



### LW5 Leonhard Euler's Mysterious Blindness and Fever

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**Learning Overview:** The goals of this presentation are for the attendee to: (1) learn how to analyze historical data in order to make a retrospective diagnosis; and (2) learn about brucellosis

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by explaining how to analyze historical/biographical data in order to diagnose distant events/conditions.

The renowned Swiss polymath Leonhard Euler (1707-1783; spent the vast majority of his adult life at the St. Petersburg Academy of Sciences in Russia) is often grouped along with Archimedes, Newton, Gauss, and Riemann as one of the five most famous mathematicians of all time and the most prolific. He produced 886 papers and books and is honored by 96 eponymous mathematical terms. He introduced the concept of a function,  $f(x)$ , the modern notations in trigonometry, and the mathematical symbols:  $e$ , for the base of the natural logarithm;  $\sigma$ , for summation; and  $i$ , the imaginary number representing the square root of minus 1. He popularized  $\pi$ . He derived "Euler's identity,"  $1 + e + i + e^i + \dots = 0$ , which has been called the "most remarkable formula in mathematics" by Nobel Laureate Richard Feynman, and he was the first to present Newtonian dynamics in mathematical form. He has been honored by stamps, currency, a Paris street, and a lunar crater.

In 1735, at age 28, he developed an inexplicable and near-fatal febrile disease that spontaneously remitted. A mezzotint copy by Vassili Sokolow of a (now lost) portrait of Euler in 1737 by Johann Georg Brucker shows a normal physiognomy and appearance of both eyes. The following year, Euler suffered a relapse of his febrile illness and began to lose the sight of his right eye associated with what was described as an "abscess" (most likely, septicemia causing a septic cavernous sinus thrombosis with ischemic optic neuropathy). His fevers continued. A 1753 portrait by the celebrated Swiss painter Jakob Emanuel Handmann shows a ptotic right upper eyelid with slight right miosis (consistent with a right Horner's syndrome), a right hypertropia (consistent with a right fourth cranial nerve palsy), and normally appearing anterior ocular segments. In 1766, Euler developed a cataract in the left eye, the unsuccessful 1771 extraction of which left him virtually completely blind, but still able to perform highly complex mathematical calculations in his head. He then continued his prodigious output of mathematical discoveries to an even greater extent. In 1783, Euler suddenly developed a fatal brain hemorrhage, most likely the result of a ruptured intracranial aneurysm.

Today, common causes of recurrent fever include immunizations, viral infections, heat exhaustion, chronic inflammation, malignant tumors, antibiotic, hypertensive or seizure medications, and certain bacterial infections, including, but not limited to, tuberculosis, typhoid fever, epidemic typhus, or tertiary syphilis, all of which are either incorrect or extremely unlikely.

For centuries, an essential part of the Russian diet has been raw milk, the consumption of which is a significant risk factor for brucellosis, the chronic debilitating febrile illness attributed to the pioneer nurse Florence Nightingale after her return to the United Kingdom from the Crimean War in 1856. Brucellosis, also known as undulant or Malta fever, is a highly contagious, and the most common, zoonosis, is caused by the ingestion of unpasteurized milk, cheese, and other dairy products or undercooked meat from animals (usually sheep or goats) infected with a small, gram-negative, non-motile, non-spore-forming, non-encapsulated, rod-shaped coccobacillary bacteria that functions as a facultative intracellular parasite, causing a chronic disease, usually persisting for life. This organism, eponymously designated *Brucella spp.*, was first noted in a splenic autopsy specimen by the Scottish pathologist and microbiologist Sir David Bruce. The Mediterranean Fever Commission of 1904–1906, chaired by Bruce, traced its transmission to the unpasteurized milk of Maltese goats.

An exhaustive literature review strongly suggests that, given the history of an acute, febrile illness that progresses to a chronic disease with ophthalmic and neurological complications (CN IV palsy, Horner's syndrome, and optic neuropathy), and having the possible terminal event being rupture of a mycotic intracranial aneurysm, the most likely diagnosis to explain this complex set of circumstances regarding the blindness and death of Leonhard Euler is undulant fever, progressing to neuro- and ocular-brucellosis, and death by rupture of a *Brucella*-infected cerebral aneurysm.

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#### Euler, Brucellosis, Fever