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Article Summary: In 1925 American manufacturers sold more than 95,000 windmills. Because of rural electrification, sales dwindled to less than 10,000 mills by 1956. This windmill "survey" article presents photos and descriptions of the development of the windmill and its significance to more remote areas of the Midwest.

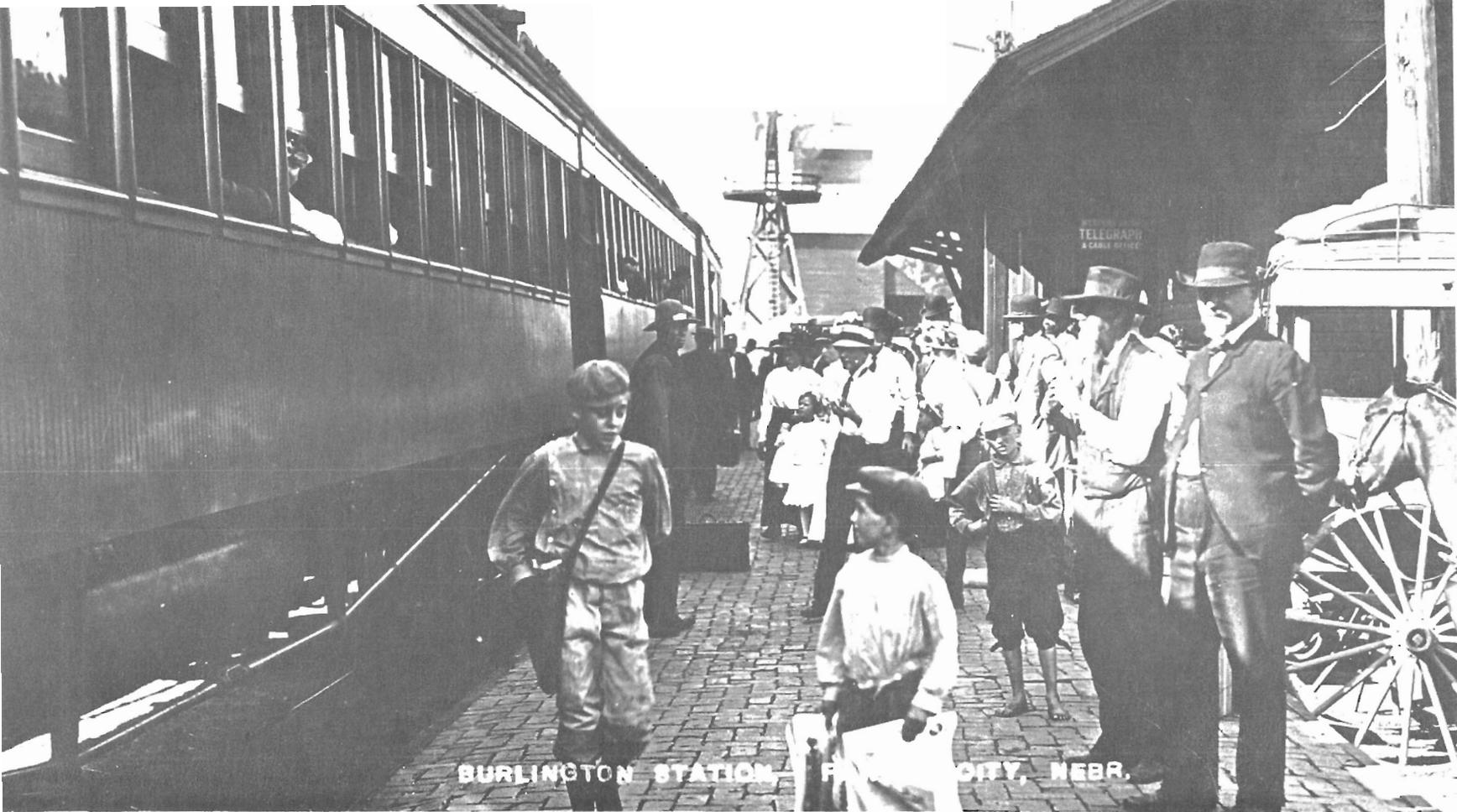
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Photographs / Images: Burlington Railroad Depot windmill, Pawnee City, 1912; Custer County homestead owned by T Cozad showing the "Iron Turbine" around 1886; Travis Brothers homemade "Jumbo" windmill in Lancaster County around 1899; Dempster "vaneless" windmill in folded or furled position with Mike Sturm family near Kearney, Buffalo County, Nebraska; Flint & Walling Star mill, Custer County about 1887; U S Wind Engine and Pump Co sold-wheel-type model windmill in Custer County around 1899; "Battle Ax" windmill on the J S Peckham farm in Dawson County around 1898; the Halladay Standard, the first successful self-regulating American-type windmill, from the Joseph Beckwith farm east of Broken Bow, Custer County, 1888; drawing of The Dempster, a self-oiling modern steel model



Thought of primarily as a farmer's device for pumping water, the windmill also had many commercial uses. One was located at the Burlington Railroad depot at Pawnee City in 1912.

Free As the Wind

By A. CLYDE EIDE

Wind, that invisible current of air, is, without doubt, the cheapest power known.”

So read the introduction to a 1925 windmill catalog.¹ Business was good that year. American manufacturers sold more than 95,000 windmills, valued at over \$5,000,000 (including the value of towers). Yet a spreading web of copper wire already forewarned the wind engine’s decline. Because of rural electrification, sales dwindled to less than 10,000 mills by 1956.²

This picturesque machine, which so profusely dotted the rural landscape, may soon be but a memory. Yet, vast areas of our nation awaited development until the wind engine made an abundant water supply possible. Most of the early settlers relied upon lakes, rivers, streams, or springs for their water needs. Since these sources were often far apart, some pioneers dug shallow wells by hand. The water was raised by the oldest method known — bailing with a rope and bucket. Eventually, the “old oaken bucket” gave way to the familiar reciprocating hand pump, with the covered well top. While this was more sanitary, raising water was still a laborious process. Furthermore, hand dug wells were usually limited to areas where the water table was above bedrock.³

With the development of the percussion well drilling machine, water

Mr. Eide is a Senior Industrial Engineer for the Columbus, Ohio, plant of the Timken Roller Bearing Company and resides in Westerville, Ohio. He received his Bachelor of Science degree from Ohio State University. He has been collecting old windmill catalogs for many years and most of those quoted in his article are from his private collection.

bearing stratum could be reached at depths of several hundred feet. Deep wells became feasible in the more arid parts of the nation. All that was needed was a cheap way to pump the water to the surface. For this purpose, the windmill proved to be the ideal prime mover.⁴

In 1860, just prior to the Homestead Act, less than \$30,000 worth of windmills were sold. By 1880 windmill manufacturing was on its way to becoming an important American industry with annual sales of over \$1,000,000. The vigorous activity is also reflected in the 908 U.S. windmill patents issued by 1880.⁵ More important was the economic effect that windmills had on the land. As one windmill manufacturer put it in 1875, "We may be pardoned for suggesting that we have added millions to the value of this prairie country."⁶

The windmill's origin seems to be lost in antiquity. Washington Irving's "History of the Caliphs" refers to its use in Persia in 634 A.D., and there is speculation that it may have been used by the Romans. During the colonial period, it was brought to America in the form of the European or "Dutch" mill. A few of these relics, which once ground the settlers' wheat and corn, still stand on Long Island, New York, and in New England.⁷

The world's largest Dutch mill was erected in the Golden Gate Park at San Francisco. Known as the Murphy Windmill, it had a wheel 114 feet across, and it once pumped water for the needs of the park. The park had two windmills, the first having been built in 1902. The park commissioners felt that Dutch windmills would lend charm to the landscape as well as serve a useful purpose. The two mills had a combined pumping capacity of 70,000 gallons of water per hour. Years of wind, weather, and vandalism have left these mills in a state of ruin. The San Francisco Recreation and Park Department is attempting to raise funds to restore them. If it fails, the park's Dutch mills will have to be demolished.⁸

The arrival of steam power precluded the extensive construction of large Dutch-type mills in the United States. The need was for a smaller, factory-built windmill, one that could be knocked down for shipment and easily erected at the well site. One of the first to recognize this need was John Burnham, who had a pump business in Ellington, Connecticut. He found many who wanted running water, but all he could offer in the way of power pumping was the hydraulic ram. The ram could only be used in locations where there were several feet of falling water to provide energy. Burnham approached Daniel Halladay, who had a small machine shop in the village, and asked him if he could make a small windmill for pumping water.

Halladay replied that he could make it, but he doubted if anyone in the world would want one. Burnham assured Halladay that he would find plenty of men who *would* want one. Halladay knew that the mill would have to be cheap enough for the average farmer yet durable enough to withstand winds up to hurricane force. In 1854 Halladay patented the first successful self-regulating American-type windmill. In the same year, he and Burnham organized the Halladay Windmill Company in South Coventry, Connecticut. Halladay served as the superintendent and Burnham as the general agent.⁹

Unlike the European mills with their four broad sails, Halladay festooned his windmills with dozens of narrow wood sails. The sails or "slats" were attached to wooden crossbars and arranged in a rosette-like pattern. A vane or "rudder" kept the wheel facing the wind, just like the weather-vane on a barn. The pump was connected to the mill through a pump rod and a crank on the wheel shaft. The main feature of Halladay's mill was its automatic speed regulation. The wheel was divided into six or more hinged sections that could fold like an umbrella. If the wheel began to race in a storm, the sections would fold enough to check the excess speed. It worked by the wheel's own centrifugal force, much the same as the ball governor on a steam engine.¹⁰

Because of the initial prejudice against windmills in the age of steam, the Connecticut-based Halladay Windmill Company enjoyed only a modicum of success. In 1863 the company moved to Batavia, Illinois, to be nearer the western market. Batavia was later known as the "Windmill City", since it became the home of five different windmill firms. Halladay's firm (later known as the U.S. Wind Engine and Pump Company), though undergoing several reorganizations, continued to make windmills until 1951. His mill, known as the Halladay Standard, was on the market until 1929, spanning three quarters of a century. It became world famous and even was made under special license in Hamburg, Germany.¹¹

If the rudder was removed from one of Halladay's sectional wheel mills, the wheel would be blown around to the leeward side of the tower. By merely designing the wheel to run with its backside to the wind, one had a "vaneless" type mill. On vaneless mills a weight was usually attached opposite the wheel to balance the mill on the tower. In an age when decorative as well as functional aspects were important in machinery design, it is not surprising that these weights took on ornamental shapes. Different makes of windmills were adorned with such features as

well-sculptured cast horses, bulls, squirrels, roosters, and even battleships. Today these weights are eagerly sought by antique dealers as collectors' items.¹²

In 1867 an Indian missionary named L. H. Wheeler patented another type of windmill. Unlike Halladay's folding or "sectional" wheel mill, it had a "solid" type wheel. In working position a weight held the wheel perpendicular to a hinged rudder so that the mill would directly face the wind. There was also a small side vane attached just behind and parallel to the wheel. In high winds pressure on the side vane would overcome the weight and swing the wheel partly out of the wind. In a severe storm the wheel would swing around the tower until it was parallel with the rudder and edgewise to the wind. It would remain in this "furled" position until the storm passed. This same principle is used to regulate modern windmills except no side vane is used. The same effect is obtained by offsetting the wheel a little to one side of the rudder.¹³

Wheeler's mills were sold under the trade name of "Eclipse" and were manufactured in Beloit, Wisconsin, by the Eclipse Wind Engine Company. The marketing end of the business was largely handled by Fairbanks Morse and Company, who eventually acquired the entire operation. Halladay's sectional wheel mills and Wheeler's solid wheel mills became the two leading types. Many windmill companies, such as the Dempster Mill Manufacturing Company, the Wigman Company, and the Challenge Windmill and Feed Mill Company, made both types to satisfy individual customer preferences.¹⁴

The first metal windmill was the "Iron Turbine" patented in 1872. Its curved sheet metal sails were arranged in a spiral pattern, giving it the appearance of a huge metal pinwheel. It was made in Springfield, Ohio, by Mast Foss and Company. While this mill was fairly successful, nearly a score of years passed before metal windmills came into general use.¹⁵

Another early metal mill was the Plymouth Iron Windmill made in Plymouth, Michigan. Clarence J. Hamilton, a clock and watch repairman, got the idea for this mill while working in the front window of a Plymouth jewelry store. He took out a patent and persuaded R. L. Root, his employer, to back him in the venture. Soon others became interested and the Plymouth Iron Windmill Company began operation in a two-story brick building in 1882. Hamilton devoted full time to the manufacturing end of the business.

Hamilton must have been a natural-born tinkerer with air power on his mind. He conceived an idea for a new kind of air rifle in 1888. He

presented a plan to the board of directors and they decided to carry on the production of both windmills and air rifles. The rifle was a tremendous success and windmills were soon forgotten. The entire plant was needed for the soon-to-be world-famous Daisy Air Rifle.

While several firms made metal windmills during the 1880's, they made no serious inroads on the wooden mills until Thomas O. Perry entered the scene. Perry, a civil and mechanical engineer, conducted some exhaustive tests on windmills under the auspices of Halladay's U.S. Wind Engine and Pump Company. Although little known, Perry is one of our early pioneers in the field of aerodynamics. His goal was to put windmill design on a scientific rather than on a trial-and-error basis. In 1882 and 1883, Perry tested sixty-one different wind wheels in what he described as an "artificial wind". Lacking such modern devices as a wind tunnel he attained a similar effect by moving the wheels through still air. Wheels five feet in diameter were attached to the end of a merry-go-round-like sweep in an enclosed room. By accurately controlling the speed of the sweep, which was driven by an 8-horsepower steam engine, Perry made careful dynamometric tests.¹⁷

A meticulous researcher, Perry fretted constantly about drafts within the room that might induce errors into his findings. He posted guards outside the doors and, if anyone stumbled in during a trial, those measurements were discarded. Perry settled many questions relating to the proper speed of the windwheel, the best form, angle, curvature, and amount of sail surface, as well as many other abstruse problems. His best test wheel was 87% more efficient than those in general use at the time.¹⁸

Although Perry's experiments were an unqualified success, he apparently was unable to sell U.S. Wind Engine's officials on the merits of redesigning their line of windmills. Evidently there was little motivation for making changes, with the reliable Halladay Standard so well accepted by the trade. Perry left Batavia in 1883 to join LaVerne W. Noyes in perfecting a self-binding harvesting machine. Noyes, a Chicago industrialist, however, was quick to grasp the merits of Perry's ideas on windmills. Encouraged by Noyes, Perry set about to develop a truly scientific windmill.¹⁹ The new mill would be all metal with curved sheet-steel sails set at weather angles (pitch), to derive the most power from the wind. Through back gearing the wheel would make three turns for each stroke — not short, quick, and jerky as in the old direct-connected mills. This would permit the wheel to develop full speed in the heavier winds without "regulating out" to avoid pump damage. The back gearing would also enable a smaller mill to work deeper wells and operate larger

pump cylinders. Perry chose the name “Aermotor” for the radically different wind engine. Although Perry invented the Aermotor, it remained for Noyes to manufacture it on a sound basis.²⁰

In 1888, the first year of business, only forty-five Aermotors were sold. The competition derisively called it the “mathematical mill” – long on theory and short on performance. Yet in 1892 the Chicago-based Aermotor Company sold 20,000 windmills. Other manufacturers were forced to bring out their own line of “mathematical” mills. Aermotor guaranteed its 8-foot steel mill would do more work than any 10-foot wooden mill. In reality it did more work than some 12-foot wood mills.²¹

While the steel windmill swept the country by storm, a minority of users stuck by the old wood mills – in fact, those made of wood actually made a comeback after the turn-of-the-century. This was caused by bad experiences with some poorly made, competitively priced steel mills. Even after the steel mill’s superiority was thoroughly established, some prejudices remained. Perhaps in part it was the warmth and artistic beauty of wood. When pressed for a reason, one old timer is reported to have said, “Wood mills are best, since wood is less likely to damage the wind.” In any case, a few improved versions of wood windmills were still on the market in 1941.²²

Like wood windmills the early steel mills were painted. Unless they were periodically repainted, the sheet metal surfaces would soon rust out. To overcome the rust problem manufacturers went to hot-dip galvanizing of exposed metal surfaces. The silvery-white coating gave the steel mill a very attractive finish and afforded protection for several decades.²³

Even the early metal windmills were mounted on wood towers. While factory-built wood towers were available, most windmill erectors chose to make their own, taking advantage of local lumber prices. Wood towers were highly satisfactory in the more arid West (some are still in use), but they had a relatively short life in the more humid Midwest and in the East. The Aermotor Company introduced the all-steel tower in the early 1890’s.²⁴

While windmills were used primarily for watering livestock on farms, they proved adaptable for many other uses. Wind engines drained lowlands too soggy to farm, while windmill irrigation brought lush crops to land otherwise barren. Entire villages often depended upon wind power to pump the town’s water supply. Windmills on highly ornate towers with elevated storage tanks to provide running water, became status symbols on the grounds of many fine suburban homes. They followed the railroad

right-of-ways to quench the iron horse's insatiable thirst. Special "Railway Pattern" mills, with wheels 16 to 30 feet in diameter, became common sights at nearly every water stop. The Union Pacific used a 20-foot wood mill in Snyder, Colorado, until diesel locomotives forced its abandonment in 1955. The ubiquitous windmill was by no means confined to rural areas. In large cities it found its way to the roofs of tenement buildings where it pumped water for the occupants.²⁵

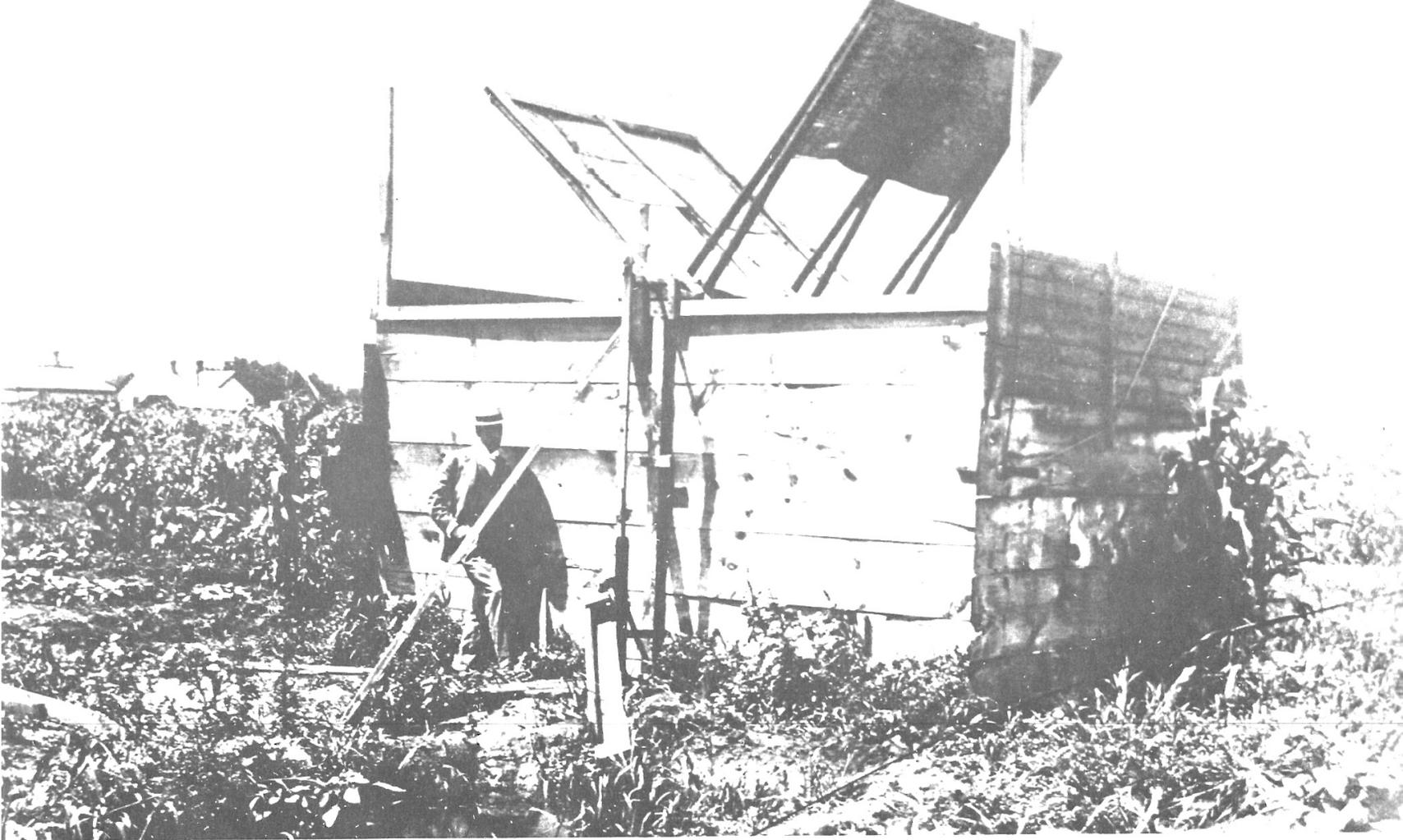
Windmills also provided power to grind feed, saw wood, run churns, and grindstones, and do other odd jobs around the farm. Mills for these purposes were known as "power windmills". Unlike pumping mills which imparted a reciprocating motion to a pump rod, power mills were geared to turn drive shafts. Allowing for frictional losses from the heavy shafts, a 12-foot power mill could deliver one horsepower in a 20-mile per hour wind. They were often mounted on barn roofs. This was convenient for driving machinery inside the barn and saved the cost of building a separate tower. The vagrant wind, however, made work planning difficult, and this class of mill was quickly replaced when small gasoline engines became available.²⁶

Frédéric Baker, who founded a windmill firm in Ohio, once installed a large power mill on his brother's barn near Roann, Indiana. Jake La Rue, a hired man, often told of the scary experience he had while helping to repair this mill. He was standing on the big wheel when a sudden gust of wind sent it spinning. He frantically hung on until someone was able to stop the unsolicited ferris wheel ride.²⁷ Not all farm windmills were factory built. The frugal farmers of Nebraska discovered homemade windmills were quite feasible in stiff plains winds. These mills became common during the 1880's and 1890's. Professor Erwin Hinckley Barbour was so intrigued by the homemade mills and their greatly varied design that he devoted considerable study to them. He found that the inventive and resourceful farmers used old lumber, packing boxes, barrel staves, coffee sacks, tin cans, and junked farm machinery in their construction. Three common types were the "Jumbo", the "Merry-go-round", and the "Battle-ax".²⁸

The Jumbo was little more than a paddle wheel in a box. The box shielded the bottom half so that it worked like an overshot waterwheel. The outfit was set to face the prevailing winds and could pump water for up to fifty head of cattle. The Merry-go-round was like the Jumbo except that the wheel was mounted on a vertical axis. A movable semi-circular hood exposed one side of the wheel to accommodate different wind



The "Iron Turbine" had the first all-metal windmill head. About 1886 this homestead in Custer County was owned by T. Cozad. The shed and house in the background are of log construction. (Photo, S. D. Butcher collection)



Travis Brothers used this homemade "Jumbo" windmill in Lancaster County (ca. 1899).



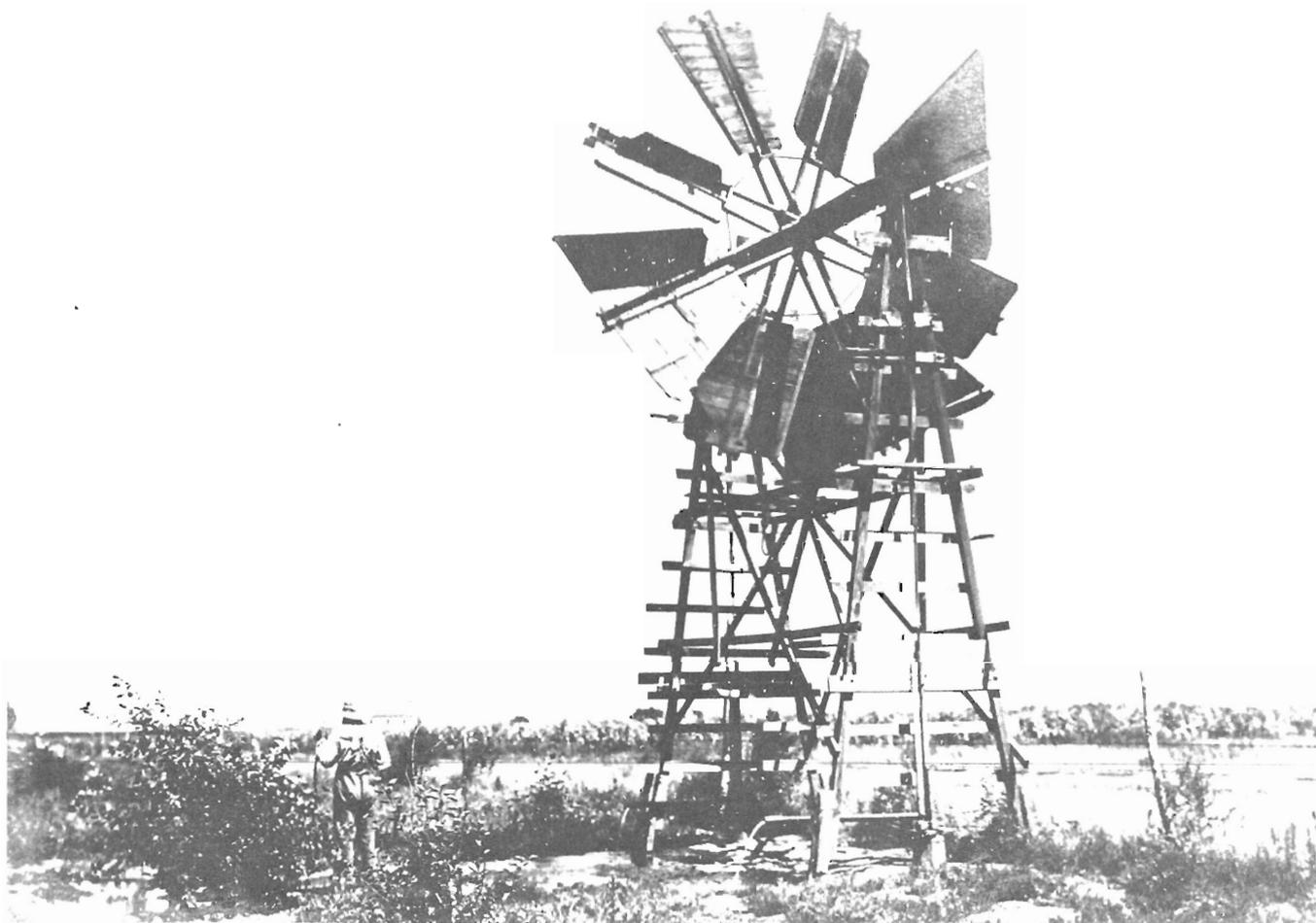
Note the “horse” counterweight on the Dempster “vaneless” type windmill. The wheel is shown in the folded or furled position. Mike Sturm and family lived on this farm near Kearney, Buffalo County. (Photo, S. D. Butcher collection)



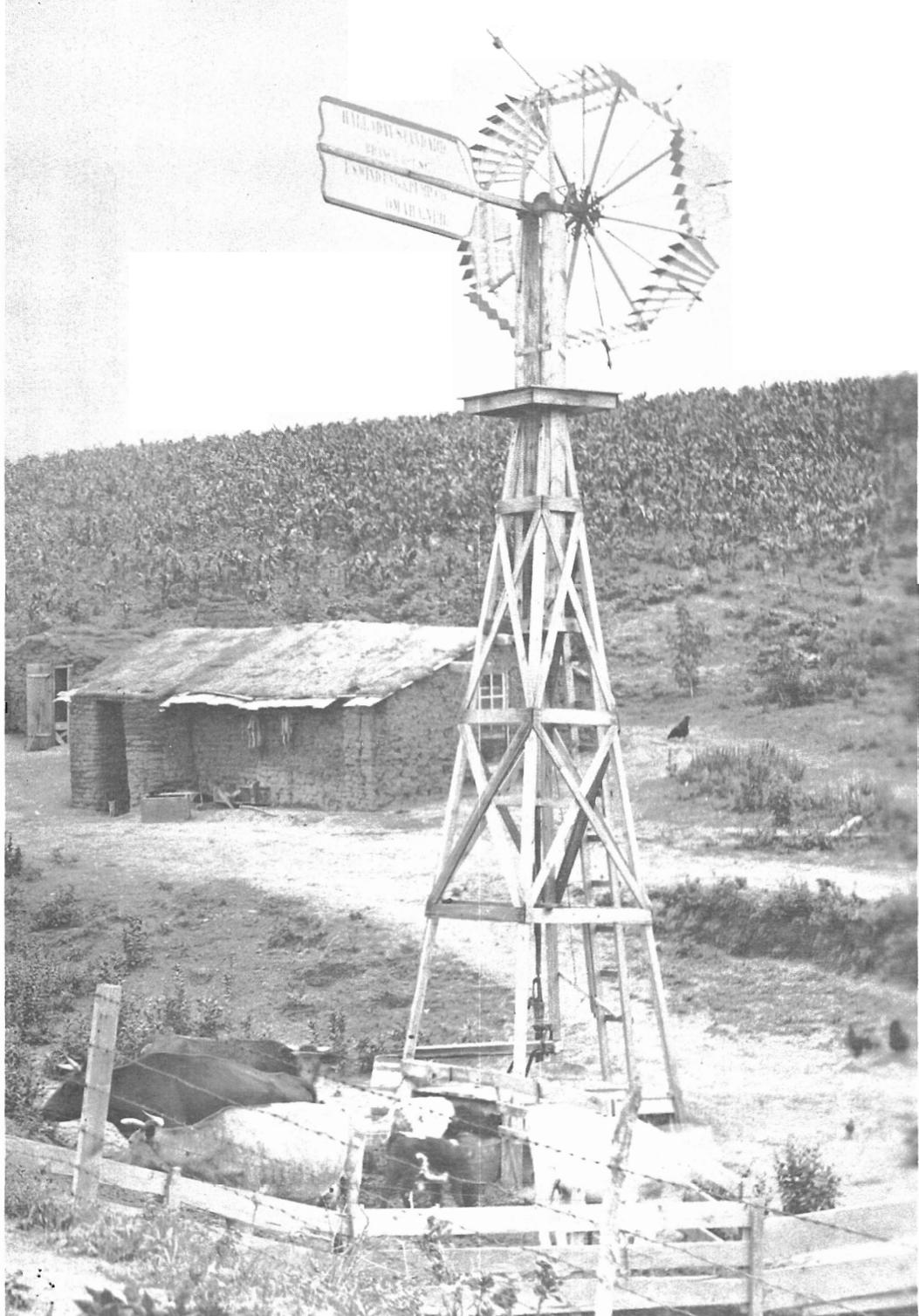
Flint & Walling manufactured the Star mill featuring a solid-type wheel. In this farm scene from Custer County (ca. 1887), notice the new sod house, the boy on the windmill platform, and the cluster of chickens at its base. (Photo, S. D. Butcher collection)



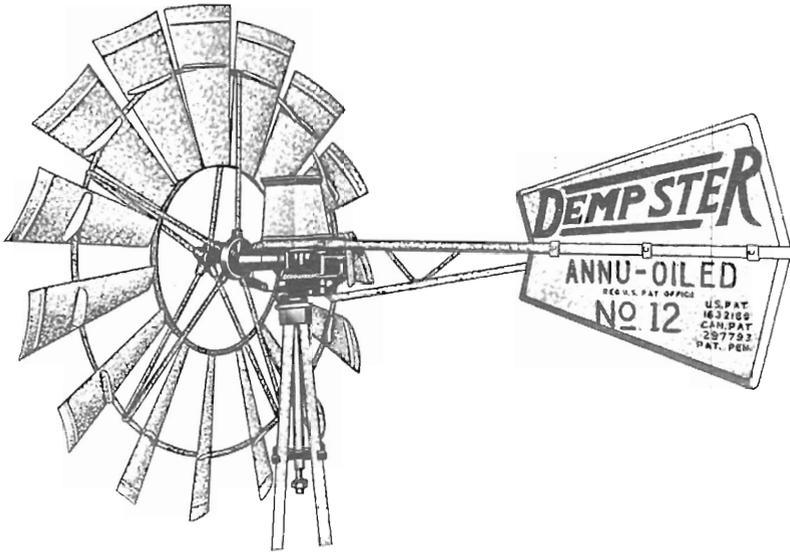
U. S. Wind Engine and Pump Co. made a solid-wheel-type model. Here a Custer County family assembled to have its picture taken (ca. 1899). A mounted horseman is in the shadows at right, and another man is almost obscured by the wooden tower.



This huge "Battle Ax" windmill was constructed on the J. S. Peckham farm in Dawson County (ca. 1898).



The Halladay Standard was the first successful self-regulating American-type windmill. The scene is from the Joseph Beckwith farm east of Broken Bow, Custer County (ca. 1888).



The Dempster, a self-oiling modern steel model, requires but one lubrication servicing each year and little other maintenance. Dempster maintains a factory in Beatrice.

direction. The Battle-ax consisted of several arms mounted around a horizontal shaft. Old boards or barrel staves were nailed to the end of the arms to serve as sails -- hence the name, Battle-ax. Perhaps the simplest homemade mill of all was one Professor Barbour found in Dawson County. The owner bolted an old wagon wheel to a beam on the end of the barn. Some boards were nailed to the wheel for sails. A heavy spike (with a pump rod attached) was driven into the hub for a crank. For only a few hours of labor and some scrap material, the resourceful farmer had a crude but working windmill!²⁹

The homemade mills demonstrated that to design a windmill was a fairly simple matter. In fact, it was said that almost every farming community where windmills were a necessity could boast of several people who had designed a windmill. Although thousands of designs were patented only a small percentage were ever put on the market as practical. For the most part successful American windmills were built around proven principles developed by Halladay, Wheeler, and Perry.

Nevertheless, a few windmill oddities were manufactured by reliable firms. Henry H. Babcock & Sons of Watertown, New York, made a mill that was regulated by a complex system of two rudders and a control vane. The two rudders, placed at right angles to each other, were alternately "featured" by the control vane to move the wheel in or out of the wind. Some mills had two, three, and even four wheels mounted on one head. The Challenge Company of Batavia, Illinois, made a monster power windmill with two 45-foot main wheels in tandem. A pair of smaller side wheels were placed between and at right angles to the main wheels. The side wheels were geared to the mill head in such a way that they automatically steered the main wheels into the wind. The Lowell-Spofford Manufacturing Company of Lowell, Massachusetts, made a "bucket windmill" for drawing water from an open well. A hoisting device in the mill head raised a bucket of water, dumped it into a storage tank, and dutifully sent the bucket back down the well for another load. The Western Land Roller Company of Hastings, Nebraska, featured a "geared gearless" windmill. This mill attained a back geared effect with no gears whatsoever. The action was accomplished by a clever cam system.³⁰

As late as 1953 windmill displays were still seen at some state and county fairs. But there was never anything to equal the exhibit at the World's Columbian Exposition in 1893, where the skyline was studded with windmills. Sixteen manufacturers were represented and each of them set up two to four different models. The Netherlands government erected a full-size "Dutch" mill making the entire display particularly attractive. With the lake-front exhibition site water was easily reached by driving pipes eight feet into the ground. This made it possible to show the mills in actual pumping operation. Competition between exhibitors was so fierce that violence rocked the Fair's Victorian serenity. One night before a demonstration on the use of wind power to grind feed for livestock a raiding party slipped into the exhibition area. The marauders quickly lashed a rope to one exhibitor's mill and toppled it to the ground. While they were never caught it took the intervention of the chief of the Department of Agriculture to settle the rhubarb.³¹

By the turn of the century fifty-six firms were vigorously competing for the windmill trade. All put out profusely illustrated catalogs, liberally peppered with testimonials. One imaginative illustrator showed his brand of windmill, the Appleton-Goodhue Windmill, standing undisturbed by a violent cyclone, while the air around was littered with flying buildings, uprooted trees, and the smashed remains of competitor's windmills. While many firms inferred that their mills were "storm proof", they usually

limited their guarantee to storms not damaging other permanent structures in the vicinity.³²

The lofty windmill was usually the first thing to be seen upon approaching the farmstead. It was axiomatic among most manufacturers that the tower should be at least fifteen to twenty feet higher than the surrounding buildings and trees. This not only gave the mill better exposure to the wind but also protected it from turbulent currents near ground level. It was claimed that more windmills were damaged or destroyed on account of being placed on low towers close to buildings and trees than from any other cause. Manufacturers also recommended that allowances be made for the future growth of trees when erecting a tower. One firm stated they had sold hundreds of extensions but had never heard of towers being lowered. Many homemade towers, however, were not as tall as recommended by the manufacturer.³³

Unlike other farm machinery the high tower made windmills relatively inaccessible for servicing. Nevertheless, until self-oiling windmills were developed a mill required lubrication about once a week. A neglected mill would squeak and groan until someone took mercy and doused its protesting bearings with oil. However, since towers were up to 100 feet high, it is understandable why many people were squeamish about making the ascent.³⁴

While many adults shunned the seemingly long and treacherous climb, this fear seemed almost lacking in children. Farm mothers were often horrified to discover their young aerialists at the top of the windmill. Repeat performances were avoided by having Dad cut ten feet off the bottom of the tower ladder. Even so, ascent could often be made by way of the braces and struts.

To combat acrophobia and its resulting neglect of windmills, Aermotor introduced the "Tilting Tower". The tower was pivoted near the center and had a weight at the base to counterbalance the windmill on top. By releasing a locking pin at the bottom and pulling on a line, the mill was gently lowered to the ground for servicing. Aermotor boasted the tower was so well balanced that "a child could tilt it with a fishing line".³⁵

The "Red King" windmill, made in Wauseon, Ohio, had a novel approach to the lubrication problem. It had a built-in oil can which was operated by pulling on a wire at ground level. Of course the owner still had to climb the tower to refill the can. Other firms, such as the Challenge Windmill and Feed Company, tried to get around the need for windmill lubrication by using self-oiling bearings of graphite- or oil-impregnated

hardwood. While these bearings worked, they were harder running and shorter lived than a lubricated metal bearing.³⁶

Roller bearings were first tried during the 1890's to get an easier running mill, but these too apparently failed for want of proper lubrication. It was not until 1912 that the Elgin Wind Power and Pump Company of Elgin, Illinois, developed a true self-oiling windmill. The working parts were totally enclosed and ran in a bath of oil. An annual change of oil was the only servicing required. This mill was called the Elgin "Wonder".³⁷

No other major improvements were made until 1937 when the Flint and Walling Manufacturing Company of Kendallville, Indiana, brought out an aerodynamic windmill. Through tunnel tests, this mill was designed along aircraft lines to produce 30% more power than conventional steel windmills. As the wheel turns, a point near the periphery must travel farther than a point near the center. Like a race horse on the inside of a turn, the inner end of a sail tends to pull ahead of the outer which chokes off the power. Flint and Walling engineers overcame this loss by twisting the sail along its length so the pitch gradually increased towards the center of the wheel. This tended to speed up the outer part of the wheel and slow down the inner, thereby balancing the rotary motion at all parts of the wheel.³⁸

The idea of the "twisted" sails was not new, having been used many years before on the old European mills and on a few American types. Flint and Walling, however, combined the twisting with a matching curvature and a streamlined shape. This caused the air currents to be picked up and disposed of at the most favorable angles with a minimum of turbulence. The "aerodynamic windmills" arrived too late to have a major impact on windmill design as manufacturers were already faced with the prospect of diversifying or going out of business.³⁹

During the 1930's there was a brief flurry of marketing wind electric plants for home use. These little mills with efficient airplane-type propellers drove generators which in turn charged banks of batteries. Wind-electric plants served admirably in giving many farmers the benefits of electric lights, radios and small electric appliances until the rural utility companies arrived.⁴⁰

In late November 1961 E. E. "Bud" Slater took a last look down the now quiet corridors of what once had been a busy windmill factory. Wansunlight from Nebraska's autumn sky filtered through the windows as the still machinery cast long shadows on the floor. For Slater it was more than

the end of a season — it was the end of an era! For more than thirty-five years, windmills had been his way of life. As sales manager of the Fairbury Windmill Company he had watched windmill sales ebb year by year. But where dozens of competitors had fallen by the wayside, Fairbury had wisely diversified its activities. From now on it would concentrate on its successful business of distributing plumbing and water supply equipment.⁴¹

Before shutting down its windmill factory Fairbury had a brief production run on a newly designed windmill. Known as the “Mini-Mill”, it had a 21-inch wheel, a 5-foot tower and came complete with a miniature pump. Made largely for sentiment, these bucolic little souvenirs of a bygone era are now scattered across the nation.⁴²

In spite of declining sales three United States firms are still making windmills. They are the Braden-Aermotor Corporation, now of Broken Arrow, Oklahoma, the Dempster Mill Manufacturing Company of Beatrice, Nebraska, and the Heller-Aller Company of Napoleon, Ohio.⁴³

Of course windmills are only a small part of their overall business. A large part of current windmill sales are for export as part of United States aid to emerging nations. The industry has temporarily settled down to about 5,000 windmills per year. Bruce Tietjens of the Heller-Aller Company points out their windmill business has actually increased. However, his optimism is tempered by one thing — the upturn resulted from Heller-Aller’s picking up some of the slack as competitors quit the field.⁴⁴

On some of the cattle ranges of the Great Plains and the Southwest, wind power is still the best solution to stock watering problems. Many, for example, remain throughout the Sandhills area of Nebraska. It would not be practical to string electric wires over miles of range land or service gasoline engines at remote well sites. Destruction of power lines by ice or wind storms makes total reliance upon electric pumps a high business risk to many farmers and ranchers, and in some instances the once slighted windmill has reappeared to provide standby power. A shallow oil field near Hobbs, New Mexico, has successfully used windmills for pumping in recent years. Also, a few Amish farmers still cling to the windmill in Indiana, Ohio and Pennsylvania. Elsewhere windmills are either broken derelicts or have T.V. antennas mounted on top of the old beheaded towers.⁴⁵

A midwestern executive dips his private plane down for a closer look at the ground. He laments the fact that windmills are no longer a plentiful substitute for “windsocks”.⁴⁶

Perhaps a space-age generation will neither note nor care as the windmill slips beneath the horizon of time. But it meant a way of survival to earlier generations. Their gratitude is expressed in a humble little poem (author unknown) that found its way into an old windmill catalog:

The wind doth blow and the mill will turn,
The housewife comes up to fill her urn,
Quoth she "this mill never does fail",
And the farmer smiles as he fills his pail.

If in this country it fails to rain,
This mill will serve to water my grain,
Irrigate, irrigate, shall be my cry,
Irrigate, irrigate, so my vegetables will not die.

NOTES

1. Challenge Company, *General Catalog No. 90* (Batavia, Ill., 1925), 4
2. U.S. Department of Commerce, *Facts for Industry, Series: M31B-86*, (Washington, D.C.: Government Printing Office, 1957), 3.
3. J. B. Davidson and L. W. Chase, *Farm Machinery and Farm Motors* (N.Y.: Orange Judd Co., 1920), 258-59.
4. Howard J. Sheets, "A Water Well Contractor Looks at the Industry", *New Mexico Driller* (Feb. 1968), 4; F. L. Dole, "History and Development of the Windmill", *Metropolitan and Rural Home*, 1906. The latter is taken from a manuscript copy in the Batavia Historical Society, Batavia, Ill.
5. "Windmills" (N.Y.: Sackett & Williams Litho Co., ca. 1880), Plate 7.
6. U.S. Wind Engine & Pump Company, *Descriptive Catalog* (Batavia, Ill., 1875), 1.
7. Davidson and Chase, *op. cit.*, 298; Jeannette Edwards Rattray, *The Old Hook Mill and Other Old English Windmills of East Hampton, Long Island, New York and Vicinity* (East Hampton: East Hampton Star, 1953).
8. "The Dutch Mills", *Annual Report* (San Francisco: Park Commission, 1912); Joyce Jansen, San Francisco Recreation and Parks Dept., letter to author, Oct. 21, 1968.
9. "Windmills and Wind Engines", *Farm Implement News* (Feb. 1887), 14.
10. A. R. Wolfe, *The Windmill as a Prime Mover* (N.Y.: John Wiley & Sons, 1885), 86-91.
11. "Windmills and Wind Engines", *op. cit.*, 14; John A. Gustafson, Batavia Hist. Soc., letter to author, Oct. 29, 1968; *Buyers Guide* (Chicago: Farm Implement News Co., 1905), 328-31, 418; Benjamin Danforth (advertisement), Batavia, Ill., 1888; C. E. Redborg, Batavia, Ill., letter to author, Aug. 6, 1968.
12. U.S. Wind Engine & Pump Company, *Catalog* (Batavia, Ill., 1889), 458-59.
13. Davidson and Chase, *op. cit.*, 299; Fairbanks Morse & Company, *Catalog No. 65F* (Chicago, 1909), 4, 5; E. C. Murphy, *The Windmill: Its Efficiency and Economic Use, U.S. Geological Survey* (Washington, D.C.: Govt. Printing Office, 1901), I, 14.
14. Eclipse Wind Engine Company, *Special Catalog* (Beloit, Wis., ca. 1884), 24; Fairbanks Morse & Company, *The Eclipse Windmill* (Chicago, ca. 1895), 1; A. R. Wolfe, *op. cit.*, 75; U.S. Wind Engine & Pump Company, *Catalog* (Batavia, 1889), 445-53; Dempster Mill Manufacturing Company, *Catalog No. 7* (Beatrice, Nebr.), 188-96; Wigman Company, *Catalog* (n.p., n.d.), 8-12; Challenge Windmill and Feed Mill Company, *Special Catalog: Windmills and Towers* (Batavia, Ill. n.d.), 17, 18, 24, 25.
15. Mast, Foose & Company, *Catalogue*, (Springfield, Ohio, n.d.), 1, 87, 104; "Windmills and Wind Engines", *Farm Implement News* (Mar. 1887); Dole, *loc. cit.*, 5; The Aermotor Company, *Aermotor Applications of Windpower* (Chicago, 1908), 2, 3.

16. E. C. Hough, "Sketch – Daisy Manufacturing Company" (Rogers, Ark.: Daisy Manufacturing Co., n.d.), 1 page.
17. "The Class of Sixty-Nine in 1887" (Ann Arbor, Mich.: University of Michigan), on file at Batavia (Ill.) Historical Society; T. O. Perry, *Experiments With Windmills, United States Geological Survey Paper No. 20* (Washington, D.C.: Govt. Printing Office, 1899), 9, 22-28, 61.
18. Perry, *op. cit.*, 65-96.
19. "The Class of Sixty-Nine in 1887", *op. cit.*
20. Smith & Winchester, *Illustrated Catalog* (Boston, 1890), 15, 16; Dole, *loc. cit.*, 4; Aermotor Company, *Aermotor Applications of Windpower* (Chicago, 1908), 2; Dole, *loc. cit.*, 4, 5.
21. Aermotor Company, *Circular* (Chicago, 1892), 1 page; Stover Manufacturing Company, *Circular* (Freeport, Ill.; n.d.), 3; Aermotor Company, *Circular: Applications of Windpower* (Chicago: n.d.), 3; Aermotor Company, *7th Annual Catalog* (Chicago, 1895), 25; E. C. Murphy, *op. cit.*, I, 64.
22. E. C. Murphy, *op. cit.*, I, 141; Davidson and Chase, *op. cit.*, 307; Baker Manufacturing Company, *The Monitor Line* (Evansville, Wis., 1941), 39.
23. Dole, *loc. cit.*, 5; Aermotor Company, *7th Annual Catalog, op. cit.*, 21.
24. U.S. Wind Engine & Pump Company, *Catalog* (Batavia, Ill., 1889), 446.
25. Charles J. Jager Company, *Eclipse Windmills* (Boston, n.d.), 4, 35, 27, 42, 54; W. H. Hulsizer, Union Pacific Railroad Co., Omaha, letter to author, Apr. 6, 1955.
26. E. C. Murphy, *op. cit.*, II, 83-84, 86; H. C. Ramsower, *Equipment for the Farm and the Homestead* (Boston: Ginn and Co., 1917), 194; U.S. Wind Engine & Pump Co., *op. cit.*, 467.
27. Gurney Baker, Roann, Indiana, letter to author, Jan. 6, 1955. Mr. Baker is a nephew of Frederick Baker.
28. Erwin Hinckley Barbour, "The Homemade Windmills of Nebraska", *Scientific American Supplement*, No. 1254 (Jan. 13, 1900), 20098.
29. *Ibid.*, 20099-100; No. 1255 (Jan. 20, 1900), 20114, 20115; No. 1256 (Jan. 27, 1900), 20130.
30. Henry H. Babcock & Sons, *Special Catalogue of Wind Mills* (Watertown, N.Y., 1881), 4, 14 (from the collection of William McCook, Melbourne, Australia); Double Power Mill Company, *Catalog* (Appleton, Wis., 1907), 2-13; Challenge Company, *Special Catalog, Windmills and Towers* (Batavia, Ill., n.d.), 19-21, 23; Lowell-Spofford Manufacturing Company, *The Lowell Windmills* (Lowell, Mass., n.d.), 8-13; Western Land Roller Company, *General Catalog No. 127* (Hastings, Nebr., n.d.), 24-26.
31. "World's Columbian Exposition – Windmill Exhibit" (reference report) Chicago Historical Society, Aug. 18, 1955; Aermotor Company, *7th Annual Catalog*, 30.
32. Farm Implement News, *Buyer's Guide* (Chicago, 1905), 327-31; Appleton Manufacturing Company, *Appleton-Goodhue Windmill* (Batavia, n.d.), 3; Althouse-Wheeler Company, *Cyclone Proof Windmills* (Waupun, Wis., n.d.), 2, 11; Appleton Manufacturing Company, *Illustrated Catalogue* (Batavia, 1898), 74.
33. Fairbanks, Morse & Company, *Bulletin H231* (Chicago, 1918), 12.

34. Aermotor Company, *Aermotor Applications of Windpower, op. cit.*, 9; Aermotor Company, *7th Annual Catalog, op. cit.*, 108.

35. Aermotor Company, *7th Annual Catalog, op. cit.*, 108.

36. Farm Implement News, *Buyer's Guide* (1905), *op. cit.*, 328; Challenge Windmill and Feed Mill Company, *Speeial Catalog, Windmills and Towers, op. cit.*, 5; Challenge Company, *General Catalog No. 90* (Batavia, Ill., n.d.), 10; Baker Manufacturing Company, *Windmill Catalog* (Evansville, Wis., n.d.), 6.

37. Butler Company, *Catalog No. 13* (Butler, Ind., n.d.), 15; Aermotor Company, *Aermotor Repair List* (Chicago, Jan. 1, 1910), 3, 4; Butler Company, *Catalog No. 50* (Butler, Ind., Nov. 1921), 24; *Buyer's Guide* (Chicago: Farm Implement News Company, 1912), 325; Elgin Windmill Company, *Catalog No. 40*, (Elgin, Ill., n.d.), 8; Elgin Wind Power and Pump Company, *Catalog No. Twenty-Two* (Elgin, Ill., n.d.), 7, 11, 14. The Butler catalog of Nov. 1921 and the Aermotor repair list of 1910 indicate that roller bearings were discontinued in later model windmills. The Elgin company claims to be the originator of self-oiling windmills.

38. M. J. Guise, Flint & Walling Manufacturing Co., Kendallville, Ind., letter to author, Dec. 30, 1954; Flint & Walling Manufacturing Company, "Star Zephyr – World's Only Streamlined Windmill", Circular (n.p., n.d.).

39. E. E. Murphy, *op. cit.*, I, 11; Flint & Walling Manufacturing Company, *Circular, op. cit.*; Stover Manufacturing & Engine Company, "Samson Air Flow Windmill", *Catalog* (Freeport, Ill., 1939), 2, 3. The Samson Air Flow was the only other aerodynamic wheel made.

40. M. L. Jacobs, Jacobs Wind Electric Company, Minneapolis, Minn., letter to author, Apr. 15, 1955; Wincharger Corporation, *Circular, Form 4902* (Sioux City, Ia., n.d.).

41. E. E. Slater, Fairbury Pipe and Supply Company, Fairbury, Nebr., letter to author, Nov. 1, 1967.

42. Fairbury Pipe & Supply Company, "Fairbury Mini-Mill", *Circular* (Fairbury, n.d.); E. E. Slater, Fairbury, letter to author, Apr. 13, 1961.

43. *Thomas Register* (N.Y.: Thomas Publishing Co., 1968), VI, 9324. This edition erroneously lists the now-defunct Perkins Corporation as a windmill manufacturer.

44. Bruce E. Tietjens, Heller Aller Company, Napoleon, Ohio, personal interview with author, July 1967.

45. L. R. Mauch, Farmers Lumber & Supply Co., Bassett, Nebr., letter to author, May 4, 1956; G. K. Miller, editor, *Water Well Journal*, Urbana, Ill., letter to author, Jan. 18, 1963; *New Mexico Magazine* (Feb. 1969).

46. J. R. Knights, James Knights Company, Sandwich, Ill., letter to author, Nov. 11, 1960.