

# Otto von Guericke — “air head”

Otto von Guericke — statesman, scientist, and engineer — was born in 1602 in the town of Magdeburg (Germany) along the Elba river in Prussian Saxony. He studied law at the University of Leipzig, and then went on to pursue mathematics, mechanics, and military engineering at the University of Leiden. After graduation, he worked as an army engineer for Gustavus II Adolphus of Sweden, and in 1646, became burgomaster of Magdeburg, a position he held until 1681.



Otto von Guericke shown here in his study holds a rope tied to a ring on a hollow bronze sphere that he used as a vacuum chamber in his pioneering experiments on air pressure. Von Guericke's spheres, made in a wide range of sizes from a few inches to more than ten feet in diameter, consisted of two symmetric halves (called “Magdeburg hemispheres”) that fit together well enough to create a seal.

Von Guericke was a sort of backyard experimentalist who had the means as well as the intelligence to perform pioneering work in pneumatics, electrostatics, and vacuum science. He is credited with inventing the vacuum pump and building the first electrostatic generator, and his discoveries led to the development of many practical innovations, including the steam engine and pneumatic cylinder.



Otto von Guericke's earliest vacuum experiments involved water-filled wooden casks and an air pump built with parts scavenged from a fire extinguisher. The goal was to draw the water from the cask and create a vacuum in the process. Leaky seals

on the ends and along the seams of the cask and the porosity of the wood itself limited the intensity and duration of the vacuum that von Guericke could achieve.

## Fun with destruction

After years of working with wooden casks, von Guericke upgraded his approach, building a vacuum system in 1656 based on a hollow copper sphere. Using



essentially the same pump, von Guericke discovered that he could evacuate a metal chamber to the point where it would crumple under the force exerted by external (atmospheric) air pressure.

Von Guericke often played the role of entertainer, putting on dramatic displays of the scientific principles he discovered. His most impressive demonstrations involved the immense forces inherent in a vacuum, pitting them against the power of man and beast alike. Here, an artist's rendition shows two teams of eight horses trying to separate a pair of copper hemispheres held together by the invisible force.



and 24 pull horses. As was his custom, after the animals were spent, von Guericke would open a valve and allow the sphere to fall apart to the wonder of all.



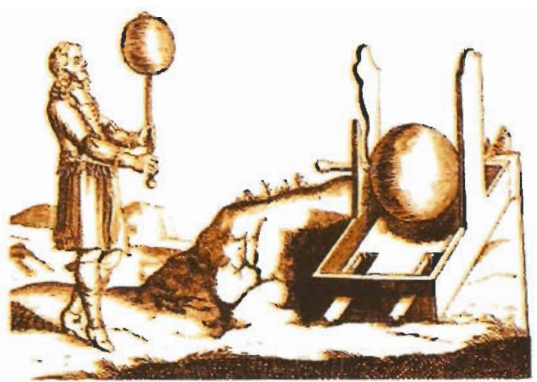
# extraordinaire

Von Guericke's work with vacuums led him to speculate that the density of air varies with both altitude and temperature. To test his theory, he built a water barometer from which he discovered that air pressure also indicates changes in weather. He then came up with a clever idea and constructed a weather indicator in the form of a human. A column of mercury moved the figure's arm up and down in response to rising and falling barometric pressure. He called the device the *Wettermännchen*, which translates to "little weatherman."



## From feathers to full power

Von Guericke continued to develop the electrostatic generator, making bigger and faster models. The earliest versions of his *elektrisiemaschine* used hand cranks and had no means of employing the static charge on the ball other than to attract feathers or send a spark to someone's extended hand. By 1663, however, von Guericke devised a machine incorporating a glass globe mounted on a pulley-driven shaft. An armature positioned near the ball conducted electric sparks when the machine was sufficiently charged. The charged globe could also be removed and used as a sort of battery for electric experiments.



William Gilbert, the "father of magnetism," envisioned the Earth as a giant magnetic globe. To study the planet, he made a sphere from lodestone — his famous *terrella* or "little earth." In contrast, Otto von Guericke viewed the Earth as an "electric" and built a similar model from sulfur, one of the more plentiful "electrics" of his time. Here he is shown holding a sulfur globe mounted on a wooden axis. He later built a base for it on which he would rotate the globe against a friction surface, thereby generating electrostatic charge.

## Glow globe

The most advanced version of von Guericke's *elektrisiemaschine* achieved such speeds that it generated enough charge to cause the surface of the sulfur ball to glow, making von Guericke the first person to observe electroluminescence. It was also von Guericke who first noted that like charges repel while opposite charges attract.



A German stamp commemorates the achievements of Otto von Guericke. Besides serving his hometown of Magdeburg as an administrator, von Guericke advanced the world's knowledge of vacuum science and electricity. Among other things, he proved that sound does not travel in a vacuum, that air pressure can possess great power, and that comets return in regular intervals as they orbit the sun.