

## “The Cell-Theory” (1853), by Thomas Henry Huxley

“The Cell-Theory” was written by Thomas Henry Huxley in Britain and published in 1853 by The British and Foreign Medico-Chirurgical Review. The twenty-two page article reviews twelve works on cell theory, including those in Germany by Caspar Friedrich Wolff in the eighteenth century and by Karl Ernst von Baer in the nineteenth century. Huxley spends much of “The Cell-Theory” on a cell theory proposed in the late 1830s by Matthias Schleiden and Theodor Schwann in Germany. Schleiden and Schwann maintained that the cell was the most fundamental unit of life and that the nucleus was the most significant cellular component. Huxley, instead, promoted an epigenetic theory of the cell, for which properties of life emerge from the outer cytoplasm, cell membrane, and wall (the periplast), as opposed to the inner contents of the cell, including the nucleus (the endoplast). Huxley’s arguments in “The Cell-Theory” influenced future scientists about the role of epigenetic processes in embryology and development.

Schleiden and Schwann's cell theory emphasized structures and morphological features, as opposed to processes, to characterize organic life. Some tenets of German cell theory persisted into later biological theory, such as the theory of the cell as a fundamental unit of life and the centrality of the nucleus to cellular activity. Biologists eventually abandoned other aspects of the theory, such as the claim that cellular processes occur due to special attractive forces. Schleiden and Schwann promoted this theory in 1838, and Schwann expounded upon the theory in his 1839 book, *Microscopic Investigations on the Accordance in the Structure and Growth of Plants and Animals*.

Both Schleiden and Schwann’s cell theory and Huxley’s review were published during a time of scientific debate on the importance of cells and their parts. Huxley’s article, however, also drew from a parallel debate between two theories of development. One theory said that development occurs through growth of an already-differentiated organism (preformationism). The other theory said that organisms develop through cellular differentiation (epigenesis). These opposing views characterized much of eighteenth and nineteenth century embryology. In Huxley’s epigenetic conception of embryogenesis, development occurred through the process of differentiation of undifferentiated matter. Schleiden and Schwann’s cell theory, similar to preformationism theories, touted structures as the most significant elements of development.

The introduction of “The Cell-Theory” briefly discusses historical definitions of organic life and focuses on development. Huxley says that Schleiden and Schwann’s cell theory significantly contributes to science in that it synthesizes data about cells that profoundly changed the field. He then criticizes Schleiden and Schwann’s interpretation of cellular life by stating that their work is based on erroneous understanding of structure, which led them to poor interpretations of physiology. Huxley focused on the structural and morphological assumptions of plant cells made by Schleiden and Schwann’s cell theory.

Huxley denies the assumptions that Schwann derived from Schleiden’s botanical research, namely the anatomical autonomy of the cell, the importance of the nucleus to cell structure, and the importance of the nucleus in cell division. He rejects the importance placed on the nucleus by cell theory, arguing instead for a passive nucleus, or endoplast. Huxley stresses the importance of the cell membrane and wall, or the periplast, in cellular processes. To him, cells were the products of an organism’s life processes, and not entities that facilitated such processes.

Huxley then elaborates on the relative importance of the endoplast and periplast. He deems the endoplast a histological element of lesser importance because it exhibits minimal morphological changes during development. On the other hand, the periplast undergoes many important morphological and chemical changes. He states that there is no evidence for molecular or vital forces

that drive development centralized in the endoplast of the cell. Huxley illustrates the periplast's importance in tissue differentiation using the cells of the peat moss (*Sphagnum*) leaf and the beet-root. Turning next to animal cells, Huxley argues for the relative importance of the periplast to the endoplast in tissue differentiation. Huxley claims that feline embryonic cartilage cells—the ossified periplast that makes up the calcified matrix of bone, lip, and oral tissues of kittens—were the integral elements of cellular change while the endoplast played little to no role in tissue differentiation.

Huxley concludes that the first differentiation of tissues in embryos—a process Schwann described as the transformation of a group of cells capable of growth (blastema) into a nucleated cell—divides endoplast from periplast, but that further development is not contingent upon this initial differentiation. Huxley further notes a lack of evidence for an endoplast that acts upon the periplast, morphologically or otherwise. Huxley also says that vital phenomena do not result from organized cell structures—it is the cell structures that result from vital phenomena. Huxley claims that vital forces are nothing more than molecular forces. Huxley contends that while some may ask what guides these molecular forces, the assumption of a guiding entity “has hitherto been a mere gaudy cloak for ignorance,” and is a not a question for the fact-based science of physiology.

“The Cell-Theory” was Huxley's departure from an interpretation of the cell accepted by many other scientists in Britain. Huxley's growing reputation as a scientist and as someone familiar with the science performed in Germany, in addition to the large audience of the journal in which he was published, garnered “The Cell-Theory” substantial attention from biologists. Though Huxley's ideas about cell biology later changed, many of his specific criticisms made in “The Cell-Theory” regained popularity at the end of the century as biologists continued to contest the legitimacy of Schleiden and Schwann's cell theory. “The Cell-Theory” also influenced the next generation of scientists in Britain and in the US. In 1870, James Tyson at the University of Pennsylvania in Philadelphia, Pennsylvania, published *The Cell Doctrine* to provide medical and dental students with an account of cell biology and its history. Tyson highlighted “The Cell-Theory”.

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