# Alessandro Volta. His life, his time, his awards

[upper floor]

Alessandro Volta was born in Como on 18th February 1745. He began his studies at the Jesuit College when he was already orphaned of his father and was entrusted to the tutelage of his uncle Alessandro who was canon of the Cathedral. He then attended the Benzi Royal Seminary, where he met Giulio Cesare Gattoni, who encouraged him to study scientific subjects. In 1769 he published his first essay on electricity, while the first invention, the electrophorus, dated back to 1775, by which he become professor of experimental physics at the Royal Gymnasium of Como. The following year he discovered methane by observing the gas produced by organic substances in the marshes on Lake Maggiore. In 1777 he embarked on a trip to Switzerland with his friend Giambattista Giovio, in which he met Bernoulli, De Saussure and Voltaire. Over the years, he continued to be in regular contact with leading European scientists, not only by correspondence but also thanks to frequent trips through Switzerland, Germany, Belgium, Holland, France, England and Austria.

He was appointed professor and later rector of the University of Pavia for his discoveries on the properties of gases, meteorology and electricity. In 1794 he received the prestigious Copley Medal, equivalent in importance to today's Nobel Prize. In the same year, he married Teresa Peregrini and to this union three children were born. The invention of the battery towards the end of 1799, by far Volta's best known tools is enough to ensure

the Como scientist a place of honour in the history of science. An invention that led him to Paris, to the Academy of Sciences of France and to meet Napoleon Bonaparte in 1801. In the next years he received the Medal of the Institut National, the cross of the Legion of Honour as well as the title of Knight of the Order of the Iron Crown. In 1809 he was appointed Senator of the Kingdom of Italy and in 1810 he obtained the title of Count. In 1819 he retired to private life in his home in Camnago, where he died on 5th March 1827. Volta was a scientist with multiple interests, attentive to the research of his contemporaries, whose interests, relationships, and influence extended far beyond the borders of Lombardy. It may be said that Volta was the expression of his time but also a precursor of ours. Symbol of the transformation from the eighteenth-century natural philosopher to the modern scientist, he had the ability to understand the strong link between the development of scientific activity and the exchange of knowledge between scientists, as well as to cultivate relationships with institutions. Volta's scientific achievements have greatly influenced contemporary science. Thanks to his intuitions he developped the concept of electric current, which was not taken for granted in his time. "Volt", the unit of measurement of the potential difference that Volta defined as voltage, takes its name from him; instead, the battery, by making possible the production and control of a continuous flow of electricity, as Albert Einstein said, is the fundamental basis of all subsequent inventions. Finally, two events organised to celebrate the genius of Alessandro Volta deserve a mention: the great International Exhibition of 1899, in which Volta's tools and relics, partly destroyed by the fire, had a prominent place, and the International Congress of physicists of 1927, in the presence of numerous Nobel laureates.


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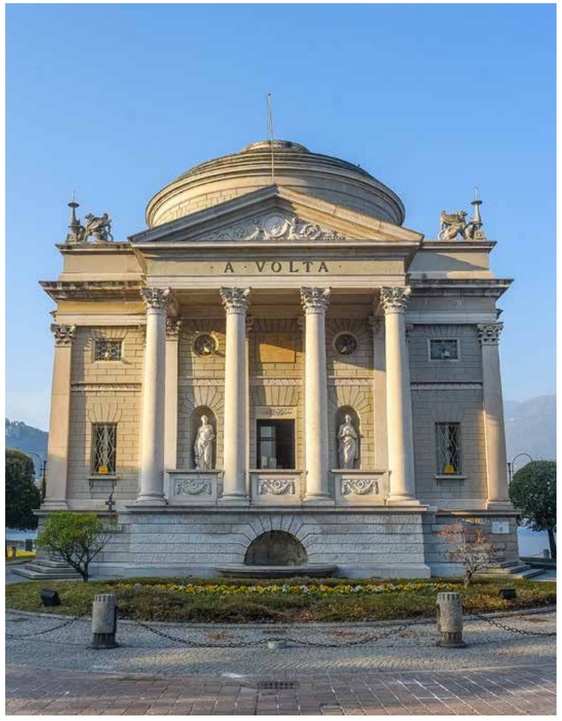


MUSEI CIVICI COMO

# Tempio Voltiano

ENGLISH

# Tempio Voltiano

The Tempio Voltiano, inaugurated on 15th March 1928, was conceived as a prestigious location to host the original works and the reconstructions of Alessandro Volta's scientific tools after the disastrous fire that destroyed the pavilions of the great International Exhibition held in Como in 1899 on the occasion of the first centenary of the battery's invention.

The promoter and donor of the work was the entrepreneur Francesco Somaini who, once it was completed, he donated it to the city of Como. Architect Federico Frigerio was entrusted with the project, who wanted the building to be worthy of the great Como scientist not only for the high scientific and documentary value of the content, but also for its monumental appearance. The Tempio Voltiano consists of a large circular hall, surmounted by a dome from whose top the light penetrates through a large curtain. Its neoclassical architecture is remarkable, with explicit reference to the Pantheon. The construction materials are functional to the museum project: the white limestone stone, the splendid polychrome marbles of the interior floor coming from different parts of the world, the large dome with central light that emphasizes wholeness and harmony of the space, in addition to four high-reliefs that reproduce the most important moments in Volta's life and the dedicatory inscription in gold. On his death, on 5th March, 1827, Alessandro Volta left a valuable legacy consisting of his studies and tools of the highest scientific and historical value.

The objects exhibited in the display cases, in the interior of the Tempio Voltiano, still represet one of the most interesting collections of scientific tool that belonged to a scientist and, as such, are of great importance in allowing the visitor to know the areas of research of Volta, from the invention of the battery to the fundamental contributions in the field of electrology, to the study of gases and their properties. The Tempio Voltiano, its collections of tools and documents, its furnishings and its scenography are part of a homogeneous and coherent whole: an example of a 'museum within a museum', which represents a historical testimony of the greatest importance.

# Gas and thermal phenomena

[showcases I-III]

In 1776 Volta discovered natural gas (methane) in a reed bed on the shores of Lake Maggiore, which he called "flammable air from the marshes". This discovery led the scientist to design a series of tools to exploit its properties, as well as to develop a method for detecting the amount of oxygen and other gases present in the air.

**Eudiometer [105]**
Already used by Priestley and Landriani, Volta radically transformd the device so as to make it a tool capable of measuring air quality, that is, the amount of oxygen contained in it. The Volta eudiometer consisted of a glass tube closed by a cap, into which two electrodes penetrated, and with the lower part open inserted into a container full of water: the spark caused the combination of gases and it was possible to determine the quantity of oxygen present from the rise in the water level in the graduated tube. The French chemist Lavoisier, using an electric eudiometer, carried out the famous experiment of the synthesis of water, demonstrating that it is composed of hydrogen and oxygen.

**Flammable air pistol [114]**
Volta created this original tool by studying the flammability of gases at the transit of an electric discharge. The container is filled with a mixture of air and gas, at the strike of a spark created between two

electrodes the mixture explods and the cap that closes the container is thrown away. Volta suggested the possibility of transmitting, through insulated wires on poles, the discharge of a Leyden jar located in Como to detonate a gun in Milan. This idea, never tested, is often interpreted as a first proposal for electric telegraphy. Volta never fully developed this invention. A few decades later, starting from the electric gun and the eudiometer, the Tuscan physicist and inventor Eugenio Barsanti, was inspired to design the first internal combustion engine.

**Flammable air lamp [131]**
It is a curious device built by Volta by combining two of his tools: the electric pistol and the electrophorus. It is made up of two superimposed glass containers: the upper one containd water, the lower one flammable gas. A small tube allowed the water to flow into the lower container, thus expelling the gas that was ignited on a nozzle by the spark produced by an electrophore. Volta's idea was taken up by several manufacturers who improved the device, especially in Germany and Europe, making it one of the fastest and most effective systems as a light source. This device was very successful and even became a fashionable item. In the mid-nineteenth century, the lamp was a living room object, used as a table lighter then replaced with the invention of matches.

# Voltian electrology and electrometry

[showcases IV-VII, lower showcases A-B and on the top]

In the eighteenth century, electrical phenomena aroused great attention. The construction and invention of new tools (such as electrostatic machines and, above all the Leyden jar), a series of important results regarding the remote conduction of the electric fluid, the distinction between insulators and conductors, the demonstration of the electrical nature of lightning and the development of new theories, made electricity the emerging sector of science in the Age of Enlightenment.

**Electroscope [215]**
The electroscope was the first tool that allowed to detect the electricity present in an object. The "bottle" version, designed by Tiberio Cavallo, was made with a small glass bottle placed on a brass base. It consisted of a conducting knob connected to two thin metal sheets called 'eaflets', free to oscillate. When an electrically charged body got close to the knob, the two sheets diverged. Volta has brought substantial improvements to the devices created by Cavallo or de Saussure. It introduced a graduated dial to measure the separation of the metal sheets and, therefore, the amount of electricity; moreover, in order to improve the reading of the graduated scale, he used bottles with a squared base. Thus the electroscope became an electrometer. Volta also modified the popular electrometer which had been designed by Henley in 1770 [220].

**Perpetual electrophorus [231]**
The perpetual electrophorus is not only the first tool designed by Volta but also, apart from the battery, the one that aroused greater interest in the scientific community. The electrophore was an electrostatic machine capable of accumulating and separating electrical charges. It consisted of a layer of resin contained in a metal plate, which is electrified by rubbing, and of a disc equipped with an insulating handle that allowed the charges to be taken from the base body. The procedure could be repeated several times, hence the name of "perpetual electrophore". It generally had a diameter of a few decimetres, but he also built in pocket versions and others had quote large diameter.

*Did you know that ...*

In the eighteenth century, electrology became also a sort of worldly science and experiments with electricity provided ideas for parlor games. In fact, in the salons of high society, entertaining 'electric evenings' were organized during which spectacular experiences were staged based on attractions, repulsions, shocks and sparks, which ladies and knights could feel on their bodies. Scientific curiosity and entertainment have been the basis of the great diffusion of electricity in the Enlightenment.

# Devices for the study of electrical phenomena and electrical meteorology

[showcase VIII-X and item outside showcase]

In the last decades of the eighteenth century Volta contributed to the considerable progress of electrometry by improving or designing several tools and by clearly defining the concepts of voltage, charge and capacity, as well as the relation that unites them.

**Condenser [307]**
This instrument consists of two conductive discs on one of which an insulating layer of sealing wax is applied. It allows to "condense", or to accumulate electrical charges. After having loaded the lower disc by contact, the other disc is placed on top of it, initially unloaded. Due to the phenomenon of electrostatic induction it is charged with the opposite sign and, by connecting it with the earth, an apparatus with a large electrical capacity is obtained, that is, "capable" of accumulating a quantity of charge. Apparatuses of this type were already known from the mid-eighteenth century, Volta announced it as an original instrument, starting from its electrophore, and gave it its current name, explaining its operation based on his theory of electrical atmospheres. Even today, condensers are used in many electrical circuits and have different functions.

**Condenser electrometer [303]**
Volta soon realized that the conderser can be transformed into an effective detector of modest electrical voltages, generated by the contact between

two different metals (the so-called Volta effect), if connected to an electroscope. With a brilliant intuition he connected one of the two condenser disks to a speck electroscope to which he applied a graduated scale to quantify the voltage degrees. This is how the capacitor electrometer was born, an instrument that marked the official beginning of electrology as a science. This discovery can also be considered the starting point of the research that will lead to the invention of the battery.

**Anti-hail protectors [406]**
This is a curious device meant to illustrate the hypothesis of the electrical origin of hail during thunderstorms. Starting from the belief that the formation of hail is connected to lightning, or the electrical phenomena accompanying thunderstorms, Volta designsed some devices with a protective function.
These are prototypes which are, substancially, elaborations of lightning protectors. These, in fact, due to their ability to discharge electricity, would turn into anti-hail protectors if made capable of subtracting a greater amount of electricity from the atmosphere. In general, Volta's activity in the field of meteorology is varied and multiple, driven by the search for a reasonable explanation for the observed phenomena.

# Dispute with Luigi Galvani and the battery

[showcases XI-XV]

**Battery [614]**
The battery is universally considered Volta's most important invention. It is the first instrument capable of producing direct current and it was not created by chance. On the contrary, it was the result of years of studies and experiments, around the theory on the contact between different metals, undertaken by Volta following the research of the doctor Luigi Galvani from Bologna on animal electricity. On 20th March 1800, Volta announced the invention of the battery in a letter addressed to Mr Joseph Banks, president of the Royal Society of London. The device is made up of a series of copper or silver discs, superimposed on as many tin or zinc discs. Between each pair of discs and the next one is inserted a cardboard disc soaked in salt or acidulated water. The invention aroused enormous interest and the battery quickly spread to laboratories throughout Europe. Volta became very famous. His device, although revolutionary, was still not very effective. Since the beginning of the nineteenth century, therefore, the battery was modified and improved, with the introduction of not just vertical-piles but also crowns of cups or trough batteries; from the twentieth century, batteries have then acquired a fundamental role and in recent decades have found an infinite number of applications.

It may be said that the invention of the Volta battery influenced considerably the mentality, lifestyles and next generations, up our days. Just think about what our life would be like without the battery.
In the eighteenth century, the success of experimental science among the cultured and aristocratic environment created a new market for scientific instruments' makers. Some devices were used for education at home, such as compound microscopes [711], while others became objects of furniture, such as finely decorated barometers and thermometers [701]. Aristocratic residences were decorated with extravagant objects such as the telescope in the shape of a stick for men.

*Did you know that ...*

Volta was well appreciated in Europe for his studies and research and he was invited by the most famous institutions of the time to present his inventions.
This was also the case for the battery, presented in Paris on 7th November 1801, during a meeting of the Academy of Sciences attended by Napoleon Bonaparte himself who was so enthusiastic about the discoveries of the Como scientist that give him several awards.

G. Bertini, *Volta presents the battery to Napoleon*