History of Neurology: 'Sparkling Italians' – Giovanni Morgagni, Alessandro Volta, and Luigi Galvani

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A live recording of this lecture can be viewed here:
RRNMF – Early, Early Neurology History Sparkling Italians

This History of Neurology segment discusses early Italian neuroscience research, subtitled "Sparkling Italians."

The first Italian physician and scientist to discuss is Giovanni Morgagni, who was the father of modern anatomic pathology. He was educated in Bologna, the first true Western university, founded in 1088 (Oxford University, by comparison, was founded in 1096). He taught at another historic university, the University of Padua, founded in 1222, for 56 years (The University of Padua was also where Andreas Vesalius taught and published *De Humani Corporis Fabrica* in 1543).[1] Morgagni wrote the book On the Seats and Causes of Diseases,[2] in which he recorded dissections or autopsies in 646 patients and correlated them with their clinical symptoms and course. He emphasized the importance of basing diagnosis, prognosis, and treatment on pathologic anatomy. This work was originally published in five books in large folios, but later English translations compiled it into three volumes.[3] One important neurologic discovery from these autopsies was that the site of the lesion in apoplexy, or stroke, was in the brain on the opposite side of the involved body parts—a major finding.

Let us now discuss the 'Sparkling' Italians who were the early leaders in the development and the concept of the use of electricity. The term "electricity" was first coined by William Gilbert in the 1600s, the famous scientist in England who published the landmark book *On the Loadstone of Magnetic*

Figure 1

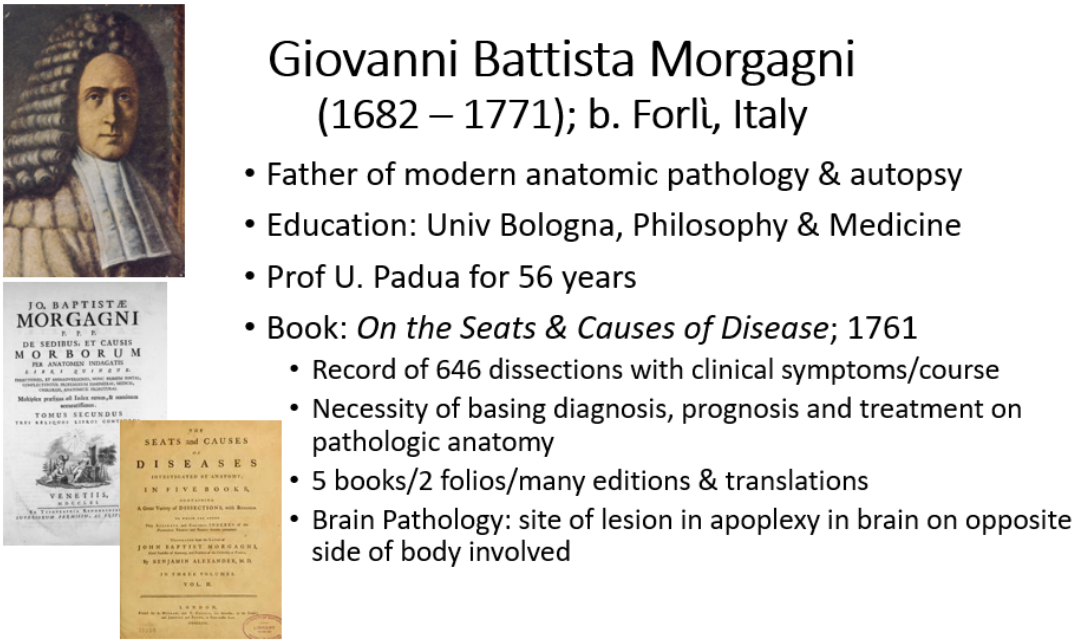
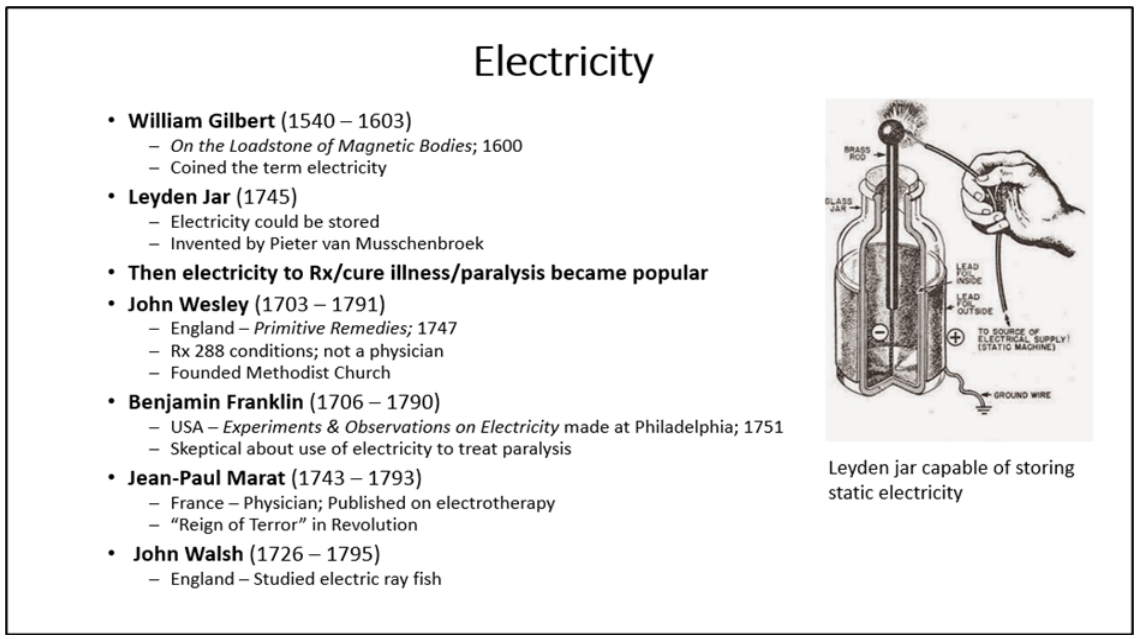
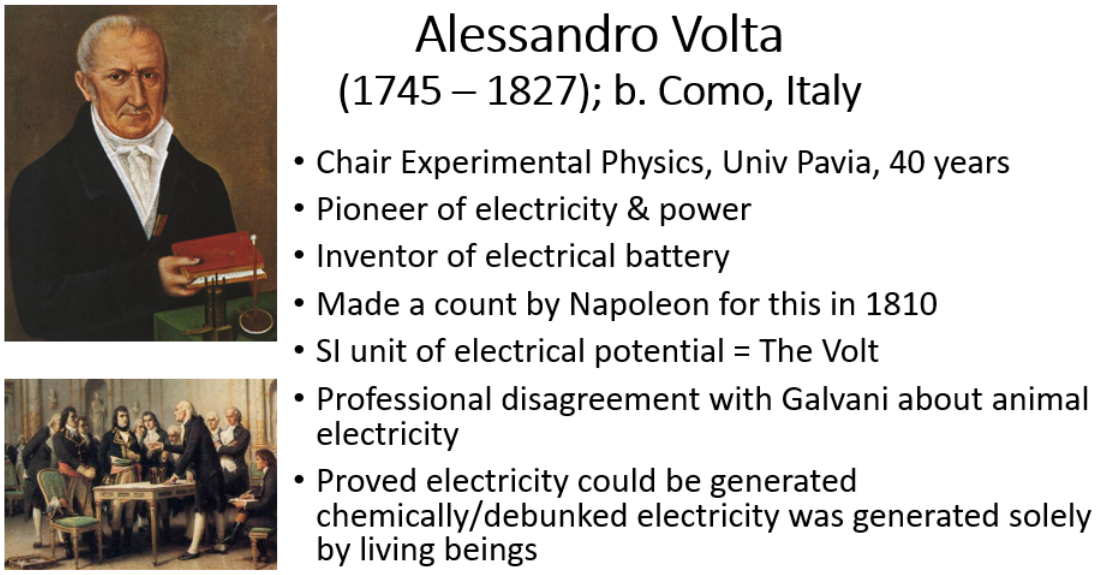


Figure 2



Leyden jar capable of storing static electricity

Figure 3



Bodies in 1600.[4] About a hundred years later, the Leyden jar was invented, allowing electricity to be stored. Soon afterward, electricity began to be used to treat patients with paralysis and other illnesses. This became very popular through the writings of John Wesley—who was not a physician but wrote several books on this treatment[5]—and who also founded the Methodist Church. Another figure, Jean-Paul Marat, a French physician and one of the leaders of the Reign of Terror during the French Revolution, also wrote extensively on electrotherapy. Benjamin Franklin,[6] who was a leader in electricity, was more reserved in his enthusiasm for using it to treat neurologic disorders. John Walsh, a scientist in English and fellow of the Royal Society, performed numerous studies on the electrical properties of torpedo fish.

Alessandro Volta and Luigi Galvani made their scientific contributions shortly after these early discoveries in electricity. Alessandro Volta was a professor of physics at the University of Pavia for 40 years. He was considered the inventor of the electrical battery and was made a count by Napoleon in 1810. An English translation of a letter by Volta describing the battery to a member of the Royal Society of London was published the *Society's Transactions* after his death in 1832 (Figure 4).[7] The volt, the standard international unit for electrical potential, is named after him. Volta had a long

Figure 4

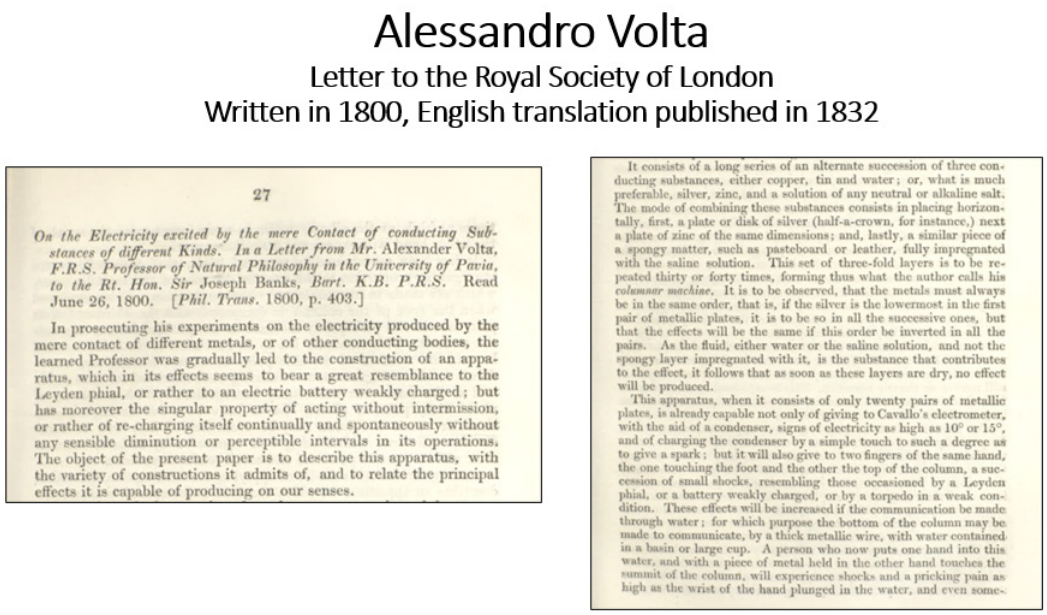
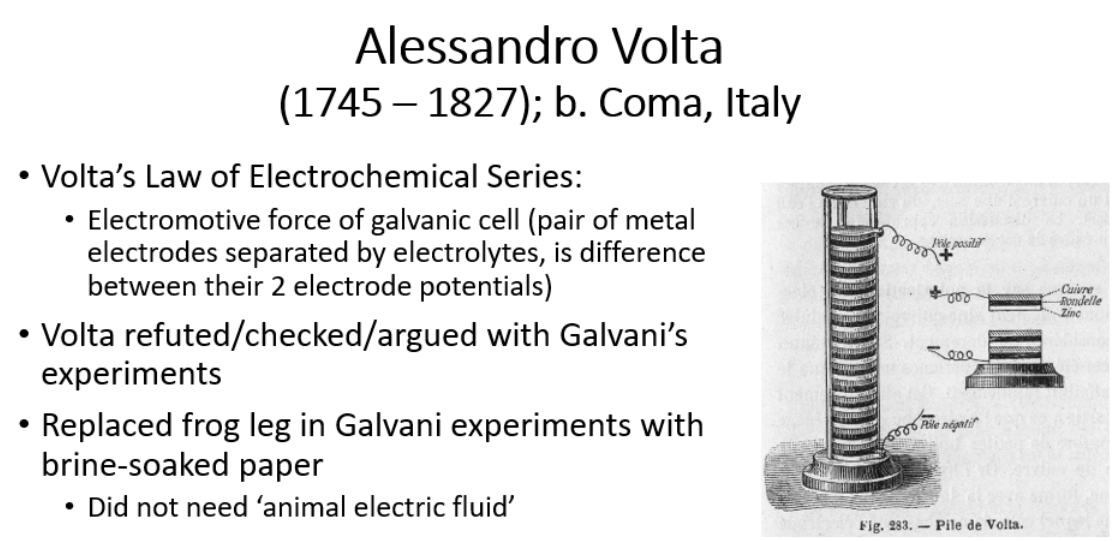


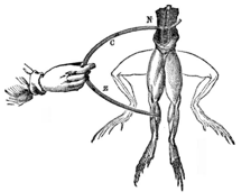
Figure 5



disagreement with Luigi Galvani (Figure 5) about whether there was such a thing as animal electricity. Galvani thought there was; Volta thought there was not. Volta proved that electricity was generated chemically and did not need to be produced by living beings.

He used his invention, known as Volta's pile or Volta's battery, to refute Galvani's ideas about "animal electric fluid. Volta carefully repeated Galvani's experiments and devised new methods to perform them—an impressive scientific approach. He even replaced the frog legs used in Galvani's experiments with brine-soaked paper, showing that the muscle tissue itself was not necessary to produce an electrical effect.

Figure 6

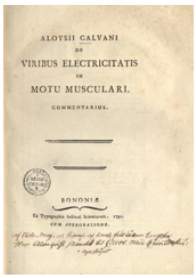


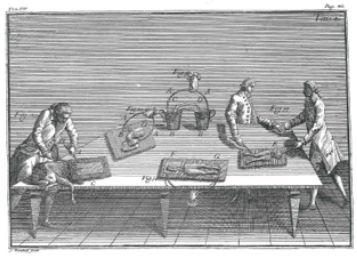
Electrodes touch a frog, and the legs twitch into the upward position

Luigi Galvani
(1737 – 1798); b. Bologna, Italy

- Physician, physicist, biologist & philosopher
- Education: Univ. of Bologna & faculty there his whole career
- Discoverer of bioelectricity and the father of electrophysiology
- 1780; muscles of dead frog legs twitched when struck by electric spark
  - Made muscle nerve preps
  - Therefore, Father of concept we can study electric patterns & signals from tissues
- "Animal Electricity" – term to define the force that activates the muscles of his specimens
- Believed conductions were due to electricity intrinsic to animal body parts

Figure 7





Galvani 1791 – Research Team

Luigi Galvani
(1737 – 1798); b. Bologna, Italy

- Volta disagreed and made 1st chemical battery to displace Galvani's theory – Volt's "pile"
  - But Volta coined term *Galvanism* for a direct current of electricity produced by chemical action
- While Volta was correct, Galvani was active pioneer in muscle & nerve research & neurophysiology
- He is the original EMG-er!
- Galvonometer – Instrument for detecting & measuring electrical current
- Book: *Commentary on the Effects of Artificial Electricity on Muscle Motion* (1791)
  - Describes detailed planning, execution & interpretation of experiments with illustrations – very popular / landmark treatise

Luigi Galvani was a physician, physicist, and biologist. Like Morgagni, he was educated in Bologna. Unlike Morgagni, he remained at the University of Bologna and taught there his entire career. He is considered the discoverer of bioelectricity and the father of electrophysiology. In 1780, he showed that applying an electric spark to a dead frog's leg muscle caused it to twitch. He performed numerous experiments using muscle and nerve preparations and is rightly considered the originator of the concept that we can study electrical patterns and signals from biological tissues. He believed there was an "animal electricity" or a force within the muscle that generated this electrical activity—a concept Volta rejected. In Figure 6, you not only see his portrait but also examples of his experiments, where electrodes were used to stimulate frog muscles.

His research team worked extensively with muscle and nerve preparations from frogs and other animals. Galvani published his findings in Commentary on the Effects of Artificial Electricity on Muscle Motion, originally published in Latin in 1791.[8,9] The book contained amazing illustrations, including long fold-out diagrams of muscle and nerve experiments (Figures 7–10). These are the experiments Volta later replicated, most of which he successfully repeated. The term galvanometer, an instrument for detecting and measuring electrical current, is of course named after Galvani.

Figure 8

Galvani 1791 – Muscle Stimulation Demonstration for the Public!

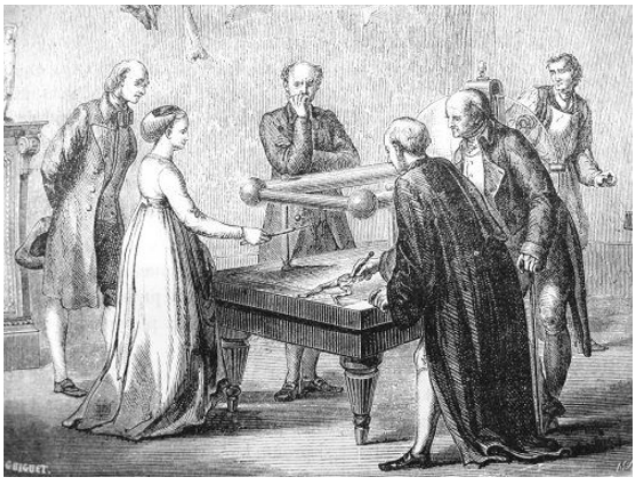


Figure 9

Galvani 1791 – The Lab!

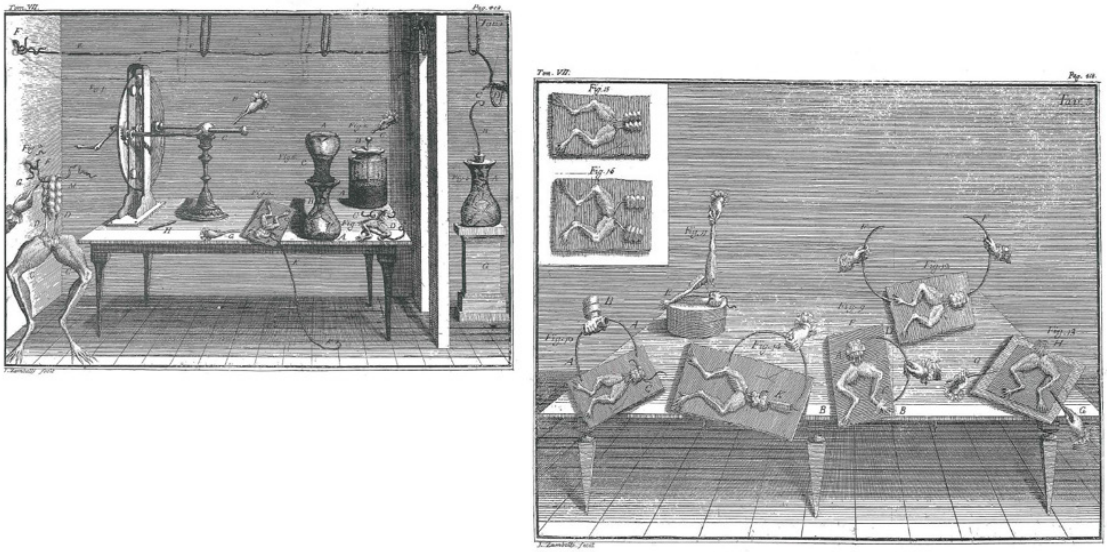
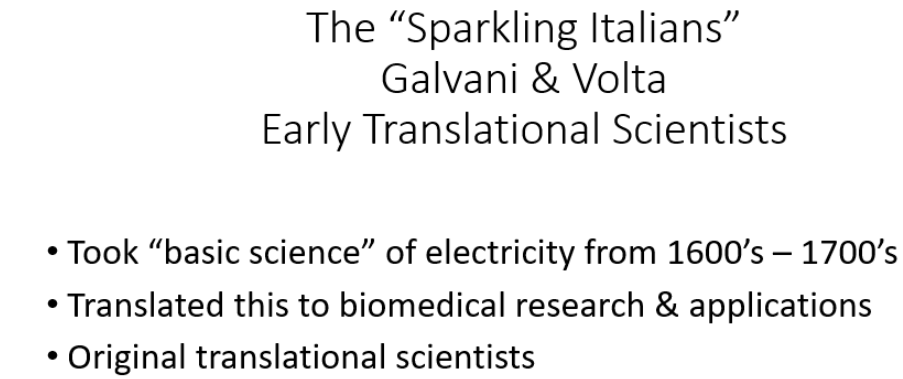


Figure 10

Figure 11



Galvani also gave public demonstrations of muscle stimulation to lay audiences, including politicians and investors (Figure 8). His laboratory featured both indoor and outdoor experiments—famously, he even conducted tests on his patio, connecting frog legs to metal wires during thunderstorms to capture lightning as a power source (Figures 9 &10). In a way, you could call him the first "Bill Gates," doing experiments in his own version of a garage.

The "Sparkling Italians," Galvani and Volta, took basic science concepts of electricity from the 1600s and 1700s and translated them into biomedical research and applications. They truly deserve to be considered among the original translational scientists. Galvani can also be considered the original electromyographer, or the first practitioner of EMG.

References

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