DIGGING UP TECHNOLOGY: THE WATER-MILL OF TEMSE

Dirk Van EENHOOGE

The former water-mill of Temse (East-Flanders, Belgium) was actually one of several buildings on an early industrial site, which also included a 16th century house and brewery and a horse mill. The water mill was built in 1616 by Alexander de Bournonville, then Lord of Temse, near the junction of the River Scheldt and a small stream called the Vrouwenhofbeek. The mill was a tide mill, its wheels being driven by the water receding from the adjacent mill pond during the ebb tides of the Scheldt: consequently the mill could only be operated during these periods of low water.

In 1876 the water wheels stopped turning, and were replaced by a steam engine, until commercial exploitation of the mill was finally brought to an end in 1893 and the machinery dismantled and sold. The building was eventually converted into a restaurant, which was severely damaged during a very high spring-tide in 1973. The property then stood empty for many years until renovation work was started in 1986, at which time archaeological research was carried out by the Administration for Monuments and Sites of the Flemish Community (*Fig. 1*; *Van Eenhooge 1988*; *1993*).

In the water-mill, five distinct building periods were recognized, but only the latest three could be well documented, since investigation of the earlier constructions would have meant the destruction of the later ones. This paper however, will not deal with the history of the building itself, but will focus on the evolution of the technology that was applied within the building. It was possible to reconstruct this evolution, not only using data from the excavation, but also by studying written sources, such as an estimation report from 1839, a contract from 1851 and documents relating to the sale of the mill in 1893.

The water-mill in the seventeenth century

As already stated, very little is known about the original constructions. What is clear however, is that from the beginning the mill possessed two water wheels, whose shafts turned in a deep pit situated in the eastern part of the building (*Fig. 2*). In 1627, written sources mention the grinding of corn and bark and the production of oil; this, of course, confirms that two totally different milling constructions were present.

The mill in which oil was produced can most probably be identified with the northern or "Upper Mill". Unfortunately, this construction was almost completely demolished when new machinery was installed in the 18th century. Only two flues in the northern wall and possibly a fireplace against the same wall (*Fig. 3:d*) belong to this period, and indicate the locations of the two ovens on which the seeds were heated before and during the milling process; wedge-shaped openings in the wall, situated next to each flue, belong to the same construction.

Fortunately, remains of the southern or "Lower Mill", in which corn must have been ground,were much better preserved (*Fig. 4*). These remains include: a freestone slab (*Fig. 3:o*) with two pairs of iron pegs, which held the wooden blocks on which was laid the waterwheel-shaft; on both sides of the slab, U-shaped brick constructions (*Fig. 3:m*) into which was fitted a heavy beam that supported the vertical pivot of the

mill; and an adjoining pit (*Fig. 3:l*) that housed the lever by which the pivot could be lifted or lowered in order to stop or start the running of the mill. A reconstruction of the actual machinery was, of course, not possible on the basis of these remains alone, but a very detailed description of the machinery in an estimation report from 1839 proves that this lower mill can be identified as an "archaic" type with only one runner, as described for example in the *Theatrum Machinarum Molarium,* published by J. M. Beyer in 1735.

In these "archaic" mills, the waterwheel (*Fig. 5:1*) and watershaft (*Fig. 5:2*) drive a smaller wheel (*Fig. 5:3*), that itself drives a horizontal runner (*Fig. 5:4*) on the lower part of the pivot (*Fig. 5:5*), which passes through the lower millstone, and drives the upper millstone. With this "archaic" mill type, only one pair of millstones could be driven by each water-wheel. Consequently it is not surprising that in the estimation report of 1839, we are able to find evidence of the progress that had been made in developing a more efficient mill technology.

The water mill in the eighteenth century

The estimation report actually mentions three different mills, which were probably already in place by the end of the 18th century. The "Lower Mill", with its archaic technology, has already been described, but the report contains further descriptions of two more mills, which required considerable investigative work before a plausible reconstruction could be worked out.

During the excavation very few traces of the northern or "Upper Mill", which had replaced the original oil mill, were found: a massive brick column in the shaft-pit (*Fig. 3:h*) and an adjoining brick platform (*Fig. 3:f*)

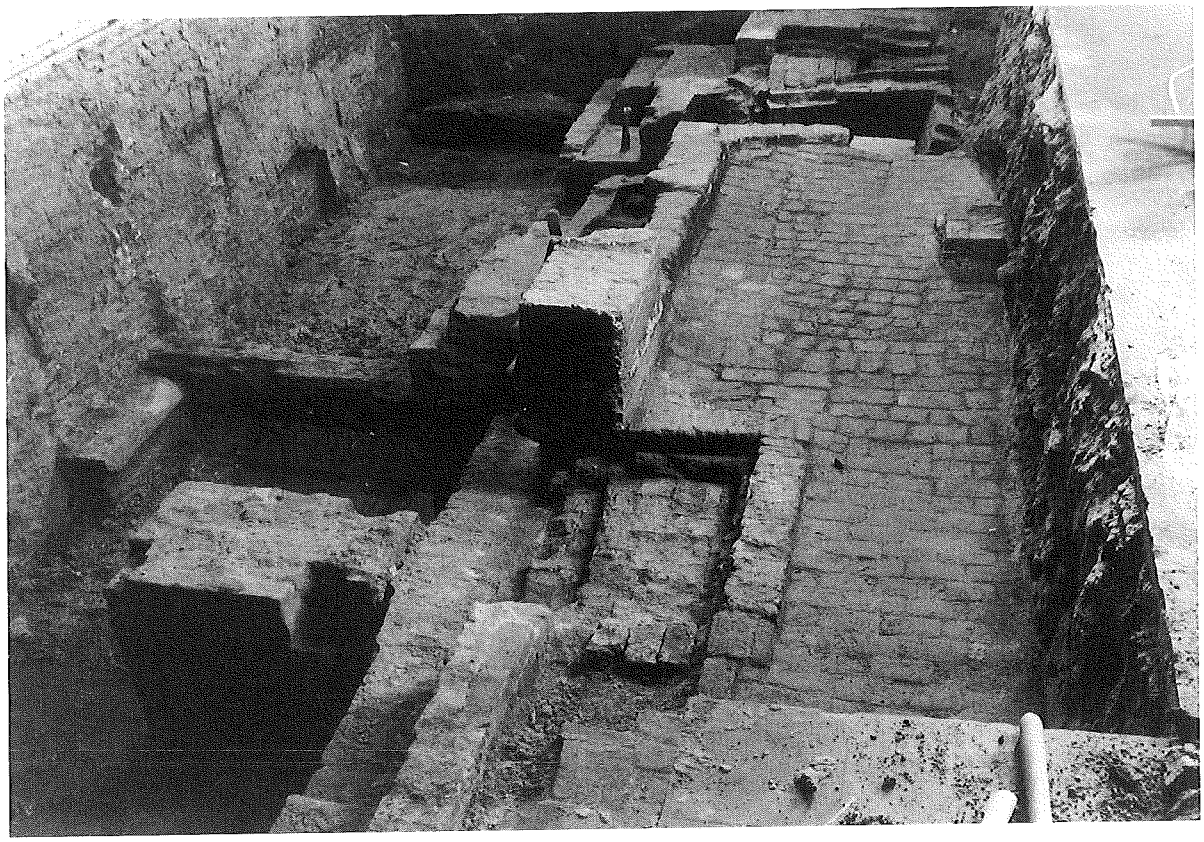

Fig. 1. Interior of the mill during excavation.

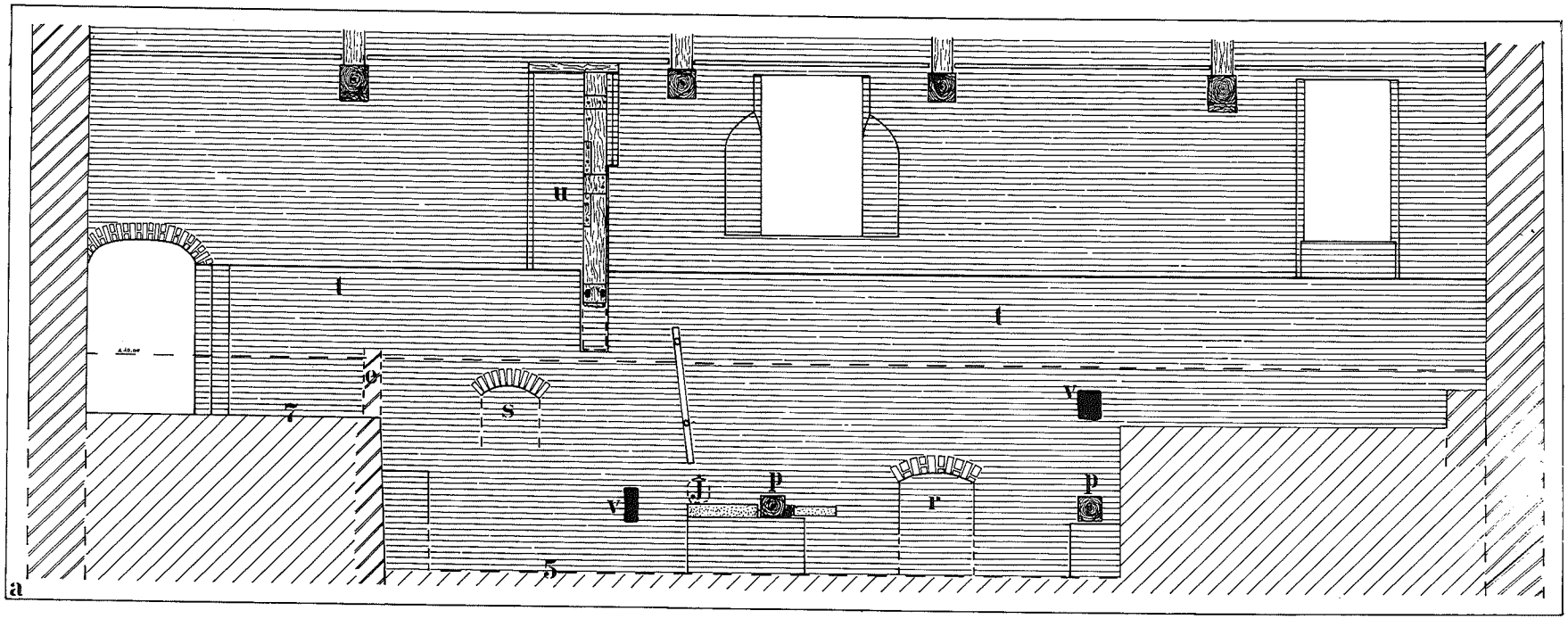

Fig. 2. Inside view of the eastern wall of the mill, with (r and s) the location of the two waterwheel-shafts.

are part of a rebuilding which possibly included the whole northern part of the pit. Consequently, the report of 1839 is the main source for a reconstruction of the new "Upper Mill".

In the list of machinery parts for this mill, two important facts can be pointed out: first, the list mentions two runners, one associated with the watershaft, the other with the millstones; secondly the "spille" or pivot is not mentioned.

The word "spille" seems to have been used only in descriptions of mills in which the pivot that turns the millstone was driven directly by a runner activated by the watershaft.

That this was not the case in the "Upper Mill" is further evidenced by the mention of two runners. This means that we have to assume a double transmission, in which the wheel (*Fig. 6:3*) that is driven by the watershaft, itself drives a first runner (*Fig. 6:4*); to this runner is attached a short pivot that drives a wheel (*Fig. 6:5*), that in its turn drives a second runner (*Fig. 6:6*) and thus the upper millstone. Although there is no reference to a wheel between the two runners in the 1839 report, there can be little doubt that this reconstruction is valid: in no other mill type can two runners be associated with the other parts mentioned in the report.

The type of double transmission postulated for this mill, was already detailed in the *Theatrum Machinarum Molarium* (1735), and therefore could have been in place as early as the beginning of the 18th century.

The introduction of the double transmission was an important improvement in milling technology, and was highly successful: it continued to be used in many Flemish water-mills, even when cast iron wheels and transmissions replaced the original wooden ones in the late-19th century. The main advantage of this relatively simple construction was that up to four pairs of millstones could be connected to one waterwheel, whereas in the "archaic" mill type one waterwheel could only drive a single pair of stones.

When, however, a third mill was added and connected to the existing constructions, the choice fell not on a duplicate of the "Upper Mill" as might have been expected, but on an entirely new and different technology. Exactly when this took place is not very clear: a lease, dated 1851, mentions "the third pair of (mill)stones... that had been installed by the miller Rooms". However, the Rooms family, as we know from other leases, and from registers of the city of Temse, exploited the water-mill for the entire period between 1715 and 1817, so this helps little in establishing a precise date.

The addition of the third mill was evidenced in the excavation by a few brick walls (*Fig. 3:g* and *k*) which were squeezed in between existing constructions and by a brick column in the shaft-pit that supported an additional wooden beam (*Fig. 3:j*).

The description of this "Middle Mill" in the 1839 report differs considerably from the others and introduces machinery parts that are typical of windmill constructions with an over-shot wheel. In this mill type, the upper millstone is driven by a runner and pivot placed above the stone, whilst we have already seen that in the traditional water mills the drive was situated beneath the stones.

The reconstruction that has been made of this "Middle Mill" (*Fig. 7*) shows the waterwheel, watershaft and wheel, and short pivot with runner and wheel of the "Upper mill" (nrs. 1 to 5 in *Fig. 6*), to which is coupled a runner (*Fig. 7:2*) on the lower part of a pivot (*Fig. 7:1*), that drives a wheel (*Fig. 7:3*) near its top; this wheel then drives a runner (*Fig. 7:4*) on a third pivot (*Fig. 7:5*) which passes through the two millstones. The report of 1839 goes on to mention the lever mechanism (*Fig. 7:6-9*) and the wooden construction enclosing the millstones (*Fig. 7:11-13*).

The use of an over-shot wheel in the "Middle Mill" makes possible a slightly more accurate dating. In 16th and 17th century books on milling technology, the over-shot wheel is conspicuously absent. This is also the case in the (German) *Theatrum Machinarum Molarium,* published in 1735. The technology of the over-shot drive was first developed in Dutch wind- mills and introduced in water mills in the first half of the 18th century. In Flemish water mills however, its application probably did not happen before the second half of the 18th century. Moreover, it is commonly believed that the over-shot drive was not found in watermills located south of Antwerp. Its presence in the Temse water mill however shows that this is not the case. Indeed if one takes into account the fact that Temse could easily be reached from Antwerp by a fast trip on the River Scheldt, it is hardly surprising that the millers in this area should have had access to the new technology.

Summing up, we can state that by combining the evidence found in the excavation of the building with a careful reading of the written sources, it was possible to make a reconstruction of the different types of mill that had been present, and to demonstrate that the estimation report of 1839 actually reflected nearly two centuries of milling technology: the 17th century archaic "Lower Mill", the early-18th century "Upper Mill" with double transmission, and the probably late-18th century "Middle Mill" with over-shot drive.

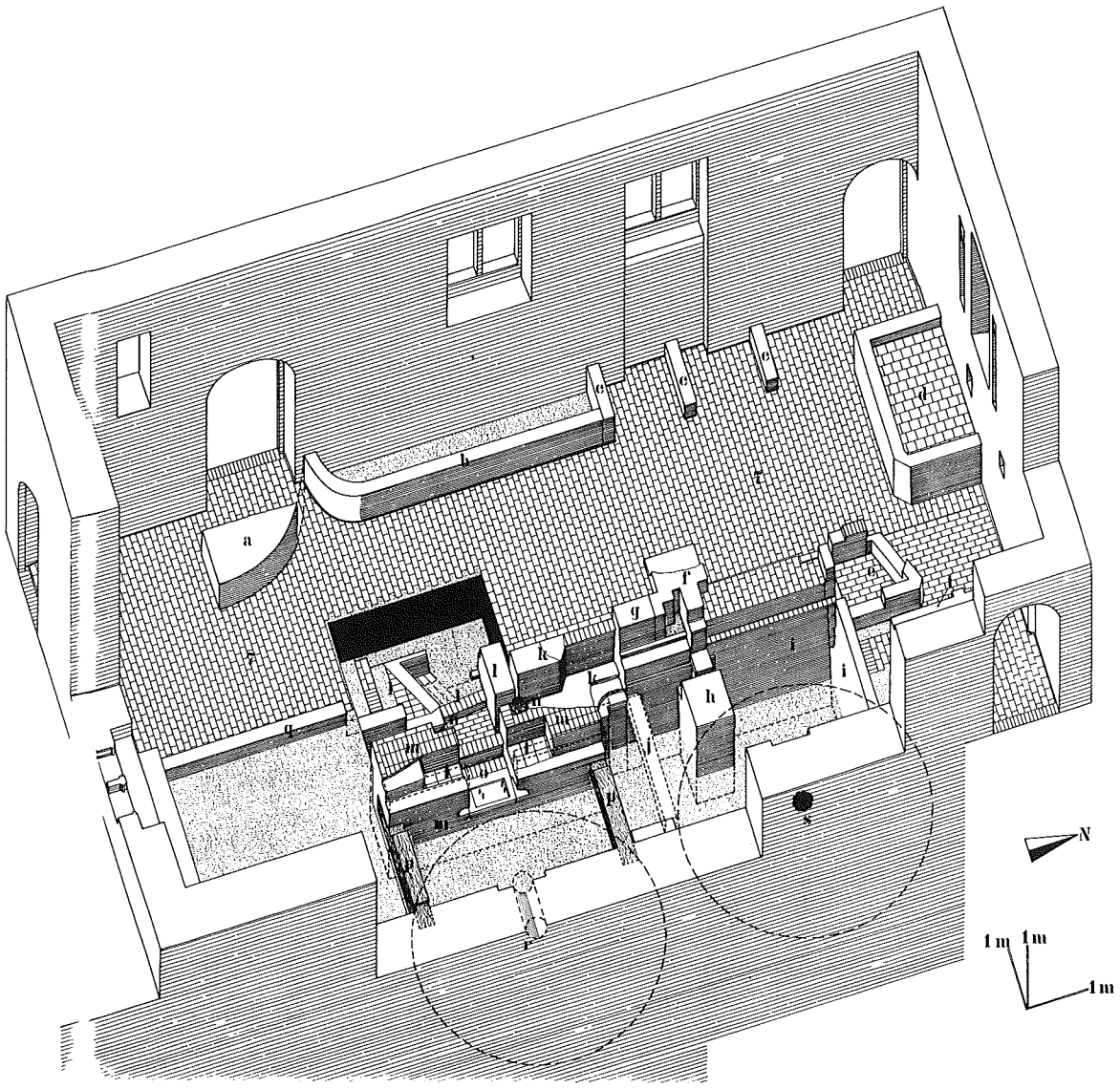

Fig. 3. Axonometrical view of the interior of the mill.

Fig. 4. The base of the 17th century "Lower Mill".

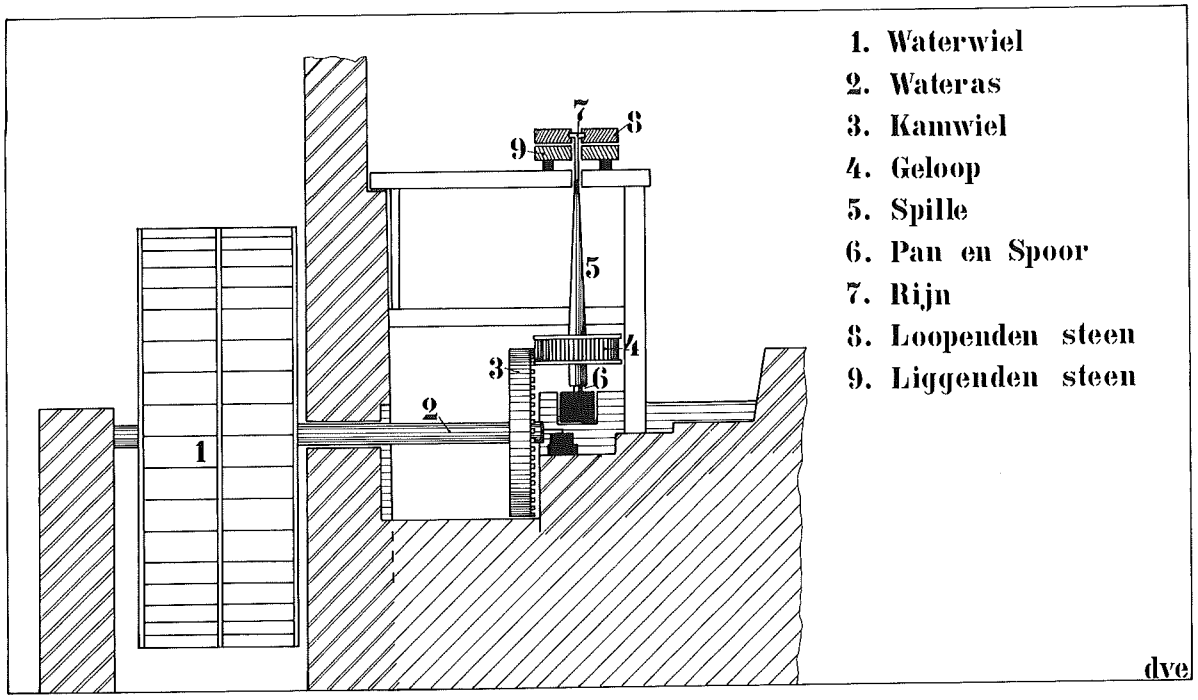

Fig. 5. Reconstruction of the 17th century "Lower Mill", and the list of machinery parts as mentioned in the report from 1839.

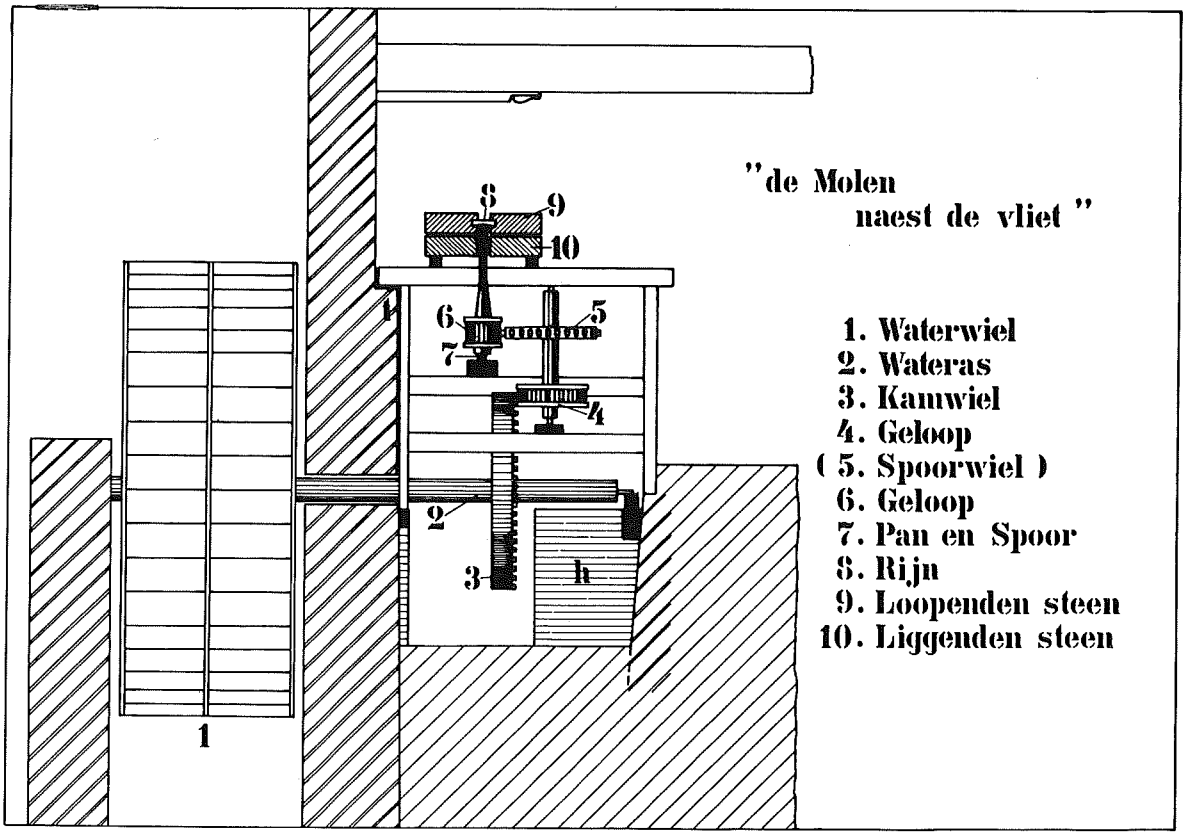

Fig. 6. Reconstruction of the early-18th century "Upper Mill"

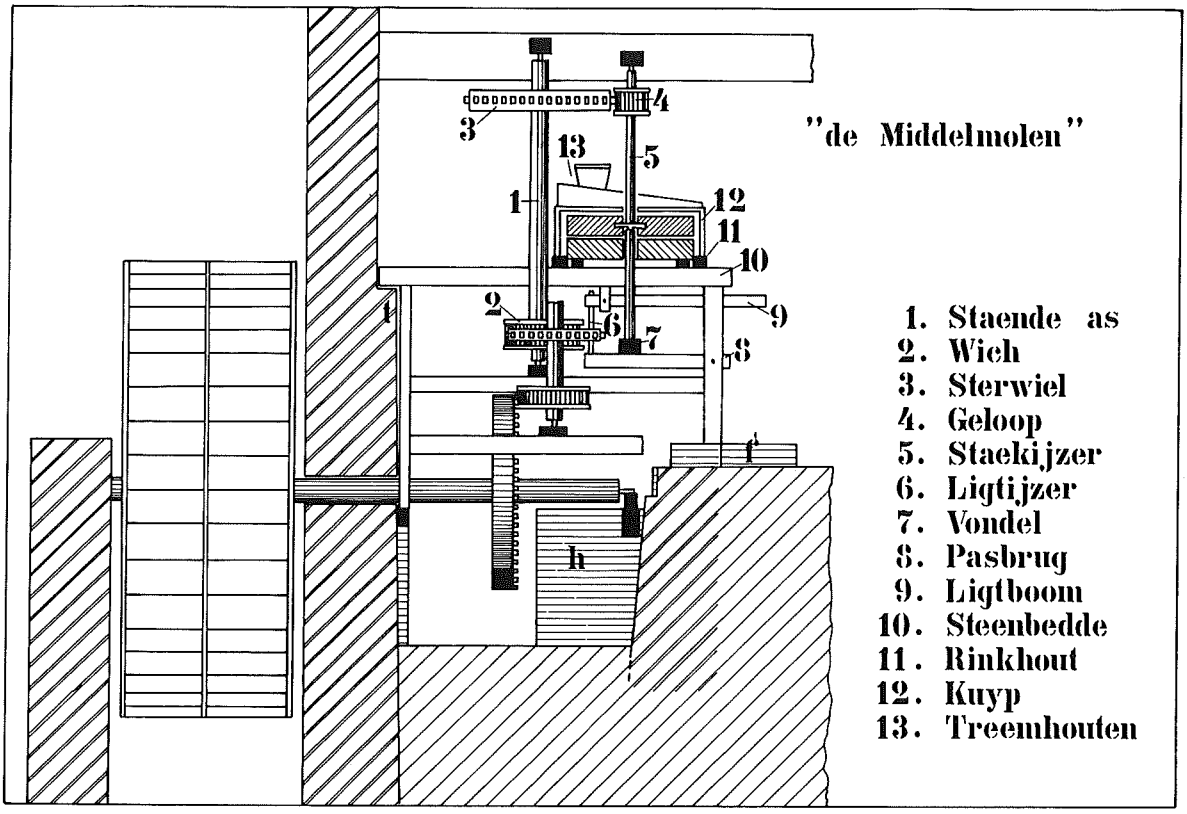

Fig. 7. Reconstruction of the late-18th century "Middle Mill"

RECHERCHE SUR LA TECHNOLOGIE: LE MOULIN À EAU DE TEMSE

Le moulin à eau de Temse faisait partie d'un site proto-industriel qui comprenait une maison et brasserie du 16ème siècle, et un moulin à eau bâti en 1616. En 1986, à l'occasion de travaux de rénovation, une investigation du moulin fût entreprise, et l'intérieur en partie fouillé. Les résultats de la fouille ont ensuite été combinés avec une étude de sources écrites. Ceci a permis une reconstruction des trois moulins qui étaient présents vers la fin du 18ème siècle, et qui illustrent l'évolution de la technologie des moulins à eau durant le 17ème et 18ème siècle.

AUSGRABUNG DER TECHNOLOGIE: DIE WASSERMÜHLE VON TEMSE

Die Wassermühle von Temse gehörte zu einer früh-industrielle Stelle die einem Haus und eine Brauerei des 16ten Jahrhundert und eine Wassermühle, gebaut in 1616, umfasste. Wann in 1986 die Gebaüde renoviert wurden, wurde die Mühle untersucht, und zum Teil ausgegraben. Die Ergebnissen dieser Untersuchung wurden kombiniert mit historischen Quellen, sodass eine Rekonstruktion der drei Mühlen die am Ende des 18ten Jahrhunderd anwesend waren, möglich wurde. Sie illustrieren die Entwicklung der Technologie der Wassermühlen im 17ten und 18ten Jahrhundert.

References

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— *1993:* De geschiedenis van het huis Sint-Anna te Temse, M & L, Monumenten en Landschappen 12/4, 10-24.