On The Origins of Hydro-Technics: The Gardens of Noisy (1570)

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In the eighteenth century, all the great European gardens had spectacular water features due to the influence of the gardens of Versailles and Marly, which had amazed their contemporaries. From Peterhof (Russia) to La Granja (Spain), from Sadabad (Turkey) to Chatsworth (England), the art of water was at its most sumptuous. From then on, sumptuary hydraulics took on a special place in the art of gardens with its specialists, the fountain builders, contributing to the creation of the basins with their pipes. The large waterfalls, which were built in imitation of those of the French king, rivalled each other in length, height and decoration. Over time, the uses of water in gardens multiplied and diversified. These great gardens are the result of three centuries of creation, innovation and progress.

The Grandes Eaux of Versailles still attract huge crowds today. The success of this show is exceptional and is based on a 17th century creation which, for the most part, has preserved the original operation and water games. It is, in fact, first and foremost a hydraulic monument: here the water effects have been admired since the reign of King Louis XIV. The water brings an art of ephemerality that embellishes a garden built around clever perspectives, parterres, topiaries, vases, statues and various constructions, but a garden built first and foremost around the architecture of water. What is admired at Versailles, in the spectacle of the Grandes Eaux, are the basins and their water jets, i.e. the effects produced by the entire hydraulic system. However, there is no such thing as a result without technical means: for hydraulics, from catchment to jet, the production of the water masterpiece requires equipment and devices, in other words, hydro-technics.

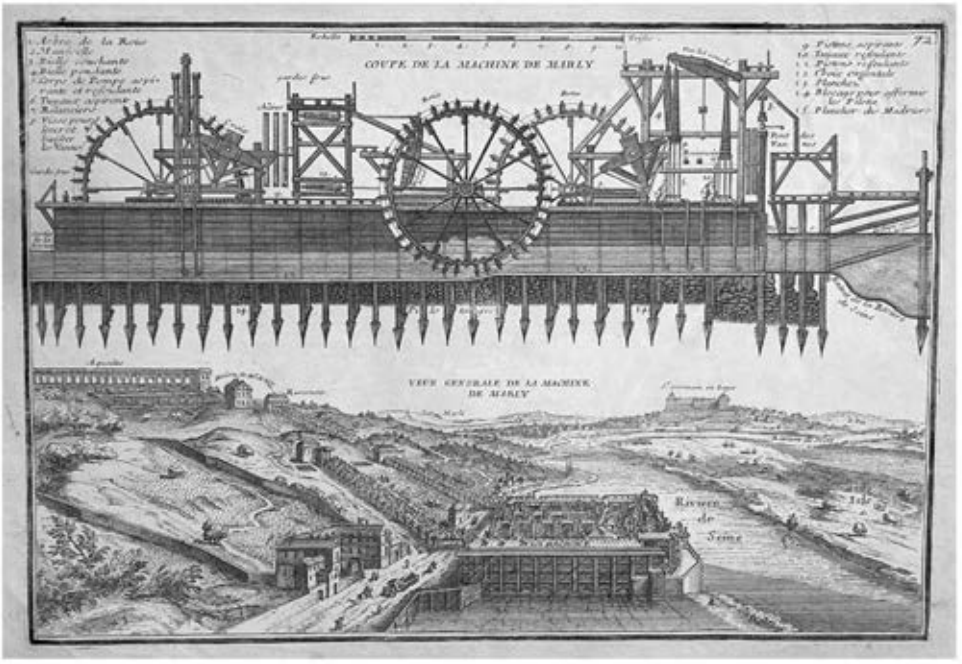

Figure 1: The Marly Machine, engraving, late 17th century (private collection)

At Versailles, the gigantic hydraulic network created for the gardens is difficult to quantify, depending on what is counted: the dozens of basins, the hundreds of kilometres of pipes or the thousands of nozzles. However, there was a problem feeding this elaborate system with enough water. This situation led to the mobilisation of many scientists, engineers, surveyors and technicians to find solutions for collecting and conducting the water in the surrounding area. Among the most daring ideas, we should mention the project to divert the Loire; the unfinished work on the aqueduct of the river Eure; and, finally, the damming up of the Rambouillet ponds which, by force of gradient, fills the great royal canal as far as Versailles. In addition, from the outset, mechanical installations were also used: the pump-mills of Clagny and then of the River Bièvre, whose flow was as weak as it was random. It was finally the creation of the Marly Machine, drawing from the River Seine, that completed the water catchment works [1]. The hydro-technical device used in this Machine was innovative as it allowed water to be raised to a height of about 150 m. This difference in level made it possible to reach the plateau overlooking the Versailles area, where storage reservoirs were dug from which the water could then be conveyed by a natural gradient network. The mechanism of this Machine was entirely set in motion by fourteen large paddle wheels which operated a series of piston pumps and linkages used, by sheer mechanical force, to carry the water off course over a long distance along the hillside in order to draw off the water in three stages. (Fig. 1) The Marly Machine was the ultimate technical achievement in the service of modern garden fountains, but in reality it was of no use to Versailles. By the time it was put into operation and the waters of the Seine finally reached Versailles in 1685, most of the fountains and waterworks had been completed and the time for great garden festivities had passed.

There was no new water feature at Versailles linked to the Marly Machine because the waters of the Seine arrived at Versailles in the Montbauron reservoirs in which the waters of the Rambouillet ponds were already stored. It is true that the Machine added to the reserves but it only enhanced the capacity of the network rather than being able to create new features. The only consequence of the creation of the Machine for the gardens of Versailles was to be able to prolong the duration of the spectacle of the Grandes Eaux which, formerly, accompanied the king's walk. In order to make the most of this abundant resource, there was a plan to double the size of the Montbauron reservoirs. This project was abandoned, probably because in the end it did not allow the creation of new features in the fountains of Versailles. In contrast, in the newly created gardens of Marly, near the Machine, the original hydraulic network were completely transformed [2]. The creation of the largest water features, the grand jet (Fig. 2) and then the cascades (Fig. 3), testifies to the success of these large-scale works.

Figure 2: Marly, the Grand jet (cl. B. Béranger)

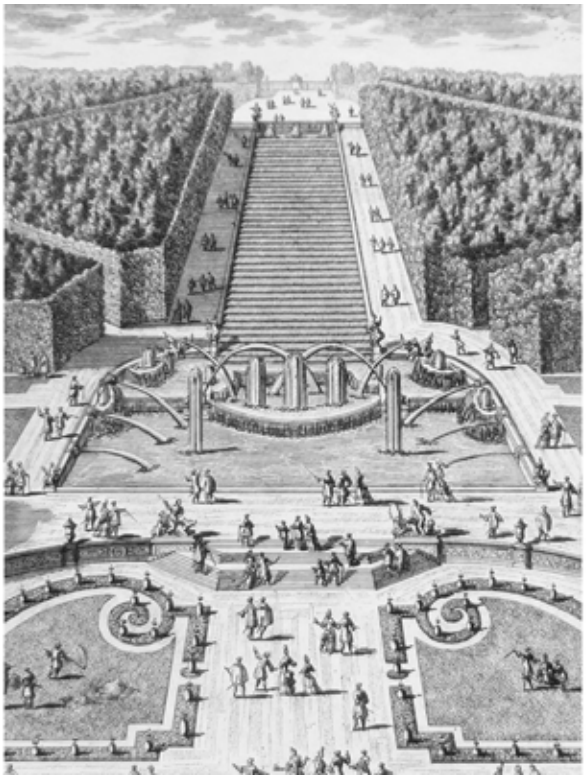

Figure 3: Marly, la Rivière d'eau, engraving by Pierre Lepautre, ca 1710 (private collection)

Water treatises

The tradition of water features is closely linked to the development of the pleasure garden. It originated in the Italian villas of the 16th century, the most famous example being the gardens of the Villa d'Este. Between Georgius Agricola's treatise *De Ortu et Causis Subterraneorum* (1546) [3] and Bernard Forest de Bélidor's *Architecture hydraulique* (1737-1753) [4], knowledge of geology and physics, surveying, the circulation of liquids, the manufacture of materials, and the science of gears evolved considerably. Heir to the works of Antiquity and the Middle Ages, the development of hydraulics thus followed the course of technical progress, giving rise to both new achievements and new processes in a continuous analysis of means and ends.

Bélidor offers a complete panorama of the hydro-technical installations created for the gardens of Versailles, in particular the new cast iron pipes with their flanged and screwed joints and the wheels and mechanisms of the Marly Machine. The work of the academics now made it possible to calculate the flows and heights of the jets, thanks to Edme Mariotte and Jean Picard, while the brothers Paulus and Rennequin Sualem perfected the mechanical remote transmission from the German minesfor raising water from the Seine. At the same time, the first tests of a motorised machine were carried out for the water of the Maisons gardens drawn from the Seine, but the result remained imperfect for a long time.

Earlier, it was the works of Jean François, *La science des eaux* (1653) and then *L'art des fontaines* (1665) [5] that renewed our understanding of the water cycle and the means of collecting and conducting it. He mentions the existence at Noisy of a remarkable device, "where the fountain that makes the water jets has no other water for source than that of a higher pond and this pond none other than that of the rains that are reserved for this effect [6]". In fact, this reservoir was dug on the plateau dominating the site: only the rainwater could fill it. It could then supply all the garden basins by gradient

flow. However, it is unlikely that this reservoir, located more than 600 m away from the garden fountains, was also used to produce the water jets.

The mechanics of the first machines for raising water are explained in the treatises by Salomon de Caus *Les raisons des forces mouvantes* (1615) [7] and Issac de Caus *Nouvelle invention de lever l'eau* (1644) [8]. The first pumps in Versailles applied these principles, in particular to pump water from the Clagny pond into the château's reservoirs. The first pump developed by Denis Jolly in 1664 was followed later by those of Claude Denis and Pierre Francine. They illustrate the progress being made in the manufacture of pumps and the various options using animal power (with one or two horses) or natural power (wind). The historian Pierre Matthieu reported in 1605 that an original machine had been tried out in Noisy:

> "The ancients were unaware of the industry of raising water higher than its source, and we and others would have remained in this ignorance without the ingenious and bold invention of Claude de Monconnis [...] who was the first to demonstrate it with admiration at the fountains of S. Germain en Laye & at the houses of the Maréchal de Retz at Noisy, & of the first President at Stains [9]."

The presence of Claude de Montconys in Noisy is not mentioned elsewhere. In 1599, he was appointed Superintendent of the King's fountains but his life and career are not well documented. Matthieu seems to be well informed, however, as he adds in the margin "The first proof of this invention was made in Rouen in the presence of the King, M. le Maréchal de Retz [Albert de Gondi] presented the inventor to H.M [10]." This meeting may have taken place in October 1596, when King Henry IV visited Rouen on the occasion of the Assembly of Notables, in which Albert de Gondi participated. This date is late for the work at Noisy, for which the role of Montconys remains uncertain, though his reputation as an engineer was established.

The Water Features at Noisy

Albert de Gondi acquired the property of Noisy in 1568 [11]. He was Count and then Duke of Retz, then became Marshal of France, making him First Gentleman of the Chamber of King Charles IX. His position at court was entirely due to the favour of the Queen Mother, Catherine de Medici, for whom he was one of the main advisors. Gondi was of Florentine origin and received important diplomatic missions, but he was also made responsible for supervising work on the royal buildings. Although he had lodgings in the Louvre and the Château de Saint-Germain, as well as his private mansion in Paris, he decided to build himself a pleasure house near the court. He had a small residence built in Noisy, with a villa built on a terrace surrounded by a wide dry moat overlooking extensive gardens with terraced flowerbeds. This layout is reminiscent of Italian gardens with, in addition, a pavilion decorated as a grotto.

The creation of the gardens of Noisy during the de Gondi period is attested to by several archival sources. In 1577, the Venetian ambassador Girolamo Lippomano, in the Relazioni di Francia, includes Noisy among the magnificent constructions around Paris:

> "where you can see arches, aqueducts, statues, gardens, parks, fishponds, and all the other amenities that you would expect from a royal building [12]."

By this time, the work was already well advanced, since Cambino de Cambini had already been entrusted with the upkeep of the gardens before 1575. It is possible that this gardener of Florentine origin participated in the earthworks. Another contract, signed in 1571 with a masonry contractor, Denis Courtin, for the walls of the castle entrance courtyard, also dates the start of the work shortly after the acquisition of the property.

During the recent archaeological excavations, new observations were made on the construction of the gardens [13]. The old terraces are still visible on the ground and can be clearly seen on a Lidar topographic survey. After the demolition of the buildings and all the visible masonry (walls of the terraces and courtyards), the site was integrated into the hunting park of the Château de Marly, and is still in a wooded area today. No construction has been carried out on the site, so that underneath a first layer of humus produced by the forest, there is still the backfill from the demolition covering some remains.

During the excavation of the grotto pavilion, built at the junction of two terrace levels, the foundations of the building were uncovered at a depth of about six metres. They were covered by the earthwork sands of the upper floor without any traces of reworking, which proves that the construction work was carried out before the terrace was built. The hydraulic pipes discovered under the grotto floor had therefore necessarily been laid at the beginning of the work. Similarly, when an old basin located in the middle of this high parterre was excavated, the drainage pipe was more than 2 m deep, in the earthwork, with no excavation trench above. It had therefore been laid when the parterre was laid out. The archaeological stratigraphy allows us to observe that the hydraulic network of the Noisy gardens was conceived at the same time as the initial project for the development of the site, i.e. between 1568 and 1570. (Fig. 4)

Figure 4: Noisy grotto, general view, 2019 (cl. I. Khmelevskikh)

According to the plans drawn around 1690, more than a century after the creation of the gardens, there were then six basins (in the middle of the upper and lower parterres on either side of the château, in the middle of the entrance courtyard and in the middle of the access ramps to the forest) decorated with water jets. (Fig. 5) The basin in the upper parterre of the grotto, rediscovered in 2020, still had a lead pipe with an opening in the centre of the basin to form a water jet. A piece of pipe from outside the basin was found in the backfill and measures 6 cm in diameter; the pipe in the basin invert

measures 5 cm in diameter and the outlet on the nozzle side is narrowed to 3 cm. (Fig. 6) The material used and this reduction show that this is an original pressure pipe, but we do not yet know its origin nor the height of the jet that was produced in this basin.

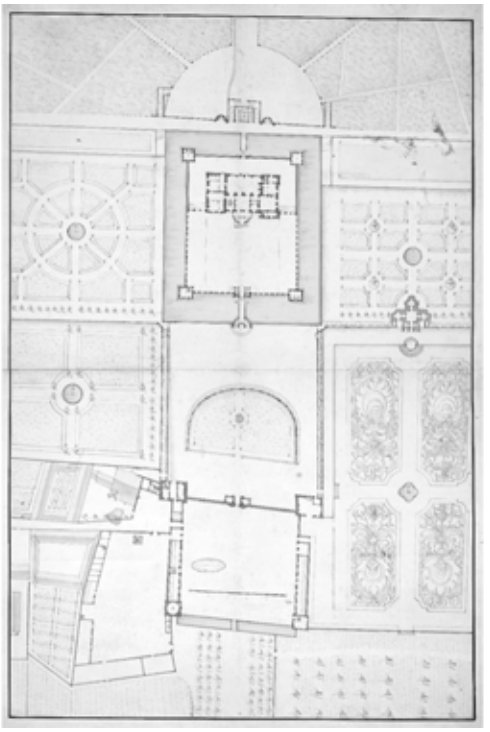

Figure 5: Noisy, Layout of the gardens, watercolour drawing, 1693 (Archives départementales des Yvelines, A 119)

Figure 6: Noisy, basin, lead pipe in the centre of the basin, 2020 (cl. Akane Hori)

Figure 7: Noisy, grotto, remains of two lead pipes, 2020 (cl. S. Chaumier)

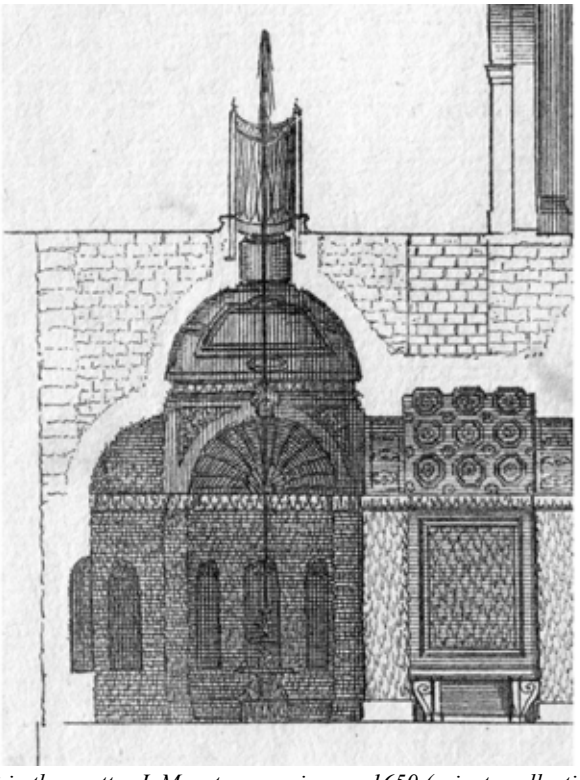

Figure 8: Noisy, the water jet in the grotto, J. Marot, engraving, ca 1650 (private collection)

However, there was also a fountain inside the grotto. It was drawn by Jean Marot in his *Recueil des plans* (1656-1659)[14] in cross-section, and described by François Boulin in his *Description du chateau de Noisy* (1732)[15]. During the excavations under its former location, two lead pipes were still lying side by side in the grotto floor. (Fig. 7) These pipes measure 3 cm in diameter: one was used to form the jet of water coming out of the fountain, the other certainly served as an outlet at the bottom of the basin while creating a pressure pipe that could feed the jet of water in the basin of the low parterre of the last terrace. We know the height of the jet from the engraving (Fig. 8) and the description: it was about eight metres high and projected through an opening in the vault so it was visible in the parterre above. The discovery of the lead pipes in the foundations and the integration of the jet into the architecture of the grotto make it possible to date this exceptional hydro-technical arrangement to the time of the original construction.

The Water Jet in the Grotto

This eight-metre high water fountain was certainly a remarkable water effect for visitors to the gardens of Noisy, but it was also a great hydro-technical achievement. None of the great gardens of the French king had such an ornament. At Chambord, situated at the bottom of the plain, the calm waters of the Cosson dominated and had to be channelled to the edge of the garden. At the Tuileries, the garden was still rudimentary and the water supply was only installed in the following century. The old chateau of Saint-Germain had only the small surface flow of the Grand Cours aqueduct. Whereas, at Fontainebleau, the hydraulic network created under François I only provided water for a few fountains. Without abundant resources and significant water effects, the hydraulics of the French royal gardens were still poorly developed in the 16th century [16].

Among the various water features, vertical water was still difficult to implement, especially in gardens located on the plain or on the heights of a plateau. The use of mechanical means was necessary when the site did not have an elevated reservoir. The hydraulic treatises of the Renaissance offer a wide variety of drainage pumps, the main challenge of which is to pump water from a depth of about ten metres below ground and to discharge it. They were mainly intended for extracting discharge in mines or for sourcing domestic water. Adapting this mechanism, Jacques Besson, in the *Livre premier des instruments* (1571)[17], proposes a machine for raising water to the top of a tower. Agostino Ramelli, in *Le diverse et artificiose machine* (1588)[18], presents, on the one hand, two fountains with various water features and, on the other hand, a series of dewatering machines placed above wells and operating with cranks or vertical or horizontal wheels manually driven.

This mechanism is probably closest to the two suction pumps for the cisterns that were located in two pavilions at the northern end of the Noisy esplanade. They are mentioned in the accounts of repair work in 1693 and in the description of 1732: "in two of these pavilions there were wells of extraordinary depth with pumps to draw water more easily [19]". This water was probably intended for domestic consumption. Another pump is also mentioned in the archives: it was located in another pavilion, this time to the south of the esplanade, about 60 m from the grotto fountain. This pavilion was referred to as the machine pavilion.

This pavilion and its machine have left few traces in the archives. Nevertheless, it is likely that this pavilion housed the machine used to create the grotto jet. The ground floor and first floor were probably used as living quarters, while the basement, which was about six metres high, was built into the moat. A plan from the end of the 17th century indicates the presence of a well to domestic supply. This well was found during an archaeological excavation in 2019, however its depth could not be measured beyond two metres (Fig. 9). Among the debris left over from the demolition, only a few fragments of clay pipes confirmed the existence of an ancient hydro-technical device.

Two important observations could nevertheless be made. The basement room, mainly occupied by the well, had a level access to the bottom of the moat. Although this door was not original, this indicates the presence of a workroom at this level. Furthermore, it was observed that the circular well (1.5 metres in diameter) was not built perfectly in the centre of

the room, whereas the entire architecture of the pavilion is built with symmetry and regularity. This imperfection can be explained by excavation work prior to the construction of the pavilion, which would have simplified the removal of the earth. This hypothesis reinforces the idea that the hydraulic network of Noisy was designed at the beginning of the construction programme.

Figure 9: Noisy, Pavillon de la machine, view of the well, 2019 (cl. B. Bentz)

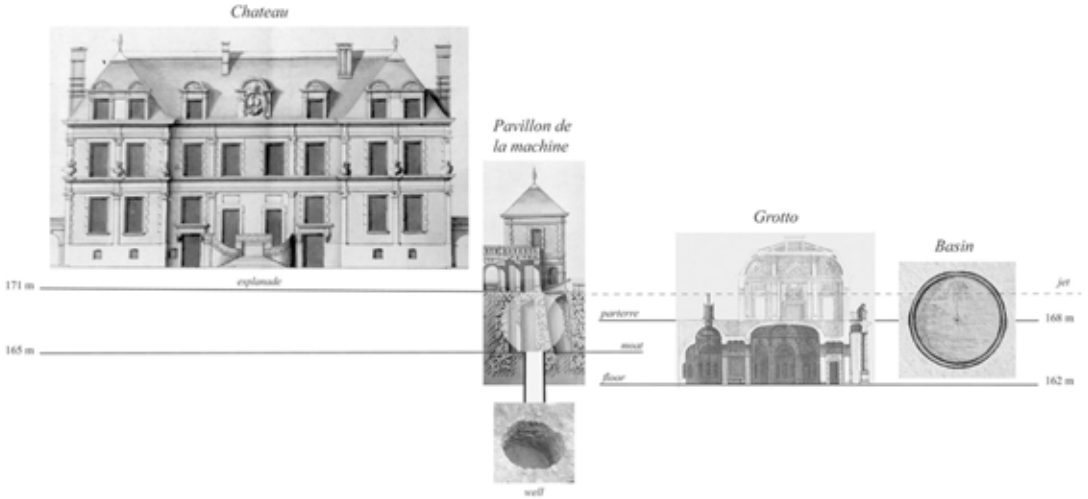

Figure 10: Noisy, graphic of the hydraulic devices

The hydro-technical device of the water jet of the Noisy grotto was perhaps associated with that of the basin of the high parterre. In fact, the two structures are close to each other and the altitude of the grotto jet could be equal to that of the jet from the high parterre basin, implying it could have a height of about 1.5 metres. In this hypothesis, the machine would have had to provide the same pressure for both jets. The position of the pavilion halfway between the level of the grotto and that of the high parterre was certainly an advantage: part of the pressure necessary to form the 8 m high water jet in the grotto was thus produced by a siphon. The machine therefore had to combine two functions: to draw water from the bottom of the well and then to force the water into a lead pipe under pressure. (Fig. 10) This performance was perhaps unprecedented [20].

At the same time, Jacques Androuet du Cerceau, in *Les plus excellents bastiments de France* (1579)[21], remarked on the water jet of the rock fountain in the garden of Diane at Chenonceau "of the height of three toises [approx. six metres] which is a beautiful and pleasant invention [22]". The hydraulic works of Chenonceau had been started in 1554 by the fountain-maker Cardin de Valence. This jet was produced by a natural slope from the fountain of La Roche situated above in a lead pipe; it was operated by a wooden pin blocking the pipe.

The creation of the Noisy gardens was also contemporary with the publication of Bernard Palissy's garden project in the *Recepte veritable* (1563)[23] in which music and water features play an important role. In particular with the use of the hydraulic organ imitating bird song which was to be found some time later in the Italian gardens or later in the grottoes of Saint-Germain. It is true that the jet in the Noisy grotto belongs to the tradition of surprise waterworks - since the outlet of the jet in the parterre of the upper terrace of the grotto was like a natural resurgence. However, it was based on an ingenious mechanism and produced an original effect that archaeological analysis has made it possible to partially reconstruct thanks to a few archival documents and the remains that escaped demolition [24].

References

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[5] J. François, *La science des eaux*, Hallaudays, Rennes, 1653 ; *L’art des fontaines*, Hallaudays, Rennes, 1665.
[6] ‘où la fontaine qui fait les jets d’eau n’a point d’autre eau pour source que celle d’un estang supérieur, ny cet estang que celle des pluies qu’on réserve pour cet effet’ : François, 1665, p. 32. I thank Aurélia Rostaing for bringing this reference to my attention.
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[8] I. De Caus, *Nouvelle invention de lever l’eau plus haut que sa source avec quelques machines mouvantes par le moyen de l’eau et un discours de la conduit d’icelle*, Londres, 1644.
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[11] B. Bentz, 'Les jardins du château de Noisy', in: L. Gaugain, P. Liévaux et A. Salamagne (dir.), *La fabrique du jardin à la Renaissance*, Presses Universitaires François-Rabelais, Tours, 2019, p. 115-128.
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[19] 'il y avoit dans deux de ces pavillons des pui[t]s d'une profondeur extraordinaire avec des pompes pour tirer plus facilement de l'eau': Boulin, 1732, p. 103.
[20] It has hitherto generally been supposed that pump-driven fountains were a late seventeenth century invention, see James W.P. Campbell, 'The significance of John Theophilus Desaguliers's Course of Experimental Philosophy to the History of Hydraulics and what it reveals about the first pump-driven fountains' in J.Campbell, N.Baker, K.Draper, M.Driver, M.Heaton, Y.Pan, N. Ruamsanitwong and D. Yeomans (eds), *Iron , Steel and Buildings: Studies in the History of Construction, Cambridge: CHS, 2019*, 331-346, pp.342-343.
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[24] Translation: Helen Spraggett. Thanks to James Campbell for his review and advice.