already claimed, immigrant groups arriving around the turn of the century came to the cities or were attracted by employment opportunities in the Twin Cities and on the Iron Ranges. These groups included Finnish, Russian, Austrian, Cornish, Italian, Slovakian, Moravian, Serbian, Croatian, Hungarian, Romanian, and Greek, with important Jewish immigration from several European countries. Many of these groups were concentrated in such small areas that they
cannot be shown on the accompanying maps, but their numbers, grouped by country of origins, appear in Table 16.

Wherever immigrant groups settled, they brought with them their churches which served important social and cultural, as well as religious functions.

In the nineteenth and early twentieth century, these differences in European cultural heritage were reflected in well-known regional variations in language, farming practices, and social or business affiliations. Large variations in the architecture of church buildings and size of church membership today bear witness to that important aspect of the state’s historical geography (for examples see pages 202 and 203). Today a number of festivals, restorations, and commercial enterprises display a continuing or revived interest in embellishing the legacy.

RACIAL MINORITIES

AMERICAN INDIANS

Before white settlement, the Sioux occupied most of Minnesota, but were concentrated in the woodland areas. Pressure from whites in eastern North America pushed the Chippewa westward. They in turn gradually pushed the Sioux from Minnesota’s woodlands onto the prairie. The horse, introduced by the Spanish, and adapted and bred by the Indians, provided the Sioux with the mobility to pursue the abundant wildlife of the grasslands. In 1970, the Bureau of the Census recorded 23,000 Indian people living in Minnesota. This has been generally regarded as an understatement: tribal rolls alone exceeded that number by more than 50 percent. Data shown on page 203 represents 1975 population estimates from the Minnesota Department of Education based upon tribal rolls, sight counts, and school enrollments, with estimation procedures reviewed by the Bureau of the Census.* Reservation populations are from the Bureau of Indian Affairs.** According to these estimates, 45,000 Indians resided in Minnesota in 1975, about 24 percent living on the state’s eleven reservations. The seven largest reservations are Chippewa, while the four smallest are Sioux. The largest reservation is Leech Lake with over 2,800 residents; the Red Lake and White Earth reservations are just slightly smaller. The four reservations in southern Minnesota have a total population of slightly over 300 Dakota Sioux. At the present time, at least 90 percent of Minnesota’s Indian population is Chippewa; most of the remainder are Sioux.

Non-reservation American Indians in the Twin Cities area numbered about 18,600 in 1975, accounting for 41 percent of the state’s total. About two-thirds of that number lived within the city of Minneapolis and were most concentrated on the city’s near south side.

BLACKS

A few black persons had come to Minnesota as free people before the Civil War. Following the Civil War, employment opportunities attracted an additional small number. Most clustered together and were segregated in areas of low cost housing in Minneapolis and St. Paul at locations easily accessible to employment opportunities by public transportation.

Following World War II, there was an unprecedented migration of rural southern blacks to the urban north. The Twin Cities area shared in that growth, usually as a second or third residence after Kansas City, Saint Louis, Chicago, or smaller metropolitan areas in the Lower Midwest.

Minnesota’s present black population is dominantly urban and highly concentrated (page 204). An estimated 46,300 blacks were living in Minnesota in 1975, 92 percent in the Twin Cities area.* The black population in the Twin Cities area represents about 2.1 percent of the metropolitan population, one of the lowest proportions among major metropolitan areas in the United States. More than 90 percent of Twin City blacks are concentrated in three neighborhoods. The largest, with about 13,000 population, is the Summit-University area, just west of downtown St. Paul. Two slightly smaller black communities of about equal size are in Minneapolis, one on the near north side, the other in the south-central area of the city. Though Minnesota’s black population is highly concentrated in these three neighborhoods, the population is inter-mixed, with very few blocks in the core cities being entirely black. Most of the state’s remaining 3,500

* Minnesota Department of Education, Minorities in Minnesota, State of Minnesota: St. Paul, 1976, pp 445 and Table B.
Table 16: Foreign Born Populations

<table>
<thead>
<tr>
<th></th>
<th>1970</th>
<th></th>
<th>1930</th>
<th></th>
<th>1890</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent of Total Population</td>
<td>Percent of Foreign Born Population</td>
<td>Number</td>
<td>Percent of Total Population</td>
<td>Percent of Foreign Born Population</td>
</tr>
<tr>
<td><strong>Total State Population</strong></td>
<td>3,804,971</td>
<td>100.00</td>
<td></td>
<td>2,563,953</td>
<td>100.00</td>
<td></td>
</tr>
<tr>
<td><strong>Foreign Born</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>British Isles</td>
<td>5,871</td>
<td>0.15</td>
<td>6.0</td>
<td>18,769</td>
<td>0.72</td>
<td>4.8</td>
</tr>
<tr>
<td>Germany and Austria</td>
<td>14,058</td>
<td>0.37</td>
<td>14.3</td>
<td>67,281</td>
<td>2.59</td>
<td>17.2</td>
</tr>
<tr>
<td>Norway</td>
<td>9,800</td>
<td>0.26</td>
<td>10.0</td>
<td>71,562</td>
<td>2.76</td>
<td>18.3</td>
</tr>
<tr>
<td>Sweden</td>
<td>12,978</td>
<td>0.34</td>
<td>13.2</td>
<td>90,623</td>
<td>3.49</td>
<td>23.2</td>
</tr>
<tr>
<td>Finland</td>
<td>4,628</td>
<td>0.12</td>
<td>4.7</td>
<td>24,360</td>
<td>0.94</td>
<td>6.2</td>
</tr>
<tr>
<td>USSR</td>
<td>6,160</td>
<td>0.16</td>
<td>6.3</td>
<td>13,470</td>
<td>0.52</td>
<td>3.4</td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>9,734</td>
<td>0.26</td>
<td>9.9</td>
<td>40,056</td>
<td>1.54</td>
<td>10.3</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>10,434</td>
<td>0.27</td>
<td>10.6</td>
<td>33,303</td>
<td>1.28</td>
<td>8.5</td>
</tr>
<tr>
<td>Canada</td>
<td>9,815</td>
<td>0.26</td>
<td>10.0</td>
<td>27,264</td>
<td>1.05</td>
<td>7.0</td>
</tr>
<tr>
<td>Asia</td>
<td>5,295</td>
<td>0.13</td>
<td>5.4</td>
<td>1,371</td>
<td>0.05</td>
<td>0.4</td>
</tr>
<tr>
<td>Other</td>
<td>9,283</td>
<td>0.24</td>
<td>9.5</td>
<td>2,731</td>
<td>0.11</td>
<td>0.7</td>
</tr>
</tbody>
</table>

* a) England, Scotland, Wales, Ireland, Northern Ireland.
  b) Includes Latvia, Lithuania, and Estonia.
  c) All of Turkey counted in Asia.
  d) Included with USSR (Russia).
  e) Russia.
  f) Poland, Yugoslavia, Czechoslovakia, Hungary, Romania, Bulgaria.
  g) Poland, Bohemia, Hungary.

Source: U.S. Censuses of Population.
blacks are located in Duluth, Rochester, St. Cloud, or other similar communities.

CHICANO-LATINOS

Minnesota's largest minority group is the Chicano-Latino population, numbering some 49,500 persons in 1975.* This population includes persons of Spanish heritage identified by surname, language, or place of birth. Minnesota's Hispanic population first arrived as migrant farm laborers, assisting with the vegetable production operations of southern Minnesota (page 77). With expansion of sugar beet production in the Red River valley, and the availability of summer-long employment, an increasing proportion of migrant laborers have sought year-round residence and employment in Minnesota (page 75).

The Census had recorded 37,300 persons of Spanish heritage living in Minnesota in 1970. It is generally agreed that this figure represents some undercounting, though not at the rate of the American Indian population. There was an increasing migration of Chicano-Latinos to Minnesota between 1970 and 1975 and this trend has continued since that time. About two-thirds of Minnesota's Hispanic population lived in the seven county Twin Cities area in 1975, with the others more widely scattered across the state than either the black or Indian populations (page 205). The single largest concentration of Chicano-Latinos was on the west side of St. Paul. Of the remaining third, about half lived in the vegetable growing areas of southern Minnesota or the sugar beet growing areas of the Red River valley.

ASIANS

Several thousand persons of Chinese, Japanese, and Filipino stock have lived in Minnesota — primarily in the Twin Cities area — for many years. Important Asian immigrant groups arriving since World War II have included Korean and Indochinese. The Indochinese were estimated to number about 10 thousand in the state in early 1980.**

** Minnesota Department of Public Welfare, Office of Indochinese Resettlement.
THE SETTLEMENT PROCESS

From its beginning in the southeastern part of the state, Minnesota's white population gradually pushed westward and northward, during the 1850s, following the stream valleys which served as means of transportation and provided wood for building materials and fuel.

DISPLACEMENT OF INDIANS; DEVELOPMENT OF RAIL PATTERN

Railroad development beginning in the 1860s joined together the existing settlements and triggered the sweep of white settlement across the state. White settlement gradually displaced the native Chippewa and Sioux populations and confined their reduced numbers to reservation lands. In recent years, nearly half the Indian population has shifted from these reservations to the Twin Cities area, particularly Minneapolis.

Until about the time of World War I, both the state's population and rail network advanced, then thickened in density (pages 206 through 211). This was the era of resource acquisition and development. Settlers spread out to cultivate the land, harvest the timber and later to settle the Iron Ranges and dig the rich, natural ores. Towns and cities sprang up and grew to serve these economic activities, to assemble and process their output, and feed it into the mainstream of the national economy.

TRACTOR-AUTO AGE

Since the Depression and World War II, the economy of the state has become more noticeably diversified, providing a great range of services in areas like finance, education, medicine, law, business, and government. These changes in Minnesota's economy coincided with improvements in personal mobility and new machinery that allowed greater production with fewer workers. This resulted in a steady increase in farm size and a decline in farm population at the same time that employment opportunities were expanding in the urban areas of the state.

Population shifts reduced rural densities and contributed to growth in the state's cities. These urbanization trends were inhibited during the 1930s by economic stagnation and by the national emergency in the early 1940s. Beginning in the late 1940s, urbanization resumed with new vigor after being restrained for
POPULATION
1870

Sources: U.S. Bureau of the Census
Harold A. Meeks, M.A. Paper, Department of Geography,
University of Minnesota, 1957
POPULATION
1900

Incorporated places
- 130,000
- 53,000
- 5,000
- 200
- 100 to 199
- Under 100

Unincorporated places
- 50

Sources: U.S. Bureau of the Census
Harold A. Meeks, M.A. Paper, Department of Geography,
University of Minnesota, 1957

Railroads, 1900
County boundaries as of 1922
more than a decade and a half.

During the 1950s, urban growth in Minnesota, as throughout the nation, was almost explosive (pages 213 and 214). Concurrently, 279,000 persons left Minnesota's farms, as the number of farms decreased and the average farm size increased rapidly. The remaining farms produced more food than ever. And the more affluent and mobile farm population was able to travel greater distances to the larger trade centers, contributing to their growth and dominance, while the smallest towns struggled to survive the competition.

The shift from natural ore mining to taconite processing on the Mesabi Range during the 1950s resulted in the emergence of several completely new communities in northeastern Minnesota.

During the 1950s, Minnesota's population increased by 431,400 persons with the urban counties increasing most rapidly in both number and percent. Meanwhile, the predominantly rural counties of the state (those without major trade centers), experienced losses in population. Notwithstanding the large urban population growth, there was a net outmigration of 98,000 persons from Minnesota, a large share of whom moved to urban centers in other states, particularly on the West Coast. Only twelve of Minnesota's eighty-seven counties experienced a net immigration during that decade; these included six of the seven Twin Cities metropolitan area counties (Ramsey being the only exception). Other counties realizing net immigration included Olmsted (Rochester), Steele, (Owatonna), Clay (Moorhead), and Lake (with the development of taconite processing at Silver Bay).

FLUCTUATION IN BIRTH RATE AND MIGRATION

Minnesota's overall population growth during the 1950s was the result of natural increase — the excess of births over deaths. Birth rates in Minnesota, as throughout the country, experienced a continual increase during the 1950s, reaching a peak in 1959. Those who migrate consist largely of young adult groups, who when leaving an area, reduce the childbearing potential and leave behind a relatively older population. Likewise, they add to the childbearing potential of the areas they go to and reduce the relative number of elderly. For these reasons, counties experiencing net immigration (page 214) are also those experiencing the highest levels of natural increase (page 214), and those counties experiencing the greatest net outmigration have the lowest levels of natural increase.

During the 1960s, Minnesota increased in population by 391,100 persons, while net outmigration declined to 0.7 percent of the 1960 population (pages 215 and 216). Birth rates dropped steadily. The state's urban population continued to shift outward from the centers of employment toward the accessible countryside areas of lakes, trees, and hills. Population increased in the metropolitan fringe counties and in certain counties in the central part of the state with physical amenities. During the 1960s, farm size increased and off-farm migration continued. Many farmers located within commuting distance of alternative employment opportunities converted to part-time farming. Other farms were purchased by exurbanites and converted to recreational, hobby, or retirement farms. But in those agricultural areas of the state which were not easily accessible to expanding employment opportunities, farmers did not have the option of securing supplemental income. The choices for many middle-aged farmers on small holdings were limited to selling out or struggling to survive — and as a result pockets of rural poverty became evident in some areas of the state.

The cities, too, were affected by the shifting patterns of population. Two-parent middle class families with children made up most of the population spreading from the cities into suburban and nearby countryside areas. This left behind a population that was less able or less inclined to pursue the suburban lifestyle. They included the elderly, minority groups, and the socially and psychologically alienated. Certain older urban neighborhoods continued to attract transient, upwardly mobile, young adults who were seeking jobs, education, and social contacts. These population groups brought new social problems and increasing costs to the cities, and even more families left. Some persons felt trapped by their environments and unable to participate in the opportunities available to others; this brought waves of violence to American cities, including Minneapolis and St. Paul in the late 1960s.

CHANGES IN THE 1970s

During the early 1970s, trends of population dispersal accelerated (pages 217 through 219). Birth rates continued to drop and then leveled off toward the end of the decade. There was a slight net immigration (about 4,000 persons) between 1970 and
MIGRATION
1950 to 1960

Net migration as percent of 1950 population:
- Outmigration 20 to 34
- Outmigration 10 to 20
- Outmigration less than 10
- Immigration less than 10
- Immigration 10 to 20
- Immigration 20 to 99

State average: -3.2

Source: U.S. Census of Population

NATURAL POPULATION INCREASE
1950 to 1960

Natural increase (births - deaths) as percent of 1950 population:
- 6 to 10
- 10 to 15
- 15 to 20
- 20 to 25
- 25 to 44

State average: 17.7

Source: U.S. Census of Population
ABSOLUTE CHANGE IN POPULATION
1970 to 1976

ESTIMATED CHANGE
IN POPULATION DENSITY
1970 to 1977

Number of persons
- Decrease 19,700 and 43,600
- Decrease 1300
- Decrease less than 1000
- Increase less than 1000
- Increase 1000 to 10,000
- Increase 10,000 to 36,300
State total: +160,000

Persons per square mile
- Decrease
- Increase less than 1.0
- Increase 1.0 to 3.0
- Increase 3.0 to 10.0
- Increase 10.0 to 30.0
- Increase 30.0 or more
State average: +2.1

Sources: Minnesota State Demographer
U.S. Census of Population

Source: Minnesota State Demographer
PERCENT CHANGE IN POPULATION
1970 to 1976

Percent change adjusted to decennial rate
- Decrease 10 and 11
- Decrease less than 10
- Increase less than 10
- Increase 10 to 50
- Increase 50 to BU
State average: +6.7

Sources: Minnesota State Demographer
U.S. Census of Population

MIGRATION
1970 to 1976

Net migration as percent of 1970 population adjusted to decennial rate
- Outmigration 10 to 14
- Outmigration less than 10
- Immigration less than 10
- Immigration 10 to 20
- Immigration 20 to 68
State average: +0.2

Sources: Minnesota State Demographer
U.S. Census of Population
1976. Five counties showed natural decreases in population. Larger numerical losses occurred in Hennepin and Ramsey Counties; while the largest gains were in the metropolitan fringe counties, particularly Anoka, Dakota, Washington, and Wright. Population growth rates were highest in the lake region of central and north-central Minnesota, with its relatively small population base. The largest portion of the immigrant population to this area were retired people, but young families with children were also included. Of those employed, some farm part-time, others commute to jobs in the cities, work their regional sales territories, practice their professions, or otherwise participate in the expanding economy of rural Minnesota.

Three principal themes have dominated the map of population change in Minnesota during the 1970s. First, farms continued to increase in size — though at a rate slower than in the 1950s and 1960s — and agricultural counties continued to lose population. In some counties the losses were offset by increases in non-agricultural employment or stabilized by an increasing proportion of part-time farms.

Second, urban areas continued the process of thinning and spreading, with single family homes on larger lots and decreasing population densities. Average commuting distances have increased and population growth has extended outward from the state's major employment centers, particularly the Twin Cities. To a lesser extent, the satellite urban centers, including such cities as Rochester, Owatonna, Waseca, Hutchinson, St. Cloud and Willmar, which lie beyond the normal commuting range of the Twin Cities, have established their own commuter patterns.

Third, there has been a shift in population toward the physical amenity areas of the state — those areas with lakes, trees, and hills. The scenic countryside of glacial moraines through much of west-central and north-central Minnesota has drawn both people and jobs, most noticeably in Crow Wing, Cass, Hubbard, Becker, Beltrami, Itasca, and parts of Aitkin County.

Together, these three themes may be considered as a continuation of post-war processes of urbanization. The major patterns of population distribution seen on the landscape in the late 1970s have been aided by cheap energy and encouraged by a variety of public and private policies. But now there are the beginning signs of change. The rising costs of energy, housing construction, and services for widely dispersed populations are
beginning to be reflected in a new demand for urban real estate and in renewed activity to rehabilitate older buildings. Whether this trend will continue remains to be seen.

NATIONAL PERSPECTIVE

In order to put Minnesota population changes within a larger context, national data are presented on pages 221 and 222. The map on page 221 compares the size and location of Standard Metropolitan Statistical Areas* with non-metropolitan population densities. The concentration of metropolitan areas in the northeast quadrant of the United States is closely tied to early patterns of urbanization and industrialization that extended from southern New England to northern Virginia and westward to the Great Lakes and the Upper Mississippi valley. General patterns of non-metropolitan population density by state are closely tied to agricultural development and farm size which increases from east to west as the amounts of precipitation decrease. Throughout the country, as in Minnesota, urban areas are spreading outward to the nearby countryside, especially where that dispersal is not constrained by physical barriers such as major bodies of water or mountain ranges. As in Minnesota, so nationally there is a population shift toward areas of physical amenities—to those areas near water, to forested hills or mountains, and to pleasant climates.

During the 1960s, migration patterns were dominated by the rural to urban shift in the South and Midwest, and by the national shift to the West Coast, particularly California. During the 1970s, the migration from farms in the South and Midwest slowed considerably, while the older cities of the Northeast experienced heavy outmigration to urban areas in the South and West. California urban areas continued to grow, but not at the rates of the 1950s and 1960s. Exceptions to the general population losses of the Northeast were the rapid growth of the Washington, D.C. area and a shift to the amenity areas of Maine, Vermont, and New Hampshire.

Migration — the most dynamic aspect of population change — is determined to a great extent by the unpredictable decisions that individuals and families make concerning where they wish to live and work. Important related factors include age, education, income, occupation, and family status.

CHARACTERISTICS OF THE POPULATION

AGE GROUPS

At different stages in life, people typically experience different living arrangements. For the following maps (pages 224 to 229) the population has been divided into five age groups: five to seventeen, the school age population living at home; eighteen to twenty-four, the most highly mobile group seeking jobs, education, and social contacts; twenty-five to forty-four, the age of establishing families and households, characterized by strong upward socio-economic mobility; forty-five to sixty-four, the period in which children leave home, income is at a peak, and there is reduced socio-economic pressure; sixty-five and over, retirement, with some changing place of residence, but most remaining where they are. The characteristic living arrangements of each age group are reflected in the changing and varied settlement patterns across the state.

Children

The school age population (five to seventeen) lives in places chosen by their parents, who considered the needs of growing children for such things as good schools, recreational opportunities, personal security, and acceptable peer groups. The highest proportion of school age population in Minnesota is found in those areas of heavy immigration, particularly the suburban counties of Anoka, Dakota, Scott, and Washington. Cultural and religious factors, contributing to high birth rates, have resulted in high proportions of children in other Minnesota counties, such as Red Lake, Mahnomen, Morrison, and Murray. The lowest proportions of children are found in counties with heavy outmigration, including the urban core counties of Hennepin and Ramsey, and rural agricultural counties, such as Grant and Norman. In some cases low fertility rates contribute to low child populations, as in Kandiyohi and McLeod Counties. An influx of

* A Standard Metropolitan Statistical Area includes a central city (or cities) of 50,000 population or more or a concentrated urban community of at least 50,000 persons, the county in which it is located, and adjacent counties that are metropolitan in character and socially and economically integrated with the county of the central city.
U.S. METROPOLITAN POPULATIONS
with non-metropolitan population densities
1970

Non-metropolitan population per square mile
- Less than 10
- 10 to 40
- 40 to 70
- 70 to 100
- 100 or more

Metropolitan population
- 10 million
- 5 million
- 1 million
- 100 thousand

Source: U.S. Bureau of the Census
retirement age persons, as in Cass County, tends to reduce the proportion of children. Counties with large college populations, such as Blue Earth and Winona, have relatively lower proportions of all other age groups.

Between 1960 and 1970, the proportion of persons aged five to seventeen increased in the state from 25.4 percent to 27.6 percent, reflecting the rising birth rates through the 1950s (page 224). The declining birth rates of the 1960s will reduce the numbers in this age group by the 1980 Census. The differences in distribution of this age group between 1960 and 1970 are a result of shifts from rural to urban areas and the thinning and spreading of the urban population during the 1960s.

**Young Adults**

Following high school graduation, personal mobility increases sharply, as persons in the eighteen to twenty-four age group seek jobs, educational opportunities, and social contacts, or just set out to see the world. Because of its employment opportunities, schools, and size, the Twin Cities metropolitan area draws large numbers of young adults from throughout the Upper Midwest. Many thousands are concentrated in areas of rental housing, such as the near southside of Minneapolis. The highest percentages in this age group, however, occur in counties where colleges are located, such as Blue Earth, Clay or Beltrami (page 225). Sherburne County ranked high in 1960 because it contains the state correctional institution for young men, but in 1970, spreading suburbanization had reduced the relative prominence of that institutional population.

Lowest proportions of this age group were found in the most rural counties of the state, such as Aitkin, Lincoln, and Traverse. Between 1960 and 1970 this age group increased from 8.3 percent to 11.4 percent of the state’s population and relatively more young adults went on to college. The opportunities for higher education were widely distributed throughout the state by 1970, with construction of new vocational-technical institutes and two-year community college (pages 161 and 163), and the distribution of young adults in the state was likewise affected.

**The Family Years**

Geographic movement of population declines gradually as persons reach their late 20s, 30s, and 40s and families are established. Families seek a "good place" in which to raise their children; housing investment and socio-economic status are other factors influencing choice in place of residence. Areas of the state with the highest proportions of population in the twenty-five to forty-four age group are in the expanding housing areas, accessible to employment. These include the suburban areas of the Twin Cities (Anoka, Dakota, and Washington Counties) and to a lesser extent the smaller growing urban areas elsewhere in the state (most notably Olmsted County). Lowest percentages in this age group are found in areas where employment levels are static and where a net outmigration has continued over a period of time (page 226). Between 1960 and 1970, the proportion of people in their family years declined (from 23.9 percent to 22.4 percent) reflecting the movement of those born during the depression years (when birthrates were low) into this age range. It is interesting to note that persons born during the low birthrate years of the 1920s and 30s, who came from small families, were those having large families during the peak birth years of the 1950s and early 1960s.

**Middle-Aged Persons**

The age group forty-five to sixty-four is characterized by low mobility. The children have grown and most have left home. Family income is at its highest point, while financial pressures are declining, and there is little need or desire to change residential location. For these reasons, the proportion of this age group is relatively low in the newer suburban areas of the Twin Cities, which are characterized by younger families with children. Older Twin Cities suburbs, however, should realize increases in this age group during the 1980s. Beyond the Twin Cities area, the proportion of this age group is relatively high in rural counties that have experienced outmigration of young persons (page 227). New employment opportunities for middle-aged persons are limited in rural counties, thus migration is limited, and they remain to com-
POLULATION AGE 18-24
1960

Percent of total population age 18-24
- 4 to 6
- 6 to 9
- 9 to 12
- 12 to 15
State average: 8.3

Source: U.S. Census of Population

POLULATION AGE 18-24
1970

Percent of total population age 18-24
- 5 to 6
- 6 to 9
- 9 to 12
- 12 to 15
- 15 to 18
- 18 to 24
State average: 11.4

Source: U.S. Census of Population

225
prise a relatively large proportion of the population. The proportions of the total state population in this age group changed little from 1960 to 1970, but the continuing urbanization process during the 1960s is reflected in the changing patterns of distribution.

**The Elderly**

Persons sixty-five years and older are most concentrated in the rural counties of the state that have experienced continuous, long-term outmigration of younger age groups (pages 228 and 229). When persons reach retirement age, most remain in their community; only a small percentage move to another location. Minnesotans who do move are commonly attracted to the physical amenities of north-central Minnesota where seasonal homes may be converted to year-round residences. High proportions or retirement age persons are found concentrated in certain neighborhood in the core cities of Minneapolis and St. Paul, where they remain after their children have grown up and left home. Conversely, the lowest proportion of persons age sixty-five and over are found in suburban Twin Cities counties. Changes in distribution patterns in this age group between 1960 and 1970 were affected largely by ongoing settlement changes—the declining farm population, thinning and spreading of urban areas, and a shift in population to areas of physical amenities.

**INCOME**

Personal income represents income earned by individuals as reported in the U.S. Census of Population in 1949 and 1969, and by the U.S. Bureau of Economic Analysis in 1976. Personal income is not only higher in urban than in rural areas, but growing at a greater rate (pages 230 to 232). By 1969, only seven of the state’s eighty-seven counties had per capita personal income above the state average. These seven were Hennepin, Ramsey, Dakota, and Washington Counties in the Twin Cities metropolitan area and Olmsted (Rochester), Steele (Owatonna), and Mower (Austin) Counties in southeastern Minnesota. In 1976, six counties were above the state average — Washington and Mower Counties were dropped from the 1969 list and St. Louis was added. It should be noted that these data tend to exaggerate the disparities between urban and rural incomes because farm in-
come is often under-reported.* Likewise, income should not necessarily be considered as a good basis for comparing the quality of life in the state. But as a general measure of differences in buying power from one county to another, income is a consistent and useful criterion.

Incomes tend to be consistently higher in those areas with high proportions of professional and industrial employment and consistently lower in the marginal agricultural counties and counties with significant under-employment. In addition, personal income in agriculturally dominated counties tends to be more variable than in non-agricultural or economically diversified counties. For example, poor crops in 1976 in western Minnesota (Swift, Chippewa, Lac Qui Parle, and Lincoln Counties) are reflected in 1976 personal income (page 230) and the change in personal income between 1969 and 1976 (page 232). During the 1969 to 1976 period, the highest rates of increase in personal income occurred in non-metropolitan growth areas, though the income gap between rural and urban areas was not reduced. This trend in the 1970s represents a change from the preceding two decades when both absolute and percentages rates of personal income growth were highest in the Twin Cities metropolitan area (page 231). The increasing rate of growth in outstate Minnesota during the 1970s has been the result of rising farm income (see Table 3) and an extension of the urbanization process, which brought new population and jobs to areas of the state beyond the Twin Cities.

OCCUPATIONS

Employment in Minnesota has grown rapidly in the post war period, increasing by 67 percent between 1955 and 1978. The largest numerical and percentage increases have occurred in the services sector, which includes accounting, legal, medical, business, personal, and repair services, recreation, and private education. The agricultural sector of the economy experienced substantial declines in employment during the same period (Table 17).

The major employment groups for each Minnesota county are shown on page 234. The Bureau of Economic Analysis data, as

shown on this map, separates proprietors (farm and non-farm) from wage and salary workers (those persons employed by proprietors). While this information is not strictly comparable with census data, it is more recent and shows the relative importance and location of various kinds of economic activity in the state.

The proportion of farm proprietors is highest in those counties dominated by agriculture and without major regional trade centers or other industries (see also page 235). Agriculture is the dominant economic activity in most western Minnesota counties and several counties in eastern and southeastern Minnesota. As a proportion of total employment, farm proprietors are lowest in the marginal agricultural counties of northeastern Minnesota and those counties with major urban centers. The category non-farm proprietors includes business proprietors and independent professional practitioners (see also page 250). Counties with relatively large numbers of small businesses — such as those with many small towns, none clearly dominant — are those that have the highest proportions of non-farm proprietors. Counties lowest in non-farm proprietors are the urban counties whose employment structure is dominated by large enterprises.

Mining employs less than one percent of the state’s work force, but is heavily concentrated in three northeastern Minnesota counties: St. Louis (11 percent), Itasca (13 percent), and Lake County (30 percent). In manufacturing employment, most southeastern Minnesota counties are above the state average; most other counties exceeding the state average have a single specialized industry, such as paper manufacturing in Carlton and Koochiching, or snowmobile manufacturing in Pennington and Roseau Counties. The proportion of employment in retail and wholesale trade is highest in those counties dominated by major urban centers, particularly Hennepin and Ramsey (pages 153 and 155). The Bureau of Economic Analysis definition tends to underestimate the significance of the service sector, since the proprietor class includes many self-employed professionals who are engaged in service industries. The state’s major urban counties are well above state averages in the proportion of their total employment engaged in services. The highest is Olmsted County with its specialized medical function, the Mayo Clinic. The government category (including public education) is in reality an additional service factor. Government employment is highest in northeastern Minnesota and in those counties which contain institutions of higher education, including vocational-technical in-
Table 17: Employment by Economic Sector

<table>
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<tbody>
<tr>
<td></td>
<td>Numbers</td>
<td>Percent of</td>
<td>Percent of</td>
</tr>
<tr>
<td></td>
<td>in Thousands</td>
<td>State Total</td>
<td>U.S. Total</td>
</tr>
<tr>
<td>Agriculture(a)</td>
<td>213</td>
<td>19.8</td>
<td>4.5</td>
</tr>
<tr>
<td>Mining(b)</td>
<td>17</td>
<td>1.6</td>
<td>2.2</td>
</tr>
<tr>
<td>Construction</td>
<td>55</td>
<td>5.1</td>
<td>2.0</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>210</td>
<td>19.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Transportation and Utilities</td>
<td>87</td>
<td>8.1</td>
<td>2.2</td>
</tr>
<tr>
<td>Wholesale and Retail Trade</td>
<td>219</td>
<td>20.3</td>
<td>2.0</td>
</tr>
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<td>Finance, Insurance and Real Estate</td>
<td>41</td>
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<td>1.9</td>
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<td>Services</td>
<td>105</td>
<td>9.7</td>
<td>1.8</td>
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<tr>
<td>Government</td>
<td>131</td>
<td>12.2</td>
<td>1.9</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1078</strong></td>
<td><strong>100.0</strong></td>
<td><strong>1.97</strong></td>
</tr>
</tbody>
</table>

|                                        | Numbers    | Percent of | Percent of             |
|                                        | in Thousands | State Total | U.S. Total             |
|                                        | 120        | 6.7        | 5.1                    |
| Mining\(b\)                            | 17         | 0.9        | 2.0                    |
| Construction                           | 80         | 4.4        | 1.9                    |
| Manufacturing                          | 358        | 19.9       | 1.8                    |
| Transportation and Utilities           | 94         | 5.2        | 1.9                    |
| Wholesale and Retail Trade             | 426        | 23.6       | 2.2                    |
| Finance, Insurance and Real Estate     | 86         | 4.8        | 1.8                    |
| Services                               | 331        | 18.4       | 2.1                    |
| Government                             | 291        | 16.1       | 1.9                    |
| **TOTAL**                              | **1803**   | **100.0**  | **2.04**               |

Percent Change 1955-77: 67%

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\(a\) Estimated.

\(b\) Includes taconite processing.

Sources: Historical Statistics of the United States; Statistical Abstract of the United States (1979 data).

During the 1970s, unemployment has been highest in the transitional agricultural zone on the north and east edge of the state's dairy region, in northwestern Minnesota, and in the seasonal recreation and forest products areas of northeastern Minnesota (page 236). Here, income is generally below the state average, the work force tends to be underemployed; though there is often a need for two or more workers in the family, supplementary employment opportunities are not easily accessible. Lowest unemployment rates are found in the urban and major agricultural areas of the state.

During the 1970s employment has spread beyond its past concentration in the state's major urban areas, following the dispersal of population and shift to the state's physical amenity areas. These population changes have stimulated new markets and new service businesses, and have provided a job-seeking labor pool that has attracted certain labor-intensive industries. The most rapid employment growth during the 1970s has been seen in the satellite centers, beyond commuting range of the Twin Cities, and in most of the state's urban areas of about 5,000 population or more (page 236). Employment in Minnesota increased by 16.9 percent between 1970 and 1977, with the Twin Cities metropolitan counties (15.6 percent) and St. Louis County (9.2 percent) increasing at rates below the state average during that period.

EDUCATIONAL ATTAINMENT

Educational attainment is to a large degree a function of population migration. The highest migration rates are among persons in their late teens, continuing and tapering off in the late 20s. Generally the higher the level of education attained, the more mobile people are: they are usually more aware of job opportunities, they tend to be more willing to take the risks of breaking local ties, and since their skills are often specialized, employment opportunities are available in relatively few locations. Measuring educational attainment of the population aged twenty-five and over, therefore, measures education after the peak migration period. The proportion of college graduates in the population is highest in the urban areas of the state, in areas of immigration,
EMPLOYMENT GROUPS*
1976

Number of employed persons
- 500,000
- 100,000
- 20,000
- 5,000

Employment groups
- State and local government
- Non-farm proprietors
- Farm proprietors
- Farm workers
- Manufacturing
- Wholesale and retail trade
- Services
- Mining
- Miscellaneous—includes any of the above groups when they are too small to be legible on a county circle, plus the following:
  (a) Transportation and public utilities
  (b) Finance, insurance and real estate
  (c) Federal government, civilian and military
  (d) Construction
  (e) Agricultural services, forestry, fishing and other

Source: U.S. Bureau of Economic Analysis
*includes full and part-time employment
and in communities with higher education facilities or offices that employ a high proportion of college-educated persons (pages 238 to 240). The share of college graduates in the population is lowest in rural areas, areas of outmigration, and areas without higher education facilities.

The numbers of college graduates in Minnesota more than tripled between 1940 and 1970 (Table 18). In 1970, 8.6 percent of the female population in Minnesota over age twenty-five were college graduates, compared to 13.8 percent of the male population. Though reliable estimates are not available, evidence suggests that since 1970 the number of female college graduates has increased at a greater rate than male college graduates.

Male college graduates tend to be concentrated in and near urban areas, where job opportunities are available. Female college graduates are more widely scattered in the state, being closely related to the distribution of elementary and secondary school enrollment, since a high proportion of female college graduates in the past have been teachers. Olmsted County has a high proportion of female college graduates employed by the medical facilities in Rochester. High school graduates, while usually not as specialized or as mobile as college graduates, tend to gravitate toward the areas of job opportunities. The proportions of high school graduates are therefore highest in and near the state’s urban areas and lowest in counties with few job opportunities. Areas of the state that have not realized economic expansion and employment increases have experienced continuing outmigration over several decades — a self-perpetuating phenomenon.

At the national scale, too, patterns of migration are the most important factors influencing the map of educational attainment (page 240). States with long-term outmigrations have low levels of educational attainment. States with net immigrations, on the other hand, tend to have high levels of educational attainment. Cultural values and economic conditions appear to modify these general patterns. For example, in Utah a high value is placed on educational achievement and in Massachusetts the economy requires and attracts persons with high education skills, despite outmigration trends. Both of these modifying factors (cultural and economic) influence Minnesota, which is one of only three states between the urban east and the Rocky Mountains that are above the national average in educational attainment.

### Table 18: College Graduates

<table>
<thead>
<tr>
<th>Year</th>
<th>Percent of Male Population Aged 25 and over</th>
<th>Percent of Female Population Aged 25 and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>1940</td>
<td>4.8</td>
<td>3.6</td>
</tr>
<tr>
<td>1950</td>
<td>6.4</td>
<td>4.9</td>
</tr>
<tr>
<td>1960</td>
<td>9.3</td>
<td>5.7</td>
</tr>
<tr>
<td>1970</td>
<td>13.8</td>
<td>8.6</td>
</tr>
</tbody>
</table>

Source: U.S. Censuses of Population.

### HEALTH

**Physicians**

Primary care physicians are the doctors to whom patients go as a first line of health treatment. These include licensed physicians in general practice, family practice, obstetrics/gynecology, pediatrics, and internal medicine. Information on primary care physicians shown on page 241 does not take into account the age or extent of a physician’s practice. Generally, the urban areas with health care facilities tend to be above the state average of five primary care physicians per 10,000 population: Olmsted County is highest with twenty-one. Non-urban areas with high ratios of primary care physicians are Cook, Kittson, and Lincoln Counties. Counties located near urban centers are often below the state average, as in Anoka, Dakota, and Washington Counties, which are served by medical personnel and facilities in Hennepin and Ramsey counties; Houston County, which is served by LaCrosse; Clay County, which is served by Farg; Wilkin County which is served by Wahpeton; Red Lake and Marshall Counties which are served by Thief River Falls; and Aitkin and Cass Counties which are served by Brainerd. Medical specialists are more concentrated than primary care physicians in the major health centers of the state.
COLLEGE GRADUATES, BOTH SEXES
1970

Percent of total population age 25 and older completing four or more years of college:

- 2 to 5
- 5 to 7
- 7 to 9
- 9 to 12
- 12 to 15
- 15 to 18

State average: 11.1

Source: U.S. Census of Population

COLLEGE GRADUATES, MALE
1970

Percent of male population age 25 and older completing four or more years of college:

- 3 to 5
- 5 to 7
- 7 to 9
- 9 to 12
- 12 to 15
- 15 to 23

State average: 13.8

Source: U.S. Census of Population
Sherburne, and Dodge — do not have hospitals.

Nursing Homes

Nursing home beds are divided into two general types: skilled nursing facilities and intermediate care facilities. Skilled nursing facilities provide twenty-four-hour licensed nurse coverage, full time qualified dietician personnel, and skilled rehabilitation services available on a daily basis. Intermediate care facilities provide some services beyond room, board, and laundry, but not the full array available in a skilled nursing facility. There are some nursing facilities in every county; but twelve counties do not have any skilled facilities, while all the facilities in six counties are classified as skilled (page 242).

NATIONAL COMPARISONS IN HEALTH

Physicians

Physician data, shown on page 244, include all medical specialists and are not comparable to the concept of primary care physicians shown on page 241. The largest numbers of physicians per population tend to be in urban areas where there are large concentrations of medical specialists. The urban states of the Northeast plus California and Colorado, are all above the national average in numbers of active non-federal licensed physicians per 10,000 population. The lowest ratios are found in the rural southern states, correlated to income and use of medical care facilities, both of which are somewhat below national averages. The northern Great Plains states and northern mountain states are below the national average, partly reflecting low income, but also reflecting service from the medical specialty centers in the Twin Cities, Rochester, and Denver. Personal income is closely related to numbers of physicians; people with higher income tend to seek medical services that are not sought by low income groups (for example, psychiatric care). As a result, states with higher levels of income per capita tend to have more physicians per capita.

Comparing the number of physicians to personal income, provides a comparative measure of the proportion of their income persons are willing, able, or need to spend on health care (page
Highest in the nation are the urban northeastern states, Utah, Colorado, and California. Minnesota is above the national average.

Hospital Beds

All north-central states are above the national average in the number of non-federal hospital beds per 1,000 civilian population (page 244). This is accounted for by the establishment of hospitals in many small towns, followed by population losses. The large number of small town hospitals represents a traditional emphasis on high quality health care. Low hospital bed ratios are seen in states that have experienced rapid growth in recent years — including all states west of the Rocky Mountains. Construction of new hospital facilities in these areas has been slow in catching up with population growth. At the same time, there has been a growing trend toward reduced hospital use as a result of shorter hospital stays, home recuperation, and the growth of health maintenance organizations that prefer to treat patients outside hospitals as much as possible, thus reducing costs to the consumer.

Dentists

The distribution of dentists is also influenced by patterns of personal income (page 244). The fewest dentists per capita are found in the rural areas of the old South, from Mississippi to South Carolina, while the entire area from Arizona to Delaware falls below the national average of five dentists per 10,000 population. The highest ratios of dentists to population are found in the New York-to-Boston area, the three West Coast states, and Minnesota. Concern for dental health and diet are also important factors that influence expenditures.

Mortality

Among the fifty states, life expectancy in Minnesota is second only to Hawaii (page 245). Average life expectancy for both sexes at time of birth in Minnesota is seventy-three years, with women on the average living about four years more, and men four years less than this. All Upper Midwest states are above the national average life expectancy. Lowest life expectancies are found in the old South. From North Carolina to Louisiana, life expectancy is below seventy years on the average. Major factors influencing life expectancy are diet, disease, health care, and heredity.

Life style plays an important role in personal health. The four leading causes of death in the United States are heart disease, cancer, stroke, and accidents. All of these are affected to some extent by elements of personal choice. Factors such as automobile accidents, nutrition, exercise, smoking, and consumption of alcohol are increasingly being recognized as important to the nation’s health status.

Motor vehicle traffic deaths account for nearly half of all accidental deaths in the United States (page 245). Traffic deaths per 100 million miles are highest in the West, particularly in states with very low population densities, such as Wyoming and New Mexico. Lowest rates of traffic deaths are found in the most densely populated states, including New Jersey, Connecticut, and Rhode Island. Minnesota (3.0) ranks slightly below the national average of 3.3. Motor vehicle traffic deaths are closely related to vehicular speeds, alcohol consumption, and highway quality.

Deaths from heart disease are highest in Pennsylvania and West Virginia (page 245). Perhaps this is related to their economies, tied to coal mining and heavy industrial production. Also above the national average are other states of the urban Northeast and Florida. Major factors influencing deaths from heart disease are heredity, lifestyle, and nutrition.* Since the incidence of heart ailments increases with age, areas of heavy out-migration (mostly young people) leave a relatively larger number of elderly persons in the population, and therefore, a higher rate of heart disease. Conversely, states with net immigration show lower rates of heart disease.

The cancer death rate is now about 75 percent greater than it was four decades ago. This increase is attributed almost entirely to the rapid increase in lung cancer.** With the exception of leukemia, death rates for other forms of cancer have remained about the same or decreased during that period of time, while the death rate from respiratory cancer has increased by about five

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times. As a proportion of all cancer deaths, lung cancer accounted for about one out of ten deaths before 1940, but accounts for nearly half the cancer deaths at the present time. High rates of cancer extend from New England to eastern Nebraska, Kansas, and Oklahoma, with the highest in Florida, the District of Columbia, and Rhode Island (page 246). The lowest rates are found in Alaska and Utah, with the West, South, and Upper Midwest generally below the national average. The incidence of cancer nationally is closely related to smoking, population density, and industrialization, which in turn influence air and water quality.*

Cirrhosis of the liver is caused to a large extent by excessive consumption of alcohol. Highest death rates from cirrhosis are found on the east coast from Washington to Boston, in the West Coast urban areas, and in Florida (page 246). Lowest rates are found in more rural states. The death rate from cirrhosis in Minnesota is about two-thirds that of the national rate.

Suicide is most common in the western states, with Nevada the highest (27.2 deaths per 100,000 persons), and more than twice the national rate (page 246). The area from the urban industrialized Northeast to the upper Great Plains falls below the national average; the South is mixed with Florida, Georgia, and Virginia having high suicide rates.

WELFARE

General trends in two selected income maintenance programs — Aid to Families with Dependent Children (AFDC) and Social Security — are shown on Table 19. Nearly 1.5 billion dollars were paid out in Social Security benefits to Minnesota retired workers, dependents, survivors, and disabled workers in 1978. This represented more than a six-fold increase in total payments since 1960. Under the AFDC program, 169 million dollars (including both state and federal sources) was paid out to Minnesota beneficiaries in 1978, representing about a nine-fold increase since 1960. Approximately 7 percent of Minnesota's child population benefited from this program in 1978.
Table 19: Selected Income Maintenance Programs

<table>
<thead>
<tr>
<th>Year</th>
<th>Payments</th>
<th>Children Benefited</th>
<th>Social Security</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total in millions of dollars&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Average monthly per family in dollars&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Total in thousands</td>
</tr>
<tr>
<td>1940</td>
<td>3.7</td>
<td>35</td>
<td>21.2</td>
</tr>
<tr>
<td>1945</td>
<td>2.6</td>
<td>52</td>
<td>11.8</td>
</tr>
<tr>
<td>1950</td>
<td>8.6</td>
<td>90</td>
<td>20.3</td>
</tr>
<tr>
<td>1955</td>
<td>11.4</td>
<td>124</td>
<td>20.6</td>
</tr>
<tr>
<td>1960</td>
<td>18.9</td>
<td>161</td>
<td>27.7</td>
</tr>
<tr>
<td>1965</td>
<td>35.9</td>
<td>188</td>
<td>41.5</td>
</tr>
<tr>
<td>1970</td>
<td>77.9</td>
<td>237</td>
<td>74.6</td>
</tr>
<tr>
<td>1975</td>
<td>148.4</td>
<td>266</td>
<td>91.5</td>
</tr>
<tr>
<td>1978</td>
<td>169.0</td>
<td>300</td>
<td>87.8</td>
</tr>
</tbody>
</table>

<sup>a</sup> Includes benefits paid to retired workers, dependents, survivors and disabled workers under Social Security Act of 1935 as amended. Does not include payments under the 1965 amendments initiating health insurance for the aged, generally known as Medicare.

<sup>b</sup> Not adjusted for inflation.


Nearly 8 percent of all families* in the state were headed by women according to the 1970 census of population. Only four of the state's eighty-seven counties — Ramsey, Hennepin, St. Louis, and Beltrami — were above the state average in the percent of families with female heads (page 248). Hennepin and Ramsey counties accounted for over half of all families with female heads in the state, but had less than 38 percent of the total number of families.

More than one-fifth of all families in Minnesota were receiving some form of social security assistance in 1970. These included cash receipts for retirement, survivor's benefits, disability insurance, dependents, and health benefits. The distribution of persons receiving social security benefits is closely related to the age structure of the population. Growth areas (that have many young families with children) are low in the proportion of families receiving social security benefits — such as the suburban counties of Anoka, Dakota, and Washington (page 248). At the high end of the scale are counties with heavy outmigration that has left behind an older population — such as Norman, Clearwater, Aitkin, and Big Stone. Growth counties — such as Hubbard and Cass — have attracted persons in their retirement years, but have also lost much of their younger population, and therefore have high proportions of families receiving social security.

The proportion of families receiving public assistance in 1970 was generally highest in the north-central counties and lowest in Twin Cities suburban counties and rural counties of southern Minnesota (page 249). Public assistance here defined includes AFDC, old age assistance, aid to the blind, and aid to the permanently and totally disabled.

**CRIME**

Serious crime rates in Minnesota have increased about five-fold over the past two decades (Table 20). They are divided into two general categories: violent crimes and property crimes. Violent
FAMILIES WITH FEMALE HEAD
1970

Families with female head as percent of all families
- 4.3 to 5.0
- 5.0 to 6.0
- 6.0 to 7.0
- 7.0 to 7.7
- 8.4 and 9.0
- 10.2 and 10.7

State average: 7.8

Source: U.S. Census of Population

FAMILIES RECEIVING SOCIAL SECURITY INCOME
1970

Families receiving social security income as percent of all families*
- 8.8
- 12.0 and 14.0
- 15.0 to 20.0
- 20.0 to 25.0
- 25.0 to 30.0
- 30.0 to 34.3

State average: 20.1

Source: U.S. Census of Population

*Includes cash receipts of Social Security pensions, survivors' benefits, permanent disability insurance payments and social benefit payments made by the Social Security Administration before deduction of health insurance premiums.
crimes are offenses against persons, including murder, forcible rape, robbery, and aggravated assault. Records of the Minnesota Department of Public Safety show an average annual violent crime rate in Minnesota of 19 occurrences per 10,000 population in the years 1976-78. Property crimes are offenses against property, including burglary, theft/larceny, and motor vehicle theft. In 1976-78, there were an average of 405 property crimes per 10,000 population each year in Minnesota.

Serious crimes are lowest in the rural and agricultural areas of the state (page 250). While property crime rates are slightly higher in urban areas, than in rural areas, violent crime rates are much higher, though the rate of occurrence for violent crime is less than one-twentieth that of property crime (pages 250 and 251). Interpretation of these data should take into account the variations in crime reporting. In some communities minor property crime may go unreported altogether, while in others even the smallest property loss may become a matter of record.

Crime rates across the nation tend to be highest in the most urban states and lowest in most rural states (page 251). Violent crime rates in Minnesota and other Upper Midwest states are among the lowest in the nation, while New York, Nevada, California, Michigan, Florida, and Maryland are among the highest. Variations in crime reporting are even more significant among the states than within states, though violent crime reporting is

<table>
<thead>
<tr>
<th>Years</th>
<th>Annual Average per 10,000 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Violent Crimes</td>
</tr>
<tr>
<td>1936-1940</td>
<td>4</td>
</tr>
<tr>
<td>1941-1945</td>
<td>2</td>
</tr>
<tr>
<td>1946-1950</td>
<td>3</td>
</tr>
<tr>
<td>1951-1955</td>
<td>3</td>
</tr>
<tr>
<td>1956-1960</td>
<td>3</td>
</tr>
<tr>
<td>1961-1965</td>
<td>6</td>
</tr>
<tr>
<td>1966-1970</td>
<td>14</td>
</tr>
<tr>
<td>1971-1975</td>
<td>19</td>
</tr>
<tr>
<td>1976-1978</td>
<td>19</td>
</tr>
</tbody>
</table>

Source: Minnesota Department of Public Safety.
probably more accurate and comparable than is property crime.*

**Housing**

Type

Single family detached housing is the dominant living style in Minnesota, accounting for more than 75 percent of all housing units in the state in 1977 (Table 21). At least half the housing in single family in all counties, with the lowest proportions in the Twin Cities metropolitan area and the highest proportions in the most rural counties (page 253). Generally speaking, counties with substantial urban or college populations, tend to have more multiple family housing than others. Between 1960 and 1970, multiple family housing increased across the state, with the growth of college enrollments, with increased construction of housing for the elderly and private nursing homes.

The proportion of single family housing reached its peak around the year 1960 after which construction of multiple family housing began to accelerate and even exceed single family construction in some counties.** Increasing construction of multiple family housing has been largely in response to changing economic conditions and increasing housing prices. In the late 1970s there has been a trend away from construction of rental units and toward condominiums (owner-occupied units within an apartment-like structure), particularly in the Twin Cities metropolitan area. In some cases older apartment units have been sold individually as condominiums. Townhouses have been another adaptation of the single family owner-occupied unit. They provide private entrances, but with common walls that extend from ground to roof, separating one unit from another.***

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**Ownership**

Owner-occupied housing of all types accounted for 71.5 percent of all housing units in Minnesota in 1970 (28.5 percent were renter occupied). This represented a substantial increase both numerically and proportionately since 1950 and was largely the result of government-guaranteed GI and FHA home loans with low interest rates; an expanding economy that allowed more persons to invest in home ownership; and high birth rates and larger families that required the space of a single family home. The highest proportion of renters in the state are in the urban areas and college communities, both catering to transient populations (page 254). Low proportions of renters are in the rapidly growing suburban fringe areas and in the most rural counties of the state where there are limited numbers of immigrants and stable populations. Many agricultural counties in southern and southwestern Minnesota were above the state average in proportion of renters in 1950, dropping to slightly below the state average by 1970. This is related to the high proportion of tenant farmers in that area of the state, many of whom either purchased their own farms or dropped out of agriculture between 1950 and 1970 (page 92).

For most persons, renting is considered a temporary arrangement until enough money is accumulated for the down payment to purchase a home. Renters, therefore, tend to seek housing at

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**Table 21: Housing**

<table>
<thead>
<tr>
<th>Year</th>
<th>All Units</th>
<th>Year-Round Units</th>
<th>Occupied Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thousand</td>
<td>Percent</td>
<td>Percent</td>
</tr>
<tr>
<td></td>
<td>s</td>
<td>Seasonal</td>
<td>Single Family*</td>
</tr>
<tr>
<td>1940</td>
<td>773</td>
<td>2.1</td>
<td>71.8</td>
</tr>
<tr>
<td>1950</td>
<td>918</td>
<td>4.5</td>
<td>71.8</td>
</tr>
<tr>
<td>1960</td>
<td>1119</td>
<td>6.5</td>
<td>78.2</td>
</tr>
<tr>
<td>1970</td>
<td>1276</td>
<td>4.5</td>
<td>73.5</td>
</tr>
<tr>
<td>1977c</td>
<td>1503</td>
<td>7.0</td>
<td>75.8</td>
</tr>
</tbody>
</table>

a) Does not include mobile homes.
b) Estimated.
c) 1977 data adjusted to 1970 Census definition: I.e. mobile homes are counted as housing units only if occupied.

Sources: U.S. Censuses of Housing; Minnesota State Planning Agency (1977 only).

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** The 1950 and 1970 housing definitions are not directly comparable on the maps. In 1950 single family housing included vacant, seasonal, and migratory units, whereas in 1970, vacant, seasonal, and migratory units were excluded from the total housing count. The net effect of this was to exaggerate slightly the proportion of single family houses in 1950 as compared to 1970. Statewide figures shown on Table 21 have been adjusted to a standard 1970 definition.

*** Such units are classified by the census as single family attached, as distinguished from the common single family detached residences. Townhouses, thus defined, are classified as single family housing, while owner-occupied condominiums with common corridors are classified as multiple family housing.
affordable rates that is accessible to employment opportunities. As a result, renting is most prevalent in older urban neighborhoods. Continued inflation and rising housing costs suggest that in the future fewer people will be able to enter the conventional housing market at an early age.

Public Housing

As of May 1978 there were over 57,000 housing units in the state under various federal programs of the Department of Housing and Urban Development and the Farmers Home Administration (page 256). Of these housing units, 38 percent were government owned and 62 percent were privately owned and subsidized through rent supplements. The state's three largest cities — Minneapolis, St. Paul, and Duluth — accounted for about 18 percent of the state's population, but 43 percent of the publicly owned or aided housing units in the state. Another 19 percent were located in the suburbs of these cities, which included nearly one-third of the state's population; while the remaining 38 percent were located in the balance of the state. Public assistance housing has been more concentrated in the older urban areas because of the greater need for such housing in those locations, and the active Housing and Redevelopment Authorities in those cities.

The Section 8 Housing Program provides rental subsidies to low and moderate income households. An eligible household is required to pay up to 25 percent of its monthly income, while the Section 8 Program pays the rent balance directly to the unit's owner. Under this program, tenants select housing of their choice anywhere in the participating community. The program thereby avoids concentrating lower income persons in a single building and moves away from the project image of public housing. As a result, it has been extremely popular with clients and appears to be an acceptable solution to providing public housing in many suburban communities.

Age of Housing

About half the housing in the state in 1970 was less than thirty years old (page 257). The highest concentrations of newer housing were in the growth areas, including the suburban fringes near the Twin Cities, many of the regional trade centers, the taconite-related development areas of northeastern Minnesota, and the areas of physical amenities, such as in north-central Minnesota. Housing tends to be older, on the average, in the rural areas of the state, particularly in those areas with lower incomes that have experienced population declines. Notable exceptions to that general pattern are in Winona and Wabasha Counties.

Plumbing Facilities

About twelve out of thirteen Minnesota homes had all plumbing facilities in 1970, including hot and cold piped water, a flush toilet, and bathtub or shower. Nearly all housing units in the state's urban communities had complete plumbing, but facilities in rural areas varied widely depending on local building codes and personal income levels. Almost all rural housing in the high income agricultural areas of southern Minnesota had complete plumbing facilities, while rural housing in north-central and northwestern Minnesota — areas of low income and often without building codes — had the lowest proportion of housing units with all plumbing facilities (page 257). In Clearwater, Mahnomen, and Aitkin Counties, nearly one-third of all housing was without complete plumbing facilities.

Factory Built Homes

Mobile homes, while increasing gradually in number, accounted for less than 3 percent of Minnesota's housing stock in 1977 (Table 21). Mobile homes are clustered in mobile home parks within commuting range of the Twin Cities area or near other urban areas — or they are scattered individually on small parcels of land across the state, particularly in northern Minnesota (page 258). The number of occupied mobile homes in Minnesota increased more than five-fold between 1950 and 1970, while all other kinds of housing in the state increased by 37 percent. The most rapid increases during this period occurred in the rural fringe near the Twin Cities area and in the wooded and lake areas in the northern part of the state (page 258).

Second and Seasonal Homes

Owners of second homes are located on the map on page 260.
PUBLIC HOUSING
May 1978

Source: Minnesota Housing Finance Agency
*includes 4,783 undesignated locations under Section 8
The highest proportion of households owning second homes in Minnesota is found in the northeastern counties and in certain other urban counties in the state. Areas of the state that are dominantly rural and at some distance from the major lake area, have the lowest proportion of households owning second homes. Second homes were owned by 6.7 percent of all Minnesota households in 1970. Second homes are considered by the Census to include single family homes, vacation cottages, hunting cabins, and ski lodges which are owned and held for use some time during the year by the owner or members of the owner's household. These data do not indicate the number of households that may own more than one additional home. The proportion of households owning second homes seems to be most influenced by two factors: proximity to the major lake and recreation areas of the state; and an above average income, which allows the purchase and maintenance of a second home.

The actual location of seasonal homes are shown on pages 260 and 261. Seasonal homes are highly concentrated in the major lake areas of the state, particularly the areas of north-central Minnesota that have been most accessible to the Twin Cities area—such as Aitkin, Crow Wing, and Cass Counties. Lowest proportions of seasonal housing are found in the prairie areas that extend across southern and western Minnesota. The location of seasonal homes is closely tied to the major moraine belt of the state that extends westward then northwestward from the Twin Cities to about Becker county, then eastward to the north-central part of the state (see page 7). Seasonal homes per square mile doubled in many counties of the state during the 1950s, but in the 1960s dropped off largely due to the conversion of seasonal homes during that decade to year-round residences, both in the lake region and within commuting range of the Twin Cities area. During the 1970s, the number of seasonal homes in Minnesota has again increased rapidly (Table 21).

Construction

The highest rates of housing construction in Minnesota for the period from 1972 through 1977 were in Twin Cities suburban counties and in Olmsted County. But even counties whose populations declined experienced some new housing construction as older homes were gradually replaced. Information on page 262 is based on building permits authorized by local government jurisdictions, but this does not account for all housing construction in the state. Comparison with population trends indicates that non-permit construction or mobile home occupancy is significant in a belt of counties extending from east-central to northwestern Minnesota, where an estimated half or more of the new housing units have not been authorized by permit. In general, building and land use controls are minimal or nonexistent in much of this area that has been experiencing rapid amenity-related growth; exceptions are in Itasca, Douglas, and St. Louis Counties which maintain strict control of building permits.

During the mid-1970s statewide housing construction rates slowed, except in west-central Minnesota, reflecting in part the higher farm income that was invested in replacement housing and the “discovery” of west-central Minnesota’s physical amenities in conjunction with completion of the interstate highway in that area of the state (page 262).
OWNERS OF SECOND HOMES
1970

Percent of households owning a second home

1 to 3
3 to 5
5 to 7
7 to 9
9 to 11
11 to 15

State average: 6.7

Source: U.S. Census of Housing

SEASONAL HOMES
1950

Seasonal homes, per square mile of land area

State average: 0.5

Source: U.S. Census of Housing
Chapter 4. The State Enterprise
Through the state government, money is taxed and pooled from a wide range of statewide sources and redistributed in response to different statewide needs (Table 22). For example, the state has equalized educational opportunities in wealthy areas and poor through a system of statewide taxes and aids. And the statewide community shifts funds geographically to equalize the quality of roads and accessibility between major centers and remote areas. Flows of government funds help to build, manage, and maintain the state's cities, towns, transportation systems, and communication networks. Government enterprises not only help to create, operate, and control the settlements, but they also continually respond to changes in the settlement pattern and natural resources.

The maps in this section portray, first, regional differences in the state tax base, as they reflect differences in the natural resource base, the production system, and the population. Second, subsequent maps show the comparable patterns of major state revenues and expenditures. And last, additional maps show how Minnesota compares with the other states.

THE TAX BASE

Individual income is the main component of the state tax base (page 230). It is both the direct source of income taxes and the basis for property improvement and consumer purchases. The range of county average incomes per capita in Minnesota is wide. Only seven or eight counties are normally above the state mean, and the lowest county average, in Aitkin, is less than half that of the highest, Hennepin. Higher income counties are generally those with the most productive soils and the largest towns and cities — hence the most prosperous agriculture areas and the main centers of business, the professions, and organized labor.

The pattern is still more uneven if personal income is compared with the number of school children to be educated, mainly because some low-income counties have relatively large school-age populations (page 265).

Retail trade provides the basis for the sales tax and numerous excise taxes (page 155). Even more than income, the sources of taxes on trade are unevenly distributed on the map of the state. Retail trade is concentrated in a limited number of counties

Table 22: State and Local Government Revenue

<table>
<thead>
<tr>
<th>State Revenue From Own Sources</th>
<th>State Taxes and Charges</th>
<th>Local Revenue From Own Sources</th>
<th>State Payments to Local Governments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Millions of dollars*</td>
<td>As percent of personal income</td>
<td>Millions of dollars*</td>
</tr>
<tr>
<td>Year</td>
<td></td>
<td></td>
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<td>114</td>
<td>5.7</td>
<td>10</td>
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<tr>
<td>1950</td>
<td>219</td>
<td>5.2</td>
<td>37</td>
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<tr>
<td>1960</td>
<td>428</td>
<td>6.1</td>
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<td>1970</td>
<td>1243</td>
<td>8.5</td>
<td>346</td>
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<tr>
<td>1977</td>
<td>2916</td>
<td>10.3</td>
<td>957</td>
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* Not adjusted for inflation.

Sources: U.S. Bureau of the Census, various reports; U.S. Bureau of Economic Analysis.
PERSONAL INCOME PER PUPIL UNIT
by school district
1975

Thousands of dollars per pupil unit*

- Less than 8
- 8 to 12
- 12 to 16
- 16 to 20
- 20 or more
- Data not available

State average: 16.7

Source: Minnesota Department of Education

"Pupil units" is a measure of school district size, computed by applying weightings to the district's average daily membership (ADM). Each kindergarten ADM counts as 0.5 pupil unit, each elementary ADM as 1.0 pupil unit, and each secondary ADM as 1.4 pupil units. Both resident pupils and non-residents served by the district are included in the computation.
where the main trade centers are located. Among those centers, per capita sales are high not only in the regions of high income but also in the places that serve large numbers of vacationers.

Land and buildings are the base for property taxes (pages 266 and 267). The pattern of assessed value reflects the level of investment in improvements and construction. Intensity of development declines sharply as one moves outward from the most urbanized counties. In rural areas average land value declines northward as the average length and warmth of the growing season decline, and westward as the risk of summer drought increases. Although the patterns are similar if one compares assessed valuation with total population or with school-age population (page 268)—the major beneficiary from property taxes—the difference between wealthy and poor counties is not quite so large. The property tax base from nonresidential developments is more unevenly distributed than the total property tax base. Taxable utility properties tend to reflect not only the over-all settlement pattern but also the locations of a few very large electric generating stations (page 269). Value of commercial land and buildings is heavily concentrated in the major commercial and industrial cities (page 269).*

**STATE REVENUES**

Income tax collection rates reflect not only the geographic variations in personal income but also the progressive structure of the tax (page 270). For example, Hennepin County, with about 2.4 times the per capita income of Aitkin County, generated about three times the per capita income tax in 1976. Sales tax collections are high in the counties with major trade centers and those with greater vacation traffic (page 271). Corporate income tax collections, a much smaller part of the state's revenue, come still more heavily from the urban business centers — especially the Twin Cities, the main concentration of corporate headquarters in the Upper Midwest (page 271).

Taxes on income and general sales, shown in the preceding three maps, account for nearly three-fourths of the state's tax collections. The remainder comes almost entirely from taxes on

---

* Per capita value in Cook County is relatively high because of the very small population there.
PROPERTY VALUATION PER SQUARE MILE
by school district
1975

EARC value* in millions
of dollars per square mile

- Less than 0.1
- 0.1 to 0.3
- 0.3 to 1.0
- 1.0 to 5.0
- 5.0 or more

Data not available

State average: 0.21

Source: Minnesota Department of Education

*the EARC value is the total taxable value of property as adjusted by the Equalization Aid Review Committee (EARC), taking into consideration variations in district assessment procedures
PROPERTY VALUATION PER PUPIL UNIT
by school district
1975

EARC value* in thousands of dollars per pupil unit**

- Less than 10
- 10 to 15
- 15 to 20
- 20 to 25
- 25 or more
- Data not available

State average: 15.9

Source: Minnesota Department of Education

*The EARC value is the total taxable value of property as adjusted by the Equalization Aid Review Committee (EARC), taking into consideration variations in district assessment procedures.

**“Pupil units” is a measure of school district size, computed by applying weightings to the district’s average daily membership (ADM). Each kindergarten ADM counts as 0.5 pupil unit, each elementary ADM as 1.0 pupil unit, and each secondary ADM as 1.4 pupil units. Both resident pupils and non-residents served by the district are included in the computation.
gasoline and alcoholic beverage sales, licenses for motor vehicles and operators, and iron ore taxes.

Total state tax collections, excluding iron ore, tend to be relatively high per dollar of personal income in counties where there is greater dependence on the sales tax (page 272). In general those are counties with relatively low personal income, counties with a large resort and seasonal home population, counties with large, diversified trade and service centers, or some combination of those characteristics.

States taxes collected in each county come out of the same tax base that supports local taxes, and through state aids, in turn, the state taxes make a significant addition to the local tax effort. Local general governments include counties, towns, and cities. They vary widely in the taxes they collect per dollar of personal income (page 272). The reasons for such wide variation are probably known in each individual locality but have not been analyzed statewide. Most striking is the face that local governments in some low-income counties make high local tax efforts — for example, Cass and Aitkin. Meanwhile, counties with similar per capita incomes and urbanization differ considerably in their tax rates for general local government. Large differences between neighboring communities seem to have gone unquestioned.

School district tax rates show similar patterns of variation (see pages 273 and 274). Part of the differences between school districts stems from chance variations in the timing of new building projects and the resulting differences in debt service costs. But again it is especially striking that in some of the poorest counties the local tax effort equalled or surpassed that in some of the wealthiest counties. In general, the wealthier counties, or those unaffected by iron ore taxes, tend to supply a higher percentage of their local government revenue from local taxes (page 275). The counties which generate smaller percentages of their revenue from their own sources—mainly in the north—are more dependent upon state aids.

**STATE AIDS AND DIRECT EXPENDITURES**

State aids serve to narrow or eliminate the gaps between poor and wealthy counties. In general, the more sparsely settled or the
LOCAL REVENUE FOR SCHOOL DISTRICTS*
1976-77 school year

Local revenue as percent of total revenue
- Less than 25
- 25 to 30
- 30 to 35
- 35 to 40
- 40 to 50
- 50 or more
- Data not available

State average: 41

Source: Minnesota Department of Education

*Revenue from sources other than federal or state governments, including property taxes, tuition and fees, sales of assets, payments from other school districts and all other local sources.
SCHOOL DISTRICT EXPENDITURES
1976

School district expenditures* from own sources as a percent of personal income, 1976, by quartile

State total: $590 million

COUNTY PROPERTY TAXES
1976

Property tax revenue as percent of total county revenue receipts

State average: 33.1

Source: Minnesota Department of Education
*Each county figure includes data for all school districts headquartered in that county. Since many school districts cross county lines, county figures are approximate.

Source: Minnesota State Auditor
lower the average income in a county, the higher the state aids paid to its local governments (page 276). Conversely, the higher the personal income and the more compact the settlement pattern, the higher the portion of general local government expenditures raised through local taxes.

EDUCATION

The same general pattern holds for state aids to local school districts (page 276). Higher aids go to more sparsely settled or lower income areas, lower aids to districts with more compact settlements or higher income. The state functions as a community to pool its resources and attempt to buy equal educational opportunities for people in widely different locations and economic circumstances.

Because of the leveling effect of state aids, expenditures per pupil in a very large majority of school districts are within about 10 percent of the state-wide mean. But some districts deviate widely from the typical level. Unusually high expenditures may result from first, a large local tax base from iron mining, urban commercial or industrial property, or prime farm land, in combination with an above-average sized school-age population; and second, unusually large aid payments — especially federal aids — because of a concentration of minority or low-income households (page 277).

ROADS

The County State Aid Highway fund (CSAH) is an important mechanism to transfer money from state to local government. The funds come from a part of the state taxes on gasoline and motor vehicles. In the 1977 fiscal year it amounted to $42.2 million dollars. There were slightly more than 60 thousand lane-miles of County State Aid Highways on which to spend the money. Meanwhile the actual share of highway user taxes generated in each county is not measured; but one can estimate it from the United States Census of Business data on the share of the state's total gasoline service station business done in each county. One can then compare the share of the CSAH allotment fund that comes from each county with the share that goes back to each county (page 278).

Most counties receive more from the fund than they generate. A few generate much more than they receive. The parts of the CSAH system that are profitable are those that serve the main urban centers and those that feed most directly into the main transportation corridors: Twin Cities-Fargo, Twin Cities-Cedar Rapids-Des Moines, and Twin Cities-Chicago.

In effect, everyone is buying access to everyone else: cities to farm suppliers and markets, farmers to city markets and suppliers, and much more. The state collects revenues where users are the most numerous, then spreads expenditures across the entire system.

WELFARE

State income maintenance expenditures, for various welfare and assistance programs, redistribute income to individuals and households (page 278). The money transferred in these direct payments is less than the amount transferred through indirect aids to school districts. The geographical pattern reflects the distribution of low income and elderly people on the population maps of the state — areas of least urbanization, marginal farmland, and heavy outmigration.

Federal payments for various social services supplement state income maintenance payments. Social security payments are a major part of the federal outlay (page 279).

Local social service and welfare payments also supplement state aids, although they equal a far smaller fraction of personal income than the state welfare payments in each county (page 279). The geographic pattern reflects many apparently capricious differences in local effort from one county to another, although there is a general tendency for the highest efforts to be in counties with relatively large elderly or low-income populations.

JOBS

State payrolls also serve to redistribute income among the eighty-seven counties (page 281). State payrolls are highest in absolute terms in the Twin Cities area, mainly because of the state capitol and the major university campus. On the other hand, the state payroll accounts for exceptionally large shares of personal income in some counties elsewhere in the state as a result of the locations of state universities and community colleges,
SCHOOL DISTRICT EXPENDITURES*
1976-77 school year

Thousands of dollars per pupil unit**

- 1.0 to 1.2
- 1.2 to 1.3
- 1.3 to 1.4
- 1.4 to 1.6
- 1.6 to 2.0
- 2.0 to 2.7
- Data not available

State average: 1.38

Source: Minnesota Department of Education

*administration and instructional salaries, other instructional costs, attendance and health services, plant operation and maintenance, fixed charges, food service, student activities, and tuition to other school districts. Not included are capital expenditures and debt service.

**"pupil units" is a measure of school district size, computed by applying weightings to the district's average daily membership (ADM). Each kindergarten ADM counts as 0.5 pupil unit, each elementary ADM as 1.0 pupil unit, and each secondary ADM as 1.4 pupil units. Both resident pupils and non-residents served by the district are included in the computation.
hospitals, correctional institutions, district highway headquarters, and regional offices of other major state departments. The state payroll reinforces at least two-thirds of the twenty-six major trade centers outside the Twin Cities area.

If employment of all local governments, schools, and other special districts is added to state employment, the result appears on page 281. Public jobs exceed 20 percent of the total in sixteen counties. Each of these counties has a relatively small urban population and employment base, and a relatively important state institution within its boundaries.

An important component of public employment is the state higher education system (page 282). Those campuses concentrate state and federal as well as private expenditures in selected urban areas.

NATIONAL COMPARISONS

In 1975 Minnesota was one of nineteen states whose citizens received less money from federal expenditures than they paid in federal taxes (page 283). Relatively low defense spending and low federal government employment were the main reasons for the deficit (page 283). While eighteenth in population, Minnesota ranked twenty-eighth in per capita volume of defense contracts, forty-seventh in per capita outlay for defense salaries, and twenty-seventh in federal government employment.

Highest federal aids per capita have been paid mainly to western states. But the trend since 1960 has favored states in the eastern half of the nation, especially those with large metropolitan populations and industrial employment (page 284).

STATE AND LOCAL BUDGETS

In 1975 Minnesota had the highest state income tax per dollar of personal income of all fifty states (page 284). Minnesota and Pennsylvania were tied for the rank of fourth highest in corporate income tax collections per dollar of personal income (page 284). The picture was different outside the income tax field. The state general sales tax rate in 1975 was well below the national median and near or well below neighboring Midwest states (page 284). Minnesota property tax collections per dollar of personal income ranked twenty-second among the fifty states and below neighboring Midwest states other than North Dakota (page 285).

Nationally, about one-third of all state and local revenue came from service charges and miscellaneous taxes other than those on income, general retail sales, and property. Examples of miscellaneous taxes and charges include sporting licenses, income from publicly-owned liquor stores and recreational facilities, and special taxes on mineral extraction. Minnesota ranked seventeenth among the fifty states in this category of taxes (page 285). If taxes on iron ore were omitted, Minnesota would drop to twenty-second. Local natural resources permit some states to tap into the national income stream by taxing mineral wealth that happens to be concentrated in their domain, and Minnesota has been historically one of those.

When all revenues from state sources were combined, Minnesota taxes and charges per dollar of personal income in 1975 were seventh highest in the nation (page 285). Combined state and local taxes were higher than those in all other states except Vermont and New York (page 285). Minnesota's state and local public debt were near the national median in 1975 (page 286). Thus the overall Minnesota picture in 1975 included high combined state and local taxes, with average indebtedness and major reliance on a progressive personal income tax.

STATE AIDS TO LOCAL GOVERNMENTS

Minnesota's high state taxes are the result of high state aid payments. In 1975, if state aids had been reduced to the average rate for the other forty-nine states, and other expenditures had remained unchanged, the Minnesota state and local tax rate per dollar of personal income would have been at the national median rather than very near the top. Of course, schools and other enterprises in poorer localities would have suffered.

State government's ultimate revenue — what state agencies actually spend on state government and services — was slightly below the national average. The state actually ranked twenty-sixth in disposable state government revenue from all sources, after paying out state aids. Minnesota state government spent an amount equal to 75 percent of the total revenue it raised through state taxes (page 283). (In fact, 56 percent of state tax revenue goes to state aids, and the rest of state expenditures are paid
from federal aids which the state retains.) Only five other states retained and spent as low a share of their revenues. Half the state governments spent more than they raised from taxes and charges, making up the difference from federal aids. Most states apparently have more centralized control of state tax revenue, and in most states local governments depend more upon their own local taxes and charges.

Thus Minnesota local governments are exceptionally dependent on the state. The increased use of state aids to pay local government costs in Minnesota reflects deliberate policies: first, an attempt to equalize educational and other opportunities by shifting support from local to statewide sources, second, an attempt to keep management responsibility in the local areas, third, an historic commitment to education as a long-term investment for the community, and fourth, a shift from “almost sole dependence on the property tax to other and more equitable taxes to raise the increased revenue needs of state and local governments in our modern society.”

**PUBLIC LANDS**

One of the most distinctive characteristics of the public enterprise in Minnesota is the large amount of land the state and counties own. Nearly one-quarter of Minnesota’s land — about 12 million acres (not including Indian or easement lands) — is in public ownership. Of Minnesota’s publicly-owned land, 11.2 million acres, or 93 percent is located in twenty-two contiguous northern Minnesota counties, which correspond to the major forested areas of the state. State government is the largest landholder in Minnesota with 5.4 million acres or 10.6 percent of all land in the state (pages 288 to 292).

During the latter half of the nineteenth century, the United States Congress granted the state of Minnesota several million acres of land, the income from which was to be used to support an educational system, the construction of railroads, public


**These maps show the percent of forty-acre parcels in each township that have some public ownership. This does not necessarily mean that whole forty-acre parcels are publicly owned, but that there is public ownership within them. Thus, in the southern and west-central parts of the state—where many small parcels of one to ten acres have been acquired for fish and wildlife, access, and other public purposes—public land ownership tends to be exaggerated.
buildings, and other improvements. The original policy of the state was to sell these lands to generate income to stimulate the economic development of the state. Gradual modification of this policy resulted in permanent state ownership of certain lands, including mineral lands, water power sites, and lands adjoining public waters.

Tax forfeiture in certain northern Minnesota areas brought the state into the administration of additional lands. For example, extensive drainage projects were undertaken by a few property owners in the peatlands north of Red Lake. Agricultural efforts in this area subsequently proved unsuccessful and the state paid off the drainage bonds in exchange for absolute title to these lands. The state has also received several hundred thousand acres of county tax forfeited land over the past forty years. Purchase of land from private owners for state parks, fish and wildlife habitats, public access to lakes and rivers, and state forest parcels, is a relatively recent occurrence. Most state land holdings have been acquired from tax forfeited lands or earlier holdings (page 289).

Federal land ownership in Minnesota accounts for 3.7 million acres or 7.4 percent of the total land area of the state. It is heavily concentrated in northern Minnesota and includes the Superior National Forest, Voyageurs National Park, and the Chippewa National Forest. The wide band of federal ownership in west-central Minnesota represents extensive federal acquisition of wildlife habitat (page 290). Minnesota, however, ranks well below the national average in the percent of its total land area owned by the federal government (page 292).

County land in Minnesota consists largely of state-owned, tax forfeited land that is administered by the counties, most of which is located in the northern part of the state (page 291). It was generally assumed that logging, draining, settling, and farming the land held the promise of long-term economic prosperity and stability. However, after timber and mineral resources were harvested, much of the northern land proved unsuitable for agriculture. During the 1920s, cutover land was assessed at as much as three times its market value, which discouraged land owners from paying taxes. As a result, by 1935 more than 6 million acres of Minnesota land were tax delinquent, primarily in the northern counties. During the last forty years, northern counties have disposed of over half the tax forfeited land, a majority of which was returned to tax roles through sale to private owners or transferred to the state for management. In recent years, however, counties have more often retained administration and management of tax forfeited lands.

OUTSTANDING PUBLIC AREAS

Certain public lands embrace outstanding natural resources for outdoor recreation. They are the scene of more intensive development and management by state and federal agencies, and they are an important component of the state’s recreational economy.

PARKS

The State of Minnesota administers some 160,000 acres in seventy-five state parks, widely distributed across the state to provide recreational opportunities and to preserve the state’s scenic resources (page 293). These range from the rocky cliffs and rushing streams along Lake Superior’s north shore to the rolling prairies of the southwest, from the steep stream-cut valleys of the southeast to the beach lines of glacial Lake Agassiz in the flat Red River valley. State park use averages close to seven million persons a year (Table 23).

The National Park Service administers three park areas in Minnesota. These include Voyageurs National Park with about 219,000 acres of land and water on the Canadian border and two national monuments which preserve and interpret national historic sites. Grand Portage National Monument, located in the

<table>
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<th>Table 23: State Park Use</th>
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<tr>
<td>Annual Averages in Thousands</td>
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<td>Years</td>
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<tr>
<td>1964-1968</td>
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<td>1969-1973</td>
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<td>1974-1978</td>
</tr>
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</table>

Source: Minnesota Department of Natural Resources.
PUBLIC LAND OWNERSHIP
1976

Percent of 40 acre parcels per township that are dominantly of federal, state or county ownership (including tax-forfeited lands)

- None
- Less than 10
- 10 to 30
- 30 to 50
- 50 to 70
- 70 to 90
- 90 or more

Source: Minnesota Land Management Information System
COUNTY LANDS
1976

Percent of 40 acre parcels per township that are dominantly of county ownership (including tax-forfeited lands)

- None
- Less than 10
- 10 to 30
- 30 to 50
- 50 to 70
- 70 to 90

Source: Minnesota Land Management Information System
natural Resources administers over 3 million acres of land in fifty-five state forests and manages another 1.5 million acres of mostly forested state lands outside the designated forest areas.

CAMPITES
There are more than 6,000 state and federal campsites located in Minnesota, not including county campsites, municipal campsites, and the many thousands of private campsites in the state. Over 3,700 campsites are provided in sixty of the state's parks; state forests provide nearly 700 campsites in the two national forests and an additional 1,700 water-access sites in the Boundary Waters Canoe Area. The Corps of Engineers maintains 300 campsites on lands near upper Mississippi River Water Control Areas (page 295).

TRAILS
Hiking, bicycling, snowmobiling, and cross-country skiing trails provide year-round outdoor recreational opportunities. Over 700 miles of snowmobile trails have been designated in Minnesota on state and federal lands. Cross-country skiing trails are maintained in many state parks and some state forests. Both national forests have skiing trails, and facilities are available at several national wildlife refuges. Through a state grant-in-aid program, 400 additional miles of trails have been developed on other public lands (page 296). During spring, summer, and fall, most snowmobiling and cross-country skiing trails—and many additional trail miles—are maintained for hiking. Bicycling occurs on designated highways and a separate right-of-way system under development by the Minnesota Department of Natural Resources.

RECREATIONAL WATERS
Public water access sites are intended to provide entrance roads to public-owned lakes and rivers for fishing, boating, canoeing, and other water-related activities. A boat launching ramp and parking area—and in some cases additional facilities—are usually provided. The Minnesota Department of Natural Resources administers nearly 1,000 water access sites. An addi-
tional 500 water access sites are administered by other state and local governmental agencies, and the federal government has developed approximately 200 water access sites (page 298).

The state and national governments have passed legislation to protect the character of three types of rivers. **Wild rivers** must have good water quality, be free flowing (undammed) and have adjacent lands that are essentially primitive. **Scenic rivers** have similar water attributes, but the adjacent lands are characterized as being mostly undeveloped. **Recreational rivers** may have undergone some impoundment or diversion in the past and adjacent lands may be developed, but must still be capable of being managed for recreational uses. Minnesota has designated portions of five rivers as wild, scenic, or recreational and administers land controls along their shorelines (page 299). Recreational development by the state is usually limited to access sites and minimal use facilities.

Under a canoeing and boating rivers program, the Minnesota Department of Natural Resources has designated eighteen rivers for recreational navigation (page 300). Along these designated rivers, access points, portages, and facilities have been provided and detailed maps are available showing the location of navigational hazards. In addition, the Boundary Waters Canoe Area offers hundreds of miles of additional canoeing and boating waters.

The United States Congress designated the St. Croix River north of Taylors Falls as a national wild riverway in 1968 and added — as a scenic or recreational riverway — the lower St. Croix south to its junction with the Mississippi in 1972.

**FISH AND WILDLIFE**

Wildlife areas of Minnesota are administered by state and federal jurisdictions primarily for waterfowl production, but other types of wildlife as well. The United States Fish and Wildlife Service administers more than 300,000 acres in the state, including seven national wildlife refuges and over 500 waterfowl production areas most of which are located in western Minnesota within the Mississippi waterfowl flight corridor (page 301). The Minnesota Department of Natural Resources administers over 900 state wildlife areas with more than one million acres of wetlands for waterfowl production and public hunting.

The state of Minnesota through its Department of Natural Resources manages and protects streams and lakes that provide habitat for trout. Where water conditions are appropriate, and public access to those waters is assured, lakes or streams are designated for trout management. Most designated trout lakes in the state are in the northeastern section where the water is naturally cool enough for trout production (page 302). Trout streams are concentrated in the waters that flow into Lake Superior and in the cool spring-fed waters of southeastern Minnesota.
WATER ACCESS SITES

* STATE ACCESS SITES
* NATIONAL ACCESS SITES

MAJOR HIGHWAYS

Source: Minnesota Outdoor Atlas, C.H. Miles and D.F. Yaeger
© Miles and Yaeger, 1979
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<th>District Number</th>
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