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Von Helmholtz, Hermann

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Without Abstract

Basic Biographical Information

Helmholtz (1821–1894) was born in Potsdam, Germany, where his father taught languages and philosophy at the *Gymnasium* (secondary school) where Hermann attended. His mother was a descendant of William Penn, after whom the colony, later, the state of Pennsylvania (USA) was named. After completing studies at the *Gymnasium*, Helmholtz wanted to study physics, but financial considerations led him to study medicine in Berlin, free of charge, in return for an 8-year service commitment to the Army. He studied under the great Johannes Müller, and among his friends and fellow students were Emil Du Bois-Reymond, Ernst Brücke, and Karl Ludwig. Despite Müller's acceptance of *vitalism* (the belief that life is based on a supernatural "force"), these students had in common opposition to it, and Helmholtz's research would serve well the rejection of vitalism.

Helmholtz's medical dissertation (1843) and his early work on conservation of energy (Über *die Erhaltung der Kraft*, 1847) gained him an offer to become Associate Professor of Physiology at the University of Konigsberg which resulted in early release from his military commitment. He stayed at Konigsberg from 1848 to 1855 when, among other accomplishments, he invented the first operational ophthalmoscope. In 1855, Helmholtz moved to the University of Bonn as Professor of Anatomy and Physiology, and in 1858, he became Professor of Physiology at the University of Heidelberg where he remained until 1871. Based largely on his extensive work in the physics of light and sound, in 1871, he was offered and accepted the Chair in Physics at the University of Berlin, the most prestigious chair in physics in Germany. He remained in Berlin until his death. While in Heidelberg, Wilhelm Wundt, a founder of experimental psychology, worked under Helmholtz as an assistant. In Berlin, Helmholtz's student, Heinrich Hertz,

conducted investigations suggested initially by Helmholtz of James Clerk Maxwell's electromagnetic theory of light. Hertz was the first to demonstrate the existence of electromagnetic waves, the basis for wireless telegraphy among other things; it was in Hertz's honor that Hz became the unit for measuring wavelength. A significant American post-doctoral student in Helmholtz's laboratory was Christine Ladd-Franklin who became internationally famous for improving Helmholtz's theory of color vision.

Major Accomplishments/Contributions

Had Nobel Prizes existed during Helmholtz's lifetime, reasonable arguments can be made that he might have received a minimum of four, one for formalizing the principle of the Conservation of Energy, one for being the first to measure the speed of a nerve conduction, one for his research and theories in vision, and one for his research and theories in audition. Disputes arose regarding priority for the Conservation of Energy principle, but Helmholtz freely acknowledged prior work and stayed above the fray. Upon his death, his classic paper was deemed by *Physical Review* to be "chief of the early attempts to give expression to the principle" (Gruber and Gruber *1956*). Ironically, the paper had been rejected as too theoretical in 1847 and was published as a private pamphlet. Formalization of the principle of Conservation of Energy together with measuring the speed of nerve conduction (1850), previously deemed to be in a supernatural realm, helped to destroy vitalism, thereby, enabling biology to begin making great advances.

Helmholtz's accomplishments in the field of vision were too many to mention here, but they included the three-volume *Handbuch der Physiologischen Optik* (1856–1866), a thorough compendium of knowledge concerning vision, including much research conducted by Helmholtz himself. Other than the ophthalmoscope mentioned earlier, he is perhaps best remembered for his trichromatic theory of color vision and for his anatomical explanation of how the lens of the eye accommodates for near and far vision. Ably anticipated by Helmholtz's vision research and trichromatic theory was the subsequent Nobel Prize winning research associated with identification of retinal chemicals and processes that enable color vision (e.g., research by Ragnar Granit, H. K. Hartline, and George Wald).

In audition, Helmholtz's book, *Die Lehre von dem Tonemfindungen* (*The Sensation of Tone*), similarly to the *Optik* handbook, summarized existing knowledge about audition including Helmholtz's extensive research findings and theories. His research in the physics of sound as well as his place theory of hearing led to refinements by Georg von Bekesy that gained him the Nobel Prize in 1961.

Apparently, Helmholtz opposed the idea of the necessity for an experimental psychology believing that physiology was sufficient, and E. G. Boring (*1950*), the eminent historian, wrote that Helmholtz would have opposed "mentalism" as much as he had opposed vitalism. Nevertheless, Boring identified Helmholtz as a significant founder of experimental psychology for his work in vision and audition. Some have written (e.g., Gruber and Gruber *1956*; Warren

1984) that among Helmholtz's most important psychological theories was his theory of "unconscious inference" to explain, for example, how humans acquire the concept of space; later, Helmholtz acknowledged difficulties with the term and changed it to "inductive inference." As noted, Helmholtz applied unconscious inference to explain how humans acquire the concept of space through empirical experience. Opposing the "intuitionists" who argued that knowledge of spatial relations is innate and intuitive, Helmholtz argued that concepts of spatial relations are acquired through an accumulation of experiences, many of which we are unaware (unconscious) when they occur. His empiricism and material reductionism were so thorough that, again opposing the intuitionists, Helmholtz argued that inductive inference explained how humans acquired the fundamental axioms of geometry. This author is unaware of any detailed arguments that Helmholtz presented, but a reasonable extension of his views would be that all mental processes result from how accumulated experiences modify the chemical and physical properties of the brain at molecular levels.

See Also

Boring, E. G.

Perception

References

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