

Innovative Water Use by Ancient Roman Engineers

Southern France/Barbegal Wayne F. Lorenz, P.E.

Aqueducts—Common; Water Power—Rare

Ancient Romans are well known for their aqueduct engineering and construction; there are many such examples at archaeological sites in southern France. There is one site; however, that is a special civil engineering masterpiece of water resources engineering. This site is known as Barbegal, a flour mill where ancient Romans used water power to drive millstones.

Water Supply Features:

- Mountain springs
- Long aqueducts
- Hydraulic head at the mill of approximately 18 meters
- 16 waterwheels, each of which powered a heavy millstone
- The Romans derived water supply from distant springs
- The Alpilles Mountain springs provided a reliable flow
- Two major aqueducts carried water from springs to the Barbegal site
- Northern aqueduct was 39 kilometers long
- Southern aqueduct was 10 kilometers long

The two aqueducts converged in a basin approximately 325 meters due north of the Barbegal mill. From the basin, two parallel channels were constructed. One of the channels conveyed water to the city of Arles for potable water use. The other channel conveyed industrial water to the Barbegal mill.

The Barbegal Mill:

- Located northeast of the city of Arles on a ridge of limestone
- Consisted of two parallel and symmetrical rows of waterwheels, millstones, and mill houses
- Each row consisted of eight waterwheels in a series on each exterior side of the building
- In the center of the two rows was a service hallway, where mules would bring in the grain and take away the flour
- The building is 61 meters long by 20 meters wide on a slope of 30 percent

The Barbegal Waterwheels:

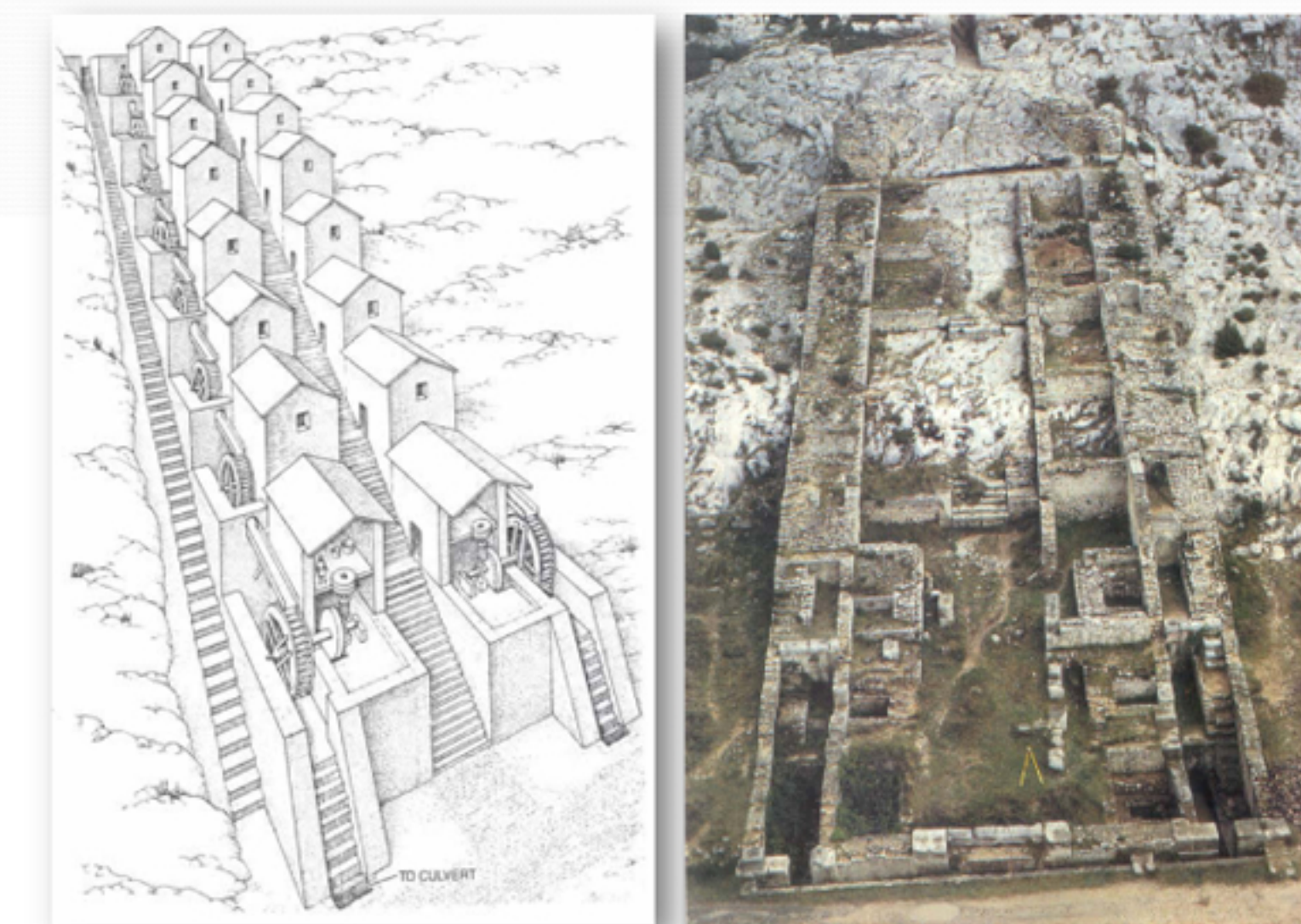
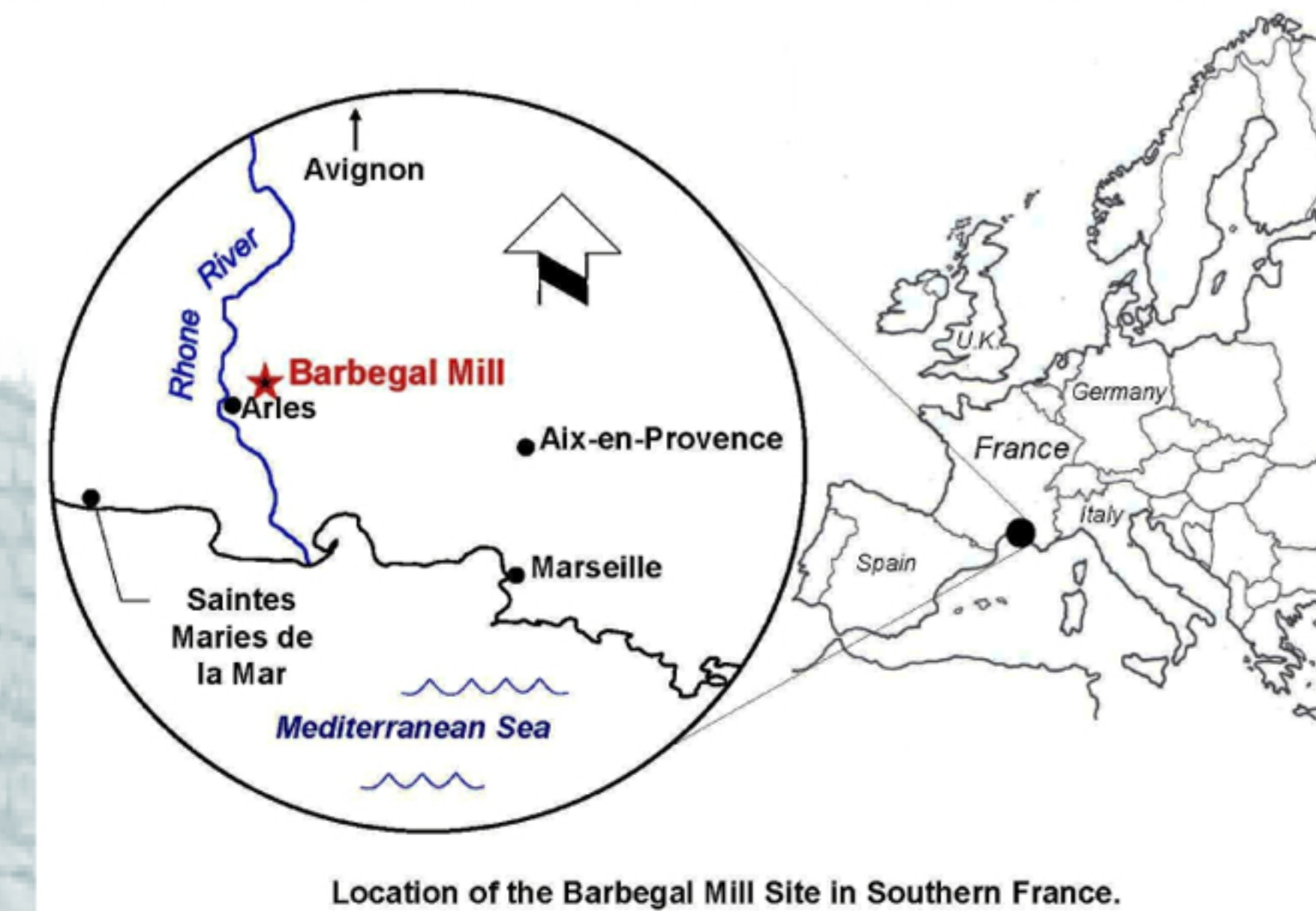
- "Overshot" type
- 2.1 meters in diameter and 0.7 meters in width
- 75 percent efficiency of energy capture (total of 32 HP)
- 2 horsepower per waterwheel

Millstone Types - Pompeii:

- Hourglass-shape common throughout the Roman Empire.
- Ranged in diameter from 45 to 64 cm
- Driven by horses and donkeys at slow rotational speeds
- Operated at a relatively low speed, probably 3 to 5 revolutions per minute
- Required a steep grinding plane

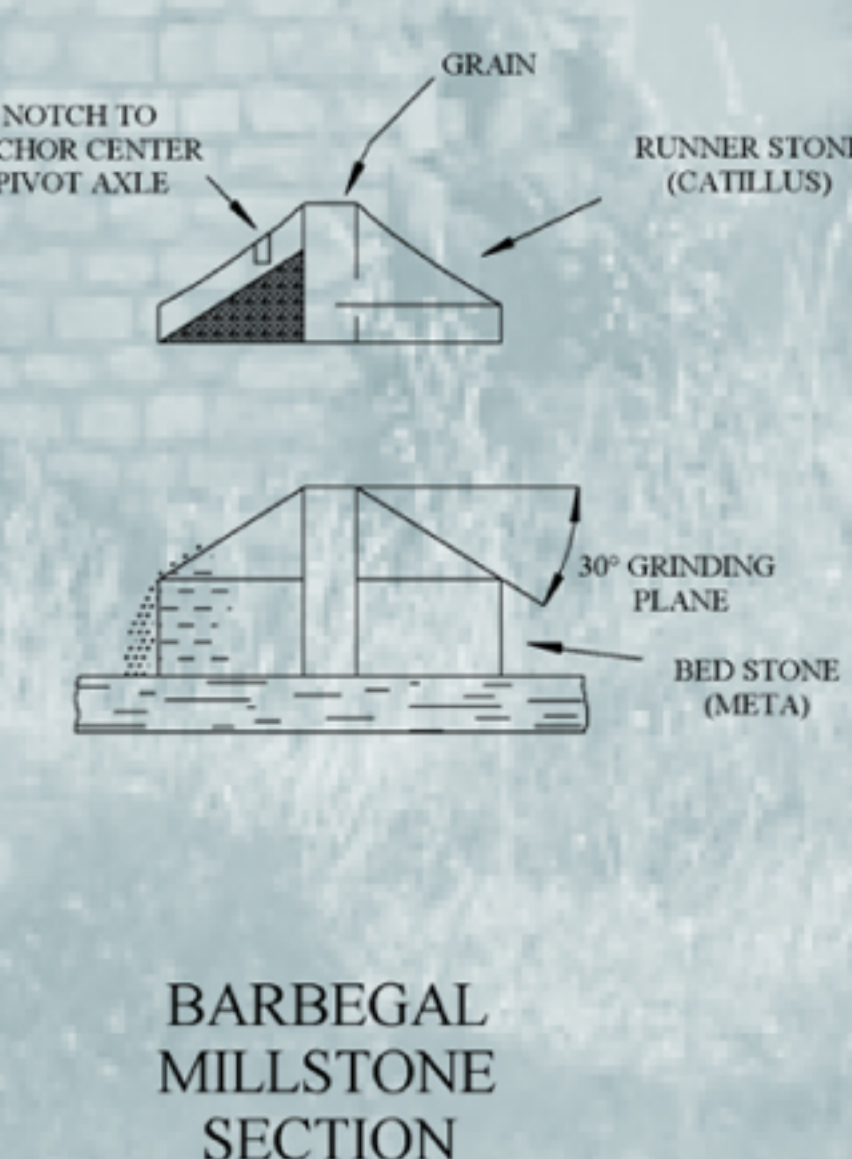
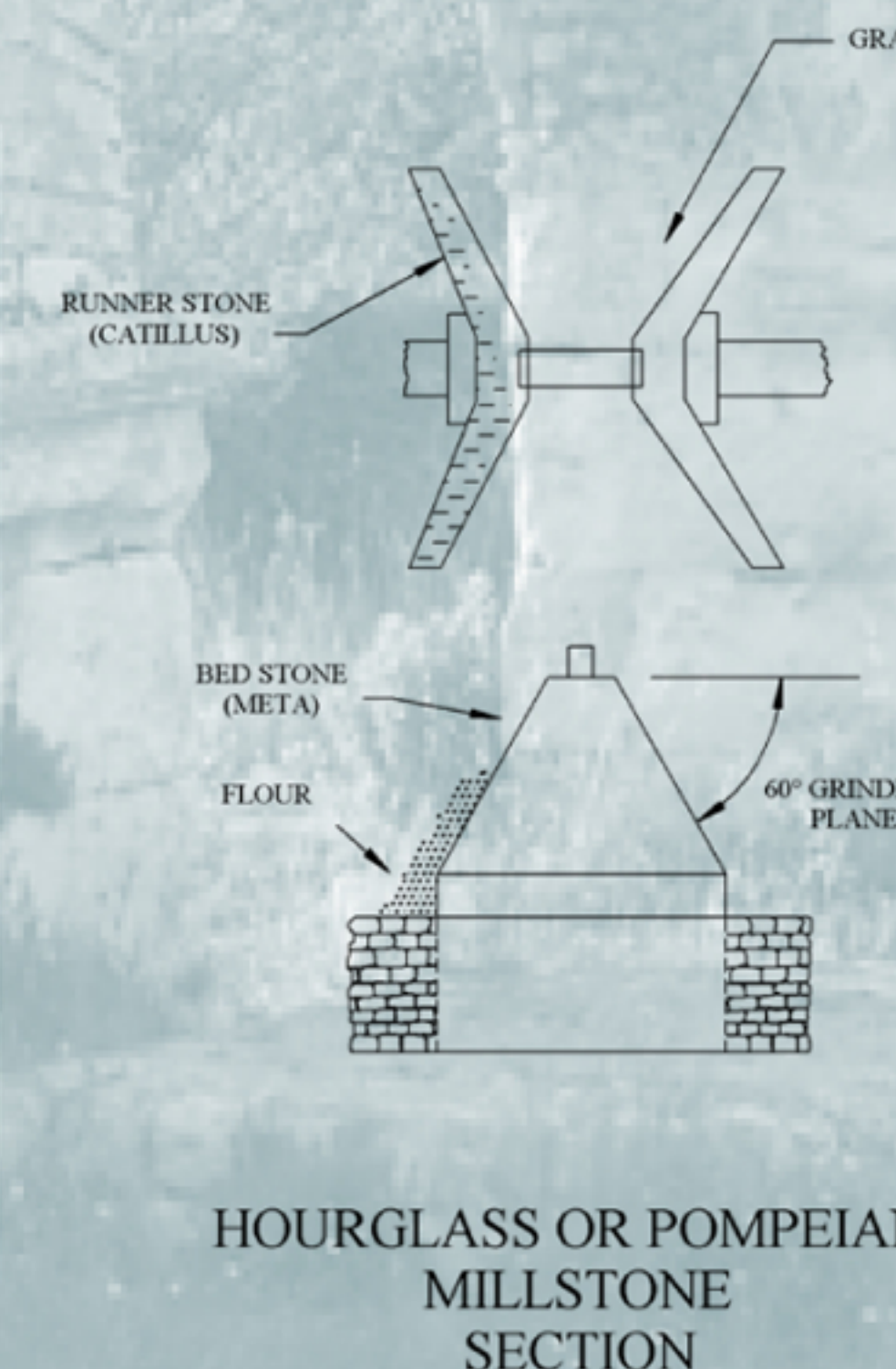
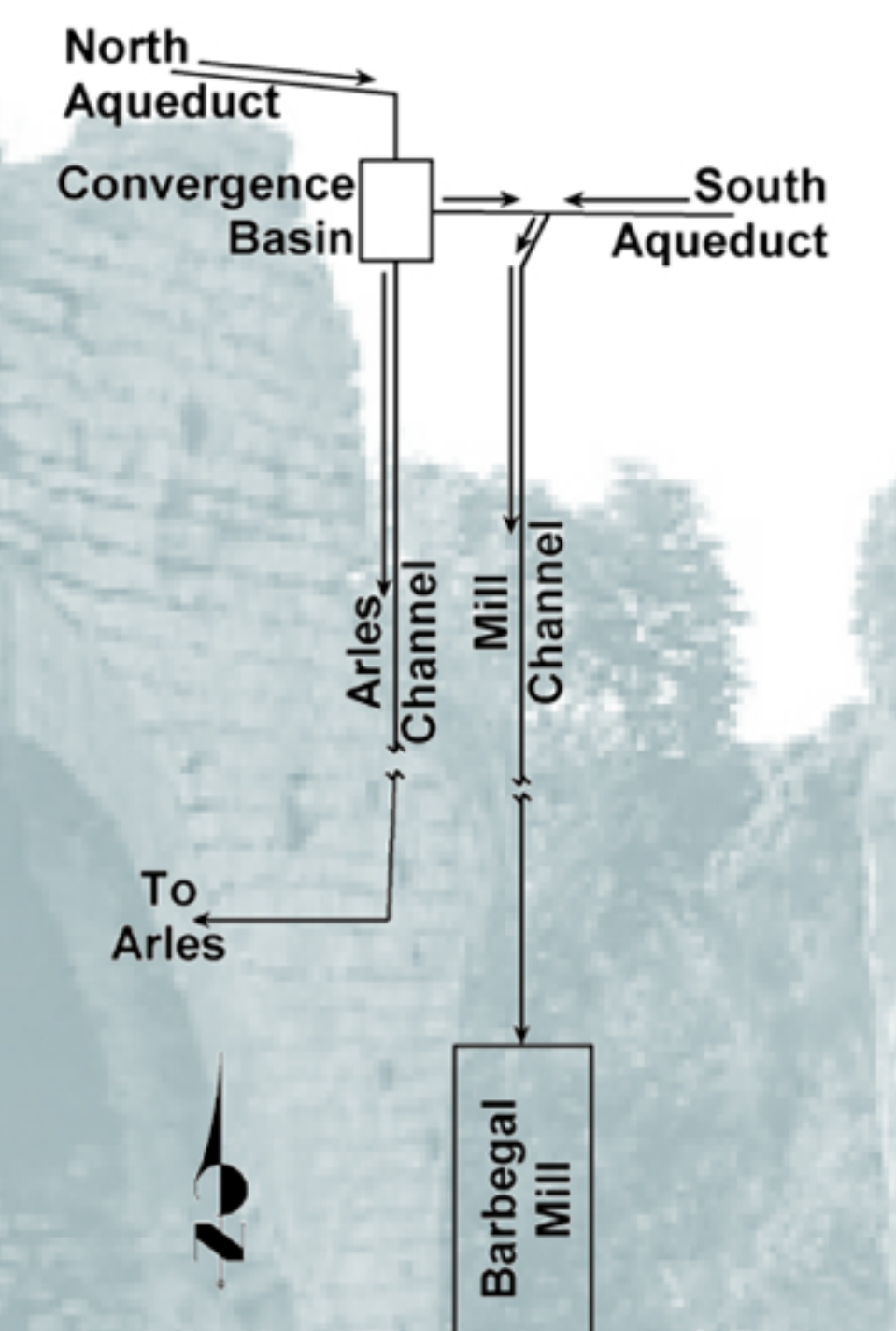
Millstone Types - Barbegal:

- Water-driven
- Gears turned millstones at much higher rotational speeds
- Resulting centrifugal force was sufficient for the grain to pass from the inside of the millstone to the outside edge
- Straight, linear grinding plane surface angle of approximately 30 degrees to the horizontal



Then

Now



Millstones



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