Gruber Wagon Works
State Route 183 and State Hill Rd.
Bernville Vicinity
Berks County
Pennsylvania

HAER No. PA-14

PHOTOGRAPHS

WRITTEN HISTORIC AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, D.C. 20240

HISTORIC AMERICAN ENGINEERING RECORD

GRUBER WAGON WORKS

PA-14

DATE: 1882, 1906

LOCATION: State Route 183 and State Hill Road, Bernville vicinity, Berks County, Pennsylvania.

DESIGNED BY: Franklin Gruber and sons.

OWNER: Until the early 1970's: Franklin P. Gruber
Since 1976 : Berks County

SIGNIFICANCE: The Gruber Wagon Works is an extremely well preserved example of factory built and operated as a family business. It retains an enormous number of wood working machines that are all still located in their original location within the works. In the 1970s the structure, including machinery, was moved by the Army Corps of Engineers to prevent its inundation following completion of the Blue Marsh Lake Project. It was moved approximately 5 miles to a site off of State Route 183 known as "Red Bridge Park." The wagon works is now (1983) part of a county park and is scheduled to be open to the public as a museum.

HISTORIANS: Army Corps of Engineers, and Alex Gratiot.

When a group of Englishmen visited the United States in 1854-1855 in the wake of the Crystal Palace Exhibition, they found that the carriage trade, like so many other industries they saw, had adopted the "American System of Manufactures." It operated on a large scale, the labor was specialized, and the processes were mechanized. [1] An early standardized type of wheeled vehicle, is the Conestoga wagon, a design attributed to a confluence of English and German traditions. Developed in Lancaster, Pennsylvania, during the 18th century, it had achieved a uniform style compared to its European counterparts as early as 1812. [2]

Lightness, another characteristic of American wheeled vehicles, can also be traced to the early 19th century. The single-piece tire, contributing greatly to the strength of the wheel rather than just preventing wear in the felloes, permitted a lightening of the remaining parts of the wheel. [3] The use of the steam-bent two-piece felloe instead of the traditional six to eight cut felloes added strength and so reduced the quantity of wood in the wheel. [4]

Shop size in the industry began to increase around 1825 and, by 1833, Knowles and Thayer of Amherst, Massachusetts, the leading manufacturer of carriages and wagons, was already steam-powered. That year they employed 70 men, a figure that increased in two years to almost 100. [5] A number of machines contributed to an increased productivity. One of the first was Thomas Blanchard's stock-making lathe (a pattern copying machine), which he patented in 1818. Under the name of "spoke lathe," the machine was adopted by the wheeled vehicle industry and greatly increased the number of spokes that could

be rapidly produced [6]. Wood-bending machinery patented by Blanchard, E. J. Updegraff, and others in the 1850's facilitated the rapid production of bent felloes and the bent wooden parts used in carriage bodies. [7] Elaborate automatic tenoning machines were in use by the 1850's.

One-step transformations were all that was necessary to convert large amounts of typical woodworking machinery into specialized wheelwright tools. For example, all that was required to cut the round tenon on the felloe end of the spoke was a special "hollow augur" used in the place of the drill on a drill press. With a clamp to hold the wheel instead of a drilling rest, and the rotating spindle of the augur placed horizontally instead of vertically, the machine became a spoke-tenoning machine and was one of the typical tools of the wheelwright. The hub-boring or 'boxing' machine was simply a drill press with a special centering device to insure that the hole drilled was precisely in the center of the wheel. Later models (similar to the one the Grubers built) had two drills that bored holes from opposite sides of the hub. There were other machines that present similar cases. [8] Although in 1854-1855 these machines seemed crude to the British commissioners, who devoted their attention to the elaborate tenoning machines and spoke lathes, they were nonetheless integral parts of the mechanized industry. [9]

Paralleling mechanization and the appearance of the large shops was what came to be known as the "parts trade." Hubs, spokes, bent wooden felloes, iron fittings, axles, wheels, and carriage bodies were all manufactured at separate establishments at one time or another. Mass-producing parts with the new

machinery at a cost much lower than what could be done by hand, these shops had a significant advantage over shops without such machines. For most shops, carriage building became carriage assembling. [10]

Wholesale carriage manufacturers began to appear around 1870. Bypassing the retailer of the parts trade, wholesalers went directly to the manufacturer. In 1893, Studebaker, perhaps the largest of the wholesalers, employed 1,860 men and produced 50,000 vehicles. Through this period woodworking machinery makers, such as Defiance Machine Works and J. A. Fay and Egan, were producing progressively heavier machines to satisfy the increasing production demands of the wholesalers. [11] There was still room for the "custom builder." Many people had little faith in the products of the wholesalers and preferred to pay more for what they believed to be a better product. [12]

The arrival of the automobile quickly killed the horse-drawn vehicle industry. The trade peaked around 1904, employing in that year more than 77,000 men in some 5,500 shops. By 1909, many manufacturers had switched wholly or in part to the manufacture of automobiles. For a change such as this the relatively modern corporate structure of a wholesaler was better prepared than the small custom builder, whose trade had been based on the preservation of old techniques rather than on innovation. Studebaker, for example, had to purchase foundries and an engine maker to produce the new product. Between 1914 and 1919, the wagon trade declined better than 83%. Through the 1920's some companies confarm machinery. Although a handful of wagon builders survived, building wagons for the Amish into the late 1950's, the wagon and carriage trade, as it had exisited in 1904, was dead by the end of the first quarter of the 20th century. [13]

THE GRUBER WAGON WORKS

Franklin Henry Gruber (1835-1898) of Robesonia, Bucks County, Pennsylvania, was apprenticed at a young age to his cousin, John Henry, a wheelwright in his town. In 1860, he went to work in the carriage shop of his brother, Isaac Gruber (1833-1906) in Mt. Pleasant, a small cluster of buildings that also went by the name of Obold. Isaac Gruber's works had been in operation since 1854, and it is likely that F. H. Gruber's attitude toward the vehicle-building trade was solidly formed there. The 1870 Bucks County Census of Manufactures, compiled the last year Franklin Gruber worked in the shop, indicates that terms of the value or quantity of the carriages produced, his capital, $2,550, was much larger than any of the 52 other carriage makers or wheelwrights listed. [15]

In 1870, Franklin Gruber returned to farming, but within a few years the number of requests made to him for wagon repairs induced him to begin his own factory. In the first years, his shop was probably very similar to the majority of small shops that appear in the 1870 census. Operating out of his farm's repair shop, his investment was small, probably in the neighborhood of a few hundred dollars. As some small machines were purchased, they were placed on the threshing floor of his barn. Since there was no large water supply near the hilltop farm, power was supplied by a horse turnstile, using either two or four hourses. [16] Eventually, he erected a two-story building, 24'x30', to satisfy a need for more space. It was in this shop that his sons, Adam, Jacob, George, and John learned the trade. A fifth son, Franklin Levi Gruber, went into the ministry. Even with the new building, the shops on top of the hill

were not sufficient, so in 1882 plans were made for a much larger building near Mt. Pleasant. The new shop, two stories tall, measuring 85'x28', was finished in 1883 and in use in the spring of 1884. A year later, the old two-story shop was moved from the top of the hill and added to the new building. Over the next 25 years, the shop grew fairly steadily to a peak in the first decade of the 20th century. The Grubers purchased new and used machinery, made some machinery themselves, and had some machines built to their specifications. F. P. Gruber, the grandson of F. H. Gruber, has indicated that the reason for their having built many of the machines was the risk involved in purchasing untried manufactured devices, which were coming on and off the market in quick succession, offering little reliability. The quality of the products of the commercial machines seems to have been too low to satisfy the Grubers. [17]

While in F. H. Gruber's mind hand labor was linked to the qaulity of the product, this was not true for his sons. In the 1890's, their view prevailed over that of their father, and consequently most of the heavy machinery dates from the period when they dominated the shop's operations. For the brothers, particularly John and Jacob, mechanization and increased production were the keys to success. Mechanization for a plant the size of the Gruber wagon works was not easy. In the late 19th century, the manufacture of the wheel, the most important part of the wagon, was highly mechanized. [18] It was possible to avoid purchasing spoke lathes, spoke-tenoning machines, curved surface shapers, and hub boring machines, either by purchasing the products of these machines from retailhouses or by manufacturing the parts by hand. Although the latter is what F. H. Gruber would have preferred, it was economically impossible to

avoid purchasing parts from retailers. F. H. Gruber prided himself on the mortices and tenons he made, the finish he gave to the rough mass-produced parts. His sons, with their eyes on mechanization and increased production, were the ones who purchased the machines.

The mechanization of the wagon and carriage building trade in the 19th century tended to compartmentalize the industry. Wood bending, spoke making, wheel making, spring making, axle forging, and carriage body building were all carried on at separate factories as early as 1860. [19] In general, the small carriage shop owner became an assembler of the products of this "parts" trade. [20] This did not happen at the Gruber wagon works. First under F. H. Gruber, when the work was done almost entirely by hand, then under his sons, when the shop was filled with all the machinery necessary for them to mass-produce their own parts, the works could have stood as an independent unit.

Aside from what may have been purely personal reasons, both ethnic background and geographical isolation may have been factors in encouraging this independence. The ethnic role, although probably significant, is hard to define. The Gruber family arrived in America in the mid-18th century and has spoken German ever since. [21] German was the language of the shop. In addition to the language, the survival of many other German craft customs among the descendants of the early German immigrants makes F. H. Gruber's distaste for machinery seem reasonable.

The Gruber wagon works was very isolated. A typical old Pennslyvania Dutch stone tavern and a house built by Jacob Gruber around the turn of the century were the only buildings near the works until F. P. Gruber built his small brick house. Reading, Pennsylvania, the source of their mass- produced parts, was many miles away, so the more parts they could produce themselves, the less hauling they would have to do.

If independence was a quality pecualiar to the works, then the first steps toward it were taken in the new shop in 1884. Previously, F. H. Gruber had finished the woodwork on the wagons at his farm shop, and then sent them some miles to a blacksmith to be "ironed," as mounting the tires, fastenings, and other metal parts was called. At the new shop, there was a special area for the blacksmith, and one was hired to do the job. When he decided to build a new shop, F. H. Gruber had begun looking for a new source of power. He settled on a water turbine, supplied and manufactured locally. [22]

In line with the value he placed on hand labor, Franklin Gruber generally bought only simple woodworking machinery. In 1885, he purchased a shaper (to bevel corners), a jointer made of cast iron, a planner made of wood and iron, and a boring machine, second hand from a tack manufacturer in Reading for a total of $275.00. Occasionally, in their attempts to economize, the Grubers made mistakes. The table shaper, for example, was too small, and was replaced a number of times before the present one was installed in 1911. [23]

There is no way of knowing whether or not the quality of the Gruber's wagons was really affected by the shift from the father's attitude toward the trade to that of his sons. An example of the shift came in 1894, when John and Jacob, feeling that the mortising was holding up the work, purchased a mortising machine from Goodell and Waters of Philadelphia, against the wishes of their father, who felt that mortising the hub was such a critical task that it had to be done by hand. [24] The death of F. H. Gruber in 1898 marks the beginning of a great period of expansion for the Gruber Wagon Works. While production in 1900 was 35 vehicles, roughly the same as had been produced at Isaac Gruber's works 30 years earlier, within 10 years it soared to 171 wagons. [25]

It is worth mentioning some of the new machines. In 1898, the brothers purchased a second-hand spoke lathe in Reading. Proving too light, it was replaced in 1900 by one (dated 1873) that had been used in a coach shop in Ashland County. Again, in 1902, to speed up another operation that limited production, a spoke-tenoning machine was purchased. That the most recent patent date on it is 1866 indicates how long the use of machinery had been important in the wheelwright's trade. For the blacksmith shop, a second hand power punch and shear and a form roller were purchased in 1905. In 1906, the source of energy for the works, which had been supplemented in typical makeshift fashion by a steam engine in 1896, was replaced by an Otto gas engine. [26]

Where it is possible to trace, it is clear that the machines built by the Grubers or constructed to their patterns closely followed contemporary manufactured designs. The spoke-tenoning machine built by Jacob Gruber and the

hub-boring machine are the most important cases. Spoke-tenoning machines had been built since the 1850's and were widely advertised. Hub-boring machines of the type the Grubers built were also well advertised. [27]

Considering the relative isolation of the Grubers from main lines of information, the general selectivity of purchases is as wise as could be expected. Although it is not clear they subscribed to any of the numerous trade periodicals, the examples of these and manufacturer's catalogues that remain in the Gruber Wagon Works papers indicates that their knowledge of what other people were doing was considerable. [28] The machines not only increased the productivity of the plant, but made it possible to quickly produce special orders that otherwise would have had to be done by hand. They produced wagons of all sizes, hay wagons, wheelbarrows, and special vehicles made to anyone's specifications. [29]

One machine stands out not only as an aid to production, but as a machine that could service old vehicles. In 1908, they obtained a second-hand West tire setter for $1,000. The usual method of setting the iron tire was to heat it in a fire or a furnace, place it around the wheel, and cool it quickly with water, shrinking the tire firmly onto the wooden felloes. The West tire setter used a ring of jacks to compress the tire cold onto the wheel. In addition to doing a better job than the old method, the saving in time and labor was enormous, and the tire setter, which could do the job "while you wait," attracted business like a magnet.

Even with all the machines added by F. H. Gruber's sons, the wagons still involved a good deal of hand work. Although the form of the wagon was typical, the process still reflected the Grubers' values. The works as they stand today do not speak of a "Gruber" method, yet if there were another factory surviving, it might be possible, in the innumeralbe patterns, wood clamps, and vices to find something that distinguished the works as theirs only. Some procedures that at first seem unusual may have been typical. Although textbooks insist that the spokes should never be sawed from stock, but split, that the Grubers sawed spokes for the spoke lathe seems defensible if it was done with care. The almost exclusive preference for oak over hickory or other woods in the construction of a wheel was probably the hallmark of a good wheelwright.

At least through 1920, the workers at the Gruber factory did not work solely at the manufacture of wagons. Most were farmers, and the workday was designed to begin after the morning chores, and end before the evening ones.. Naturally, the labor was seasonal, smaller numbers of workmen being available during the harvest, than in winter. In the winter parts were mass produced and stored in the attic ready to be assembled when less labor was available. While F. H. Gruber specialized as a wheelwright, each of his sons adopted a different department to his own liking. John had business ability and after his fathers death in 1898 became business. Jacob, the master wheelwright, enjoyed working with machinery, repaired (turn to Next page)

clocks, and was responsible for the design of much of the Gruber-built machinery. Apparently, John, in administration, and Jacob, with his love of machines, dominated the factory's operation. Adam was killed in a runaway horse accident in 1903. George headed the blacksmith shop and enjoyed making his own tools. That the calling card of the Gruber Wagon Works has a picture of the West tire setter on its reverse side seems to reflect more the aspirations of John and Jacob than the love George felt for the forge.

Labor safety appears as a significant concern in the part of the shop constructed under Franklin Gruber. Since the main line-shaft is located under the first floor, low overhead belts are not present in the older part of the shop. The old drill press, joiner, table saw, planing machine, and the bandsaw all have Gruber-built guards covering their belts, and, in the case of the band saw, its blade. These features do not characterize the later part of the plant.

The decline of the Gruber Wagon Works paralleled the decline of the wagon trade in general. Although their production increased through 1910, while the national decline began five years earlier, this follows from their product. The automobile industry first hit the carriage trade, since it aimed at the same clientele. The market for wagons continued in rural areas for a number of years. Studebaker, for example stopped production on all horse-drawn vehicles, except farm wagons, in 1919. For the Grubers, other products became important. In the 1920's, they sold truck bodies, 51 in 1922. Special work had always been important to small shops and the 1870 census reveals that it

was not unusual for a small shop to earn as much as a quarter of its profit from miscellaneous jobs. Some of the machines were put to new uses; the spoke lathe made excellent axe handles. A blacksmith was always useful for odd tasks.

The survival of the works was chiefly due to Franklin P. Gruber, John Gruber's son. The year after John died in 1934, George and Jacob retired, giving the shop to Frank. Already 51, he was too old to change trades. The isolated site and his desire to remain there led to the survival of the plant.

BUILDING WAGONS AT THE GRUBER WAGON WORKS

In the 19th century, wagons were the key to short-distance freight hauling. Unfortunately, information on their construction is slight. The most complete study of the methods of wagon construction is Paul A. Kube's M.A. thesis, A Study of the Gruber Wagon Works (Millersville State College, 1969), a study completed before the last employee at the works, Franklin P. Gruber, retired. What follows is an outline of the methods used at the Gruber Wagon Works that is largely drawn from Kube's thesis. [30]

The wheel required more of the wagon builder's effort than any other part of his product. Its major parts were the hubs, spokes, felloes, and tire. The hub was cut from the center of a 12" to 14" diameter log, drilled through the center with a 2" drill and dried for four to six years. The Grubers sometimes cut their own but more frequently purchased hubs, roughly turned to cylinders, from local retail suppliers. After marking the cylinder with a jib, the hub was turned on a wood lathe to the correct shape. The mortices for the tenons at the foot of each spoke were originally cut by hand, but hub-morticing machines were then sent to the smith shop, where iron bands were placed on both sides of the mortice to prevent the hubs from splitting when the spoke tenons were driven in.

Since the spoke was subjected to extreme pressures, great care was taken to insure that the grain followed the long axis, and the wood was generally split with a frow, rather than cut, for drying. While both hickory and oak were commonly used, the Grubers used only oak. Originally, the shaping of the

spokes, which were rectangular at one end and circular or oval at the other, was done entirely by hand. The plane, draw knife, and spoke shave were used, in that order. In this way, the Grubers sometimes processed as many as two wagon loads of spokes in the bench shop at one time. As with hubs, the Grubers also frequently purchased club spokes (spokes without tenons) from retailers. When the Grubers used their spoke lathe, they cut the lumber rather than split it. Although this went against textbook practice, it does not seem to be an extreme liberty. The tenon at the foot (hub-end) of the spoke was made with the spoke-tenoning machine, which naturally replaced manual methods. The tenon was then cut to the correct length on the "spoke cut off saw," which the Grubers had mounted on their old lathe bed. If the tenon was too long, it would intrude into the space occupied by the bearing in the hub, causing the wheel to work itself loose in time. The sides of the tenon were fashioned so that the spoke, seated in the hub, would assume the correct angle to give the wheel the dished shape it required for rigidity. The foot of the tenon was then chamfered slightly with the aid of jigs on the table shaper so the tenon could be easily driven into the mortice in the hub without splitting.

The felloes were generally made of either ash or oak, although again, the Grubers used only oak. The felloes were either made in short arcs cut from flat stock, one felloe to two spokes, or they were made of steam-bent wood, two segments to each wheel. The Grubers almost always purchased both kinds in bulk. Originally, wheels were probably processed in sets of four, one wagon being manufactured at a time. Later, when the shop was running at its peak production, they were assembled as with the wagon undercarriage and boxes, in

batches sufficient for 6 to 12 wagons. The hub was clamped in the wheel pit in the bench shop, and the spokes were driven in, one man driving, the other guiding the spokes were driven in, one man driving, the other guiding the spoke-tenoning machine built by the Grubers in the woodworking shop, where the spokes were cut to uniform length and the round tenon was made on each spoke. It was returned to the bench shop, clamped horizontally on a work bench, hind side down (concave up), and the felloes were placed on top of the tenons, marked, and drilled to receive the tenons on the drill press. The end of each spoke was cut so that the kerf (wedged), driven into the end of the spoke to hold it tightly in place after the felloe was on, would not cause the spoke to split. The spokes were bent with the aid of the tool called a spoke dog and inserted into the holes in the felloes. They were then tapped down with a hammer. Great care was required to insure that adjacent felloes met at the same time that the shoulders of the spoke tenons met their felloes. A hole was then drilled from the outside of one felloe into the next, and a dowel was inserted to secure the joint. Wedges were set in the saw kerfs and the wheel was returned to the Gruber spoke-tenoning machine, where it was rotated and shaved by a spinning cutting head that made it truly circular. Ready for the tire, it was sent to the blacksmith shop.

The wheel was rolled on the bar that was to be the tire for a rough measurement of circumference, and 2-1/2" were added to that. The bar was cut in the power shear and the end bent at the forge to start it in the tire bender,where it was formed to roughly the correct diameter. The circumference of the wheel was then measured accurately with a traveler and transferred to the tire, which was

cut to that measurement plus one half inch. The ends were then cut to a 45° angle and welded at the power hammer after heating at the forge. With a small amount of hand hammering, the joint was almost invisible. Using the old method of setting the tire on the wheel, it was then necessary to heat the tire, causing it to expand. From the opening of the new shop in 1844 until 1898, a fire was built on the ground over to stack of tires. In 1898, a vertical brick over was built, which lasted until 1908. After the tire had expanded, the wheel was placed on a three legged stool, the tire placed around it and cooled with warm water from the stream, thus contracting firmly onto the felloes. The system of heating and cooling the tire was replaced when the Grubers purchased the West Tire Setter in 1908. Using a ring of hydraulic rams, it compressed the tire cold onto the wheel. Tires intended for use on the tire setter were made with a diameter from 1/2" to 5/8" larger than their wheel. Using the power press, the blacksmith then put an iron ring on each side of the hub.

Hub boxing, the final boring of the hole in the hub, required great accuracy. Originally done by hand, the Grubers eventually eventually had a hub-boxing machine made to their own patterns in Reading. The wheel was mounted vertically by its rim in a self-centering chuck and bored from both sides by different sized heads. Without removing the wheel, the heads were replaced with two that sank the holes for the collar and the hub retaining nut. The wheel was then taken to the blacksmith shop, where the bearing was inserted with the power press; the iron bands placed by the smith earlier prevented the hub from splitting. After painting, the wheel was finished.

The undercarriage was made of oak, processed in two or more wagonloads at a time. After being planed to a thickness of 2-3/4", patterns were used to trace the required shapes on the wood, which were cut out on the hand saw. The edges were smoothed on the curved surface shaper (built to patterns made by the Grubers), the table shaper beveled the edges, and dadoes were cut ona dado machine in the bench shop. The table shaper and the curved surface shaper obviated the use of a sander, although earlier one had been used to eliminate the marks made by the band saw. The parts went to the plant shop, were given a coat of vermillion paint, and were placed in storage.

The box, typically capable of holding a 6-ton load, was made of poplar boards with oak supports. Each size of wagon had a different sized box, and every piece was made with the use of jigs. The boxes were set up in the bench shop on sawhorses, then taken to the blacksmith shop for "ironing."

The blacksmith assembled the undercarriage and attached the axles, which were forged by him from rough parts received from retailers. The box was placed on the undercarriage after its fittings had been mounted, and the braking system installed.

The completed wagons were then taken to the paint shop on the second floor, away from the dirt and dust of the bench and woodworking shops. Originally, the wagons were hauled by block and tackle up a ramp, through a door in the second floor. The flimsy board ramps were practically a trademark of the small wagon factory. The process was made easier by the addition of a simple

elevator in 1905. [31] The wagons were given a second coat of venetian red and linseed oil, followed by a coat of venetian red and turpentine. Finally decorated with the Gruber name and some scroll mark, the wagons remained in storage on the second floor until they were sold.

Although the Grubers adopted a mass-production technique, parts were not completely finished before assembly; the process can be paraphrased as: manufacture, assembly, more manufacture with reference to that assembly, more assembly. For example, spokes were not tenoned at both ends, but were tenoned at the foot, driven into the hub, then the ends were cut to equal lengths, then the other end of the spoke was tenoned. In another case, the position of the holes in one felloe were not correct for another felleo but were drilled for each wheel with specific reference to the position of the spokes in that particular wheel.

FOOTNOTES

1. Nathan Rosenberg, ed., The American System of Manufactures, Edinburgh, 1969, p. 113.

2. George Shumway, et al., Conestoga Wagon 1750-1850, York, Pennsylvania, 1966, pp. 15, 19; J. G. Jenkins, The English Farm Wagon, Trowbridge, England, 1961, p. 57.

3. Shumway, Conestoga Wagon, p. 15; Edwin Valentine Mitchell, The Horse and Buggy Age in New England, New York, 1937, p. 21.

4. Rosenberg, The American System of Manufactures, p. 167.

5. William Louis Gannon, Carriage, Coach, and Wagon: The Design and Decoration of American Horse-drawn Vehicles, State University of Iowa thesis,1960, p. 89; The Carriage Monthly, 40th Anniversary Historical Number, April 1904, vol. XL, no. 1, p. 101.

6. Rosenberg, The American System of Manufactures, pp. 137, 168.

7. Carriage Monthly, p. 114.

8. Rosenberg, The American System of Manufactures, p. 167.

9. See G. & D. Cook & Co.'s Illustrated Catalogue of Carriages..., p. 18, and M. T. Richrdson, comp., Practical Carriage Building, New York, 1892.

10. Rosenberg, The American System of Manufactures, p. 113.

11. The Carriage Monthly, pp. 99, 101.

12. Carriage Monthly, p. 101; Studebaker Bros. Mfg. Co., Illustrated Souvenir of the Studebaker Bros. Mfg. Co., South Bend, Ind., U.S.A., Buffalo, New York, 1893, not paged.

13. Carriage Monthly, p. 96' Gannon, Carriage, Coach, and Wagon, p. 233; U.S Bureau of the Census, Census of Manufactures: 1909 Statistics for the Carriage and Wagon Industry, Government Printing Office, 1910, p. 3; U.S. Bureau of the Census, Census of Manufactures: 1921 Carriages and Wagons..., Government Printing Office, 1923, pp. 4-5.

14. Again, the data for this section relies heavily on Kube, A Study of the Gruber Wagon Works, pp. 168, 179.

15. 1870 Census of Manufactures for Bucks County, Pennsylvania, not paged.

16. Ibid; Kube, A Study of the Gruber Wagon Works, pp. 37, 168, 179-180.

17. Kube, A Study of the Gruber Wagon Works, pp. 180-181.

18. John Philipson, The Art and Craft of Coachbuilding, London, 1897, p. 112.

19. G. & D. Cook & Co., Illustrated Catalogue, pp. 22, 36, 52, 128, 136, 150.

20. Carriage Monthly, p. 99.

21. Morton L. Montgomery, Historical and Biographical Annals of Berks County, Pennsylvania, Chicago, 1909, pp. 1001-1003. F. P. Gruber speaks (in 1974) English with a German accent.

22. Kube, A Study of the Gruber Wagon Works, pp. 38, 100-101, 177.

23. Ibid., pp. 50, 56.

24. Ibid., p. 57.

25. From production record cards at Gruber Wagon Works.

26. Kube, A Study of the Gruber Wagon Works, pp. 42, 60, 62, 85, 87.

27. G. & D. Cook & Co., Illustrated Catalogue, p. 18; Rosenberg, The American System of Manufacture, p. 113.

28. Catalogues and magazines in the possession (1974) of Elsie Gruber, (Mrs. John Gruber), Reading Pennsylvania.

29. See Kube, A Study of the Gruber Wagon Works, for details on the products of the works.

30. This description of the Gruber's methods relies almost exclusively on Paul A. Kube, A Study of the Gruber Wagon Works, Millersville State College Master's Thesis, 1968, pp. 104-158, the most detailed and clear explanation of how to build a wagon this writer was able to locate.

31. Mitchell, Horse and Buggy Age, p. 24.

RELOCATION OF
GRUBER WAGON WORKS

This account of the relocation of the Gruber Wagon Works has been included here not only because it is a relatively unique industrial structure, listed on the National Register and recorded by the Historic American Engineering Record (HAER), but primarily because its move, carried out by a Federal agency, was necessitated by Federal legislation designed to protect cultural resources.

The Gruber Wagon Works in Berks County, Pennsylvania, built in stages between 1833 and 1911, is considered to be a rare surviving example of a rural factory and therefore was listed on the National Register in 1972. Although its operation, the manufacture of wooden farm wagons, had been declining since the mid-1920's, the building and all its tools, machinery, and power generating and transmission equipment had been preserved by the Gruber family. Within the last few years the Wagon Works had begun to deteriorate at an accelerating rate and would no doubt by now have had its machinery and tools sold and dispesed. partly because of concern for its future, the Gruber Wagon Works complex was recorded and documented by the Historic American Engineering Record (HAER) in 1973-1974.

By 1975-76, however, it had become clear that the continued existence of this building complex was in imminent danger because of its location within the impoundment area scheduled for inundation by the Corps of Engineers Blue Marsh Lake Project. However, in accordance with the provisions of the Moss-Bennett Archeological and Historic Preservation Act of 1974 (P.L. 93-291), which

provides for the recovery, protection, and preservation of historical and archeological data which might otherwise be lost as the result of any Federal or federally licensed project, the Corps was required to find a means to ensure the preservation of the Wagon Works complex. In order to carry out this requirement, it was obvious that the structure would have to be moved. Thus, in March 1976, the Corps embarked upon the preparation of detailed route and site maps, showing the existing site, two possible sites for relocation, and a carefully prepared map outlining the two alternative routes along which the disassembled buildings could pass to reach the sites, and the obstacles which would be encountered on each route.

Since the Gruber Wagon Works was already listed on the National Register, in accordance with National Register regulations (Title 36, Chapter 1, Part 60.16 b 5), as revised January 5, 1976, the proposal for the disassembly and relocation of the complex had to be submitted for comment to the Advisory Council on Historic Preservation, if the structure was to remain on the Register during and after the move. After the proposal had been reviewed in complaince with the Council's Procedures (36 CFR Part 800), a memorandum of agreement between the State Historic Preservation Officer, the Corps of Engineers, and the Executive Director of the Council was prepared and signed on May 24, 1976, accepting the Corps' planned undertaking.

The following July, the Philadelphia District of the Corps of Engineers awarded a $387,000 low bid contract for all services involved in the relocation of the Wagon Works from its original location to a new site out of the impoundment

area of the reservoir. A pre-qualifying proposal, submitted prior to the acutal bidding, required the preparation of a detailed preliminary analysis and design of the overall project. This proposal had to meet the requirements of the low bid that was within the financial means of the Corps, while at the same time preserving the building complex intact, including the machinery and rural industrial ambience that had been maintained at the Wagon Works virtually without change since before World War I. The contract was awarded to R. S. Cook and Associates, Inc., general contractors and construction managers, Philadelphia, who formed the relocation team which included: John Milner Associates, historic architects, West Chester, Pennsylvania; Keast and Hood Company, structural engineers, Philadelphia; and C. Van Howlling and Sons, building movers, Wallingford, New Jersey. Together, this professional collaboration successfully carried out this difficult move. This team, after analysis of the two sites, one of which (Site A) was selected only a possible stoarge site until a permanent site could be found, and of the route plans already prepared by the Corps, was able to determine that the structure could be moved directly to Site B. site B is located on land known as "Red Bridge Park" and owned by Berks County. The County agreed to provide the land for the new site of the Gruber Wagon Works, in a contract which stipulated that the title to the relocated Wagon Works would be transferred to the County. Berks County further agreed to maintain the restored historic Wagon Works complex and operate it as a museum.

Since the structure had to be separated into parts not exceeding approximately 30 feet wide for movement 5 miles along a two-lane primary highway and onto the new site a mile down a narrow secondary road, it was necessary to adopt a

dismantling procedure that would satisfy cost restructions, and at the same time establish separation planes that would meet the size limitations, and yet minimize removal and disturbance of original fabric.

The individual tasks required to stabilize, separate, and remove all building material, machinery, and the power transmission system were studied in advance. The resulting work outline was presented in explicit working drawings and specifications in the full development of the project outlined in the pre-qualifying proposal. Work in this area was faciliated by the existence of the measured drawings and other documentation done by the Historic American Engineering Record in 1974, and 1975.

At first it seemed logical to separate the building only along the planes between the several historical additions, but this proved to be impractical because it would have resulted in greater fabric disturbance. The building was carefully separated into four major sections and the appendages divided into several minor parts to avoid indiscriminate cutting of the fabric. The usual practice of slicing a structure apart along a single plane with a chain saw was not permitted because the disassembly plans provided detailed instructions for removing individual pieces of original fabric with specific procedures for cutting or disassembling each affected structural member of joint. The butt cut members could not be crudely reconnected with exposed plates and cleats, which is the easier method, because this would have been visible on the exposed interior framing, or "open finish" common to most early frame industrial structures.

The structural connections to be separated were sketched in not-to-scale axonometric projection in the field and transcribed directly to the working drawings. Care was taken so that the joints all came apart horizontally. In addition, disconnection of joints along the same separation plane was systematically studied to make certain that any member continuous between two adjacent joints was included with the same building section. In those few cases where it was necessary to make new cuts through structural members, the joints were alp cut and, upon reassembly, pegged together. The building section in which each member siding and flooring were removed either to existing joints or to new staggered joints. Structural reinforcing was added throughout the building to both streghten existing unstable conditions and provide support along separation planes where the structural system was temporarily disconnected.

In addition to the building itself, the machinery, power generating and transmission system had to be relocated. Wherever possible, these mechanical devices and assemblies were left in place, stabilized as required, and moved along with the building. However, it was necessary to remove the entire main drive shaft and several secondary shafts hanging from the basement ceiling to accommodate the rigging beams. The Otto gasoline engine and several machine tools were also removed separately because they were in the basement or on slabs on grade. In order to schedule these removals a complete inventory had to be made of the mechanical system for pre-move tagging to ensure that each pulley and shaft assembly was returned to its correct location during the reassembly.

Before moving the first of the three largest sections, the overhead electrical primaries that crossed the route with less thatn 40 feet of clearance were temporarily raised, and the secondary wire coiled to their poles. The roof and gables of the elvator penthouse of the central section were removed to bring its overall height down to that of the other two large sections so that the cost of relocating the electric primaries was minimized. Temporarily lengthened electric secondaries and telephone cables were then dropped directly on the road ahead of, and crossed by, the moving rigs. At no time was any service interrupted. The cost of utility relocation came out of the original contract sum along with all other costs.

The actual pulling apart and relocation of the various sections followed the aforementioned structural stablization and structural and mechanical disassembly. Each of the three largest section of the building was supported on a cribbing of steel beams and carried on three 8- of 12-wheel dollies. This steel was pushed through holes punched through the foundation. The cribbing consisted of stringers placed transversely to the direction of travel and converging girders placed longitudinally, under which the dollies were located in triangular support. Smaller sections of the building were moved on "low boy" type flat bed trailers.

The three largest sections were taken to the new site in two separate operations. The central and largest section, 26 feet wide by 71 feet long, was moved on December 8 and 9, and the other two, 28 feet wide by 35 feet long and 24 feet wide by 43 feet long, was in convoy on December 22 and 23. The actual

transportation over the chosen route, although certainly the most dynamic and photogenic portion of the entire operation, was probably also the least novel part of the job. As explained earlier, this procedure has been repeated many times in much the same way and has been practiced at least since the late 18th century in the United States.

The three large dolly-transported building sections were each moved about 800 yards through a frozen, and fortunately level, corn field just above the new site because the trees along the narrow public right-of-way at that point made it impassable. The largest of the three major sections was moved to the new site first because it was the central piece and it was advantageous to re-attach the adjacent smaller and lighter sections to it.

As might be expected, the reassembly proceeded in approximately the reverse order of the disassembly. The success of the entire scheme, of course, lay in the reassembly, not in the disassembly or in the transportation. During reassembly, several badly rotted structural members, principally sill plates, were replaced where it would have been extremely difficult and costly to do so after the reassembly had been completed. A new foundation was built beneath each section after it was finally positioned, leveled, and structurally reassembled. The foundation consists of a permanent core and temporary exterior block veneer which will eventually be replaced with stone from the original walls. The roof was temporarily sheathed in plywood and roofing felt while awaiting a new slate roof to replace the decayed and discarded original. All machinery and shafting were replaced but will not be finally leveled and made operational until restoration of the building fabric is completed.

The success of the total project was a combination of the various elements outlined in the preceding pages, and to some extent can only be measured in years to come when the Wagon Works complex will have had some time "adapt" to and integrate with its new site. The well-executed relocation of the Gruber Wagon Works is further highlighted by the fact that the Wagon Works will undergo complete restoration beginning in 1978, under the supervision of the John Milner Associates, the same firm of historic architects which supervised the move.

Addendum to:
Gruber Wagon Works
State Route 183 at Red Bridge Park
Bernville Vicinity
Berks County
Pennsylvania

HAER PA-14

HAER
PA,
GRUBER.V,
8-

PHOTOGRAPHS

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, D.C. 20240

ADDENDUM TO:
GRUBER WAGON WORKS
Pennsylvania Route 183 & State Hill Road at Red Bridge Park
Bernville vicinity
Berks County
Pennsylvania

HAER PA-14
HAER PA,6-BERN.V,8-

FIELD RECORDS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
U.S. Department of the Interior
1849 C Street NW
Washington, DC 20240-0001