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Helmholtz Who Revolutionized Ophtalmology

Nāsir pūyān (Nasser Pouyan)

Tehran, Iran

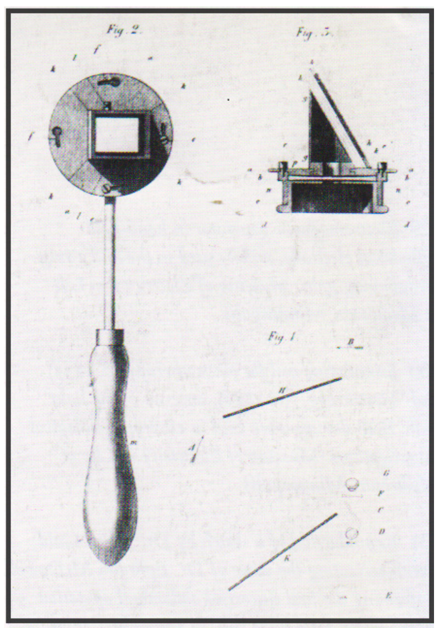
Abstract Helmholtz (1821-1894), German physician, surgeon and scientist who studied medicine in Berlin, wrote his thesis on ganglia. He studied biophysics of nerves, and muscle contraction. Helmholtz developed a method of obtaining electromyogram of the muscles in 1851, and carried out pioneering work on muscle energy. He invented on ophtalmoscope aiding work on vision (1851), and described the mechanism of accommodation of the eye and perception of color. His name occurs frequently in physics associated with Helmholtz resonators, Helmholtz free energy, and Helmholtz coils. He published a far reaching importance to physics and physiology "The Conservation of Forces".

Keywords Helmholtz, Ophthalmology, Acoustic, Energy tangent galvanometer

Hermann Ludwig Ferdinand von Helmholtz one of the great genius of medicine, born (August 31, 1821) in Potsdam, Kingdom of Prussia. He studied medicine at the Friedrich- Wilhelm Institute of Medicine and Surgery in Berlin. His thesis was on the nerve cells in ganglia. Helmholtz was professor of physiology in turn at the universities of Königsberg, Bonn, and Heidelberg. On July 23, 1847, Helmholtz presented his treatise of far- reaching importance to physics and physiology, "Uber die Erhaltung der Kraft" ("One the Conservation of Force"), to the Physical Society of Berlin. This treatise death with the conservation of energy, a subject which he deeply clarified [1].

Helmholtz's great work, "Handbuch der Physiologischen Optik" ("Handbook of physiological Optics" or "Treatise on Physiological Optics"), (1856-1866) provided empirical theories on depth perception, color vision, and motion perception. It became the fundamental reference work, during the second half of the 19th century. In the third and final volume, published in 1867, he described the importance of unconscious inferences for perception. "Handbuch der Physiologischen Optik" was first translated into English under the editorship of James P.C. Southall on behalf of the Optical Society of America in 1924-1925.

Helmholtz became professor of physics in the University of Berlin in 1870. He began serving concurrently as director of the "German Bureau of Standards." He studied the biophysics of nerves, muscle contraction, optics, and color theory [2], but his accomplishments include the invention of the ophtalmoscope and ophtalmometer. He improved on Young's[1] theory of color vision, now referred to as Thomas "Young-Helmholtz theory.[**]" His name occurs frequently in physics associated with Helmholtz resonators, Helmholtz free energy, and Helmholtz coils [3]. As one of the gifted students of Johannes Peter Müller[*] (1801-1858), German pioneering physiologist, he became one of the trendsetters in scientific and medical research [4].



The ophthalmoscope devised by Hermann von Helmholtz that made the inner eye visible to an examining diagnostician

* Corresponding author:
nasser_pouyan@yahoo.com (Nasser Pouyan)
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[1] Ophtalmoscope: An instrument for inspecting the interior of the eye by light reflected from amirror.

[**] Thomas Young (1773-1829), outstanding British physician and polymath, founder of physiological optics, who wrote "On the Mechanism of the Eye," described astigmatism and accommodation, color vision and color blindness. He also developed the ware theory of light.

[*] Four promising Young physiologist associated with Müller- Helmholtz, Du Bois- Reymond (1818-1896), German physiologist, Karl Fw Ludwig (1816-1895), pioneer German physiologist, and Ernst Bruke- in 1847 published a manifesto proclaiming that physioly's goal was to explain all vital phenomena in terms of laws.

Helmholtz explained the mechanism of accommodation of the eye and perception of color [5]. This went unchallenged until the final decade of 20th century.

Hermann Ludwig Ferdinand Helmholtz, who made the inner eye visible to ophthalmologists

In 1849, while at Königsberg, he measured the speed at which the signal carried along a nerve fiber. Helmholtz used a dissected scientific nerve of a frog and the muscle of a calf to which it attached, and used a galvanometer as a sensitive timing device, attaching a mirror to the needle reflecting a light beam across the room to a scale which gave more greater sensitivity. He reported transmission speed in the range of 24.6- 38.4 meter per second.

He published "On the Sensation of Tone" in 1863 which influenced musicologists into the 20th century[**]. Helmholtz invented Helmholtz resonator, a device exhibiting a sharply defined, mechanical, or acoustic resonance effect, e.g., a stub, piezoelectric crystal. The translation of this work by Alexander J. Ellis was first published in 1875[***].

Herman von Helmholtz is examining the inner eye of a patient

[**] Helmholtz showed that different combinations of resonator could mimic vowel sounds: Alexander Graham Bell (1847-1922), in particular was interested in this but, not being able to read German, misconstrued Helmholtz's diagrams as meaning that Helmholtz had transmitted multiple frequencies by wire- Which would allow multiplexing of telegraph signals- whereas, in reality, electrical power was used only to keep the resonators in motion. Bell failed to reproduce what he thought Helmholtz had done but later said that, had he been able to read German, he would not have gone on to invent the telephone on the harmonic telegraph principle.

[***] The first English edition was from the 1870 third German edition; Ellis's second English edition from the 1877 fourth German edition was published in 1885; the 1895 and 1912 third and fourth English editions were reprints of the second.

Helmholtz's sensory physiology was the basis of the work of Wilhelm Max Wundt (1832-1920), German philosopher and psychologist who founded the world's first psychological laboratory at the University of Leipzig in 1879. Wundt, a student of Helmontz, more explicity than he described his research as a form of empirical philosophy and as a study of the mind as something separate. Helmholtz had, in his early repudiation of Naturphilosophie, stressed the importance of materialism, and was focusing more on the unity of "mind" and body.

Helmholtz studied the phenomena of electrical oscillations (1869-1871). In a lecture delivered to the "Naturhistorisch- medizinischen Vereins zu Heidelberg" (Natural History and Medical Association of Heidelberg), on April 30, 1869 titled "On Electrical Oscillations", he indicated that the perceptible damped electrical oscillations in a coil joined up with a leden jar were about 1/50th of a second in duration.

Helmholtz moved from Heidelberg to Berlin to become a professor in physics in 1871. He became interested in electromagnetism and the Helmholtz equation is named for him. Although he did not make major contributions to this field, his student Heinrich Rudolf Hertz[****] became famous as the first to demonstrate electromagnetic radiation. Oliver Heaviside criticised Helmholtz's electromagnetic theory because it allowed the existence of longitudinal waves. Based on work on Maxwell's equations. Heaviside pronounced that longitudinal waves could not exist in a vacuum or a homogeneous medium. Heaviside did not note, however, that longitudinal electromagnetic waves can exist at a boundary or in an enclosed space. There is even a topic by the name "Helmoltz Optics", based on the Helmholtz equation.

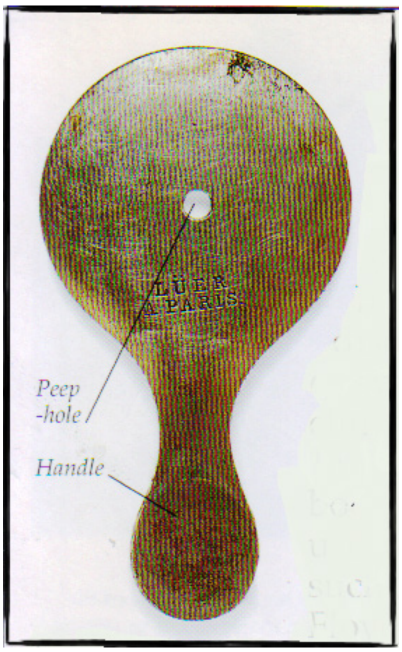
1. The Highlights

- He is responsible for a great number of acoustic instruments, the most fundamental probably being the resonator theory of hearing, making possible the analysis and synthesis of complex sound[6].
- Pioneer work on energy was done by him arou 1850.
- He improved tangent galvanometer by adding two co-axial cables. This was followed in 1840 by an electrodynamometer invented by another German physicist, Wilhelm Eduard Weber[*] (1804-1891) [7].
- He invented the ophtalmoscope to facilitate his research on the physics of vision.

[****] Heinrich Rudolf Hertz (1857-1894), German physicist and discover of Hertzian waves, the short- length radio waves essential to modern wireless communication.

[*] Weber's instrument was further developed by William Thomas, Lord Kelvin (1824-1907) and James Prescot Joule (1818-1889), in 1883. An improved form of the galvanometer was built in 1880 by Jacques Arsene d'Arsonval (1851-1940) physicist, biologist and physician, and it was named after him. Riverain, Jean. Dictionnaire des Médecins Celebres. P.10.

- Helmholtz measured the speed of conduction along a nerve fibre, and reported transmissions speeds in the range of 24.6- 38.4 meter persecond [8].
- He developed a law of the conservation of energy- that energy could neither be created nor destroyed- which delivered a body blow to the theory of vitalism.
- In 1880, he theorized that the time difference corresponded to the nerve conduction time between the toe and thigh [9].
- He was conferred with Honoray Membership of Institution of Engineers and Shipbuilder in Scotland (1884).
- As a philosopher, Helmholtz is known for his philosophy of science, ideas on the relation between the laws of perception and the laws of nature, the science of aesthetics, and ideas on the civilizing power of science.
- The largest German association, is named after him.
- He died at Charlottenburg, German Empire in September 8, 1894 at the age of 73.



The later version ophthalmoscope acts as a mirror to reflect light into the eye, with a central peep- hole for viewing.

The leading contributions to the study of ophthalmology

1. Pierre Félix Lagrange (1857-1928), French ophthalmologist who, in 1907, devised a drainage procedure (cyclodialysis) for glaucoma.
2. Stanislaus Joseph Mathias von Prowazek (1875 / 1876 -1915) German microbiologist who, in 1907, found cell inclusion bodies in conjunctiva cells in trachoma. He postulated that they were collections of virus enveloped by material deposited from the infected cell.
3. In 1912, an ophthalmologist in Japan, Chuta Oguchi observed Oguchi syndrome, characterized by night blindness and grayish appearance of the fundus.
4. Japanese ophthalmologist, Shinobu Isihara of Tokyo, in 1917, devised, the standard color- blindness.
5. In 1925, a New York ophthalmologist, Manuel Uribe y Tronchoso, devised visualization of the recesses of the anterior chamber of the eye, normally not seen with a slit lamp (gonioscopy).
6. Jules Gonin (1870-1935), Swiss ophthalmic surgeon who devised a method of operative treatment for detachment of the retina in 1927.
7. In 1938, Theodore E. Obrig, founder of the Obrig Laboratories, introduced the plastic contact lens.
8. In 1954, a Ziess operating microscope was developed for use in eye and other surgery.
9. Gabriel J. Cocas from France developed laser used in ophthalmology, in 1978.

Ophthalmoscope

2. Conclusions and Impact

As the very old beliefs about the invisible humours faded, physicians came to this perception that diseases were caused by malformation and malfunction of the organs of the body. Therefore they invented various techniques and devices for clinical diagnosis- examining the patient to identify the ailment. In about 1850, in Germany, Helmholtz made his greatest impact on medicine, specially in ophthalmology through quantative determination in the physiology of sight, sound and nerve impulse.

Intent on trying to look inside the eye of living person, he invented ophtalmoscope which shone light into the pupils and enabled the doctors to see the reflected image of the retina, and the invisible blood vessels and nerves of the eye to be seen easily. From then on, abnormalities in the eye were open to the diagnostic gaze of the physician. He also explained the mechanism of accommodation of the eye and perception of color and sound.

In a nutshell, his everlasting accomplishments include ophtalmoscope and ophtalmometer. From then on, abnormalities in the eye were open to the diagnostic gaze of the doctor.

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