**Technology of the Oil Mill Industries**

**From the Collections at Historic Bethlehem [PA]**

## Waterpower System

The waterpower for the 1765 oil mill came from the adjacent Monocacy Creek. A low dam, just northwest of the building diverted water to the oil mill, as well as to the 1762 waterworks located 30 feet further east. the precise construction of this dam is unknown. It, apparently had a wooden frame which was built in sections on shore and then installed in the creek, probably by leading with stones.

Twin undershot waterwheels in the center of the building furnished power to the various mills. This side-by-side location of the wheels minimized the excavation needed for the wheelpit and raceway, while enclosing the wheels inside the building helped to reduce icing during the winter. The two waterwheels used water from a common headrace, though each had its own sluice gate. Separate wheels allowed operational flexibility, since two mills could be run simultaneously when water was plentiful. On the other hand, one wheel was powerful enough to operate one mill during periods of low demand without wasting water.

Each wheel was 17.5 feet in diameter and 4.5 feet wide. The available net head of water was about 2 feet. It is theorized that each wheel might have rotated at 7.5 rpm and have developed 5-6 horsepower.

In retrospect, it is apparent that the power requirement of the 1765 oil mill exceeded the waterpower resources available at the site. The Monocacy Creek was used to drive three waterwheels (two at the oil mill, one at the adjacent waterworks) from one low dam without sizable storage reservoir. As Bethlehem grew, there were times when the oil mill had to shut down so that the waterworks could pump sufficient water to the town.

## Oilseed Mill

Flaxseed was a by-product of the flax fiber crop and was received at the oil mill in bags or in baskets. If the seed was too damp, so that it might become moldy during storage, it probably was spread out on the floor of the loft and dried for a few days. Before crushing, the seed was cleaned to get rid of both the fine and the coarse impurities. The sieving machine in the groat mill was used for this purpose. However, the fanning machine probably also was used to clean flaxseed.

The next step was to crush the flaxseed in the four stamping mortars on the southern side of the oil mill. Breaking up the seed greatly aided oil release during the subsequent pressing. The stamping mortar was hollowed out of a large base log and an iron plate was installed on its bottom surface. Four such stampers were placed together and lifted in rotation by a revolving cam shaft and then released to fall into the mortar bowls. While filling or emptying a mortar, the operator raised the stamping pole out of the

action by means of a rope, lever, and peg mechanism. Flaxseed was thoroughly crushed to an oily meal in these mortars and then taken to the roasting pan.

The third step was to roast the flaxseed meal. Brief heating before the pressing increased oil yields by causing further rupture of the oil-containing cells in the seed. Sometimes the roasting step was omitted, however; and a lower yield of lighter colored, better quality "cold pressed" oil was produced. Constant mechanical stirring was always employed to avoid charring the seed with consequent oil loss.

The final step in the process was to press the linseed oil from the crushed and roasted flaxseed using a wedge press. This press consisted of a large wooden beam 27 inches square with a rectangular trough hollowed out of the center. The bags of roasted seed were wrapped in leather-backed horsehair mats and then placed between heated iron plates at each end of the trough. The remaining space between them was filled with two wooden wedges and several spacer blocks. One of the wedges was pointed downward so that blows on its top surface would produce lateral pressure to express the oil. The other was an inverted wedge that would release the press components when it was hammered downward. Heavy wooden stamping poles were positioned above each wedge.

With the press thus assembled, the idle pressing stamper was engaged with its lifting cam so that it was repeatedly lifted and dropped upon the pressing wedge. Some 40-60 blows on the wedge compressed the bags of roasted seed enough to cause linseed oil to trickle downward and drain into collector pans beneath the base log. After this oil flow stopped, the releasing wedge was pounded several times with the releasing stamper; and the press could then be disassembled and another run started. The oil produced was then poured into wooden kegs for storage and shipment.

After disassembling the press, the woolen bags were peeled off the hard, brittle press cake; and the cake was coarsely ground in the adjacent crushing mill. This ground cake was reprocessed in the same manner as fresh flaxseed to recover an additional amount of linseed oil. The cake from this second pressing was then ground and used for either cattle feed or fertilizer.

Flaxseed processing was mainly a wintertime activity at the null. The crushing started in late October or early November soon alter the flax harvest and continued more or less regularly through the winter and spring until all the seed was processed. Two men could process ten bushels of flaxseed per day to produce 14-17.5 gallons of linseed oil. Highest yields were obtained when less seed was put into the press bags and the bags were left in the press longer. The sound of the stamping poles falling every few seconds made the oilseed mill a noisy place. Anyone working there for a number of years probably suffered from "oil miller's disease" (partial deafness) as a result.

Linseed oil was not the only oil produced at the Bethlehem oil null. Hempstead, a by-product of the hemp crop grown for fiber, was crushed in the same manner as flaxseed to produce Hempstead oil, a product that could partially be substituted for linseed oil in

paints. In 1768 Dr. John Otto, a Bethlehem physician and apothecary, experimented with making sunflower seed oil and cottonseed oil at the oilseed mill, The sunflower oil was "frequently used by our brethren for salad," while the cottonseed oil served as medicine for the treatment of colic.

**Hemp Mill**

Following the tradition of their German homelands, the Moravians utilized some hemp for making strong, durable cloth. Hemp fiber was spun into hempen yarn and then woven into hempen cloth. To make the coarse hemp fibers soft and pliable enough for normal spinning and weaving, it was necessary to hammer, stamp, or roll them to break down their natural resinous coating and to subdivide the fibers after they had been processed much like flax fibers by rotting, drying, crushing in a hemp brake and hackling. This softening process was accomplished using machinery at the oil mill. The stamping heads shown in the 1766 Herrnhut drawings appear to be stepped like those used in fulling mills. This interpretation seems likely for two reasons. This was a dual purpose mill designed to full leather as well as to stamp hemp. Moreover, before the 1752 hemp stamping mill was built, the Moravians had used their cloth fulling mill to stamp hemp.

Then in 1767-68 another type of hemp softening machinery was installed at the oil mill. This was a hemp roller consisting of a stone that rolled around a circular bed.

The fact that the Moravians built a second type of hemp softening mill in only two years after completing the 1765 machinery implies tliat their 1765 hemp stamping mill did not yield satisfactory results. In their 1765 advertisement they had claimed a distinct advantage for their stamping mill: "The Hemp is not rubbed with a Pumicestone [roller stone] in the common Way, that being attended with many Dangers; but it is stamped in a particular Manner and becomes pliabler and fitter than with the Stone." Apparently this claim was not realized. Their customers may have been quite satisfied with the "common" hemp roller mill, or perhaps the roller mill processed hemp with less manpower and thus at less cost.

Hemp was usually processed at the mill during the late fall and winter months. Hemp softening continued, at least through 1792. No mention of the process after that date has been found.

**Tanbark Mill**

Tanbark used in the tanning process was stored in a shed just north of the oil mill to prevent rainwater from washing out the valuable tannins. It was stamped as needed. Before the bark could be used for tanning, it was reduced to a very coarse powder with a tanbark mill. A coarse product was desirable for several reasons: small particles could be handled more easily than a fine powder, water would penetrate better for leaching out the tannins, the tannin-rich liquor would filler out more readily, and the tan vat residue would dry more quickly. Most early American bark mills were animal-powered

and consisted of a large cylindrical stone rolling around a circular bed, crushing the bark with its weight. The Moravians, however, followed contemporary German practice and built a bark stamping mill in Bethlehem.

The tanbark stamping machinery installed in 1766 consisted of four stamping poles 18 feet high which fell upon bark placed in two mortars hollowed out of a large base log 9 feet long and 26 inches square. Each stamper had a large iron head with cutting knives on the bottom. Lifter cams on the waterwheel shaft raised the stampers, then released them to fall and chop up the bark in the troughs. The vibrations from the alternately falling stampers and the asymmetrical shape of the mortar bowls continually shifted the bark for even cutting. To contain the inevitable dust resulting from stamping dry tanbark, a wooden case was built around the mortars shortly after the mill was installed. From 17-23 mortarloads of tanbark could be stamped in one day, so the loading/stamping, unloading cycle must have lasted about one hour. The production capacity of the mill was about 175 cords of raw bark per year.

The 1766 tanbark mill remained in use for four decades. The records show a major repair or improvement of the machinery in 1794, but no details of this alteration have been found. In 1806 the tanner complained that the continual shortage of water prevented the oil mill from stamping as much tanbark as he needed. A new horse-driven tanbark mill was installed in a separate building and tanbark stamping at tire Bethlehem oil mill ended in 1807.

**Groat Mill**

Groats, coarsely ground cereal grains, were a regular part of the diet for Bethlehem's early population. They were produced from barley, oats, buckwheat, and millet by first removing the outer hull of the grain and then coarsely grinding the interior kernel. Barley groats (peeled barley, pearl barley) were used in soups. Oat groats (oat grits, oatmeal) and millet groats were boiled into a porridge. Buckwheat groats (grits or meal) were also boiled into a hot cereal, which was sometimes made into small cakes and fried.

Initially, when the oil mill opened, groats were first stamped to free the hulls from the grain and crack some of the kernels. The product was then cleaned by winnowing before use. As soon as the new millstones were in place, the groats were ground by millstones. Ten bushels of barley yielded five bushels of pearl barley. Ten bushels of oats produced 3 bushels of oat meal. Various other grains were sometimes processed in the groat mill. Spelt, a variety of wheat on which the husk remains after threshing, was husked from time to time using the hulling mill in the oil mill. Maize was occasionally ground into meal. Large quantities of split peas were produced in 1768-70. The groat mill also ground barley malt for the local brewery.

Grain milling at the oil mill continued for over a century, 1766-1875. Some equipment changes were made from time to time, but very little is known about these alterations. An oat meal sieving or bolting device was installed in the groat mill in 1794. In 1814 the oat dyer was redesigned to reduce the fire hazard. "A run of stones for buckwheat" was

installed sometime between 1835-1847. In general, however, the basic technology remained very similar to the original 1766 milling process.

**Snuff Mill**

The Moravians operated a profitable tobacco manufactory at Bethlehem producing cigars and snuff as well as smoking and chewing tobacco. The bulk production of snuff required milling equipment to reduce the tobacco leaves to powder and this processing was carried out at the Bethlehem oil mill from 1766 into the 1820s and possibly even later. The oil mill did not make and sell finished snuff for its own account; rather it provided custom milling services for the Moravian tobacco manufactory and other local tobacco processors who made snuff.

Snuff milling at Bethlehem falls into two definite eras. From 1766 to 1793 stamping machinery was used to produce a finely-cut tobacco. Then in 1794 the Moravians purchased a new snuff null capable of making a powdered product. This latter mill remained hi use for over 30 years. Although tobacco milling was a major activity at the Bethlehem oil mill for 60 years, no description of the precise machinery has been located.

**Some Master Oil Millers**

- George Christ (Work Years 1745-1752)
- Albrecht Klotz (Work Years 1752-1757)
- Johann Georg Geitner (Work Years 1757-1762)