CHAPTER III

Manufacturing Boiler Plate

In 1850 Frederick Overman, author of The Manufacture of Iron in all its Various Branches, wrote that "the making of sheet iron is a branch full of intricacies and difficulties, but once thoroughly understood, it is very simple and agreeable."[1] Overman was wrong. The manufacture of sheets of boilerplate was simple in principle and the process easily described. But there simplicity ended, for in 1850 the production of good boilerplate called for fine judgment, manual dexterity, careful selection of materials, and good luck. Further, contemporary accounts suggest that the job was seldom agreeable at all. The work was hot, dangerous, and exhausting.

In 1850 "boilerplate" meant a sheet of laminated, charcoal refined wrought iron. Gibbons and Huston described its manufacture thus:

> It, as well as all the iron we have made for you, is manufactured from charcoal blooms made from cold blast runout charcoal pig metal -
> We take the blooms - heat them in a

> furnace with bituminous coal - roll them into 'covers', pile them together with trimmings off of cuts between - We then take this pile of iron and put it into the same furnace and bring it to the rolls - pass it through until all the pieces of iron are brought into contact with each other - carry it back to the furnace and bring it to welding heat again - then roll it into the plate -[2]

Re SUIT on COlumters

Given good blooms and machinery, such boilerplate was strong and easily worked. It could be bent, rolled, cut, punched, drilled and flanged without losing its strength. However, proper manufacture and the acquisition of satisfactory blooms was not easily achieved. Iron working was prey to several variables that were not then subject to scientific control; the manufacture of boilerplate was an inexact art.

For the men working at the mill, the science of metallurgy amounted to a series of maxims and a bundle of recollections gathered at painful cost over a period of time. It was all very much on a recipe basis.[3] Every heat amounted to an experiment. With blooms obtained from familiar suppliers, success resulted. Even so, there were often embarrassing failures that defied explanation.

Most often the apparently inexplicable failure of a sheet of iron during manufacture was due to the inadvertent use of defective blooms. Usually, the defect was caused by poor refining or the ores used to make the bloom, causing it to be either red short or cold short. Bad blooms could not be easily detected. Visual inspection was not enough and the hidden flaw would show itself only after the bloom was heated and rolled. Worse yet, the defect might remain hidden until Lukens's customers were fabricating the finished plate into a boiler.

All this could be a vexing business. In August, 1855, Charles Huston complained to one of his favored suppliers, a William Watts of Carlisle, that his blooms were not working well.[4] Watts replied that he was using the same ore, fuel and men to make his blooms. Neverthe-less he sent his manager to the rolling mill to watch his bloom used.[5] His man returned and reported that the Watts blooms worked well. Still Huston continued to complain, and later in the month Watts wrote Huston that he did "not consent to your depreciation of my iron." He went on to say that he would not guarantee the quality of his blooms because the defective plates might have been made from some one else's blooms. He also observed that the men in Huston's mill may have been mishandling perfectly good metal.[6] The complaints were not stopped by this explanation, and finally Watts exploded,"If I can deal with you in my own way as I have done for years I will send you blooms but I cannot bear this continual bickering."[7] At that point the acrimonious episode ended and Watts and Huston continued to do business in an amicable fashion. Yet something had happened which made some of the plate unsatisfactory and the blame for those failures could not be fixed on either of the parties involved. This rather trying stalemate between two old friends illustrates the metallurgically inexact nature of plate making at that time.

As Watts had charged, the manufacturing process was open to mistakes. The opportunities for error were numerous indeed. The manufacture of boilerplate started at the heating furnace. A furnace ran too hot or too cold would ruin a plate. Too much heat "wasted" the iron.[8] Too little heat prevented proper welding of the iron as it passed through the rolls. To further complicate matters, each bloom required more or less heat according to its red or cold shortness.[9] Finally, the furnace itself might collapse onto its charge, ruining everything.[10]

If none of the difficulties noted above occurred, and if the pile was properly handled, then it was ready for rolling. At this point in the process two general requirements had to be met in order to make a good plate. First, high pressure was needed to assure a good weld in the pile as it passed through the rolls. Second, the rolling had to be done quickly to prevent the pile from cooling to less than welding heat. Adjustable screws on the top of the roll housings controlled the distance between the upper and lower rolls and determined the pressure on the pile and the thickness of the plate. This part of the operation was straightforward. A successful pass through the rolls depended upon the eye and gauge of the screwman and the strength of the machinery. However, the rolls and power train of the rolling mill were not models of reliability. Rolls were prone to sudden unexpected breakage. When this happened workmen removed the sheet from the rolls, recycled back to the furnace, and replaced the broken roll within a few hours. This kind of break was a nuisance and not a catastrophe.

Occasionally though, other parts of the machinery broke down and caused serious production delays. For example, the late summer and fall of 1856 saw a series of exasperating breaks in the machinery. On August 18 a rod housing broke and closed the mill for two weeks.[11] One month later, a water wheel power shaft snapped, necessitating another shutdown, and in November a roll housing cracked.[12] This series of major breaks combined with low water in July, August, and October through December, conspired to wreck production schedules.[13] Their New York commission agent was frantic:

* SAME year RC DIES

> Please advise us as soon as your mill is

> in operation - because we are going to make you do something for us - the amount of Iron from your mill this year is not the same as we intend to have the next!![14]

Buckling sheets constituted another problem in the rolling operations that was quite independent of breakdowns. Buckling usually occurred with the lighter gauges of iron. The fault lay in the design of the machinery. Iron less than one quarter inch thick cooled quickly and differential cooling occurred as the iron was rolled down to gauge by a series of passes through the rolls. The resulting temperature variations in a single sheet caused the buckle. In principle the remedy was to roll the iron hot and fast, but this was impossible, for each sheet had to be manhandled back over the top roll for each subsequent pass through the rolls. A reversing or three high mill would have relieved this difficulty but Lukens adopted neither innovation probably because power and space were both limited in the plant in use from 1850 to 1870. The reversing mill was seldom used in this country and the three high mills confined themselves mainly to rail production in the mid nineteenth century.[15] Given this, it is not remarkable that they neglected these innovations in the mill up to 1870. However the owners erected a new mill in 1870 and still spurned these high and reversing mills even though they were in successful use by other plate mills by that date.[16] As will

New mill 1870

be seen below, a suspicious conservatism marked their attitude to all innovations.

Finally, simple human error at any place in the entire manufacturing cycle disrupted production. If a man miscalculated the heat of a pile from the furnace, bad plate was the result. If the screwman let his attention wander, the plate emerged rolled to the wrong gauge. Most embarrassing of all, there were several instances when the men at the shears cut perfectly good plate to the wrong size. Not surprisingly, inferior workmanship increased when the press of orders drove the mill hard.[17]

Quality control under these conditions was a difficult business and it obsessed the owners at all times. They felt that the survival of their business depended on the production of superior iron. One response to this situation was to concentrate on iron manufacturing to the exclusion of all other things, and to that end the partners abandoned a freighting business in 1849.[18] In addition, they considered the feasibility of mkaing a special high quality boiler plate that would enhance their reputation. The Boston agency in September, 1850 had complained of the quality of the iron it was receiving and had warned that Lukens was losing its market.[19] The mill moved to remedy the problem and by early 1851 it was assured that its iron was preferred once again.[20] In an attempt to secure that position, Gibbons and Huston told their agents of their plan to produce a special high quality boiler plate for those customers who wanted the best and were willing to pay for it. They would assure the quality of the iron by double heating it at an increase in cost of about seven per cent. The New York agent objected to the idea and pointed out that their best iron was good enough as it was and that further improvement might price the iron out of the market.[21] That argument won out for the time, but the mill owners would return to the idea of a premium iron at a later date.

The ordinary best iron produced by Lukens seems to have enjoyed a high reputation among most users up to the time of the Civil War. In 1855 Lukens iron went into a boiler that was to be shown at the World's Fair in Paris, and in 1860 the Corliss Steam Engine Company reported that the average tensile strength of Lukens iron was over sixty thousand pounds per square inch, better than the average of any other lot tested by Corliss up to that time.[22] All that was high praise, but as noted above, the possibilities for mistakes were numerous and flawed iron did leave the mill from time to time.

Normally when a customer made a complaint about defective iron, he returned the plate to the mill along with a detailed description of the failure. For example, in 1860 the Corliss Steam Engine Company got a bad batch of iron and reported that two or three blows of a hammer would break pieces off the plate and that that batch of iron was no better than common puddled iron.[23] The years 1866 and 1867 were marked by a series of complaints. In June, 1866, a New York agent reported that twenty per cent of one lot of iron had failed and that some of the sound iron was not cut straight.[24] Later that year the Hudson River Railroad condemned a shipment of Lukens iron and refused to purchase any more of their iron because the railroad "did not consider it safe to be put in a boiler or any other place where good iron is required." Unfortunately it was all true, for the agent checked the complaint and had to make apologies for the iron.[25] The next year saw two more embarrassments. In one case where Lukens provided the iron for the machinery of the ship Onzaba, a United States Inspector of Boilers failed five sheets out of forty. Later that year an agent saw some of the mill's iron condemned and said that "they were without exception the most inferior plates he had ever looked at, the likes of which condemn any worker, we did not know what to say and particularly so as they came from your mill."[26]

At times, the owners themselves could not explain the failure of some of their iron. In 1851 a lot of iron sold in Baltimore was condemned though Lukens had made it from the best materials available and had used extra care in its production.[27] In 1857 the Norris Locomotive Works was dissatisfied with the iron supplied them and the men at the mill were at a loss to explain things. Huston complained that Norris seemed to get all his bad iron and that in the preceding quarter only five sheets had failed out of one hundred fifty tons produced.[28] In 1861 the same firm complained again and Huston asked them to make sure that their own foreman wasn't being bribed. No one else, he pointed out, was complaining at the time. In fact, the engineer of a Russian steam frigate just built using Lukens iron had "expressed astonishment to me at the strength of the iron...."[29] For some failures, there were no adequate explanations.

In the face of charges like these, the men at the mill did what they could: they replaced the defective iron and assured the complainants that the mistakes would not happen again. Generally the assurance was a simple pledge saying "We exceedingly regret it and will use still greater detective measures than heretofore...." In 1855 the mill hired a hand whose job was to check all iron as it was rolled and to examine finished plates for defects.[30]

As seen above, the quality of the plate produced depended in large part on the quality of the blooms purchased by the mill. Lukens made a continuing effort to head off complaints by securing good materials for its iron. This was not always easy, especially in times of high demand like 1864-65. In 1864 Huston confessed that "at these times the furnacemen [bloom manufacturers] are very saucy and will not bear much scolding."[31] The high demand for iron during the Civil War had made the bloom makers kings of a seller's market. There was little that could be done beyond timid scolding. In 1865 Huston told one furnaceman that his blooms worked badly. Even so the mill continued buying blooms from him.[32] However when the demand for iron was not high, the mill was in a better position to control the quality of blooms coming in. In 1869 when one "old forgeman ... got astray in some way ..." he found himself abandoned while other suppliers sold acceptable blooms to Lukens.[33]

There was another obvious way for the owners to assure their agents and customers that they would receive good iron. In 1857 Lukens began offering a warranty on their iron. Under the terms of the guarantee the mill agreed to replace or take back at the original cost any sheet of iron that failed to flange or that contained a flaw due to improper manufacture. The mill would not pay for any labor expended on the iron by their customers during its fabrication into a finished boiler, for they suspected that some rejected plates were badly handled during fabrication.[34] This suspicion may or may not have been appropriate at that time, but eleven years later Huston got back a sheet of condemned iron only to find that the workman in the boiler shop had misused it by forcing the rivet holes into long oval shapes, thus ruining good plate.[35]

Shortly after the end of the Civil War the partners once more considered the possibility of producing a special high quality iron to protect their place in the market. The agents rejected the idea again, due to the higher prices involved.[36] Still, that predilection was a durable one and by the spring of 1868 the mill found its way clear to manufacture a special iron. A minor hitch developed at this time: the iron needed a brand name. "I have it" was considered for a time but in the end the label selected was "Wawasset".[37]

Aside from the difficulties peculiar to the manufacturing process, there were exterior forces and events which affected production adversely at one time or another. The mill, like any water powered operation, was vulnerable to seasonal changes in the water level and the vagaries of the weather. Dry summers and autumns often left the dam too low to drive the water wheel for any length of time. This was apparently a serious matter occasionally, as in August to October, 1851 and July to December, 1856 when lack of water crippled the mill for months on end.[38] Too much water could be worse than too little, and winter and spring floods damaged the dam, millrace and waterwheel several times.[39] Hard freezes also stopped the mill, but this was much less a problem than low water and flooding.[40] Several times the heat of high summer, combined with the heat of the mill, sickened the hands and drove them off the job.[41] Harvesting also pulled men from their place at the mill at least once. They were let go by the owners even though it had "thrown our work back."[42] Holidays were allowed of course, and there was at least one that spilled over into the next workday. On July 5, 1865, the correspondence shows that the mill was standing idle because of too much celebration on the preceding day.[43] Doubtless the hands had been drinking to the preservation of the Union. Finally, the Civil War and the Panic of 1857, as will be shown below, had a marked effect on the pace of activity at the mill.

It is evident that the manufacture of boiler plate was any thing but "simple and agreeable." Men, things and events often conspired against the kind of order and tranquillity which the owners must have desired.

CHAPTER III

[1]Frederick Overman, The Manufacture of Iron in all its various branches (Philadelphia, 1850), p. 365.

[2]Lukens, 346. April 8, 1861. Gibbons and Huston to Curtis, Leavens & Co.

[3]This point can be perfectly demonstrated by glancing through Frederick Overman's The Manufacture of Iron in all its various branches and his Treatise on Metallurgy (New York, 1850).

[4]Lukens, 417. August 6, 1855. W. M. Watts to Huston.

[5]Ibid.

[6]Ibid., August 24, 1855. W. M. Watts to Huston.

[7]Ibid., August 25, 1855. W. M. Watts to Huston.

[8]Overman, The Manufacture of Iron, p. 388.

[9]Ibid.

[10]Lukens, 342. Nov. 10, 1852. See also Ibid., 347, 348, 349. passim.

[11]Lukens, 344. August 18, 1856. Huston to Kemble and Warner. The author is unable to determine the function of a rod housing.

[12]Ibid., Sept. 27, 1856. Nov. 1, 1856. Huston to Kemble and Warner.

[13]Ibid., 344. July through December, passim.

[14]Ibid., 415. Nov. 21, 1856. Kemble and Warner to Huston.

[15] Peter Temin, _Iron and Steel in Nineteenth Century America_ (Cambridge, 1964), p. 105.

[16] Lukens, 353. August 13, 1869. Huston and Penrose to Totten and Co. An inquiry about three high mills was made on this date. It came to nothing.

[17] See footnote 10.

[18] Lukens, 341. Feb. 4, 1850. Gibbons and Huston to Curtis, Leavens & Co.

[19] _Ibid._, 414. Sept. 5, 1850. Curtis, Leavens & Co. to Gibbons and Huston.

[20] _Ibid._, 414. Feb. 15, 1851. Kemble to Gibbons and Huston.

[21] _Ibid._, 414. March 5, 1851. Kemble to Gibbons and Huston.

[22] _Ibid._, 346. May 5, 1860. Corliss Steam Engine Co. to Huston and Penrose.

[23] _Ibid._, 195. August 23, 1860. Corliss Steam Engine Co. to Huston and Penrose.

[24] _Ibid._, 415. June 19, 1866. Holdane & Co. to Huston and Penrose.

[25] _Ibid._, 415. Dec. 27 and 31, 1866. Kemble and Warner to Huston and Penrose.

[26] _Ibid._, 419, April 29, 1867. Charles Bemis to Huston and Penrose. Dec. 18, 1867. A. B. Warner to Huston and Penrose.

[27] _Ibid._, 342. Dec. 12, 1851. Gibbons and Huston to E. Pratt & Son.

[28] _Ibid._, 344. Jan. 27, 1857. Huston to Richard Norris.

[29] _Ibid._, 345. Feb. 2, 1861. Huston and Penrose to James Norris.

[30] _Ibid._, 341. May 15, 1851. Gibbons and Huston to Kemble. 343. May 4, 1855. Huston to Curtis, Bouve & Co.

[31]*Ibid.*, 349. Sept 7, 1864. Huston and Penrose to John Flagler.

[32]*Ibid.*, 350. Dec. 14, 1865. Huston and Penrose to W. Boyd Jacobs.

[33]*Ibid.*, 353. June 28, 1869. Huston and Penrose to Carpenter and Wilson.

[34]*Ibid.*, 344. March 1, 1857. Gibbons and Hilles to Huston.

[35]*Ibid.*, 352. Jan. 4, 1868. Huston and Penrose to A. B. Warner & Co.

[36]*Ibid.*, 350. August 26, 1865. Huston and Penrose to John Flagler.

[37]*Ibid.*, 352. March 20, 1868. Huston and Penrose to A. B. Warner. Wawasset is a traditional name for the Brandywine River.

[38]*Ibid.*, 342. September to Oct. 14, 1851. *Passim.* See also footnote 13 above. There is an apparent anomaly that deserves consideration here. While the correspondence was loaded with complaints of low water in 1851 and 1856 the production time series fails to show any significant decline. This contradiction of evidence has no straightforward explanation. Perhaps the writers were naturally apprehensive of low water levels and assumed that this condition would impede production more than it did. It may be noted however, that low water was an excuse for a slipping production schedule from which there was no appeal and so might calm the incessant compalints of agents.

[39]*Ibid.*, 346. Nov. 3, 1860. Huston and Penrose to Kemble and Warner. 348. April 15, 1863. Huston and Penrose to Kemble and Warner.

[40]*Ibid.*, 352. Jan. 1867 to Feb. 7, 1867. *Passim.* This is the only instance where bitter cold affected production more than a few days.

[41]For example: *Ibid.*, 353. July 17, 1869. Huston and Penrose to Carpenter and Wilson. It was an unusual summer that had no complaint about the heat slowing production.

[42]*Ibid.*, 342. July 28, 1855. Gibbons and Huston to Kemble.

[43] *Ibid.*, 350. July 5, 1865. Huston and Penrose to Kemble and Warner.