

## Rudolf Virchow, the founder of cellular pathology

DOMENICO RIBATTI

*Department of Basic Medical Sciences, Neurosciences and Sensory Organs, University of Bari Medical School, Bari, Italy*

### Abstract

The cell theory was firstly formulated by Schleiden, Schwann, and Virchow. They sustained that the cells originate from pre-existing cells and that the living organisms are composed by cells organized in different tissues. In particular, Virchow not only established the principle of *omnis cellula e cellula*, but considered for the first time that alterations on cell organization was at the basis of disease.

**Keywords:** cell theory, cellular pathology, history of medicine.

### Background

Rudolf Ludwig Karl Virchow (Figure 1) was born on October 13, 1821, in Schievelbein. He studied medicine at Friedrich-Wilhelms Institut in Berlin and his mentors were Johannes Müller and Johann Schönlein. In 1843, Virchow received his medical degree and was appointed prosector at the Charité Hospital in Berlin. In 1847, Virchow with Benno Reinhardt founded a new Journal, *Archiv für pathologische Anatomie und Physiologie und für klinische Medizin*, later known as *Virchows Archiv*. This Journal constitutes the most important collection of original contributions to scientific medicine. Virchow acted as Editor of the Journal until his death.



**Figure 1** – A juvenile portrait of Rudolf Virchow (Wikipedia).

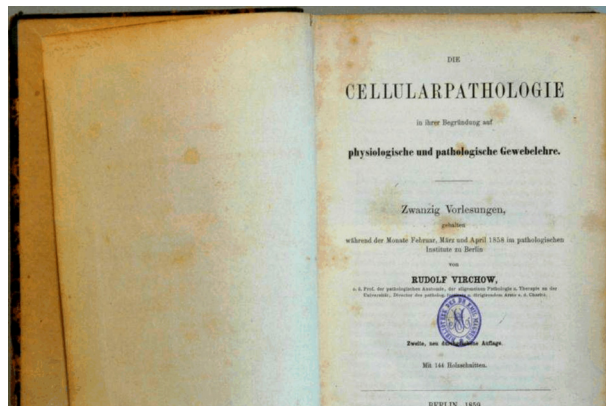
In 1849, Virchow was suspended by the government due to his liberal views, and moved to Bavarian University of Würzburg. In 1856, Virchow was recalled to Berlin and became Director of the Institute of Pathology. Virchow

was responsible for many social, sanitary, and medical reforms, and opposed Otto Bismarck when he became Prime Minister. In 1861, he was elected to the Prussian Diet. Virchow's career in social medicine was equally remarkable. Virchow died in Berlin on September 5, 1902.

### *Omnis cellula e cellula*

*Die Cellularpathologie in ihrer Begründung auf physiologische und pathologische Gewebelehre* [1] appeared in 1858 (Figure 2). It was a shorthand report of 20 Lectures given to medical men, since Virchow was too busy to write out his Lectures by himself. Here, Virchow demonstrated that the principle of *omnis cellula e cellula*, applied equally to pathological formations and to normal embryological development. The Virchows' theory was inspired by Theodor Schwann's cellular theory, who has generalized to all animals the conclusions of Matthias Jakob Schleiden, who was the first to state that each plant was a community of cells [2]. Virchow corrected and extended Schwann's cellular theory, but he was not in accord with Schwann as concerns the existence of an amorphous protein mass called cytotblastema. Schwann retained that "The entire process of the formation of a cell consists of precipitation, around an initially arising small body (nucleolus), of first one (nucleus), and then, around it, a second layer (cell substance). The different layers grow by intake of new molecules among those already present, by intussusception, and this according to the law that the precipitation is more pronounced in the outer parts of every layer... Because of this law, only the outer part of every layer condensates into a membrane (of the nucleus and of the cell)." [3]. Virchow was influenced by Robert Remak, who sustained: "The division of the cleavage cells starts from the nucleus and, when at the end of cleavage, the nucleolus can be recognized from the latter... At the lower, white half of the uninjured egg, one can observe by use of a magnifier, in the last stages of cleavage, how the light spot representing the nucleus divides into two spots, how those spots move away from one another, and how the cleavage cell divides in a way that each half is furnished with a light spot (nucleus)... Following cleavage, the cells begin to form an embryo

by separating themselves into three layers (a sensory, a motoric, and a trophic one) and by proliferating within those layers through division, thus creating the cells that serve as the basis of tissues.” [4].



**Figure 2 – The cover of Die Cellularpathologie in ihrer Begründung auf physiologische und pathologische Gewebelehre.**

Virchow for the first time considered the cell at the basis of the disease: “What Schwann, however, has done for histology, has as yet been but in a very slight degree built up and developed for pathology, and it may be said that nothing has penetrated less deeply into the minds of all than the cell-theory in its intimate connection with pathology. ...The chief point in this application of histology to pathology is to obtain a recognition of the fact, that the cell is really the ultimate morphological element in which there is any manifestation of life, and that we must not transfer the seat of real action to any point beyond the cell (...) Each disease originates from the alterations that affect a smaller or larger number of cellular units within the living organism; every pathological disturbance, every therapeutic effect can only then ultimately

have interpreted, when it is possible to tell which particular group of living cellular elements is concerned, and which kind of alterations each element of such a group has undergone. The long searched for essence of disease is the altered cell.” [1]. Virchow thus regarded the study of cells as basic to the understanding of cancer where he invested much time, and, among other things, he described leukemia for the first time. He was one of the first to observe the leukocytosis, which appeared in some cases of leukemia and understood the role of lymph nodes or the spleen in those conditions. Moreover, Virchow studied the microscopic aspects of inflammatory lesions, understood how the lesions of tuberculosis, the supporting cells of the central nervous tissue (to which he gave the name “neuroglia”), the role of the lymph nodes in the extension of cancer. Finally, Virchow retained that cancer may be considered a particular form of inflammatory reaction, and this concept has been more recently re-evaluated [5, 6].

## References

- [1] Virchow R. Die Cellularpathologie in ihrer Begründung auf physiologische und pathologische Gewebelehre. Verlag von August Hirschwald, Berlin, 1858.
- [2] Schleiden MJ. Beiträge zur Phytogenesis. Arch Anat Physiol Wiss Med (Müller's Archiv), 1838, 5(2):137–176.
- [3] Schwann Th. Mikroskopische Untersuchungen über die Uebereinstimmung in der Struktur und dem Wachsthum der Thiere und Pflanzen. Verlag der Sander'schen Buchhandlung (G. E. Reimer), Berlin, 1839.
- [4] Remak R. Ueber extracelluläre Entstehung thierischer Zellen und über die Vermehrung derselben durch Theilung. Arch Anat Physiol Wiss Med (Müller's Archiv), 1852, 19:47–57.
- [5] Balkwill F, Mantovani A. Inflammation and cancer: back to Virchow? Lancet, 2001, 357(9255):539–545.
- [6] Hussain SP, Harris CC. Inflammation and cancer: an ancient link with novel potentials. Int J Cancer, 2007, 121(11):2373–2380.

## Corresponding author

Domenico Ribatti, Professor, MD, PhD, Department of Basic Medical Sciences, Neurosciences and Sensory Organs, University of Bari Medical School, Policlinico – 11 Piazza Giulio Cesare, 70124 Bari, Italy; Phone +39.080.5478326, Fax +39.080.5478310, e-mail: domenico.ribatti@uniba.it

*Received: January 16, 2020*

*Accepted: January 27, 2020*