

Tornadoes of Fire at Williamsonville, Wisconsin, October 8, 1871

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***Abstract.** A small Door County park northeast of Brussels, Wisconsin, is a memorial to sixty people who lost their lives when a wildfire destroyed the tiny village of Williamsonville on the night of October 8, 1871. The tragedy was compounded by what eyewitnesses described as “tornadoes of fire” that accompanied the inferno. Today, we know that large wildfires often spawn intense vortices that resemble Williamsonville’s tornadoes of fire. The Williamsonville fire was one of several major wildfires on the same day that claimed more than seventeen hundred lives and destroyed millions of hectares of forest land in the upper Midwest. A dry summer coupled with a general disregard of fire prevention strategies contributed to the disaster. In southern Door County, the fires meant the end of lumbering and shinglemaking as major industries and served as an impetus for development of agriculture.*

On the night of October 8, 1871, a wildfire swept through the tiny village of Williamsonville in Brussels township, southern Door County, Wisconsin (Fig. 1). All but seventeen of the settlement’s seventy-seven inhabitants perished. The Williamsonville tragedy was one of many that night when fires swept into lumber and shinglemill towns located on both sides of the bay of Green Bay; in all, perhaps thirteen hundred lives were lost and seventy-five hundred people were left homeless. Most victims were either lumberjacks or homesteaders. In addition to the tragic loss of life and human suffering, wildfires so devastated the forests—more than a half million hectares were burned—that the historical course of the region’s economy

changed significantly. In southern Door County, the fire that destroyed Williamsonville and other settlements was a singular event that marked the end of lumbering and shinglemaking and spurred the region’s transition to agriculture.

Geographic Setting

In 1871, the Door County peninsula was thickly forested and sparsely populated. The glacial era had shaped a gently rolling terrain that was covered by northern mesic forest species (maple, hemlock, and yellow birch). Cedar swamps and tamarack and black spruce bogs occupied moist lowlands. The southern half of the county (south of Sturgeon Bay) had been settled in the mid-1850s primarily by Belgian immigrants. They were mainly farmers but the densely forested condition of their new homeland forced them into logging as their primary occupation at least for a time (Friedman 1989).

Settlers built small dwellings in isolated

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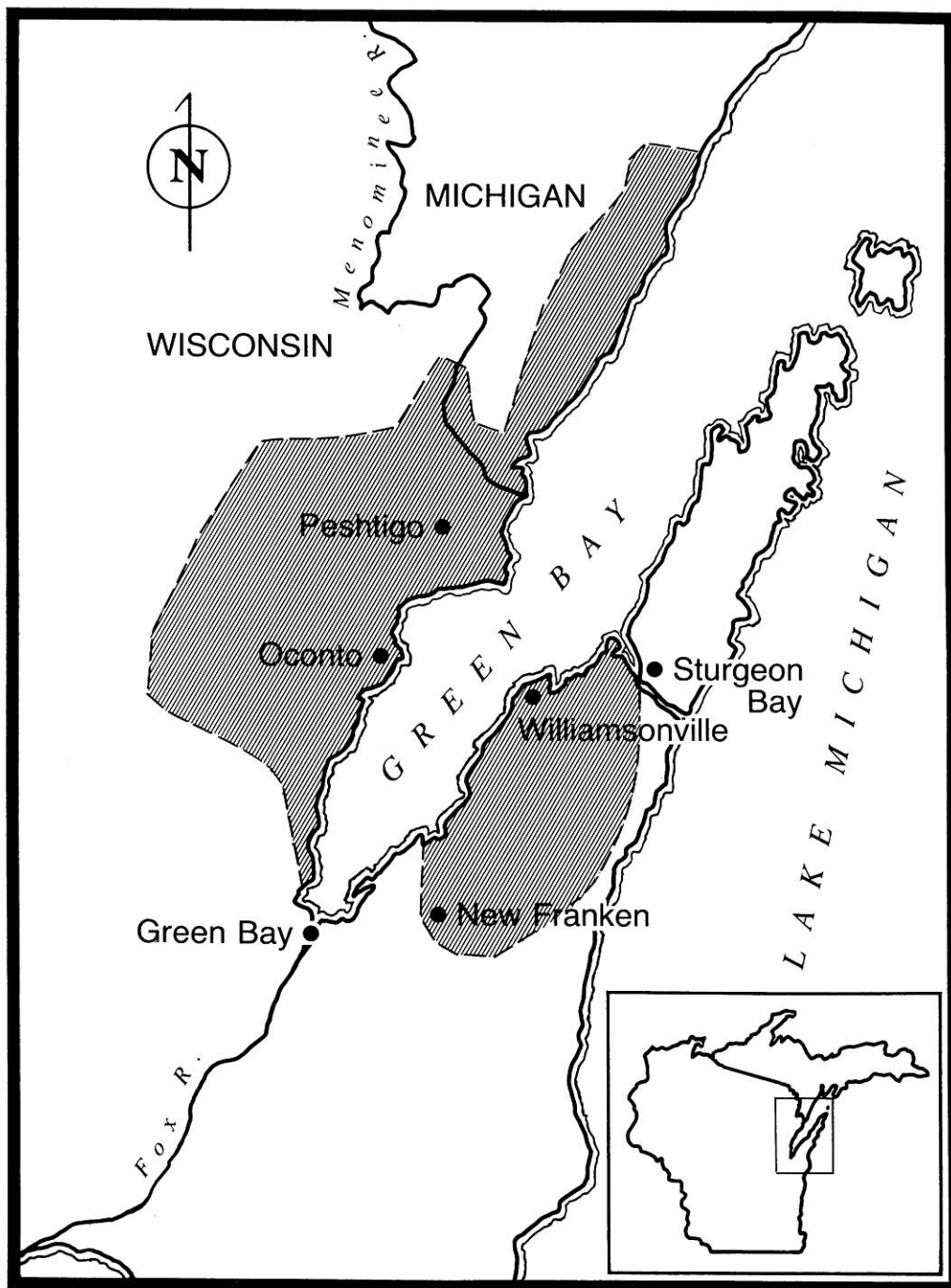


Fig. 1. Wildfires burned over large areas of northeastern Wisconsin on the night of October 8, 1871. Shading indicates the approximate location of the burned-over region based on maps by Tilton (1871) and Wells (1968).

settlements in the woods and survived by shinglemaking, lumbering, and some farming and fishing. At first, poor roads limited the marketing of logs, and no doubt much valuable timber was wasted during slash-and-burn clearing of land for crops. Eventually, markets opened for wood products including lumber, railroad ties, and shingles. Shingles were split from pine and cedar logs, shaved by hand, and transported via ox carts or sleighs to Green Bay or to boats on the Bay for eventual transport to Milwaukee or Chicago. Later, shinglemills were built.

Williamsonville, site of one of Door county's largest shinglemills, occupied a clearing of about 4 hectares. A sketch map of Williamsonville (Fig. 2) shows a linear pattern of settlement along the original stage road that linked Sturgeon Bay and Green Bay. The

mill and a large storage barn were located well away from other buildings presumably as a fire safety measure. Roadside buildings consisted of a boarding house, store, blacksmith shop, and eight dwellings (C. I. Martin 1881). The present highway on the map was built in the late 1920s and is now State Highway 57.

Today, the former site of Williamsonville is marked by a small roadside park on land purchased by the county in 1927 at the suggestion of the Door County Historical Society (Holand 1931). Tornado Memorial Park (Fig. 3) is located 6.6 kilometers northeast of Brussels, Wisconsin. Bronze tablets commemorate the sixty victims who on the night of October 8, 1871, burned to death in the "tornado of fire" that "blotted out" the village.

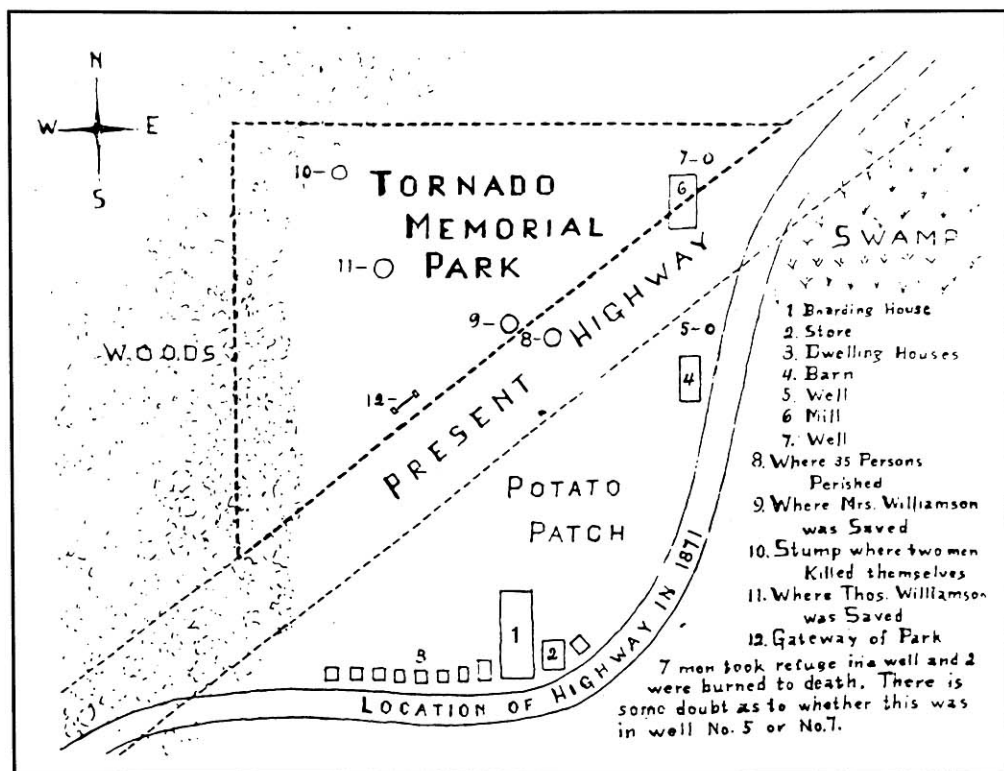


Fig. 2. Sketch map of Williamsonville, Wisconsin. On October 8, 1871, this shinglemill village was destroyed by a wildfire; only seventeen of its seventy-seven inhabitants survived. (From Holand 1931.)



Fig. 3. Tornado Memorial Park is the former site of Williamsonville, Wisconsin, and commemorates the sixty people who lost their lives to a "tornado of fire" on the night of 8 October 1871. The park is 6.6 kilometers northeast of Brussels, Wisconsin, on State Highway 57. (Photograph by J. M. Moran)

The Fire

Although the Williamsonville fire is often considered part of the same conflagration that destroyed Peshtigo, Wisconsin, actually separate fires engulfed the two settlements. According to Wells (1968), at least two major wildfires ravaged the west side of the bay of Green Bay—one spread from near the Green Bay city limits to just south of Oconto and another burned north of Oconto into Peshtigo and then on to Michigan's Upper Peninsula (Fig. 1). On the less populated east side of the Bay, another wildfire spread from south of New Frankin northeastward to near Sturgeon Bay. By far, the greatest loss of life was in Peshtigo and neighboring settlements.

The Peshtigo and Williamsonville fires occurred on the same night as the great Chicago fire, which claimed more than two hundred lives and destroyed 17,450 buildings. Between October 8 and 10, 1871, other major

wildfires burned over perhaps one million hectares of woodland in lower Michigan and may have claimed another two hundred lives. In all, these were the most destructive wildfires in United States history.¹

We are fortunate in having a detailed eyewitness account of the Williamsonville fire. Thomas Williamson, one of the owners of the mill and village, was startled by the rapid approach of flames. He reported that as he sat with several relatives on the stairs of his family home

there came a heavy puff of wind, the trees fell in all directions, and I saw the reflections of a big fire south of us. I thought it was a mile and a half off. In less time than it takes to write this, there came another heavy gale, and the flames came rolling through the woods up to the back of the barn. . . . Then the sparks came down like a heavy snow-storm. . . . (Holand 1931)

Williamson then describes how he and his family tried to save themselves and their possessions, but their efforts were to little avail. The next day, the bodies of thirty-five victims were found huddled together in a potato patch located about one hundred meters from the charred forest. Two of seven persons who sought refuge in a well perished. Of the eleven members of the Williamson family, only Thomas and his mother survived. Williamsonville was literally erased off the map. On

a Door County map published only seven years after the fire, Williamsonville was replaced by Tornado, which apparently consisted of nothing more than a post office and saloon (Fig. 4).

Why it Happened

Although wildfires are largely random and unpredictable events, fire specialists cite fuel, ignition, and weather as key contributing factors. No one of these ingredients alone usu-

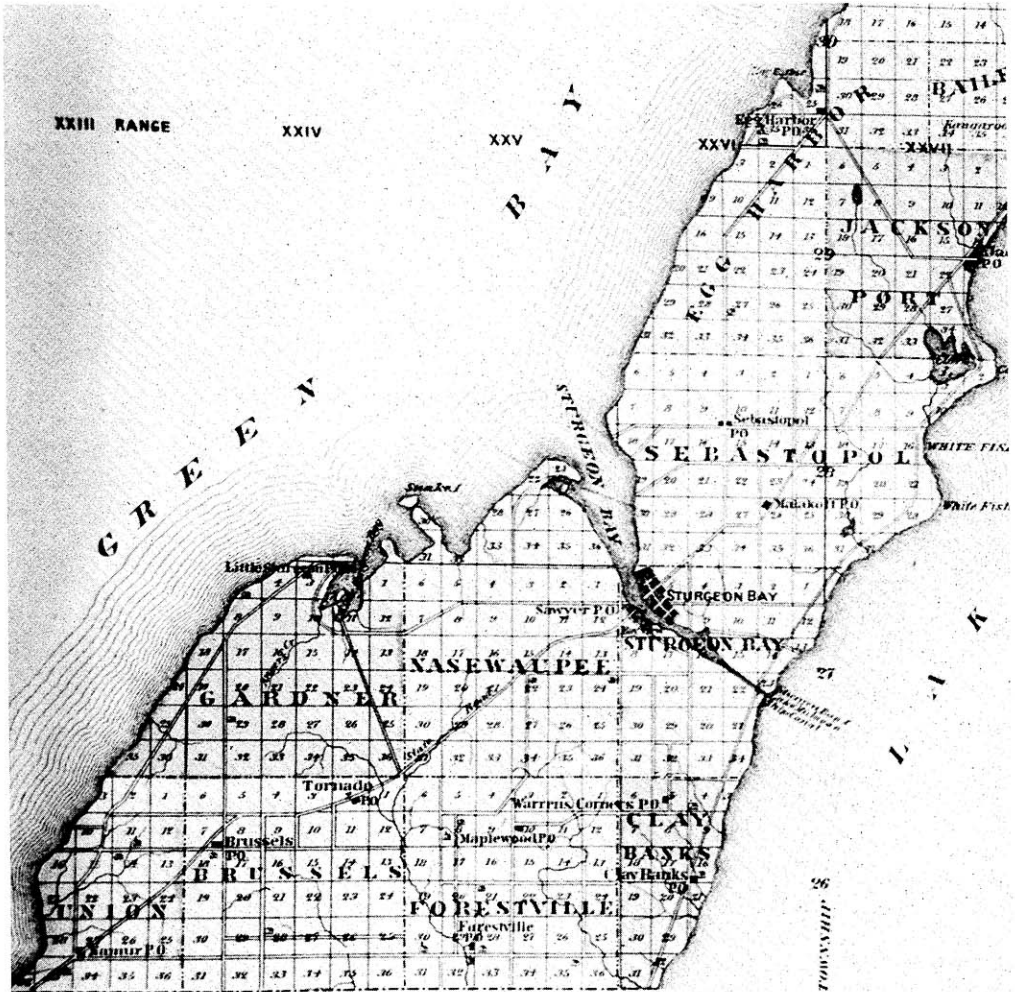


Fig. 4. On this 1878 map of Door County, "Tornado" marks the former site of Williamsonville, Wisconsin. Tornado apparently consisted of nothing more than a post office and saloon. (Map from Historical Atlas of Wisconsin, Milwaukee: Snyder, VanVechten and Co., 1878, p. 101; courtesy of the American Geographical Society Collection, The University of Wisconsin-Milwaukee Library.)

ally is sufficient to trigger major wildfires. For example, even if the weather is unusually dry for a lengthy period, wildfires are unlikely unless sufficient fuel (e.g. humus, woody debris) has accumulated.

In his review of wildland fire behavior, Albini (1984) notes that wildfires are loosely classified on the basis of the type of fuel through which they burn. Ground fires slowly consume the subsurface organic materials that compose peat bogs and swamps; surface fires engulf forest litter, fallen trees, and other vegetation; and crown fires rapidly burn through tops of standing (usually coniferous) trees. Eyewitness accounts (e.g. Tilton 1871) indicate that the northeastern Wisconsin wildfires were unusually intense and involved all three sources of fuel. For example, Williamsonville survivors described a "sheet of fire that rolled along over the tree tops," probably indicating a crown fire (C. I. Martin 1881). Also, eyewitnesses noted that the fire was so intense that stumps were burned out and roots were gone (Holand 1931).

By early October 1871, the fire danger had become acute over much of the upper Midwest partially because of the wasteful logging practices of the day. Lumbering, clear-cutting for farming, and the railroad right-of-way (then under construction between Green Bay and Menominee, Michigan) left behind considerable residue and slash accumulation in the woods. The debris fueled numerous small fires that broke out frequently throughout the summer. In fact, newspapers reported that smoke blown from the smoldering woods often obscured the midday sun and sometimes was so thick over the Bay that it slowed ship traffic. The week before the wildfires, fog horns were sounded continuously and navigation was done by compass (Pernin 1971).

Numerous small fires burning in the woods of northeastern Wisconsin in the days prior to the main conflagrations meant many points of ignition, which is one reason why fire burned so rapidly over such huge areas (Haines and Sando 1969). Today, wildfires usually burn over much smaller areas because mod-

ern fire prevention practices mean that wildfires typically originate from only a few ignition points. Back then, wildfire was a tolerated hazard, and as long as winds were light, workers were able to contain the flames whenever they drew close to settlements. Residents of Williamsonville, for example, vigilantly controlled small fires that flared up around their clearing in the woods, and, if winds permitted, they would set protective backfires confident that fire would not burn over the same area twice (Holand 1931).

One obstacle in reconstructing the weather conditions on the day of the wildfires as well as the months preceding is a lack of reliable data. Weather-observing practices were not standardized as they are today, instruments were less reliable, and weather stations were few and far between. Nonetheless, available data indicate that the summer of 1871 was very dry throughout northeastern Wisconsin (Haines and Sando 1969; Haines and Kuehnast 1970). Precipitation records at Embarrass (about 58 kilometers northwest of Green Bay) and Sturgeon Bay indicate that rainfall was below average during June, July, August, and September of 1871.

Although summer dryness likely contributed to the wildfires of early October, we would be remiss in assuming that the area was in the grip of a drought of unparalleled severity. Lorimer and Gough (1982) computed a drought index for northeastern Wisconsin for each day, May 1 through October 31, 1864–1979, and tabulated the number of days per month of moderate and severe drought. From May through September of 1871, moderate drought occurred on 33 days and severe drought characterized only one day. In the 116 years of record, 22 years had a greater frequency of moderate drought and 29 years had a greater frequency of severe drought. Furthermore, March and April of 1871 were relatively wet at both Embarrass and Sturgeon Bay (Haines and Sando 1969). But what may be more important than summer drought in contributing to the fire weather of early October was the very low relative

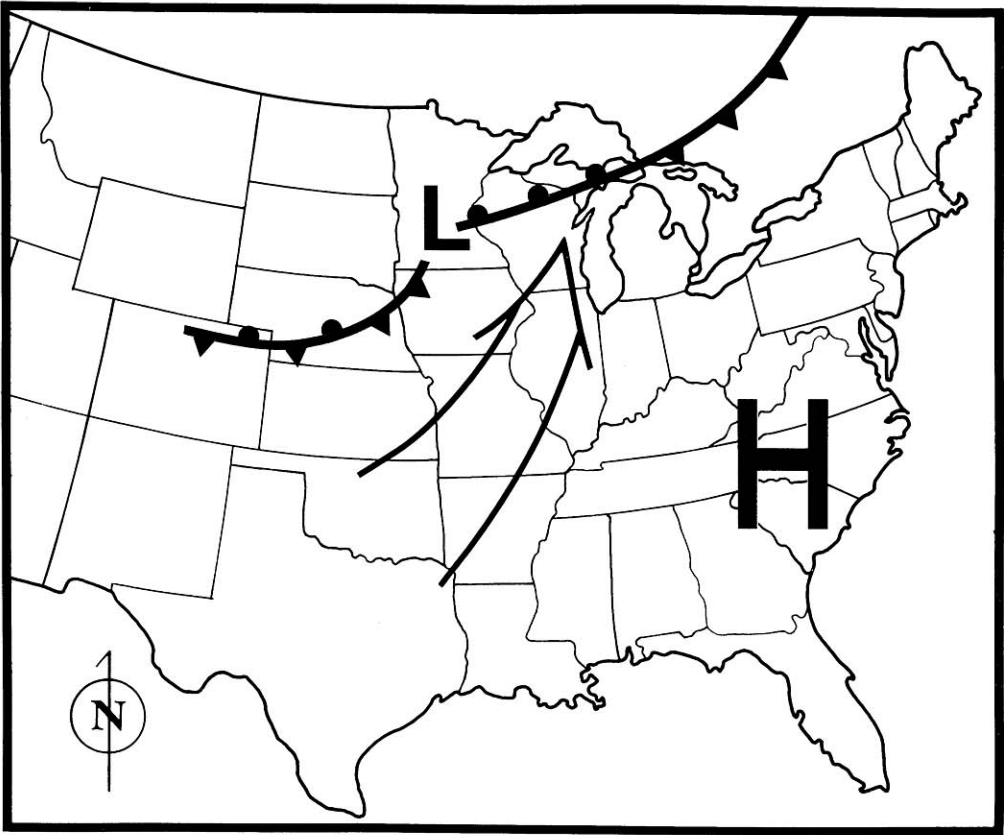


Fig. 5. Reconstruction of the major features of the synoptic weather pattern on the evening of 8 October 1871 based on a study by Haines and Kuehnast (1970). Low pressure (L) over southwest Minnesota coupled with a slow-moving high pressure system (H) over the mid-Atlantic states meant a south to southwesterly flow over the upper Midwest. Fronts stretch northeast and southwest of the low center.

humidity that persisted during the week or so prior to the wildfires (Haines and Kuehnast 1970). Low relative humidity is known to significantly elevate the fire danger by reducing the moisture content of dead logs and branches.

We are indebted to Haines and Kuehnast (1970) for their reconstruction of the synoptic weather pattern of the day of the wildfires (Fig. 5). On the evening of October 8, 1871, a slow-moving high pressure system was centered over Virginia and the Carolinas, and a deepening Alberta-type low pressure system was over southwestern Minnesota. A nearly stationary front stretched northeastward from the low center across northwestern Wisconsin to just north of Lake Michigan.

The relatively steep pressure gradient between the two weather systems gave rise to south to southwesterly winds over portions of Iowa, northern Illinois, and most of Wisconsin and Michigan. The strongest winds were over southeastern Wisconsin and northern Illinois; at 2 PM winds at Chicago and Milwaukee were from the south/southwest at a brisk 37 and 52 kilometers per hour respectively. Winds were weaker over northeastern Wisconsin with Embarras and Sturgeon Bay reporting winds of only 19 kilometers per hour at 9 PM. Nonetheless, winds were sufficiently strong to fan many small blazes into larger conflagrations. By late on the evening of October 8, southwesterly winds were driving major wildfires to-

ward Peshtigo and Williamsonville. By about 2 AM on October 9, the wildfires were over and the burned-over region lay in smoldering ruin.

Fire Vortices

Although regional winds were only light to moderate over northeastern Wisconsin, by many eyewitness accounts, wildfires were accompanied by winds strong enough to twist and uproot large trees and rip the roofs off barns and other buildings. Also, some survivors reported that wind and fire whirled about like a tornado and produced a roar similar to the sound that often precedes a tornado. In his fascinating report of the fire, Tilton (1871), a Green Bay newspaper man, quotes two residents of Sugar Bush, a small settlement near Peshtigo, who witnessed "tornadoes of fire."

Says Alfred Griffin, of the lower Sugar Bush, "When I heard the roar of the approaching tornado I ran out of my house and saw a great black, balloon-shaped object whirling through the air over the tops of the distant trees, approaching my house. When it reached the house it seemed to explode, with a loud noise, belching out fire on every side, and in an instant my house was on fire in every part."

G. H. Brooks makes a similar statement. He went out of his back door to see the approaching storm, saw a similar cloud or ball approaching, and then ran into the house and with difficulty closed the door, so strong was the wind. The ball had by this time reached the house and exploded with a loud noise, filling the air with great sheets of flame. A stream of fire entered his house through the crack under the back door, and swept through the house to the front door. Of course the house was ablaze in an instant from foundation to roof, the family barely escaping with their lives, supremely happy to do that. We visited the place afterwards. The house stood at a considerable distance from the woods—so far, that in any ordinary fire, it would have been perfectly safe. But here were remaining but the stone walls of the cellar, dilapidated stoves, melted stove-pipe and broken crockery. . . . (Tilton 1871)

Tornadoes of fire were actually fire vortices, which are frequently spawned by large wildfires (Graham 1955; Haines and Updike 1971; Albini 1984). Development of fire vortices was probably the principal reason for both the rapid pace and destructiveness of the wildfires. Fire vortices are of two general types: fire whirlwinds and horizontal roll vortices. The Wisconsin wildfires likely generated both types of vortices.

Fire whirlwinds are the more common vortices. They are vertically oriented and vary in diameter (1 to more than 100 meters) and height (1 to more than 1000 meters) and range in intensity from weak dust-devil-like whirls to severe tornado-like disturbances. Whirlwinds develop both within and immediately downwind of a wildfire and are made visible by swirling smoke and masses of burning embers.² Horizontal roll vortices, whirls that rotate about a horizontal axis, are less common and rotate more slowly than fire whirlwinds (Haines and Smith 1987). If either type of fire vortex develops at the downwind leading edge of a wildfire, they can hasten the spread of fire by scattering firebrands (burning embers) and igniting spot fires well beyond the perimeter of the main body of fire. In controlled burns, for example, fire whirlwinds are known to ignite spot fires many kilometers downwind from the main inferno. This is likely what happened as regional southwesterly winds steered wildfires toward Williamsonville and Peshtigo, for it explains how objects situated some distance downwind of the main body of the wildfire were quite suddenly consumed by fire.

In some respects, wildfires that scorched northeastern Wisconsin in October 1871 may have resembled the huge fire storms that engulfed hundreds of city blocks during Allied bombing raids on cities in Germany and Japan during World War II. In those fire storms, violent updrafts formed over the fire center and strong cyclonic (counterclockwise) winds developed at the surface. For example, on July 27–28, 1943, heavy incendiary bombing of Hamburg, Germany, set off a fire storm

that engulfed an area of about 12 square kilometers. Surface winds likely exceeded hurricane strength and the fire storm was accompanied by intense local vortices (Ebert 1963).³

Models and experimental burns provide some insight on the genesis of fire vortices. For example, Church et al. (1980) attempted to model fire whirlwinds during experiments at the Meteotron facility in southern France near the central Pyrenees. The Meteotron is a 140 by 140 meter square array of 105 fuel oil burners which, when ignited, produces fires that merge into a highly energetic inferno. A network of weather instruments and cameras continually monitors the fire plume, a hot and buoyant mixture of combustion gases and entrained air. Church and his colleagues found that vortices of varying intensity develop within the fire plume, and some travel downwind and away from the fire perimeter. Apparently surface winds interact with the fire plume in such a way that vorticity (a measure of the rotational tendency of the fluid) is concentrated in a series of anticyclonic (clockwise) and cyclonic (counterclockwise) vortices.

Haines and Updike (1971) point out that, once formed, a fire whirlwind feeds itself. A fire whirlwind occupies an air column that is heated intensely by the underlying burning ground cover. Intense heating destabilizes the air, especially close to the ground, and gives rise to a strong updraft that draws surface winds radially inward toward the whirlwind. In this way, horizontal surface winds transport fuel (burning logs and other debris) into the whirlwind. Burning fuel further heats the air enhancing its buoyancy and thereby the whirlwind circulation strengthens.

Historical Significance

In many of the devastated settlements, including Peshtigo, survivors of the wildfires stoically tried to put their lives back together. Some saw and shingle mills destroyed by fire were rebuilt but not in southern Door County where the wildfires had permanently altered

the landscape and the local economy. The thick forests were gone, replaced by burned-over vegetation and tree stumps; the lumbering era had ended.

Clearing trees and stumps had always been a slow and arduous task for settlers living independently on isolated plots of land and relying on their own muscle power and that of their sluggish oxen. Ironically, the devastating wildfires of 1871 helped farmers to clear the forest and open the land to crops. Furthermore, when news of the wildfires reached the rest of the state and nation, an enormous relief effort began which brought food, clothing, money, and farm implements to the area. Xavier Martin, a prominent Green Bay politician and real estate dealer, observed that by 1874, only three years after the fire, the Belgian immigrants of Door County were in better condition and circumstances than ever before (X. Martin 1895).

In effect, the fire was a catalyst that accelerated the transition to agriculture in southern Door County, a conclusion that is supported by area census data that bracket the 1871 fire. Censuses of 1870 and 1880 indicate sharp increases in population, number of farmers, and land area in cultivation in the five southern Door County townships most severely affected by fire (Tables 1 and 2). In fact, the rate of development was much faster than statewide trends during the same period. While population more than doubled and cultivated land area almost tripled in the five southern Door townships, statewide population increased 25% and farm acreage increased 31% (Ebling et al. 1948). Census data also tell us that the number of sawmill or shinglemill workers in the five townships declined from thirty-nine in 1870 to none in 1880.

Farming in Door County in the 1870s was largely of the mixed or subsistence type with an emphasis on livestock (Ebling et al. 1948). That is, farmers produced primarily for their family's essential needs (food, fiber, and shelter). Nonetheless, this stage in the region's agriculture was a key step in the even-

Table 1. Percent change in population and farm statistics between 1870 and 1880 for the five southern Door County townships most severely affected by the 1871 wildfires.

	<i>Brussels</i>	<i>Forestville</i>	<i>Gardner</i>	<i>Nasewaupée</i>	<i>Union</i>
Population	+146%	+197%	+ 50%	+120%	+108%
Households	+141%	+181%	+ 53%	+ 87%	+ 87%
Farmers	+145%	+269%	+100%	+115%	+ 98%
Farm land*	+167%	+341%	+ 25%	+129%	+156%

*Tilled plus permanent meadow

Source: U.S. Census, 1870 and 1880. Population and Agricultural Schedules, Door County, Wisconsin. Wisconsin State Historical Society, Madison, Wisconsin.

Table 2. Change in population and farm statistics between 1870 and 1880 for the combined five southern Door County townships most severely affected by the 1871 wildfires.

	<i>1870</i>	<i>1880</i>	<i>Percent Change</i>
Population	1800	4016	+123%
Households	328	692	+111%
Farmers	273	673	+147%
Farm land (acres)*	6614	17755	+168%

*Tilled plus permanent meadow

Source: U.S. Census, 1870 and 1880. Population and Agricultural Schedules, Door County, Wisconsin. Wisconsin State Historical Society, Madison, Wisconsin

tual development (after 1890) of dairy farming, which remains important today. In 1895, Xavier Martin wrote that "it is a beautiful sight to see fine crops of wheat, rye, barley, and oats covering fenceless and stumpless fields with an even height along the highways. The wilderness of 40 years ago begins to look like the fields of Belgium. . . ." (X. Martin 1895).

Conclusion

Several factors contributed to the outbreak of wildfires that destroyed Williamsonville and other villages in northeastern Wisconsin on October 8, 1871: wasteful logging practices, summer drought, low relative humidities just prior to the fires, and, on the day of the fires, a weather pattern that favored the region with moderate southwesterly winds.

But perhaps the most devastating aspect of the wildfires was the spawning of intense fire vortices. Based on vivid eyewitness accounts, it appears that fire vortices set spot fires ahead of the main infernos, thereby accelerating the progress of the wildfires and producing isolated pockets of destruction. From an historical perspective, the wildfires altered the economy of the region—especially in southern Door County where the fires meant the end of lumbering and spurred the development of agriculture.

Acknowledgments

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Endnotes

¹During the summer of 1988, in perhaps the worst wildfires since 1872 (Romme and Despain 1989), more than two million hectares of U.S. forest land burned including about 290,000 hectares in Yellowstone National Park. By contrast, in an average year, 130,000 wildfires burn over about one million hectares of U.S. land (Albini 1984).

²The North Central Forest Experiment Station (East Lansing, Michigan), has produced an excellent videotape, "Vortices in Wildland Fires," which includes dramatic footage of a variety of vortices spawned by wildfires.

³An important difference between urban fire storms and forest fires is the fact that the former tends to be stationary while the latter are in motion.

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