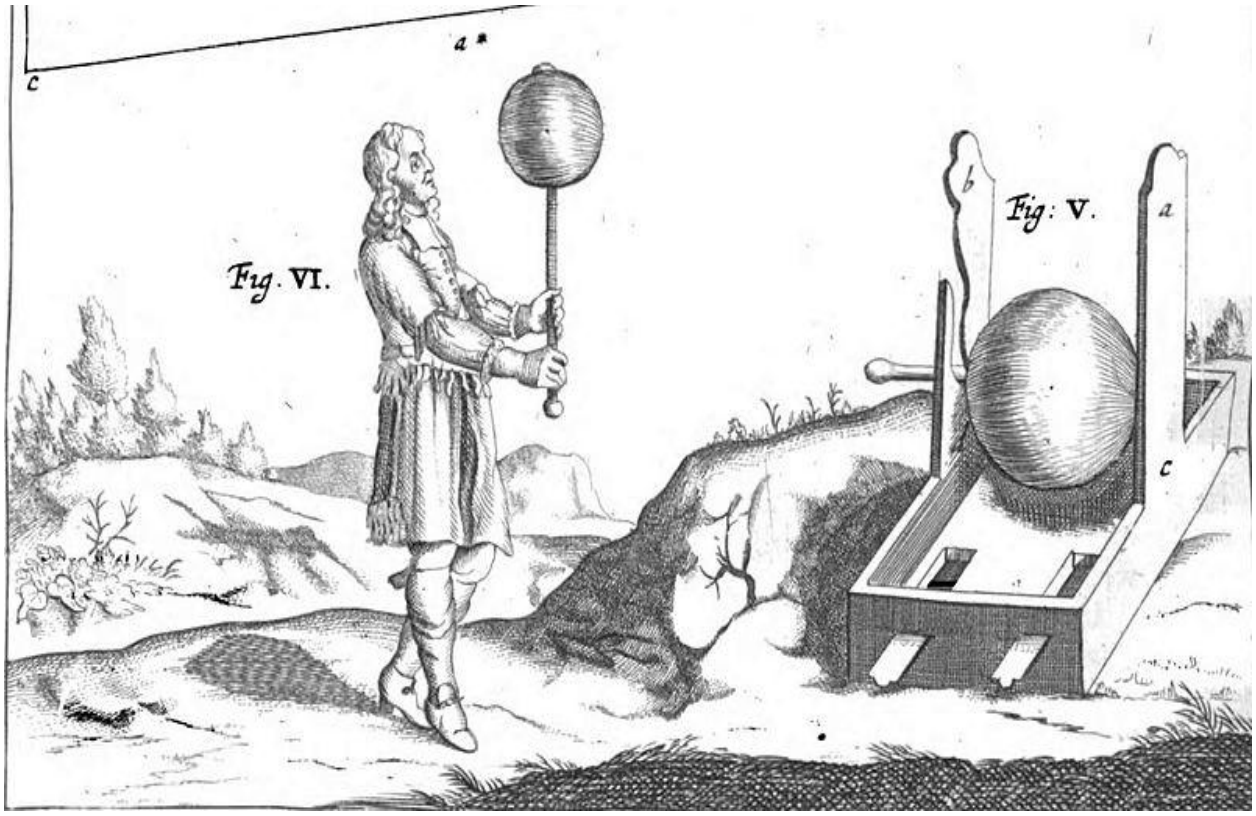
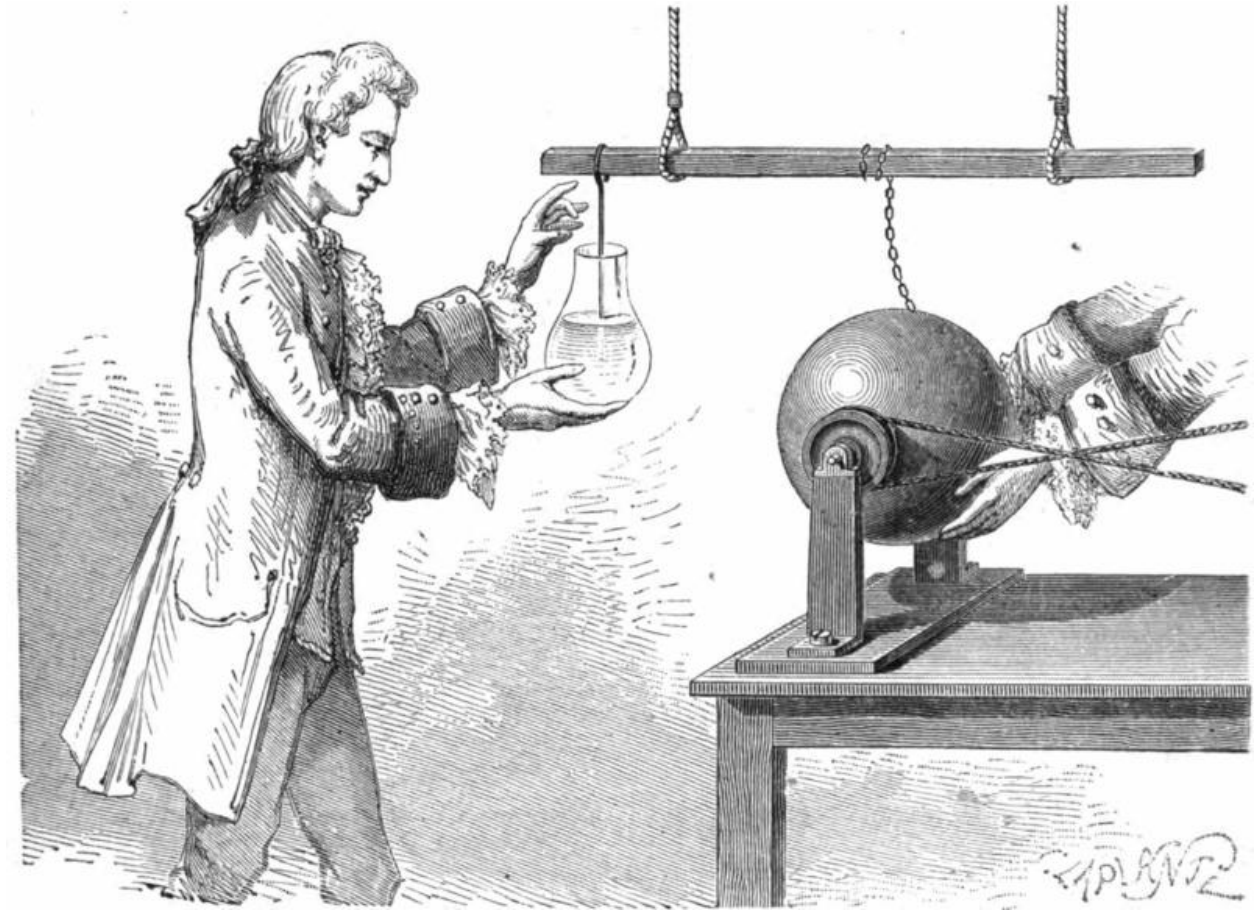
## From creation of static charge, to a simple battery

Around 1650, **Otto von Guericke** built a crude electrostatic generator: a sulphur ball that rotated on a shaft. When Guericke held his hand against the ball and turned the shaft quickly, a static electric charge built up. This experiment inspired the development of several forms of "friction machines" , that greatly helped in the study of electricity.



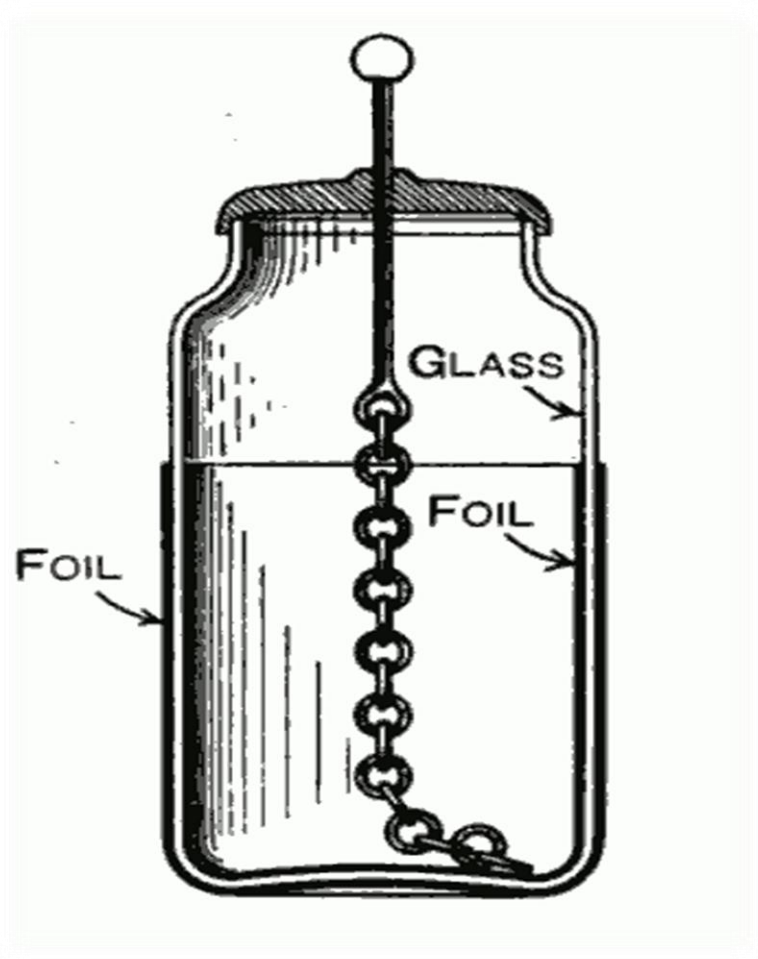

At that time, transient electrical energy could be generated by friction but there was no way to store it.

**Pieter van Musschenbroek** is credited with the invention of the first capacitor in 1746.Musschenbroek and his student Andreas Cunaeus discovered that the energy could be stored. Using a jar of water with a metal rod in it, he touched the rod to his electrostatic generator. Nothing seemed to happen, but when the person holding the jar touched the rod, he got a terrific shock.

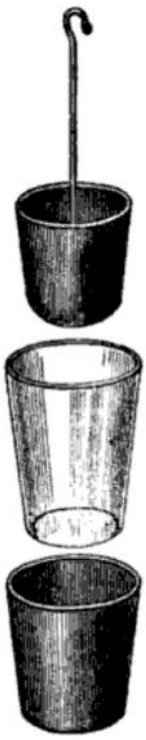


A typical design consists of a glass jar with conducting tin foil coating the inner and outer surfaces. The foil coatings stop short of the mouth of the jar, to prevent the charge from arcing between the foils. A metal rod electrode projects through the stopper at the mouth of the jar, electrically connected by some means (usually a hanging chain) to the inner foil, to allow it to be charged. The jar is charged by an electrostatic generator, or other source of electric charge, connected to the inner electrode while the outer foil is grounded. The inner and outer surfaces of the jar store equal but opposite charges.

The original form of the device was just a glass bottle partially filled with water, with a metal wire passing through a cork closing it. The role of the outer plate was provided by the hand of the experimenter. Soon it was found that it was better to coat the exterior of the jar with metal foil, leaving the impure water inside acting as a conductor, connected by a chain or wire to an external terminal, a sphere to avoid losses by corona discharge. Later the water inside was replaced with a second metal foil lining. Early experimenters found that the thinner the dielectric, the closer the plates, and the greater the surface, the greater the charge that could be stored at a given voltage.




It was initially believed that the charge was stored in the water in early Leyden jars. In the 1700s American statesman and scientist **Benjamin Franklin** performed extensive investigations of both water-filled and foil Leyden jars, which led him to conclude that the charge was stored in the glass, not in the water. A popular experiment, due to Franklin, which seems to demonstrate this, involves taking a jar apart after it has been charged and showing that little charge can be found on the metal plates, and therefore it must be in the dielectric. The first documented instance of this demonstration is in a 1749 letter by Franklin. Franklin designed a "dissectible" Leyden jar, which was widely used in demonstrations. The jar is constructed out of a glass cup nested between two fairly snugly fitting metal cups. When the jar is charged with a high voltage and carefully dismantled, it is discovered that all the parts may be freely handled without discharging the jar. If the pieces are re-assembled, a large spark may still be obtained from it.



**Daniel Gralath** was the first to combine several jars in parallel into a capacitor "battery" to increase the total possible stored charge. The term "battery" was coined by Benjamin Franklin, who likened it to a battery of cannon