

## **Perrault's experiments, a matter of soil hydrology and epistemology**

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The studies conducted in the second half of the Sixteenth Century were crucial both for the hydrological knowledge and for the modern epistemology. In fact thanks to the new experiment-based scientific approach the Sun was about to be fully recognized as the engine of the hydrological cycle instead of an endogenous engine placed in the depths of the Earth, and the original Aristotelic approach to the description of the nature, based on the the four *qualities* (hot and cold, dry and moist), was got over. At the same time, the questions posed on the hydrological cycle and on the soil hydrology, which are hardly reproducible by means of a controlled laboratory model, severely tested the modern scientific approach at its beginning, and contributed to the development of modern epistemology.

Perrault's classical book *De l'origine des fontaines* (*On the origin of springs*, 1674) is deeply rooted in these debates. In this book he performed experiments and collected many observations both to assess the water balance at the basin scale and to understand the water movement in the upper soil layers. Particularly he performed four experiments to understand whether the water could spontaneously rise within the soil from the water table and originate springs (1<sup>st</sup> and 2<sup>nd</sup> experiment), how deep the rainfall could percolate through the soil and recharge the groundwater table (3<sup>rd</sup> one), and whether salty water remained salty when rising into the soil by capillary action (4<sup>th</sup> one). In order to do so he filled with different soils a leaden pipe, 65 cm long, and observed their performances against capillary rise, infiltration, percolation and water-content redistribution.

The great detail of the experimental report allowed us to quantitatively re-experience the first three ones in the laboratory, with comparable results to Perrault's ones. Moreover it allowed us to recognize both the omitted data which would be needed for a complete repeatability, and the observations which leded Perrault to misinterpretate the experiments by a physical point of view. As his interpretation of the experiments did not corroborate the hypothesis that precipitation might be at the origin of all the springs, it accepted one of the forms of the traditional scheme of water circulation. According to it, greatly productive springs should be sustained by evaporation and condensation processes taking place below the soil surface.

Even if Perrault's conclusions went in the direction of the ancient opinion, not only *De l'origine des fontaines* is a seminal work of experimental hydrology, but also it can be regarded to as a milestone of scientific revolution. In his critique of both ancient (e.g. Aristotle) and modern scholars (e.g. Nicolas Papin) he makes use of principles drawn by the works of Bacon, Galilei and Pascal. Stating that "the first and most usual maxim of our moderns is to doubt everything", he shows deep awareness of the specific essence of scientific modernity. Moreover his rejection of alchemy, analogical reasoning and astrological influences arises from the conviction that "it is to experiments that we owe the finest knowledge we now have concerning the things of nature". According to this perspective, despite of all the difficulties of the soil-hydrologic laboratory practice, Perrault was nevertheless able to report his experiments in terms that we can properly reproduce nowadays.