Matthias Jacob Schleiden (1804?1881) [1]

By: Parker, Sara Keywords: cells [2]
?

Matthias Jacob Schleiden helped develop the cell theory in Germany during the nineteenth century. Schleiden studied cells as the common element among all plants and animals. Schleiden contributed to the field of embryology [3] through his introduction of the Zeiss [4] microscope [5] lens and via his work with cells and cell theory as an organizing principle of biology.

Schleiden was born in Hamburg, Germany, on 5 April 1804. His father was the municipal physician of Hamburg. Schleiden pursued legal studies at the University of Heidelberg [6] in Heidelberg, Germany, and he graduated in 1827. He established a legal practice in Hamburg, but after a period of emotional depression and an attempted suicide, he changed professions. He studied natural science at the University of Göttingen in Göttingen, Germany, but transferred to the University of Berlin [7] in Berlin, Germany, in 1835 to study plants. Johann Horkel, Schleiden's uncle, encouraged him to study plant embryology [3].

In Berlin, Schleiden worked in the laboratory of zoologist Johannes Müller [8], where he met Theodor Schwann. Both Schleiden and Schwann studied cell theory and phytogenesis, the origin and developmental history of plants. They aimed to find a unit of organisms common to the animal and plant kingdoms. They began a collaboration, and later scientists often called Schleiden and Schwann the founders of cell theory. In 1838, Schleiden published "Beiträge zur Phytogenesis" (Contributions to Our Knowledge of Phytogenesis). The article outlined his theories of the roles cells played as plants developed.

Schleiden again transferred, this time to the University of Jena [9] in Jena, Germany, where he received his doctorate in botany in 1839. He then worked for the university as a professor in botany and studied a range of topics in which to lecture and publish. In 1844, Schleiden married his first wife, Bertha Mirus, with whom he had three daughters. Mirus died in 1854, and Schleiden remarried in 1855 to Therese Marezoll, who survived him.

Schleiden used microscopes from the onset of his career, and he contributed to its use in biological research. Both Schleiden and Schwann encouraged Carl Zeiss [4] to develop new and improved microscopes. Zeiss [4] established a factory in Jena and continued to work on microscopes and microscope [5] lenses. With the help of these more powerful and advanced lenses, Schleiden and Schwann developed their cell theory through microscope [5] observation and experiments.

Schleiden entered a debate with Giovan Amici, who lived in Italy, in 1842. At the Fourth Italian Scientific Congress in Padua, Italy, Amici presented his observations "Sulla fecondazione delle piante *Cucurbita Pepo*" (On the fertilization [10] of plants Cucurbita Pepo). Schleiden agreed with Amici that the growth of the pollen tube in plants went through the stigma and style, located inside a flower, and about its entry into the ovule. However, Schleiden expanded this theory by stating that the tip of the pollen tube developed into the embryo after entering the embryo sac. Schleiden's theory allowed for no sexuality in plants. Amici opposed Schleiden's position by showing that the embryo developed from a portion existing in the ovule, not from the tip of the pollen tube. Schleiden maintained his position despite evidence from other experiments until 1856, when Ludwig Radlkofer, a professor of botany at the University of Munich [11] in Munich, Germany, confirmed Amici's results.

Scheliden reviewed his theories about how plants developed in his 1842 textbook on botany *Grundzüge der wissenschaftlichen Botanik* (Principles of Scientific Botany). Schleiden said in his textbook that the cell is the most general expression of the concept of the plant, so it is necessary to study the cell as the foundation of the plant world. This theory started a branch of biology that focused on the study of plant cells called plant cytology [12]. Before Schleiden and Schwann's cell theory, biologists argued that individuals came to have a particular form from a pre-existing form, a theory called preformationism. This theory was applied to cells because cells inherited their forms from earlier cells. However, Schleiden, Schwann, and other scientists rejected preformationism in favor of a theory of epigenesis [13], arguing that cells emerge anew in each generation through the gradual diversification and differentiation [14] of an undifferentiated entity.

Schleiden said that when the cytoblast, which later scientists termed the nucleus [15], reaches its final size, a transparent vesicle forms around it, creating the new cell which then proceeds to crystallize within a formative liquid. He said that cells can only form in a liquid containing sugar, gum, and mucus, or the cytoblastema. The mucous portion condenses into round corpuscles, and the liquid transforms into jelly. The external liquid penetrates the closed, gelatinous vesicle and the jelly of the wall is transformed into a membranous substance and the cell is completed.

Many scientists worked on the crystallization of cells before Schleiden. The claim that cells crystallized inside a primary substance traced back at least to Nehemiah Grew, who studied plants in England during the seventeenth century. Other who studied crystallization in the nineteenth century included François-Vincent Raspail and Charles Robin in France, and Hugo von Mohl in Germany.

Schleiden's research on cytogenesis and the free genesis of cells sparked many scientific debates and controversies. Many of these controversies started with Schleiden's criticism of botanists from the early nineteenth century. Schleiden declared himself an enemy of all philosophical speculation, especially speculative botany, because he argued that the botanists should conduct observations that help them form hypotheses that can be further tested. He claimed that scientists could not learn botany from a book and that they may as well set it aside unread. His philosophy was to study plants, not books, and that the object of botanical science was the whole living plant, not solely the plant's particular parts. He also argued that scientists could not expect botany to follow the same laws and principles as physics and chemistry. For example, scientists attempted to explain the ordering and positioning of leaves as an expression of geometry and spiral configurations. Schleiden argued against this approach because botanists used mathematical rules as the causes of the regularities in nature and failed to investigate the causes of these natural phenomena. Scientists could then use inductive logic to proceed with subsequent experiments.

Schleiden published *Botanik als inductive Wissenschaft*, (Botany as Inductive Science) published in 1855. In this monograph Schleiden argues against the philosophy of Frederick

Schelling, a philosopher in Germany who published *Ideen zu einer Philosophie der Natur als Einleitung in das Studium dieser Wissenschaft* (Ideas for a Philosophy of Nature: as Introduction to the Study of this Science) in 1797. Schleiden also criticized philosopher Georg Hegel's *Philosophie der Natur* (Philosophy of Nature) published in 1817. He criticized Schelling and Hegel for basing their work solely on ideas rather than on observations and experiments. In Berlin during the 1850s Rudolf Virchow [16] advocated for the cell theory, for the use of the microscope [5] in pathology, and he refuted some of Schleiden and Schwann's claims about cell formation.

Schleiden gave many lectures, often for large audiences, some of which were published, such as 1850's *Die Pflanze und ihr Leben* (The Plant and Its Life) and 1857's *Studien* (Studies). In 1850 he became a full professor of botany at the University of Jena [9]. Schleiden left Jena in 1863 to become a professor of anthropology at the University of Dorpat [17], which later became the University of Tartu when Estonia gained independence from Russia. After the Russian government granted him a pension, Schleiden became a *Privatgelehrter*, a private scholar, and frequently moved from city to city.

Schleiden died on 23 June 1881 in Frankfurt am Main, Germany.

Sources

1. Amici. Giovanni. "Sulla fecondazione delle piante *Cucurbita Pepo*." [On the Fertilization of Plants *Cucurbita Pepo*]. In *Atti della Quarta Riunione degli Scienziati Italiani*. [Reports of the Fourth Congress of Italian Scientists]. Padova: Co' Tipi del Seminario, 1843: 134?39.
2. Bhatnager, S. P. and Sant S. Bhojwani. *The Embryology of Angiosperms, 5th edition*. Vikas Publishing House, 2009.
3. Cantor, Geoffrey N., John R. R. Christie, Michael J. S. Hodge, and Robert C. Olby, eds. *Companion to the History of Modern Science.* Routledge, 2006.
4. Cittadino, Eugene. *Nature as the Laboratory: Darwinian Plant Ecology in the German Empire, 1880?1900*. Cambridge University [18] Press, 2002.
5. Grew, Nehemiah. *Anatomie des plantes*. [Anatomy of Plants]. Paris: Lambert Roulland, 1675. http://bibdigital.rjb.csic.es/ing/Libro.php?Libro=4746 [19] (Accessed May 19, 2017).
6. Hegel, Georg. *Encyklopädie der philosophischen Wissenschaften im Grundrisse*. Heidelberg: Offenbach, 1817. https://archive.org/details/encyklopdiederp00unkngoog [20] (Accessed May 19, 2017).
7. Masters, Barry R. 2008. "History of the Microscope in Cell Biology and Medicine." *eLS*: 1?8.
8. Mohl, Hugo Von. *Grundzüge der Anatomie und Physiologie der vegetabilischen Zelle*. [Principles of the Anatomy and Physiology of the Vegetable Cell]. Brunswick: F. Vieweg und Sohn, 1851. https://books.google.com/books?id=W8o9AAAAYAAJ&dq [21] (Accessed May 19, 2017).
9. Müller, Johanes. *Handbuch der Physiologie*. [Handbook of Physiology]. Koblenz: Hölscher, 1835?1840. http://www.biodiversitylibrary.org/bibliography/128395#/summary [22] (Accessed May 19, 2017).
10. Radlkofer, Ludwig. *Ueber Krystalle proteinartiger Körper: pflanzlichen und thierischen Ursprungs*. [On Crystals of Protein Bodies of Vegetable and of Animal Origins]. Leipzig [23]: Engelmann, 1859. https://play.google.com/store/books/details?id=U-jENp4ceaQC&rdid=book-U-jENp4ceaQC&rdot=1

[24] (Accessed May 22, 2017).
11. Robin, Charles. *Histoire naturelle des végétaux parasites qui croissent sur l'homme et sur les animaux vivants*. [Natural History of Parasite Plants Growing on Man and on Living Animals]. Vol. 1. Paris: Baillièe, 1853. https://play.google.com/store/books/details?id=x1LPVA9rdRAC&rdid=book-x1LPVA9rdRAC&rdot=1 [25] (Accessed May 22, 2017).
12. Selow, Edith. "Schelling, Frederick Wilhelm Joseph." *Complete Dictionary of Scientific Biography* 12: 153?9.
13. Schleiden, Matthias Jacob. "Beiträge über Phytogenesis." *Müller's Archiv für Anatomie and Physiologie* (1838): 137?176. http://biodiversitylibrary.org/page/14166290 [26] (Accessed May 22, 2017). Translated by Henry Smith as "Contributions to Phytogenesis," in *Microscopic Investigations on the Accordance in the Structure and Growth of Plants and Animals*. London: The Sydenham Society, 1847: 229?63. http://www.biodiversitylibrary.org/item/43441#page/263/mode/1up [27] (Accessed December 5, 2013).
14. Schleiden, Matthias J. *Grundzüge der wissenschaftlichen Botanik*. Leipzig [23]: Engelmann, 1842. https://books.google.com/books?id=8fETAAAAQAAJ&printsec=frontcover&source=gbs_ge_summ [28] (Accessed November 10, 2015). Translated by Edwin Ray Lankester [29] as *Principles of Scientific Botany*. London: Longman, Brown, Green, and Longmans, 1849. http://www.biodiversitylibrary.org/item/201289#page/7/mode/1up [30] (Accessed May 22, 2017).
15. Schleiden, Matthias Jacob. *Schelling's und Hegel's Verhältniss zur Naturwissenschaft*. [Schelling's and Hegel's Relation to Natural Science]. Leipzig [23]: Engelmann, 1844. https://play.google.com/store/books/details?id=C_RkAAAAcAAJ&rdid=book-C_RkAAAAcAAJ&rdot=1 [31] (Accessed May 22, 2017).
16. Schleiden, Matthias Jacob. *Die pflanze und ihr leben: populäre vorträge*. [The Plant and Its Life: Popular Lectures]. Leipzig [23]: Engelmann, 1850. http://biodiversitylibrary.org/page/12869154 [32] (Accessed May 22, 2017).
17. Schleiden, Matthias Jacob. *Studien: populäre vorträge*. [Studies: Popular Lectures]. Leipzig [23]: Engelmann, 1857. http://biodiversitylibrary.org/page/48558088 [33] (Accessed May 22, 2017).
18. Schwann, Theodor. *Mikroskopische Untersuchungen*. 1838?39. Translated by Henry Smith as *Microscopic Investigations on the Accordance in the Structure and Growth of Plants and Animals*. London: The Sydenham Society, 1847. http://dx.doi.org/10.5962/bhl.title.11431 [34] (Accessed December 5, 2013).
19. Virchow, Rudolf. *Die Cellularpathologie*. Berlin: Hirschwald, 1858. https://archive.org/details/diecellularpatho1858virc [35] (Accessed November 10, 2015).
20. Vincent-Raspail, François. *Nouveau système de chimie organique*. [New System of Organic Chemistry]. Bruxelles: Sociètè Belge de librairie, 1840. https://archive.org/details/nouveausystmede04raspgoog [36] (Accessed May 22, 2017).

Matthias Jacob Schleiden helped develop the cell theory in Germany during the nineteenth century. Schleiden studied cells as the common element among all plants and animals. Schleiden contributed to the field of embryology through his introduction of the Zeiss microscope lens and via his work with cells and cell theory as an organizing principle of biology.

Subject

Schleiden, M. J. (Matthias Jacob), 1804-1881 [37] Cell biology [38] University of Jena [39] Botany [40] Schwann, Theodor, 1810-1882 [41] Epigenesis [42] Embryology [43] Biology, Experimental [44]

Topic

People [45]

Publisher

Arizona State University. School of Life Sciences. Center for Biology and Society. Embryo Project Encyclopedia.

Rights

Format

Articles [46]

Last Modified

Wednesday, July 4, 2018 - 04:40

DC Date

2017-05-29

DC Date Accessioned

Monday, May 29, 2017 - 16:54

DC Date Available

Monday, May 29, 2017 - 16:54

DC Date Created

2017-05-29

DC Date Created Standard

Monday, May 29, 2017 - 07:00

- The Embryo Project at Arizona State University, 1711 South Rural Road, Tempe Arizona 85287, United States

---

Source URL: https://embryo.asu.edu/pages/matthias-jacob-schleiden-1804-1881

Links:
[1] https://embryo.asu.edu/pages/matthias-jacob-schleiden-1804-1881
[2] https://embryo.asu.edu/keywords/cells
[3] https://embryo.asu.edu/search?text=embryology
[4] https://embryo.asu.edu/search?text=Zeiss
[5] https://embryo.asu.edu/search?text=microscope
[6] https://embryo.asu.edu/search?text=University%20of%20Heidelberg
[7] https://embryo.asu.edu/search?text=University%20of%20Berlin
[8] https://embryo.asu.edu/search?text=Johannes%20M%C3%BCller
[9] https://embryo.asu.edu/search?text=University%20of%20Jena
[10] https://embryo.asu.edu/search?text=fertilization
[11] https://embryo.asu.edu/search?text=University%20of%20Munich
[12] https://embryo.asu.edu/search?text=cytology
[13] https://embryo.asu.edu/search?text=epigenesis
[14] https://embryo.asu.edu/search?text=differentiation
[15] https://embryo.asu.edu/search?text=nucleus
[16] https://embryo.asu.edu/search?text=Rudolf%20Virchow
[17] https://embryo.asu.edu/search?text=University%20of%20Dorpat
[18] https://embryo.asu.edu/search?text=Cambridge%20University
[19] http://bibdigital.rjb.csic.es/ing/Libro.php?Libro=4746
[20] https://archive.org/details/encyklopdiederp00unkngoog
[21] https://books.google.com/books?id=W8o9AAAAYAAJ&dq
[22] http://www.biodiversitylibrary.org/bibliography/128395#/summary
[23] https://embryo.asu.edu/search?text=Leipzig
[24] https://play.google.com/store/books/details?id=U-jENp4ceaQC&rdid=book-U-jENp4ceaQC&rdot=1
[25] https://play.google.com/store/books/details?id=x1LPVA9rdRAC&rdid=book-x1LPVA9rdRAC&rdot=1
[26] http://biodiversitylibrary.org/page/14166290
[27] http://www.biodiversitylibrary.org/item/43441#page/263/mode/1up
[28]
https://books.google.com/books?id=8fETAAAAQAAJ&printsec=frontcover&source=gbs_ge_summary_r&a
[29] https://embryo.asu.edu/search?text=Edwin%20Ray%20Lankester
[30] http://www.biodiversitylibrary.org/item/201289#page/7/mode/1up
[31] https://play.google.com/store/books/details?id=C_RkAAAAcAAJ&rdid=book-C_RkAAAAcAAJ&rdot=1
[32] http://biodiversitylibrary.org/page/12869154
[33] http://biodiversitylibrary.org/page/48558088
[34] http://dx.doi.org/10.5962/bhl.title.11431
[35] https://archive.org/details/diecellularpatho1858virc
[36] https://archive.org/details/nouveausystmede04raspgoog
[37] https://embryo.asu.edu/library-congress-subject-headings/schleiden-m-j-matthias-jacob-1804-1881
[38] https://embryo.asu.edu/library-congress-subject-headings/cell-biology
[39] https://embryo.asu.edu/library-congress-subject-headings/university-jena
[40] https://embryo.asu.edu/library-congress-subject-headings/botany
[41] https://embryo.asu.edu/library-congress-subject-headings/schwann-theodor-1810-1882
[42] https://embryo.asu.edu/library-congress-subject-headings/epigenesis

[43] https://embryo.asu.edu/library-congress-subject-headings/embryology
[44] https://embryo.asu.edu/library-congress-subject-headings/biology-experimental
[45] https://embryo.asu.edu/topics/people
[46] https://embryo.asu.edu/formats/articles