MAKING MAPS MAPPING HISTORY

300 YEARS OF ORIGINAL MAPS
WISCONSIN AND THE GREAT LAKES REGION
MARCH 19 - JUNE 29, 2007

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Audio Tour

An audio tour of selected maps in this exhibit complements the information in this booklet. The comments have been generously offered by UW-Madison experts in the history of cartography, the history of the Great Lakes region, and remote sensing technology.

The tour is available on two iPods, which can be checked out from the librarian at the Special Collections reference desk. You will need a student ID or driver’s license.

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Website

This exhibit and accompanying audio and written materials will be available at www.greatlakesmaps.org.
MAKING MAPS, MAPPING HISTORY

Maps show much more than boundaries and locations—they also provide insights into the cultural, historical, and technological contexts in which they are produced. This exhibit illustrates the evolution of mapmaking since the 1600s and the historical influence of the Great Lakes on the history of Wisconsin.

The maps in this exhibit are from the UW-Milwaukee American Geographical Society Library and the UW-Madison Space Science and Engineering Center. The AGS Library is one of North America’s foremost geography and map collections. It holds more than one million maps, atlases, books, journals, pamphlets, photographs, slides, Landsat images, and spatial datasets. The Space Science and Engineering Center includes one of the first remote sensing facilities in the United States. Its scientists, researchers, and students apply cutting-edge remote sensing and geospatial technologies to gain improved understanding of environmental systems.

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Displayed in the foyer, 9th floor Special Collections:


These maps are featured in the audio tour.

This map appears three-dimensional (3-D) when viewed with provided glasses. Please leave the glasses when you are finished with them.
FROM WORDS TO PICTURES

The drive to find a water route to the Orient brought French explorers into the heart of North America. Their first-hand accounts were the primary “data” European cartographers used for drawing maps of the region.

This English map of the Great Lakes region was based on a French map of North America made in 1650 by Nicholas Sanson, geographer to the king of France. It is one of the first maps to show all five Great Lakes, although “Lack of Puans” may have actually been Green Bay. The bay shows up as “Baye des Puans” on later maps. The French name for the Ho-Chunk (Winnebago), who lived along Green Bay, was Puans.

The French knowledge of the Great Lakes region at this time was far more advanced than represented on this map. French exploration of Lake Michigan took place gradually between 1634, when Jean Nicollet made landfall on the eastern shore of Green Bay, through 1679. French explorers, missionaries and fur traders had also circumnavigated Lake Superior by 1670. This exploration was the result of the rival efforts of France and England to lay claim to North America, reap the rewards of the fur trade and find the elusive Northwest Passage to the Orient.

Geographers used information from explorers, traders and missionaries to draw this map. It was printed from a copper plate, hand-tinted and published in an atlas or book. Because a book at that time cost as much as a European peasant earned in two years, it probably graced the shelves of an English aristocrat.
INTO THE HEART OF THE CONTINENT

To Europeans in the late 1600s, water routes in the interior of North America were known in greater detail than the land itself.

A cosmographer of the Republic of Venice, Vincenzo Maria Coronelli, produced this map in a 1688 atlas. It was based on reports of French and Spanish explorers.

This map is one of the first to accurately portray the five Great Lakes and the northern section of the Mississippi River. Because the Great Lakes and connecting channels were the major routes to the heart of the continent, this region was as well known as the eastern seaboard, Caribbean Sea and Gulf of Mexico.

Maps of this period typically include ornate drawings reflecting European preconceptions of America and notes describing rapids, portages, missions, forts, and the names of Native tribes inhabiting the region.
A PROGRESSIVE MAPMAKER
This cartographer championed the cause of using up-to-date information to make maps as accurate as possible. It was a novel idea at the time.

This map portrays what was known of the New World from near the equator to the Arctic Circle. While this map may not appear highly accurate today, Guillaume De L’Isle was one of the reformers in French cartography whose work greatly improved the representation of much of the world. For example, De L’Isle correctly showed that California was not an island, but part of the mainland.

De L’Isle notes on his map that his changes represent accurate updates, and he advertises his new book on geography. He was fighting a conservative trend in cartography at the time: cartographers often relied upon sources that were decades old, and most maps were nearly a half-century out of date by the time they were published.

De L’Isle’s maps were among the best made before longitude could be determined accurately and before systematic land and lake surveys were conducted.

The colored divisions on the map do not represent the land holdings of the European powers laying claim to North and Central America; rather, they represent the names given to broad geographical areas.
A NEW MAP OF YE NORTH PARTS OF AMERICA
Herman Moll
ca. 1711

CONTESTS OF EMPIRES
Published in England, this map directly challenged territorial claims made two years earlier on a French map. The mapmaker also used newer information to more accurately depict the Great Lakes.

A French map made two years prior to this one portrayed the British colonies on the east coast as smaller than the British conception of them. This map was in part a response to that earlier one: British holdings are correspondingly enlarged here.

The mapmaker was Herman Moll, a German who came to London in about 1678 and worked as an engraver for other publishers in the city. He soon set up his own business publishing atlases and separate maps of all parts of the world. His work was varied, ranging from miniature maps to large very decorative wall maps.

Moll and John Senex (see the next map in this exhibit) were the two most active publishers of maps of America. Their maps were used widely in the English colonies in America.
MAKING (UP) MOUNTAINS
This mapmaker inserted an imaginary mountain range running from Michigan to Florida.

During the Age of Exploration, cartographers often succumbed to the temptation to insert imaginary topography in places about which little or nothing was actually known.

This map of the eastern part of North America features a prominent, entirely fictitious, mountain range extending from Michigan into Florida, connecting with the Appalachians along the way. The map is based on numerous Jesuit and French sources of information on the Great Lakes and Canada. The error was perpetuated on maps into the nineteenth century.

Off the eastern seaboard is a large inset map of the North Atlantic, showing the eastern part of North America and the West Indies, as well as the coastlines of Europe and Africa. Above that is a smaller inset of Boston and vicinity.
AN ANCIENT GATHERING PLACE

The St. Marys River has been a focal point of human activity on the Great Lakes for thousands of years.

This stretch of river, between the modern cities of Sault St. Marie in Michigan and Ontario, once produced whitefish in remarkable abundance and supported Ojibwe communities as early as 2,500 BC. The river is the only water route between Lake Superior and the lower Great Lakes, and thus spawned French, English, and American fur-trading posts and military forts from the seventeenth through nineteenth centuries. Today, it is the site of the world’s busiest canal—the famous Soo Locks, which each year allow some 10,000 freighters to bypass the river’s rapids and twenty-foot waterfalls.

When this map was drawn in 1828, the fur-trading era was drawing to a close. Fort Brady had been built just four years earlier. The fort was part of a U.S. effort to exert authority in territory gained from Britain in the Treaty of Paris in 1783, but which had remained under British influence. The presence of Fort Brady became a major factor in the early growth of Sault Ste. Marie, Michigan.

The canal shown on the U.S. side of the river was used by canoes and small vessels to bypass the rapids and falls. A portage road was used on the Canadian side. As early as 1798, British fur traders had built a canal that carried freight canoes and bateaux.

This map was drawn by H.W. Bayfield, then a lieutenant in the Royal Navy of Great Britain. Bayfield went on to spend forty years charting most of the Great Lakes shores, sleeping outdoors in extreme heat and cold, working six and seven days per week. He rose to the rank of Admiral, and he is today remembered in the names of a peninsula, town and county in Wisconsin and a town, river, and research institute in Canada.
EDUCATING THE MASSES
These were published in England to educate people unable to obtain a formal education.

The Society for the Diffusion of Useful Knowledge was founded in London in 1823 to publish inexpensive but authoritative public education materials for people unable to obtain a formal education. The Society’s series of high-quality maps was one of its most successful projects.

The maps were sold by subscription. People bought one map every week or month, hoping to eventually own an entire atlas that could be kept in a home library. These were the first atlases that were small enough to be practical in the home. Unfortunately, many people were disappointed by extreme delays between new maps.

The maps were widely used in England’s emerging library system and universal public education.
PARTITIONING THE LAND

This map helped immigrants and settlers understand the survey system and locate the land they bought.

This map, compiled from public surveys of the Wisconsin territory that began in 1831, shows townships surveyed by 1837. These surveys represented the beginning of accurate and detailed land maps. The maps were published by the surveyors themselves; the U.S. government was not yet in the business of publishing maps for general distribution.

In 1785, the U.S. Congress passed the Land Survey Ordinance, which became the model for surveying all U.S. public land. The survey provided for a system of square townships six miles on a side, divided into 36 one-square-mile sections. The ordinance also mandated that section 16 of each township be set aside for the benefit of public schools. The U.S. formally agreed in 1794 to respect the previous land claims of individuals in areas acquired from Great Britain in 1783. Note the long lots in Green Bay and Prairie du Chien, which reflect the French system of land holdings along riverfronts.

With this system, a prospective land buyer could go to any U.S. Government Land Office—wherever it was located—and look in tract books that contained detailed descriptions of the land. The map shows the established roads, trails, natural land forms, vegetation, mill sites, and the lead and copper deposits of the time.
BENEATH THE SURFACE

The first fully detailed map of Wisconsin’s geology reveals the structures that formed Door County’s limestone cliffs—and, far off this map, Niagara Falls.

Increase A. Lapham, a noted Wisconsin naturalist, scientist and conservationist, produced and signed this map. It was based in part on the work of U.S. geologist David Dale Owen, who had published a geological survey of Wisconsin and other states earlier in the century. However, Owen’s work only showed the position of certain geological features; he did not attempt to connect these features nor show the bedrock of the state under every point, as does this map.

Lapham’s map illustrates the Niagara Escarpment (light blue), a dominant feature of the otherwise gently sloping Lake Michigan shoreline. In Wisconsin, it is most evident in the exposed limestone cliffs of Door County before it dips underground further south along the Lake Michigan shore. Those cliffs supplied the stone for many a harbor improvement. Probably the most famous outcropping of the escarpment bedrock is the spectacular 193-foot-high Niagara Falls, where waters from Lake Erie plunge toward Lake Ontario.
HARBORING RESENTMENT

An 1856 map of the Sheboygan harbor documents the town’s frustration with the federal government.

Although this map was produced by the U.S. Topographical Engineers, it contains an interesting disclaimer:

*The harbor piers, here laid down, were constructed entirely by the local authorities of the City and County of Sheboygan, Wisconsin. The United States had no agency in their construction whatever.*

Behind the statement lies a record of local exasperation with the federal government. Early developers repeatedly requested funding from Congress to help with harbor improvements. Congress did pay for construction of a lighthouse in 1839, but the small community had to pay for other early harbor improvements with local money. Finally, in 1852, Congress appropriated a modest amount for the harbor.

Incoming settlers and goods and outgoing lumber and agricultural products made Sheboygan a busy port and shipbuilding center. Lake Michigan served as Sheboygan’s major artery of transportation until the 1870s.

This map is number 43 in a series of harbor plans produced by James D. Graham, a major in the Topographical Engineers. Graham produced it before the Civil War, as part of his annual report to the Topographic Bureau. At the time, Graham was in charge of harbor improvements on Lake Michigan. The map was lithographed in Chicago, Graham’s headquarters.
PAPER RAILROADS

To entice settlers to buy land, some railroad developers and land speculators printed maps showing more towns and railroads than actually existed.

Although the railroads shown on this map did not yet exist, the map documents the natural resources that provoked much interest in the Upper Great Lakes region.

Based on U.S. Land Survey records by W.R. Wood, the map shows the extent of copper and iron ore in Michigan’s Upper Peninsula and in northern Wisconsin. By the 1840s, the rich deposits of copper were being mined in Michigan’s Keweenaw Peninsula. This mining activity resulted in Michigan’s Upper Peninsula being more extensively surveyed at this time than northern Wisconsin.

Extensive mining of iron ore in the various ranges of Michigan’s Upper Peninsula and northern Wisconsin began between the 1850s and 1880s as railroads provided transportation to ports along Lakes Michigan and Superior. In 1855, completion of a canal at Sault Ste. Marie also permitted inexpensive shipment of iron ore from Lake Superior ports to large smelters along southern Lake Erie.
MAP OF THE COUNTY OF MILWAUKEE, WISCONSIN (UPPER LEFT QUADRANT)
H.F. Walling
1858

BOOMTOWN MILWAUKEE
A picture of the city on the brink of becoming the leading wheat market in the world.

This map, which details the northern part of Milwaukee County, was published as part of a subscription series in 1858. It is part of a much larger map that shows county and city land holdings. A detailed section of land holdings in the city can be seen in the far right-hand side. The vignette in the upper right corner probably portrays the residence of an early subscriber to the map series.

After Native Americans ceded their Milwaukee-area lands in 1831 and 1833, Milwaukee was swept up in the settlement and land speculation boom of the 1830s. The juncture of the Menomonee, Kinnickinnic, and Milwaukee Rivers near Lake Michigan provided an excellent harbor site.

City promoters succeeded in their campaign to secure funding to improve the harbor and build a railroad connecting Lake Michigan and the Mississippi River. By 1862, Milwaukee became the leading wheat market of the world, a position that lasted nearly a decade.
A MODERATING INFLUENCE

This is the earliest known climatological map showing the effects of Lake Michigan on air temperatures in Wisconsin.

Because of the tremendous amount of water they hold, the Great Lakes have a pronounced effect on the climate of surrounding lands. In summer, the waters are cooler than the land and help to cool off nearshore areas. In winter, the waters are warmer than the land and thus help to keep coastal areas warmer than interior lands. Increase Lapham was one of the first scientists to examine these effects.

Isotherms, lines of equal temperature, were first used by meteorologists in the mid-1800s. Assuming east-west isotherms in the absence of any lake effect, the black isotherms on this map illustrate how Lake Michigan elevates the mean air temperature of Wisconsin in January. The red isotherms show how the lake effect depresses average air temperatures in July.

For example, Lapham found the average monthly temperature in Milwaukee in July to be similar to that of Eau Claire, and Milwaukee’s average air temperature in January equaled that of Beloit. The moderating influence of the lake on temperatures in Door County makes it possible for this peninsula between Green Bay and Lake Michigan to sustain large cherry and apple orchards.

Lapham was renowned as a scientist, naturalist and conservationist who collected data and published maps and texts based on his analyses. While climatologists today understand a more complicated picture of Lake Michigan’s effects on Wisconsin’s weather, Lapham’s early analysis was correct in its general idea.
DEATH’S DOOR AND OTHER HAZARDS

Between 1872 and 1889, one lighthouse keeper recorded two shipwrecks per week at Death’s Door.

Steamship and sailing captains used maps like these to navigate the Great Lakes’ many hazards. Famous among them was the treacherous entrance to Green Bay from Lake Michigan, known as Death’s Door. On this map, the French name Port des Mortes persists.

This chart includes sailing directions from the Straits of Mackinac to Green Bay. Navigation charts were provided free of charge to ship captains. They showed shoreline vegetation, roads, houses, soundings, dangers, magnetic declinations and lighthouses.

The narrow passage separating Door County from Washington Island is characterized by strong currents, fierce winds and rocky shorelines that wrecked many a ship and claimed the lives of hundreds of people. Some say Death’s Door was named when a Native American war party, negotiating the passage in canoes, smashed against the rocks in a sudden storm. Others say the French named it because many of their people died there.

Shipping products via the Great Lakes was vital to the economies of many lakeside communities in the 1860s, which were dominated by lumbering, fishing, and shipbuilding.

By 1882, the Sturgeon Bay ship canal enabled ships from lower Green Bay bound for Chicago to enter Lake Michigan without passing through Death’s Door.
TAKING STOCK

Published as part of a report to Congress, this map shows locations of iron, copper and lead deposits, federal land grant railroad holdings, U.S. Government Land Offices, Native American reservations, and wagon trails.

The Wisconsin public land surveys were nearly completed when this map was made. At the time, the first government land offices established in Wisconsin at Green Bay, Milwaukee and Mineral Point had already closed down, since most of the available land nearby had been bought or given away. Land sales were still going strong, however, in central, western and northern Wisconsin.

To encourage the development of railroads, the U.S. government granted the state of Wisconsin 3.65 million acres. These lands lay in an alternating, or checkerboard, section pattern on each side of the right-of-way. They were sold to help finance railroad construction. The grants to Wisconsin were part of 131 million acres granted by the federal government for railroad construction in states included in the Public Land Survey System.

The border between Wisconsin and Illinois was the east-west baseline used for systematic land surveys in Wisconsin. The north-south anchor line was the fourth Principal Meridian. As noted on the map, correction lines were established every tenth tier of townships because of the convergence of meridian lines as they approach the North Pole.
INSPRIED BY THE ERIE CANAL
For Green Bay developers, the opening of the Erie Canal rekindled old dreams of an efficient water route between Lake Michigan and the Mississippi River.

The U.S. experienced a canal-building craze in the 1830s and 1840s after the opening of the highly successful Erie Canal, which connected New York’s Hudson River to Lake Erie in 1825.

This map illustrates the horizontal distance (270 miles) and vertical rise (210 feet) involved in creating a waterway from Green Bay to the Mississippi River. The map shows the many locks and dams already constructed along the Lower Fox River to Lake Winnebago. It was prepared as a report to Congress.

Wisconsin promoters of the Fox-Wisconsin waterway project sought federal land to finance their plans. The state ultimately received almost 70,000 acres to support construction of locks, dams and a canal at Portage. Congress donated a total of 820,000 acres of federal land to Wisconsin in support of the Fox-Wisconsin and the Rock River canals, both designed to connect Lake Michigan with the Mississippi River.

In 1856, a small steamer traveled from Prairie du Chien up the Wisconsin River through the Portage Canal and down the Fox to Green Bay. However, the Wisconsin River proved unnavigable for cargo vessels due to its shallow waters and shifting sandbars.

By 1858, two railroad lines also connected Lake Michigan to the Mississippi River. The speed and convenience of railroads soon made the Fox-Wisconsin waterway obsolete.
PRECISION VIA TRIANGULATION
Maps for navigating the Great Lakes were far more accurate than those made for traveling by land.

The importance of waterborne transportation in the late nineteenth century—and the inherent dangers posed by rocky shorelines and narrow passages—called for highly accurate nautical charts. In fact, the U.S. Lake Survey conducted far more rigorous surveys than those of the General Land Office.

The Lake Survey used an array of precision instruments and employed triangulation to form the geographic framework of its maps. This technique allowed geographical locations to be determined with precision for the first time.

The first step in the mapping process involved establishing a baseline. Two of the baselines for the Great Lakes region can be seen at Chicago and Duluth. Baselines are established by determining two points and then precisely measuring the distance between the points. Surveyors determine the position of a third point by calculating the angle it makes with each end of the baseline.

Once the first triangle is produced, surveyors can use any two points of that triangle to continue this process, called triangulation. These calculations are repeated until the whole area to be mapped is surveyed.

The lake survey was begun in 1841 by the Corps of Topographical Engineers and was completed in 1882 by the U.S. Army Corps of Engineers, which merged with the Topographical Bureau during the Civil War. Most of the officers detailed to this duty were West Point graduates, trained in mathematics and the use of survey instruments. This triangulation became part of the general geodetic structure of the nation.
PRAIRIES, WETLANDS, AND TREES

This is one of the earliest maps to show Wisconsin’s native vegetation—including the extensive forests that made northern Wisconsin a major lumber-producing area from the 1840s through the early 1900s.

The map shows extensive forests of oak, maple, hardwoods and evergreens, as well as native prairies and wetlands. Lumberjacks floated logs down Great Lakes tributaries to sawmills located in many port cities, where lumber schooners filled their holds for delivery points downlake.

Peshtigo’s history dramatically illustrates the destructive effect of lumbering at its worst. In 1871, the town burned to the ground the night of October 8 in a great conflagration that killed at least 800 people and consumed 2,400 square miles of timberland along the western and eastern shores of Green Bay.

In terms of lives lost, the Peshtigo Fire was much worse than the famed Chicago Fire on the same date. The carelessness of hunters, lumberjacks, farmers and railroad workers, combined with extremely dry weather and strong northeasterly winds, caused many small fires to develop into a firestorm fed by the debris of lumbering.

This map was published as a plate in the *Atlas of the Geological Survey of Wisconsin*. Thomas C. Chamberlin, chief geologist of the survey (and president of the University of Wisconsin from 1887 to 1892), used the extensive notes on vegetation gathered by his team of topographers, who later also surveyed the state’s glacial deposits.
MAPMAKERS TAKE TO THE AIR

The city of Milwaukee, and the technology of mapmaking, changed dramatically between 1901 and 1958.

These maps were produced by the U.S. Geological Survey (USGS) as part of an effort to map the entire United States. The 1901 map was compiled using data obtained entirely by field crews. It was lithographed in three colors from hand-engraved copper plates, a method that could not effectively produce large areas of solid color. Thus, Lake Michigan is represented by “water lining,” the technique of drawing increasingly simplified replications of the shoreline inward toward the center of the water body.

Mapping and printing techniques had changed significantly by 1958, when the second map was printed. The map was compiled stereoscopically from aerial photographs—a technique scarcely dreamed of in 1901. This map uses five colors and represents Lake Michigan with blue tint. Depth curve lines and sounding values have been added to Lake Michigan from U.S. Lake Survey charts.

These are known as 15-minute topographic “quadrangle” maps, because they are four-sided and cover 15 minutes of latitude and 15 minutes of longitude. These particular quadrangles are bounded by the following parallels and meridians:

- South boundary: N 45º 00’
- North boundary: N 45º15’
- East boundary: W 87º 45’
- West boundary: W 88º 00’
A COLORFUL AID

This chart of western Lake Superior was printed in color to help ship captains recognize navigational aids, such as lighthouses and reefs. Color was first used in the early 1900s.

Lake survey charts are constantly updated to provide accurate information to ship captains. Note the location of dry docks, the bearing and distance between various points, and the opening and closing dates of many of the lakeside harbors.

Nautical charts contain information about the nature and form of the coast, the depths of the water, and general character and configuration of the sea bottom, locations of dangers to navigation, the rise and fall of the tides, locations of navigation aids, and characteristics of the earth’s magnetism.

The mandate to create nautical charts of the nation’s coasts dates back to 1807, when President Thomas Jefferson ordered a survey of the young nation’s coasts. The Organic Act of 1807 authorized the newly formed coastal survey agency to construct and maintain the nation’s nautical charts. This agency, the Office of Coast Survey, is the oldest scientific organization in the U.S. It has been a part of National Ocean Service since 1970, when the National Oceanic and Atmospheric Administration was created.
THE AGE OF RAILROADS

As railroads stretched across the continent, they competed with—and occasionally cooperated with—Great Lakes shipping.

Railroads dominated shipping in 1912, when this 15th biennial railroad map of Wisconsin was published. Intrastate, interstate, and city railroads provided a reliable means of transportation for people and cargo. Yet the continuing importance of waterborne transport is illustrated by the many railroads serving port cities on Lakes Michigan and Superior.

Railroads and shipping companies often fought bitterly for contracts to ship regional products, but sometimes they worked together in the Great Lakes region. Car ferries carried railroad cars across Lake Michigan between Milwaukee and Ludington, Mich., between Milwaukee and Grand Haven, Mich., and from Kewaunee and Algoma, Wis., to Ludington and Frankfort, Mich.

The ferries allowed trains to avoid the long haul around Lake Michigan and the busy terminals in Chicago. The S.S. Badger car ferry was one of these. Today it carries passengers and automobiles on its historic route between Manitowoc and Ludington, Mich.

Railroads also recognized the scenic beauty of the Great Lakes and advertised transcontinental packages featuring journeys aboard trains and excursion boats. In fact, railroad companies built the Grand Hotel on Mackinac Island in the strait that separates Lakes Michigan and Huron as a stopping point for excursion boats. The Grand Hotel is one of the few large resorts in the Great Lakes area that survived the heyday of railroads and excursion boats.
THE RUBBER HITS THE ROAD
The advent of mass-produced cars spurred new forms of boosterism.

Travel on Wisconsin’s highway system was adventurous in 1924. Few roads were paved, and wet and dry weather alike caused problems on the state’s gravel, dirt, and sand roads.

However, this did not dim the view of the Wisconsin Highway Commission, which proclaimed the state “The Playground of the Middle West” in its efforts to lure people to vacation in the state. It offered this highway map and an accompanying tour booklet for 25 cents. The map alone cost 5 cents.

The commission boasted, “It’s harder to get lost in Wisconsin than to find the way in many states.” The developing highway system helped create tourism for Door County and other coastal areas. This effort also provided a boost to recreational development, which still plays a major role in Wisconsin’s Great Lakes communities.
NOT TO BE USED FOR NAVIGATION

This map was prepared with an eye toward the needs of researchers, rather than ship captains.

In the 1840s, the Lake Survey (now merged into the National Ocean Service) began collecting data on the bottom topography of the Great Lakes. During the next century and a half, the density of the soundings became increasingly great, revealing with ever-increasing detail the surface of the Earth under the water.

Maps based upon these data were published primarily as navigation aids. They were well suited to helping ship captains avoid hazards, but they did not clearly display the morphology of lake bottoms.

This chart, published in 1981, was an attempt to synthesize available data and present them in an easily perceived format. Depths are shown with both isobaths and bathymetric tints — the deeper the water, the darker the blue. The map also includes other graphs and data of interest to scientists.
LIVING OFF THE LAND

Thousands of years ago the ancestors of today’s Native Americans filtered into the Great Lakes Region, took up the challenge of adapting to a wilderness untouched by humans, and learned how to survive.

In the seventeenth century, Native People of the Great Lakes relied on the natural world around them for subsistence, as they had for centuries. They fished with spears, gaffs, hooks and lines, weirs, seines, and gill nets. Fish primarily sustained the Ojibwe (Chippewa), Ottawa, and Hurons living at the southern end of Lake Superior and northern shores of Lakes Michigan and Huron. Fish were eaten fresh or preserved by smoking and freezing. They were also used as a trade item. Note the areas of intensive fishing in bright blue and areas of inshore fishing in lighter blue.

North of the Great Lakes, hunting for moose and deer was the main form of subsistence.

Wild rice was the mainstay of Native People west of Lake Michigan and south and west of Lake Superior.

Corn, beans, and squash became mainstays in the diet of those Native People living in lower Ontario, southern Michigan, and Wisconsin, and in southeastern Minnesota. The line on the insert shows the approximate limits of subsistence by cultivation around A.D. 1000. South of this line, the land was frost-free at least 140 days of the year.
A CENTURY OF DATA—IN 3-D

More than 120 years of depth soundings were compiled to make this map in 1996. It revealed some features of the bottom of Lake Michigan for the first time.

This map shows the bathymetry, or depths, of Lake Michigan. The deepest parts, reaching 280 meters (923 feet), are shaded dark blue. As glaciers retreated from the region some 10,000 years ago, these deep parts formed a smaller lake, known now as Lake Chippewa.

To make this map, researchers compiled data from more than 120 years of soundings (depth measurements). This work was done by the NOAA National Ocean Service and its predecessor agency for Great Lakes surveying, the U.S. Army Corps of Engineers.

Over 600,000 bathymetric soundings were employed in compiling this map. About 60 percent of these were already in digital form, while the remainder were digitized for the effort. This map revealed lake bottom features more accurately than ever before and showed some features for the first time. One of those is the Mackinac Channel, which can be seen in the northern part of the lake. This was a river that drained Lake Chippewa.

NOAA is engaged in a program to compile Great Lakes bathymetric data and make them readily available to the public, especially to the communities concerned with Great Lakes science, pollution, coastal erosion, response to climate changes, threats to lake ecosystems, and health of the fishing industry.
GREEN BAY FROM SPACE
A pair of satellite images taken 21 years apart shows the advantages of a spaceborne viewpoint and the evolution of the Landsat program.

The modern, civil earth observation satellite era began with the launch of the first Landsat satellites in the 1970s. In contrast to earlier military satellite missions such as those in the classified “Corona” program, the Landsat satellites were designed to support civilian applications ranging from natural resources management to urban and regional planning.

These two images cover a portion of Green Bay and western Lake Michigan. The city of Green Bay, Wisconsin, is located at the lower left, while Sturgeon Bay on the Door peninsula is at the center right.

The top image was taken on June 25, 1979, from the Landsat 2 satellite. The original scanner instrument on Landsats 1, 2, and 3 was not sensitive to the full range of wavelengths of visible light, so this image is shown as a “false-color” composite, using wavelengths of green, red, and near-infrared light. In this representation, features that reflect highly in the near-infrared part of the spectrum (such as healthy vegetation) appear in red hues. Each pixel represents a square on the ground about 76 meters on a side (250 by 250 feet). Even from an altitude of 570 miles, features such as roads, fields, and coastal landforms can be seen.

The bottom image is a nearly true-color Landsat 7 scene from September 8, 2000. Landsat 7 has more spectral channels, making it sensitive to more wavelengths of light, and five times greater spatial resolution. Each pixel in the image covers a 15-by-15-meter (50-by-50-foot) area on the ground. Among the features visible in this image are algal blooms and submerged sandbars in Green Bay, various types of wetland plant communities, and the expansion of urban and suburban areas since the 1979 image was taken.
THE BIG PICTURE

This navigational chart provides mariners with a broad overview of the Great Lakes and their connecting waterways.

For centuries, the navigational chart has been one of the most fundamental tools available to the mariner. A nautical chart is a graphic portrayal of the marine environment showing the nature and form of the coast, the general configuration of the sea bottom, including water depths, locations of dangers to navigation, and locations and characteristics of man-made aids to navigation, such as buoys, lights, and other markers.

This chart is used in conjunction with much more detailed, larger-scale maps of individual lakes, harbors, and channels. Because of the big-picture view it provides, it is also popular as a decorative wall hanging in offices, homes, restaurants, and other places.

Today, new forms of nautical charts have supplemented traditional paper formats. Raster nautical charts, for example, are digitized charts that can be integrated with GPS (the Global Positioning System) and other geospatial data. With these tools, a ship’s navigator can view charts on a computer screen at many convenient scales while the ship’s position, speed, and heading are indicated on the chart. Although these systems are tremendously useful and convenient, paper charts continue to provide essential backup information.
Four Seasons

NASA’s Earth Observing System includes a constellation of satellites that are keeping watch over a changing planet.

The Earth Observing System (EOS) includes satellites, data archives, and scientific research programs dedicated to improving our understanding of the earth as an integrated system. These images of the western Great Lakes region were acquired by the MODIS instrument onboard Terra, the flagship EOS satellite. They show the cycle of the seasons over Lake Michigan, Lake Superior, and surrounding areas.

In February, most of Lake Superior is covered with ice. Its grayish-white color suggests there’s little or no snow on the ice. On Lake Michigan’s Green Bay, the ice appears to be mostly covered with snow.

By April, the remaining ice is limited to a few bays on Lake Superior. Snowmelt flows from streams and rivers into the lakes, causing sediment plumes that are visible along the southern shore of Lake Superior and in the western end of the lake. In southern Lake Michigan, sediment is stirred up by wave action and forms a long green-blue plume running along the south shore.

By early September, the region’s forests and agricultural fields are dark green. Tiny plants, known as phytoplankton, bloom in the warm waters of Lake Michigan and alter the chemical and optical properties of the lake, creating swirling pale-blue patterns when seen from space.

As October brings shorter days and cooler temperatures, the forests in the north begin to turn red and orange, while harvested fields in the south appear tan or light brown. On the date of this image, large algal blooms brought a vibrant green color to Lake Winnebago and parts of Green Bay.
SPRINGTIME IN THE GREAT LAKES

In mid-April, the Great Lakes’ surface temperatures range from a mild 52° Fahrenheit in shallow southern bays, to a chilly 33° north of Lake Superior’s Isle Royale.

Mariners, fishing vessels, and meteorologists all look to satellites to provide timely and accurate maps of sea surface temperatures—or lake surface temperatures in this case. This map shows lake surface temperatures across the entire Great Lakes system on April 18, 2006. It was created by analyzing data from the MODIS remote sensing instrument on NASA’s Aqua satellite, which measures thermal radiation emitted from the lakes’ surface.

The temperature patterns shown here are affected by latitude, lake depth, winds, currents, river discharge, and other factors. The warmest spots are located in shallow bays and nearshore waters of the southern lakes. The deep waters of Lake Superior are much colder, as is Lake Huron’s Georgian Bay.
The mapping of the Great Lakes region began in the early seventeenth century, when the first indications of the lakes appeared on maps made by European cartographers. By the mid-1600s, the maps of French Royal Geographer Nicolas Sanson had recognizable depictions of all five Great Lakes. His map is imprecise—Lake Superior lacks its distinctive shape and is unbounded on the west—but Lakes Ontario, Erie, Huron and Michigan can be discerned without difficulty. The lack of any reference to the Mississippi River in Sanson’s map reflects how little cartographers really knew about the region at the time.

Until the late eighteenth century, maps were made with information acquired in an irregular and imprecise manner. They were not based on formal surveys, but on written records supplemented with sketches by explorers, missionaries and trappers traveling the Upper Midwest. European cartographers had the task of fitting together this often contradictory information and putting the results into the framework of a geographic map. Instead of being mapped in terms of latitude and longitude, prominent places were usually located in relation to other places, which were, of course, similarly positioned. Distances could not be measured with any accuracy at this time, so these maps were liable to gross errors.

The early maps in the “Making Maps, Mapping History” exhibit provide a capsulized view of the growth of geographical knowledge of the Great Lakes region. As noted above, Sanson’s map was the first to display all five of the Great Lakes. Vincenzo Maria Coronelli, the cosmographer of the Republic of Venice, used information supplied by Jesuit missionaries in a 1688 map that was the first accurate depiction of the Great Lakes and the Mississippi River. French cartographer Guillaume De L’Isle further refined the image and provided an outline that was not substantially improved until surveyors entered the region in the nineteenth century.

The first official government surveys of the Great Lakes were hydrographic surveys conducted by the British Admiralty under the direction of Capt. Henry W. Bayfield. Bayfield spent his entire career surveying the St. Lawrence River and the Great Lakes, beginning with Lake Superior in 1816. The lake-shore city of Bayfield, Wis., was named in honor of this pioneer surveyor.

One of the first acts of the new government of the United States was to establish a system for the orderly settlement of its western lands. Under the Ordinance of 1785, land surveyors went into the western territories in advance of settlement to divide the land into townships of 36 square-mile sections. Though mapping was not the government’s primary aim, the surveys provided ample grist for the mapmaker’s mill, and the regions were, for the first time, mapped with considerable accuracy. The federal government, however, was not yet in the business of making maps for the public. That was left to enterprising individuals, such as Samuel Morrison, Elisha Dwelle and Joshua Hathaway, who produced one of the first topographical maps of the Wisconsin Territory in 1837.
The surveys of the General Land Office served as the basis for the mapping of much of the Great Lakes region from around 1800, when the surveys began, until about 1890, when the U.S. Geological Survey began to map the region again. In some cases, however, the old surveys were not entirely superseded until the mid-20th century. The distinctive feature of maps based on these surveys is the invariable presence of the township grid.

As population and commerce in the Great Lakes region grew, the federal government assumed responsibility for charting the lakes for navigation. The U.S. Lake Survey began in 1841 with an appropriation of $15,000. Before the Civil War, the work was conducted by officers of the Corps of Topographical Engineers. Its initial survey was completed in 1882, but the need for continuous revisions caused it to be reactivated a few years later. The Topographical Engineers merged with the U.S. Army Corps of Engineers in 1863, and the Lake Survey remained in the hands of the Corps of Engineers until 1970, when it became part of the newly formed National Ocean Survey (now known as the National Ocean Service).

The U.S. Lake Survey conducted far more rigorous surveys than those of the General Land Office, which used instruments no more sophisticated than a surveyor's compass and a Gunter's chain. The Lake Survey used an array of precision instruments and employed triangulation to form the geographic framework of the maps. Triangulation allowed the transfer of geographical coordinates from point to point throughout the system and, for the first time, geographical locations were determined with precision. Inland navigation prompted Congress to order a variety of government surveys. During the era of canal building, surveys like the one for the Portage Canal were common. Most of them were conducted by the Corps of Engineers, as were the surveys of the great rivers, such as the Mississippi.

The degree of accuracy accorded Great Lakes navigators was generally not matched on land for many years to come. The task of precisely mapping the United States by covering it with large-scale topographic quadrangle maps was given to the newly formed U.S. Geological Survey (USGS) in the 1880s. John Wesley Powell, the second director of the USGS, stated that the mapping of the United States could be accomplished in 25 years, but that goal was not accomplished until the 1980s. The first topographic maps of Wisconsin appeared in the 1890s, when much of the southeastern part of the state was surveyed. The surveys were quickly done, however, and most of the sheets needed at least minor revision within the next decade. Despite a rapid start, the topographic mapping of Wisconsin bogged down and ultimately was not completed until 1983. Mapping standards changed entirely with the application of aerial photography around 1930. Following World War II, all Wisconsin topographic sheets were derived from photographs.

Today, polar-orbiting satellites with thematic mappers can, in a single day, record images that reveal Great Lakes water quality and temperature, the streets and large buildings of urban areas, and the general health of forests, wetlands and farmlands, including the identity of such crops as corn, hay and alfalfa. The detailed precision of today's computerized Space Age technology no doubt would have astounded Nicolas Sanson—but the seventeenth-century mapmaker's ability to create a fairly accurate map of a world he had only heard and read about is equally astounding to twenty-first-century mapmakers.
A HISTORIAN’S VIEW
by Margaret Beattie Bogue

“Making Maps, Mapping History” mirrors centuries of human experience in the Great Lakes region and at the same time reflects major changes in the art of mapmaking. These maps show how the Great Lakes influenced the development of the mid North American continent and how human activity changed the lakes. Viewing the display, in the mind’s eye one sees a human procession led by prehistoric Native People, followed by French explorers, missionaries, fur traders, and empire builders. It concludes centuries later with farmers, lakeside city dwellers, sportsmen, summer home builders, people concerned about Great Lakes water quality, and scientists pondering remedial action to save the lakes. From hundreds of miles above the earth a Landsat satellite maps the Great Lakes.

Nearly 12,000 years ago, the first human inhabitants began to adapt to the Great Lakes environment. They relied on the region’s natural wealth of fish, wild rice and game for food, and they used the Great Lakes to travel from the St. Lawrence River in the east into the very heart of the continent.

More than three centuries ago, Native guides escorted the first Europeans through this maze of waterways. Using the skills, technical knowledge and trade networks of the Native People, the French ventured into the fur trade, an enterprise that became the economic foundation for New France. As the French continued to explore North America, they collected a vast body of knowledge that mapmakers in Europe used to depict the land and waterways.

By 1840, the fur trade was fading, and the westward thrust of growing U.S. and Canadian populations signaled a new era. Settlement and agricultural development rapidly changed the wilderness and the lives of its Native inhabitants. Miners moved into southwestern Wisconsin’s lead fields during the 1820s and into Upper Michigan’s copper-rich Keweenaw Peninsula during the 1840s. The U.S. and Canadian governments obtained land cessions from the Native People through treaties and then surveyed the region’s land to encourage frontier development.

As farming and mining began, port cities along the western shores of Lake Michigan became centers of commerce, trade and manufacturing. The Great Lakes facilitated this rapid change, serving as the region’s principal transportation routes until 1860. The port cities pressed the federal government for harbor surveys and improvements, lighthouses, navigational charts, weather reporting and canal construction. Hoping to imitate the success of the Erie Canal, Wisconsin sought and secured federal aid to build two canals joining Lake Michigan and the Mississippi River. The most famous of them, the Portage Canal, linked the Fox and Wisconsin rivers.

By mid-century, the railroads challenged the waterways, and a quarter-century later they dominated transportation in the region. Although Great Lakes ships lost most passenger traffic and much of the package freight business, they continued to carry bulk cargoes—the rich timber harvests, Lake Superior’s iron ore, and wheat, coal, stone and petroleum products.
Lake and railroad carriers ultimately became interdependent. Car ferries across Lake Michigan linked railroads in Michigan’s Lower Peninsula and Wisconsin to provide east-west traffic. Great Lakes port cities eagerly sought railroad connections to enhance shipping, commerce and manufacturing. The spread and dominance of railroad transportation from 1850 to 1920 brought a marked growth in the region’s population, agriculture, urban areas and industry.

Economic development produced major environmental changes in the region. Lumbering and farming destroyed much of the original vegetation and encouraged soil erosion. The draining of wetlands and the construction of dams altered water quality in streams, rivers and lakes. Urban sewage, industrial waste and mining runoff introduced a variety of toxic chemicals into the waters. By 1900, thoughtful observers already were worrying about pollution of the Great Lakes.

These problems became worse during the next 100 years. Cars and trucks began to replace the railroads after World War II, and the vast urban-industrial-residential expansion increased the demands on the water, fish and other resources of the Great Lakes. At the same time, the growing popularity of outdoor recreation and the region’s growing abundance of state and federal parks and forests helped create a new awareness of the natural environment. The 20th century’s view of Earth from space brought home the knowledge of the fragile nature of life on this planet.

And so these maps bring the viewer full circle—from the incomplete and distorted views of the Great Lakes during the Age of Exploration to the comprehensive and sweeping view of the lakes in the twenty-first century.
Additional Reading

The following books are available from the Water Resources Library and other campus libraries. Additional titles can be found in “A Guide to Recent Trends in the History of Cartography” by Matthew H. Edney available at fas.harvard.edu/~atlantic/biblographies/cartography/edney.html.


Both travel guides feature essays on the history of their respective lakes, as well as brief histories of specific lakeshore sites, communities, state and federal parks and forests, etc. Although *Around the Shores of Lake Michigan* is somewhat out of date (attraction hours, prices, etc.), the historical information is still valid and fascinating.


Using maps from David Rumsey’s private collection, this atlas bridges the gap between historical cartography and exploration and the new technologies and applications of geographic information systems (GIS). If you are not already convinced, let Rumsey show you why old maps are so interesting. Then see more of his collection online at www.davidrumsey.com.


Two-time Pulitzer Prize winner John Noble Wilford recounts the history of cartography from antiquity to the space age in this fascinating historical account of mapmaking that stresses its evolving technology.


A superbly illustrated historical survey of the mapping of North America from the Age of Exploration to the Space Age, it is also marvelously written and highly readable.


From recent developments in digital image processing to the next generation of satellite systems, this book provides a comprehensive introduction to the field of remote sensing and image interpretation.


The most significant maps and mapmakers are discussed beginning with the first European maps of New Netherlands in the early seventeenth century and concluding with the Rand McNally atlases of the 1890s.


The atlas uses historical data, full-color maps, descriptive text, photos and illustrations to provide a fascinating and colorful portrait of the state’s complex development.
This educational exhibit was originally created as a University of Wisconsin Sea Grant Institute project funded by a grant from the Wisconsin Humanities Committee and produced in cooperation with the UW-Milwaukee American Geographical Society (AGS) Library and the UW-Madison Environmental Remote Sensing Center (now part of the Space Science and Engineering Center). It was displayed in 1988-91 in eleven Wisconsin communities and had an estimated viewing audience of over 61,000.

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In 2007, the University of Wisconsin Sea Grant Institute, in cooperation with the AGS Library and UW-Madison Space Science and Engineering Center updated and enhanced the exhibit to bring it to the Madison community in the Memorial Library Department of Special Collections.

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