VON HELMHOLTZ

CENTENARY OF THE OPHTHALMOSCOPE

It was on December 6, 1850, when von Helmholtz was 30 years of age and Professor of General Pathology and Physiology at the University of Königsberg, that he communicated to the Physical Society in Berlin his observations on "an optical apparatus which enables the living retina to be seen". But the full description of the instrument and the theory on which it was based was published in the autumn of 1851 (the year of the Great Exhibition in London), under the title "Description of an Ophthalmoscope for the Investigation of the Retina in the Living Eye", and thus it is that the year 1951 is celebrated as the centenary of this admirable discovery.

It is amusing to read of the scepticism of some of von Helmholtz's colleagues, but on the whole the instrument was well received, and he writes that by December 16, 1851, there were already eighteen orders for this new ophthalmoscope. Forty years later he told the story of its discovery. While preparing lectures on physiological optics he had to explain the theory of the emission of reflected light from the eye as discovered by Brücke, and desired a method by which he could make the subject clear to his students. For this purpose he devised the apparatus which became the ophthalmoscope.

Hermann Ludwig Ferdinand von Helmholtz was born on August 31, 1821, at Potsdam, where his father Ferdinand was a professor in the local High School. His mother, Caroline Penn, was an Englishwoman. (It is interesting in this connection to note that the mother of Immanuel Kant was a Scotswoman.) As a schoolboy Helmholtz developed a love for science and studied the books on physics in his father's library. While still at school he traced out for himself the paths of the rays in a telescope. Owing to this bent towards science his father advised young Helmholtz to take up medicine. He entered the Army Medical School and came under the influence of a profound teacher, Johannes Müller. He eventually became a military surgeon, until in 1848 he was appointed assistant in the anatomical museum of Berlin and teacher of Anatomy at the Academy of Arts.

On July 23, 1847, while he was still a military surgeon, his essay "On the Conservation of Energy", was read to the Physical Society of Berlin, with results in the field of physics which at that time were startling. This paper altered the direction of physical research, all phenomena being henceforth referred to the laws which govern the transformation of energy. The essay had been previously submitted to E. H. Dubois-Reymond who urged its submission to the Physical Society and its subsequent publication. Since the editors of

Poggendorff's *Annalen der Physik* refused it as being too theoretical and too mathematical, it was issued as a separate publication.

In 1849 von Helmholtz went to Königsberg to take the chair of General Pathology and Physiology, and it was during this period that the ophthalmoscope was invented. His subsequent academic career may be briefly summarized:

1856 Professor at Bonn;

1859 Professor of Anatomy and Physiology at Heidelberg;

1871 Professor of Natural Philosophy at Berlin.

His two greatest works are "Physiological Optics" and "Sensations of Tone", both splendid examples of the application of methods of analysis to the two kinds of sensation which furnish the largest proportion of the raw material for thought. The first volume of "Physiological Optics" appeared in 1856, and it was in the course of the studies for this work that von Helmholtz made a whole series of investigations and developed various theories on the subject of vision. An enumeration of some of these will show how widely his thoughts ranged:

1. The theory of accommodation
2. Composition of spectral colours
3. The sensitivity of the human retina to certain forms of light
4. After-images
5. Colour-blindness and the theory of colour vision
6. Contrast phenomena
7. Movements of the human eye, both singly and in connection with binocular vision
8. The relation of optics to painting, etc., etc.

In 1855 von Helmholtz first met William Thomson (Lord Kelvin), of whom he became a great admirer. He also became a friend of Faraday, Tyndall, Donders, Bunsen, and other scientists, and maintained a vivid correspondence with many of them. In 1868 he published that astonishing essay "On the Facts that underlie Geometry", and in 1870 an essay "On the Origin and Significance of Geometrical Axioms". These papers, together with Riemann's work "On the Hypotheses that underlie Geometry", were crucial for the development of the mathematico-philosophical conceptions of the second half of the nineteenth century, and brought von Helmholtz into conflict with Kant's hypothesis of the "Intuitive Knowledge of Geometrical Constants".

Von Helmholtz gave his illustrious pupil Hertz the inspiration to find experimental proof of Maxwell's "electric waves" and provided him in the Institute of Physics of the University of Berlin with the apparatus and appliances by means of which these investigations could be carried out.

He died on September 8, 1894.

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