Rudolf Carl Virchow (1821-1902) [1]

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Rudolf Carl Virchow lived in nineteenth century Prussia, now Germany, and proposed that *omnis cellula e cellula*, which translates to each cell comes from another cell, and which became a fundamental concept for cell theory. He helped found two fields, cellular pathology and comparative pathology, and he contributed to many others. Ultimately Virchow argued that disease is caused by changes in normal cells, also known as cellular pathology.

Virchow was born in Schivelbein, a small town in rural Pomerania in Prussia on 13 October 1821. He was the only child of Johanna Hesse Virchow and Carl Virchow, a merchant. Virchow attended the Gymnasium in Köslin in 1835, after receiving private lessons in the classical languages. His academic prowess earned him a military scholarship to the Prussian Military Academy in 1839 to study medicine at the Friedrich-Wilhelms Institut in Berlin, Germany. There Virchow studied with two prominent professors of anatomy and medicine, Johannes Müller [4] and Johann Schönlein, who exposed him to experimental laboratory techniques and epidemiological studies.

Virchow completed his medical degree at the Friedrich-Wilhelms Institut in 1843 and began work as the house officer in the Charité Hospital in Berlin, where he also studied vascular inflammation under the tutelage of Robert Froriep. He spoke at the Friedrich-Wilhelms Institut twice in 1845, and in his speeches Virchow addressed his vision of medical progress: clinical observation, animal experimentation, and pathological anatomy.

After becoming a licensed doctor in 1846, he traveled to Vienna, Austria and Prague, in what is now the Czech Republic, to study methods in pathology and succeeded Froriep as prosector at the Charité Hospital. In 1847 Virchow became an instructor at the University of Berlin [5], in Berlin, Germany, where his former professor, Johannes Müller, [4], was now dean. During this time, Virchow and a colleague, Benino Reinhardt, began a new journal called *Archiv für Pathologische Anatomie und Physiologie, und für die klinische Medizin* (*Archives for pathological Anatomy and Physiology and Clinical Medicine*) now known as *Virchow's Archives*). After Reinhardt's death in 1852, Virchow alone edited the journal until his own death in 1902.

In 1848 Virchow was among a group of physicians sent by the Prussian government to evaluate typhus outbreaks in Silesia, a poor rural area in what is now Poland. The poverty and destitution Virchow witnessed altered his priorities and helped form his political views. When Virchow returned from Silesia to Berlin in 1848, he advocated for increased education and freedom, as well as government involvement in public health. In July 1848, he helped found a weekly newspaper called *Medical Reform*, which advocated for social medicine, the idea that people’s health could be improved by better social and economic conditions. His political activism interfered with his work, ultimately resulting in his suspension from his position as prosector for Charité Hospital in 1849. Virchow’s students and medical colleagues protested, and Virchow was partially reinstated to this position.
In late 1849, Virchow left Berlin to become Germany's first chair in pathological anatomy at the University of Würzburg, in Würzburg, Germany, where he taught students like Ernst Haeckel, Adolf Kussmaul, and Edwin Klebs, as well as William Welch and William Osler, two of the four physicians who later founded Johns Hopkins Hospital. In 1850, Virchow married Rose Mayer, the daughter of a colleague. In 1852, Rose gave birth to the couple's only son, Hans Virchow. Hans would later succeed his father as the professor of Anatomy at the University of Berlin in 1902.

Virchow's research at Würzburg helped to establish the concept of cellular pathology, the idea that all diseases are caused by changes in normal cells. Virchow argued that life was merely the sum of the processes of cellular activities. He eventually published a six-volume series on pathology called the Handbuch der speziellen Pathologie und Therapie (Handbook of special Pathology and Therapeutics) in 1854. In 1855, he further developed his ideas by publishing his famous aphorism omnis cellula e cellula which became a part of the foundation for cell theory. Virchow's theory stated that just as animals are unable to arise without previously existing animals, cells are unable to arise without previously existing cells. The idea that new cells arose from pre-existing cells in both diseased and healthy tissue was not original. Robert Remak, a neuroscientist, had already come to this conclusion in 1852, though his publication went largely unnoticed. Virchow also discovered that bones and connective tissue were composed of cells.

Virchow also studied parasitic worms. He focused on Trichinella spiralis in swine, which he discovered caused the parasitic disease trichinosis when humans consume raw or undercooked pork. This relationship, as well as the findings of parallel human and animal microbial pathogens by others, including Louis Pasteur and Robert Koch, led Virchow to the idea that there was a relationship between human and animal diseases which he termed zoonosis. Many credit him as a founder of comparative pathology because of this work.

Virchow returned to the University of Berlin in 1856 as professor of anatomy and pathology and the director of the new Pathological Institute. His work in cellular pathology culminated in his 1858 book Die Cellularpathologie (Cellular Pathology). In this book, Virchow argued that the idea of spontaneous generation, like the theory of free cell formation that Matthias Schleiden had proposed, must be rejected in pathology.

After the publication of Die Cellularpathologie, Virchow refocused on political and public health issues when he was appointed to the Berlin City Council in 1859. During his time as a council member, he helped improve Berlin's water and sewage systems, meat inspection because of his discovery that Trichinella spiralis in swine caused trichinosis in humans?and public hygiene. Virchow was elected in 1861 as a representative of the Deutsche Fortschrittspartei (German Progressive Party), to serve as a member of the Landtag, a section of the Prussian assembly. He was a member of the Reichstag, the Prussian parliament, from 1880 to 1893.

In 1897 Virchow was honored for a half-century of service to the University of Berlin and the following year he was invited to lecture before the Royal Society in London. He received the Great Gold Medal of Science from Emperor Wilhelm II on his eightieth birthday for his contributions to medical science. In 1902 Virchow fractured his hip when he jumped out of a moving tram. He died a few months later in Berlin on 5 September 1902 from heart failure.
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