Special Report

Jan Evangelista Purkinje: A Passion for Discovery

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December 2017 was the 230th anniversary of Jan Evangelista Purkinje's birth, which prompted us to review the life of this remarkable man who established the world's first department of physiology in Wroclaw and whose name is immortalized in the cardiologic eponym, Purkinje fibers. This paper offers an overview of Purkinje's life, legacy, and numerous scientific discoveries. ***(Tex Heart Inst J 2018;45(1):23-6)***

December 2017 was the 230th anniversary of Jan Purkinje's birth. To mark the occasion, we present an overview of the life, legacy, and numerous medical discoveries of this remarkable scientist who established the world's first physiology department in Wroclaw (Breslau) and whose name is familiar to many cardiologists because of the eponym, Purkinje fibers.

Jan (Johannes) Evangelista Purkinje (Fig.1) was born on 17 December 1787 in Libochovice Castle, which is in the Czech Republic. His father, Josef Purkinje, was an administrative and economic supervisor for the estate of Prince Dietrichstein, and Purkinje was the first son born to him and his wife, Rosalie (née Safranek). Two more sons followed: Emanuel (1789–1791) and Josef Jindrich (1793–1833). When Purkinje was 6 years old, Josef died suddenly at the age of 47. Although the loss affected the social status of the family and threatened the boys' educational plans, Purkinje was fortunate to attend the local primary school, where he learned the basics of music by singing and playing the violin and where John Comenius' *The World in Pictures* became his favorite book.[1-5] Did reading Comenius' book spark his passion for discovery? Could he have imagined that, dozens of years later, he, like Comenius, would also be an author and that cardiologists around the globe would recognize his name?

Impressed with young Purkinje's intelligence, the local chaplain taught him the basics of Latin, Greek, and astronomy while he was still in elementary school. He was one of the best singers in the church, so after completing his elementary education in 1798, he was sent to Mikulov, one of Prince Dietrichstein's estates in southern Moravia, to attend a Catholic (Piarist) secondary school tuition-free in exchange for singing in the monastery choir. The school, which taught its students in German, had a good reputation, and it possessed a rich collection of physical and astronomic instruments. The curriculum included philosophy, Latin, Greek, modern languages, history, geography, mathematics, and physics; Purkinje was most interested in studying the natural sciences.[1-5]

Purkinje became a novice in the Piarist order and took the name Silverius, but instead of becoming a priest, he left the order in 1807 and returned home. The chronicle of the monastery in Litomysl includes a record of the event: "Cleric Silverius Purkinje left our institute and went to his hometown Libochovice" (translated from Latin).[2]

In 1808, while working as a tutor for several aristocratic families, Purkinje began studying physiology at Charles University in Prague. In 1813, he began his medical studies, which culminated with his dissertation, *Contribution to the Understanding of Vision from the Subjective Point of View.* During his investigations into the physiology of vision, he had studied the phenomenon of color perception at low levels of light: at dusk, blue light, which has a short wavelength, seems to be brighter than red light, which has a longer wavelength. Today, this phenomenon is called the Purkinje effect or Purkinje shift. Wolfgang Goethe, whose experiments had inspired Purkinje's investigations, called him the "Brilliant Piarist" and, in 1823, helped him obtain the position of Professor of Physiology and Pathology at the University of Wroclaw. Karl Asmund Rudolphi, a professor of anatomy and physiology in Berlin, also supported Purkinje's candidacy for the professorship by personally recommending him

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Fig. 1 *Jan Evangelista Purkinje (1787–1869).*

Photograph courtesy of BIU Santé. Available at: http://www.biusante.parisdescartes.fr/histoire/images/index.php?refphot=08269.

to the Prussian minister for education. Rudolphi, who was called the "father of helminthology," later became Purkinje's father-in-law.[1-5]

Unfortunately, Purkinje's start at the university was not easy. For example, when he asked for a new microscope, his request was denied because his respectable predecessor had had a brilliant academic career without having used such an instrument. Purkinje had to wait 9 years for his microscope, but the one he got was worth the wait: it was an achromatic Simon Plössl microscope, the best device of the time.[1-5]

The year he arrived in Wroclaw, Purkinje presented a new method for objective investigation of the eye, which enabled physicians to measure the curvature of the cornea and diagnose eye disorders. Today, reflections of structures within the eye, such as the inner and outer surfaces of the cornea and of the lens, are called Purkinje images or Purkinje-Sanson images.[1,2,6] Purkinje was also interested in studying hearing disorders, notably the conduction of sound through bone and hearing aids, as well as articulation, acoustics, speech, and phonetics; vertigo and balance; brain injury; and the physiologic basis of sleep and wakefulness.[1,2,6] His wide spectrum of research also included ciliary movement in epithelial cells and comparisons of animal and plant cell structures.[7] He was the first to use a microtome and to use Canada balsam to prepare tissue samples, and he used daguerreotypes, which had recently been invented, to make images of the tissues.[1,2,6]

Purkinje tested drugs on himself to determine their appropriate doses. To prove his claim that the doses prescribed by doctors were too small, he took digitalis and atropine and registered their effects on his body (bradycardia, blurred vision, and pupil dilation). He also took camphor, nutmeg, and turpentine to observe their side effects.[8,9]

Purkinje also made notable achievements in dactyloscopy. His 1823 thesis, *Commentary on the Physiologic Examination of the Organs of Vision and the Cutaneous System,*[10,11] contains a detailed description, complete with meticulous illustrations, of 9 principal fingerprint patterns, classified in Latin. This and his many other publications brought fame to him and his Institute of Physiology in Wroclaw.[1-6]

In 1827, Purkinje celebrated his 40th birthday and married Rudolphi's daughter, Julia Agnes, who was 27 years old. The couple had 2 daughters and 2 sons, whom they raised in a cosmopolitan, trilingual (German-Czech-Polish) home. (Purkinje was also fluent in Latin.) Unfortunately, the family's happiness was short-lived. Purkinje's daughters, Rosalie (age, 2.5 yr) and Johanka (1.5 yr), died on 29 August 1832 during a cholera epidemic. Three years later, his wife died of typhoid. Purkinje never remarried. His sons survived into adulthood. Emanuel (1831–1882) was a naturalist and a meteorologist, and Karel (1834–1868) was a well-known portrait painter.[1-6]

After a period of mourning, Purkinje focused on his work. During this time, he made his best-known discoveries. In 1837, he discovered and described the large brain cells found in the middle layer of the cerebellum (Purkinje cells). Two years later, he discovered the specialized fibers in the heart that conduct electrical impulses (Purkinje fibers); his findings were published in Polish in *The Yearbook of the Faculty of Medicine at the Jagiellonian University.*[12,13]

On 8 November 1839, Purkinje officially opened Wroclaw's Institute of Physiology—later considered to be the cradle of histology[1]—and moved his experiments, classes, and animal-breeding efforts from his home to the institute. His strong organizational skills made it easy for him to obtain funds for modern equipment for the facility, which helped him advance his knowledge of physiology. In 1845, in the *Archive for Anatomy, Physiology and Scientific Medicine*, he described the nerve fibers and ganglia in various organs, and on the last 2 pages of the text he presented the experiments he had conducted on the hearts of sheep and his further observations on Purkinje fibers.[14] The Purkinje fibers form the terminal part of the heart's conduction system, a 3-dimensional subendocardial network beginning in the bundle branches. The Purkinje network consists of 2 components: the subendocardial fibers, which are connected

to the bundle branches and guarantee activation from the apex to the base of the ventricle, and an intramural part, variably present. Their main function is to rapidly transmit the depolarization signal to the working ventricular myocardium. The Purkinje fibers are known to have a unique ion channel expression and faster conductivity in comparison with the working cardiac myocytes. This heterogeneity in conduction velocity can be a cause of reentry tachycardia.[15]

Purkinje's time in Wroclaw was not solely dedicated to research. The great scientist promoted Czech and Polish culture, and he advocated for cooperation between Slavic nations. He also translated poems and novels from German into Polish and Czech—most notably, the works of Goethe and Schiller (into Czech). In addition, Purkinje founded the Literary-Slav Society in 1836, the aim of which was to study literature and Slavic languages, especially Polish.[1,2,5]

In spring 1850, Purkinje returned to Prague, where he was offered the chair of physiology at Charles University. On 6 October 1851, he opened a second Institute of Physiology, one floor below his residence. However, he subsequently focused more attention on cultural and artistic pursuits than on scientific achievements. In 1853, he created the magazine *Ziva*, which is published today by the Czech Academy of Sciences and which dedicated a special issue to Purkinje.[16] During his time in Prague, Purkinje, a strong patriot, also became one of the first academics to give lectures in Czech. He also became involved in local politics, was elected to the national parliament (Landtag), and participated in Prague's Slavic Congress.[1,2]

Jan Purkinje died in Prague on 27 July 1869 and was buried at the National Cemetery in Vysehrad (Prague). He left behind a remarkable scientific legacy. The authors of the book *Purkinje's Vision: The Dawning of Neuroscience* summarized his contributions as follows:

> The life of Jan Evangelista Purkinje has fascinated students from many disciplines. Histologists marvel at his early descriptions of cells, physiologists admire his attempts to relate structure to function, pharmacologists view in awe his heroic experiments on self-administered drugs, forensic scientists acknowledge his role in the use of fingerprints for identification, and Czech patriots salute his awakening of pride in their nation.[17]

His passion for innovation, his capacity for original thought, and his scientific achievements made Purkinje so famous that he purportedly received letters from all over the world addressed simply to "Purkinje, Europe."[18]

Europe has made many tributes to Purkinje (spelled Purkyne in Czech, Purkinje in German, and Purkynie in Polish). The ground floor of the castle in Libochovice houses a permanent exhibit dedicated to his life and works. The Jan Evangelista Purkyne University (UJEP) in Usti nad Labem is a public university established in the Czech Republic in 1991. In the center of Wroclaw is a plaque that marks the spot where Purkinje's Department of Experimental Physiology stood. A commemorative bilingual plaque commemorating Purkinje is located on the main building of Wroclaw University. There are Purkynie streets in Wroclaw and Prague. The Palac Purkinova now stands in place of the neoclassical building in Prague where Purkinje lived and died. One can find a marble bust of Purkinje in the Physiology Department of Wroclaw Medical University, and a monument to him in the center of Prague. Finally, a lunar crater bears Purkinje's name.[19]

Ironically, a statement Purkinje made in the year of his death makes it clear that he neither sought nor expected fame:

> I have indeed discovered various things, but, as for immortality of my name, this should not be taken literally. A hundred years hence perhaps only a few will know who Purkinje was. But that makes no difference. For indeed we do not know who discovered the plow, and yet it serves all humanity. The cause remains the same, but not the name, and that is the important thing.[20]

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