A Note from History: Discovery of the Cerebrospinal Fluid

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The presence of fluid in the brain was known to ancient physicians. Hippocrates (460-375 BC), when describing congenital hydrocephalus, commented on "water" surrounding the brain [1]. Galen (130-200), the premier anatomist prior to Vesalius (1514-1564), referred to "excremental liquid" in the ventricles of the brain from where it is purged into the nose [2].

Despite the recognition by Hippocrates and Galen of some kind of fluid in the brain, subsequent anatomists missed it for 16 centuries. This was perhaps due to their autopsy technique, ie, cutting off the head from the neck, which drained the cerebrospinal fluid (CSF) and blood from the brain and spine.

The discovery of CSF is attributed to Emanuel Swedenborg (1688-1772), who had graduated from the University of Upsala, Sweden, with a degree in mining and engineering (Fig. 1), Working as a mining engineer, Swedenborg often came across an underground stream of water that lead him to search for its source. As a religious man and a teacher of theology, he took upon himself to search for the seat of the soul. His search for the soul brought him into contact with anatomists in France, Germany, and Italy. Having observed and participated in numerous dissections between 1736 and 1740, he felt prepared to engage in original medical investigations of the brain, which seemed a likely seat of the soul.

Swedenborg summarized his observations on the brain, spinal cord, and blood circulation in a manuscript written between 1741 and 1744. Not having medical credentials, he was unable to find a publisher. The manuscript was discovered in Stockholm one and a half centuries later; it was finally published in translation in 1887 [3].

Fig. 1. Emanuel Swedenborg (1688-1772)

Swedenborg referred to the CSF as "spirituous lymph" and "highly gifted juice" that is dispensed from the roof of the fourth ventricle to the medulla oblongata, and the spinal cord [3]. His manuscript also contained comments on the subarachnoid space and the arachnoid membrane. Swedenborg recognized the cerebral cortex as the seat of thought and the source of the sensory and motor functions of the extremities.

The next person of note is Albrecht von Haller (1708-1777), a Swiss physician who is regarded as the first European physiologist and the father of

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Fig. 2. Albrect von Haller (1708-1777)

modern physiology (Fig. 2). He was an infant prodigy and a protected child in a learned family. He was able to read by the age of 4 yr; by the age of 10, he had written scores of poems and published a Greek and Hebrew dictionary. He began to study medicine at the age of 15 and received his medical degree at the age of 19.

Albrecht von Haller turned to physiology and research because he failed as a practicing physician. He excelled at medical science and he was soon invited to join the faculty of the new University of Göttingen, Germany, as professor of anatomy, botany, and medicine. von Haller was known for outspoken stubbornness. He did not accept theories and based his descriptions on anatomic observations and physiologic experiments. His published works included more than 2000 reports and papers and 86 books.

In 1747, in a landmark work in physiology [4], von Haller presented factual information, based on his experiments, that the "water" in the brain is secreted into the ventricles and absorbed in the veins; in case of excess secretion, it descends to the base of the skull and into the "spinal marrow," resulting in hydrocephalus. After teaching for 17 years in Germany, von Haller retired to Switzerland. He quit medical writing and returned to his childhood hobbies, poetry and languages, and he became magistrate of the city of Bern.

Domenico Contugno (1736-1822), an Italian anatomist, physiologist, and professor of surgery at the University of Naples, discovered the semicircular canals and the cochlea of the internal ear. He also demonstrated the presence of fluid in the labyrinth [5]. Contugno never referred to CSF in humans, but he described it in fishes and turtles.

A pioneer experimental physiologist in France, Francois Magendie (1783-1855), was professor of medicine at the College de France. Magendie studied the properties of cerebrospinal fluid by experimenting on living animals. He discovered the foramen Magendie, the opening in the roof of the fourth ventricle, but erroneously concluded that CSF was secreted by the pia mater [6]. On the other hand, his description of the CSF as a fluid in which the brain and the spinal cord are suspended like the fetus in the uterus opened thinking about roles of the CSF in health and diseases. In 1845, Magendie retired from full-time medical practice, but he kept teaching and traveling. He regarded pathology as the "physiology of the sick" [7].

Thomas Willis (1621-1675), an English physician, is remembered for his discovery of the "circle of Willis" and the eleventh cranial nerve. It is less well known that, in 1664, he described "a liquid" in the aqueduct of Sylvius that connects the ventricles, noting that in "epidemic fever," ie, meningitis, the consistency of the "liquid" is altered [8]. This comment presaged Magendi's observations that diseases cause alterations of the CSF.

Four decades after Magendi's studies, rapid advances occurred in understanding the role of CSF. In 1891, W. Essex Wynter (1860-1945) treated tuberculous meningitis by tapping the spinal subarachnoidal space [9]. In the same year, Heinrich Quincke (1842-1922) popularized lumbar puncture by presenting the technique at the German Congress of Medicine and advocating its use for diagnostic and therapeutic purposes [10].

It is appropriate that two eminent neurologists, William Mestrezat (1883-1928) and Harvey W. Cushing (1869-1939), brought the two thousand year saga of the CSF into the modern era. In 1912, Mestrezat gave the first accurate description of the chemical composition of the CSF [11], and in 1914, Cushing produced conclusive evidence that the CSF is secreted by the choroid plexus [12].

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