Ancient Agricultural Powered-Mills, Part I

by C. Mundigler

In the last issue of *Labyrinth* we looked at the ingenuity that went into the development of early hand-mills used in processing harvested grains. This ancient ingenuity, however, did not stop there, but continued to produce a number of labour and time saving devices which did the same job of agricultural grinding in far less time and with far greater efficiency.

Powered grain-mills came in a variety of shapes and sizes to suit any need -- private or commercial -- and any environment -- rural or urban. The rotary hand-mills of Hellenistic and Roman design, described in the last issue, may well have undergone a direct transformation from the small, portable quern into the massive hourglass-shaped donkey-mills standing almost seven feet high at sites such as Pompeii and Herculaneum. By enlarging the upper and lower grinding stones and attaching wooden grips to the upper millstone, two people could easily put all their weight into turning the large rotary-mills in order to produce substantially more flour than many hand-mills could produce in far more time. These so-called "Pompeiian" mills, or *molae* consisted of three parts (as shown in the accompanying cross-sectional diagram): a lower, conical-shaped millstone, called the *meta*; an upper millstone, or *catillus*, which was hollowed out on the inside to fit over the *meta*; and a framework of wooden beams, which fit over the *catillus* and provided the means by which the whole apparatus was turned. The top portion of the hourglass-shaped *catillus* was also hollowed out to act as a hopper which held the grain as it slowly fell between the two grinding stones. The rotary action of these two stones on each other produced a usable flour, the fineness of which was regulated by the amount of space the miller allowed between them by means of an internal pivot pin.

Holes were cut into the middle of the *catillus* to support the wooden framework and allow the whole upper assembly to be turned by horses, mules or even slaves pushing on them. Apuleius, writing in the second century AD, described the poor state of life for these unfortunate slaves engaged in the drudgery of working the Pompeiian mills -- bruised, shackled, scarred, "befouled" and blinded by the whirling flour as they continued their "heavy toil...dragging all day at the fatiguing machine." (*Golden Ass*, IX.12 and VII.15). The conditions would have been horrendous for these slaves -- the working space cramped, and the work itself hard and boring, not even fit for the donkeys or worn-out horses that were forced into the work as well.

The human factor aside, controversy has raged for some 60 years now as to whether the rotary hand-mill preceded the donkey-mill or vice versa. References to donkey-mills go back as far as the fifth century BC in Greek literature and some may even predate references to rotary-querns as well. Sources, both literary and archaeological, are still sketchy. Academic papers presented as far back as the 1930's and 1940's argue that the rotary-quern evolved from the larger Pompeiian-type mill. Many other scholars, however, contend that the rotary hand-quern gave rise to the larger Pompeiian donkey-mill.

While hard evidence seems to suggest that animals were used as the first source of power for milling by at least the second century BC in Europe, this is not the only form of power harnessed to revolutionize agricultural food processing. By this same time, the Chinese had adapted water-power to the grinding of grain on a large scale. This was, in fact, the predominant source of power in China and Asia until about 175 AD when

animal-powered mills began to appear in the Far East as well.

The first century BC historian Strabo (in his *Geography*, XII.3.30-40) was one of the first to describe a water-mill dating to about 100 BC at the palace of Mithridates in Pontus (now north-central Turkey). This dates to before the time of the Roman engineer Vitruvius and his undershot water-wheel mill (described in *Labyrinth* No.54) and was probably of the vertical-shaft, horizontal-wheel type. This particular breed of water-mill was simply a marriage of the rotary-mill, already described, with the water-wheel laid on its side, vanes angled against the force of the water directed on them via a millrace from a fast mountain stream. It had a vertical axle which led up to a rotating millstone which in turn ground against another round millstone to produce the desired flour meal. This seems to be the earliest and simplest type of water-mill, although the evidence as to its real origin and date is still under review. Evidence of these vertical-mills has been found from the Caspian Sea to northern China, and from Syria to Greece, Italy and Spain, then north through France to Ireland, and from there, via the Vikings, to Norway. Where exactly between China and Norway it developed is not entirely clear but obviously its invention predates its appearance in the Mediterranean region around the first century BC. Again, controversy surrounds the question as to whether the vertical-mill was a direct adaptation of the earlier rotary-mill we have already looked at. It does, for all appearances, seem to be merely a mechanized version of the rotary-quern, but the definitive answer still awaits some startling new discovery....

The efficiency and longevity of this simple device, which needed no gearing and was easy to build and maintain, can easily be seen by the fact that it survived well into the modern world, even through the "darkness" of the Middle Ages. Gregory of Tours, for example, writing in the sixth century AD, described the Benedictine monastery vertical water-mills as being turned around at "wondrous speeds" by the rushing rivers nearby (*History of the Franks*, III.19).

As with most technologies, the simple leads to the complex as we shall see next time when we continue our look into the mechanization of agricultural grinding and milling.