Volkmann's Vision

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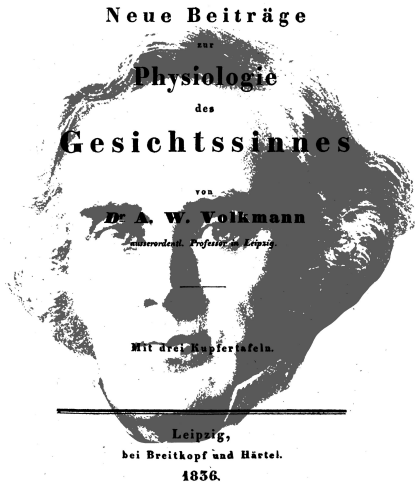

A.W. Volkmann (1836): "New Contributions to the Physiology of the Visual Sense". Translated by H. Strasburger and N, J. Wade, 2025.

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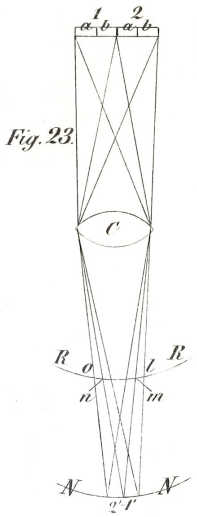
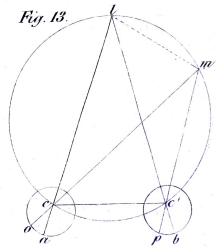
Linking Function to Structure

The first estimates of the dimensions of retinal elements were based on measures of visual resolution. A variety of stimuli and methods were used but the values were similar (see Wade, 2004). It was not until the early 19th century, when achromatic microscopes became available, that such estimates could be compared with anatomical measurements. Volkmann's contemporary, Treviranus (1835), provided illustrations of the microscopic structure of the retina together with estimates of the limits of visual resolution. Volkmann added precision to measurements of visual resolution by using the hairs of a spider's web as stimuli. He also based his measurements on more observers than himself. He distinguished between detection of a single hair and the discrimination of the separation between two hairs concluding that the limits of acuity were smaller than the size of retinal elements revealed by microscopy.[5)]



Two overlapping stimuli on the retina

Binocular Single Vision

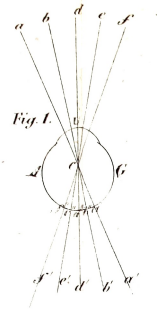


In 1836, Volkmann still restated the then accepted theory of single vision with two eyes proposed by Vieth (1818) and Müller (1826): stimulation of identical retinal points resulted in single vision, otherwise double vision occurred. Depth was thought to be coded by vergence.

Two years later, Wheatstone, in contrast, demonstrated that the stimulation of **slightly non-identical** points resulted in **single vision** and **stereoscopic depth**. Volkmann (1859) with his newly developed tachistoscope showed vergence could not code depth, and voiced, "If Wheatstone were right on this point, the doctrine of vision was threatened to be overturned completely". Unlike many of Volkmann's fellow German visual scientists, he accepted Wheatstone's observations and conducted detailed experiments on stereoscopic thresholds. Helmholtz (1867) relies on Volkmann's work in his section on stereoscopic vision and, indeed, Volkmann is accorded more citations on the topic than Wheatstone.

Nodal Point

Volkmann coined the term "direction ray" as the hypothetical line that connect the object to its retinal image (1836, p. 24 and 27). At their crossing point, inner and outer visual angles are equal[1)]. He determined their crossing point empirically in a rabbit eye and eight human eyes. The average for the latter was 0.466" (12.19 mm) behind the cornea's apex, or 1/6 Zoll[2)] (4.4 mm) behind the lens's rear surface[3)]. Later (1863)[4)], he denoted it as "Knotenpunkt" (nodal point). The nodal point, by today's state of knowledge, is located right behind the lens for small angles, but is located more backward for larger angles, closer to the eye's rotational centre (Strasburger & Simpson, 2023). – The concept of the crossing point is still used in textbooks today.



Mind-Body Problem

In Chap. 2, a chapter on general principles, Volkmann explains his position regarding the mind-body problem, noting that studying the senses inevitably crosses into the field of psychology. Following Kaspar Theobald Tourtual (1802–1865), he distinguishes three views on perception: objective theory (strong physical realism), subjective theory (phenomenalism), and interaction theory. The first, he dismisses without any hesitation; the second he rejects after considering it at length, and the third he adopts.

References

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Footnotes

[1)] "wenn man den Punkt angiebt, in welchem die beiden geraden Linien sich schneiden, deren Kreuzung den Gesichtswinkel hervorbringt"
[2)] The Prussian Zoll measures 26.15 mm, it is divided in 12 lines.
[3)] p. 33, based on Treviranus' estimate of the latter's distance from the apex of 0.297"= 7.77 mm
[4)] 1863, in the chapter on irridation and elsewhere
[5)] Those distances [i.e., the perceivable distances] are incomparably greater and exceed the smallest images in my eye, for example, by a hundredfold. The reason for this phenomenon can be twofold, namely either the aforementioned propagation of the stimulus, or insufficient unification of the light in a focus. It is also possible that both circumstances work together" (p.203).