Neurosurgical Classic—XXXVIII

ROBERT H. WILKINS, M.D.

The invention of the ophthalmoscope and the early application of this instrument to the study of papilledema were largely the work of three young men—Hermann von Helmholtz, Albrecht von Graefe, and John Hughlings Jackson.

Von Helmholtz was born at Potsdam in 1821. He received his medical education at the Friedrich Wilhelm Institute in Berlin, and even as an undergraduate he demonstrated the genius that was apparent throughout his later career.10,11 After graduation he was a surgeon in the Prussian Army for five years, and it was during this time that von Helmholtz performed his important studies on animal heat. These studies led to one of the most important contributions ever made in the field of physics—the theory of the conservation of energy.10 During his subsequent career as Professor of Physiology at Königsberg, Bonn, and Heidelberg, von Helmholtz made several other outstanding contributions to medical physics.9 He measured the velocity of the nervous impulse in motor and sensory nerves, he invented the ophthalmoscope, and he added many original observations on physiologic optics and acoustics.10,15–17 In 1887 he became director of the Physioco-Technical Institute at Charlottenburg, and he devoted the remainder of his life to basic studies in thermodynamics and electrodynamics.10

"The greatest discovery in the history of ophthalmology, not excepting the extraction of cataract, was the invention (1830) of the ophthalmoscope . . . , because by its use ophthalmology has been made an exact science. In the early years of the nineteenth century, Prevost (1790–1850) of Geneva demonstrated that the light from the eyes was from reflection and that it disappeared in the dark, Jean Méry (1645–1722) of Paris, a century earlier observed through the widely dilated pupils of a cat which by accident had been held under water, the highly colored fundus with its optic nerve. A short time later, de la Hire explained the cause by declaring that the water had interfered with the refraction of light by the cornea and caused all the emergent rays to leave the eye in divergence. As the human eye began to be studied more closely, someone noticed that the eyes of an Ethiopian albino were luminous; and Scarpa (1758–1832) remarked that a reflection could be seen in certain deep-seated diseases, such as the ‘amaurotic cat’s eye.’ Beer, in 1819, noted the red reflection in a case of absence of the iris; a few years later a normal eye, the pupil of which had been artificially dilated, permitted a similar observation. In these years the mystery of the blackness of the pupil was solved by the discovery that the fundus lies at the focus of the refractive powers of the cornea and lens, which powers keep the fundus invisible and the pupil dark.

"Cumming, a student in the London Hospital in 1846, by shading it from the light, was able to look directly into the eye of a fellow student and obtained both the ‘retinal reflex’ and the white light from the entrance of the optic nerve.

"In 1847, Brücke of Vienna by passing a tube through a candle flame was able to see the fundus, and reported that it was also possible to illuminate the pupil by the light reflected from an observer’s spectacle lenses."

". . . The technical difficulty of placing the light and the observer’s head in the same straight line was solved by the English mathematician, Charles Babbage [1807] (1847), who held to his eye a mirror which served as the immediate source of light, in the centre of which a hole in the silvering acted as a window through which he looked . . . "

". . . To him should be credited the invention of the first ophthalmoscope, but his idea did not receive publication until seven years had passed (Wharton Jones, 1854). In the meantime, von Helmholtz [1851] had elaborated his ophthalmoscope and had elucidated the optical principles governing the path of the rays into and out of the eye, and since his discovery was . . . publicized and taken up intensively by von Graefe and the other leading ophthalmologists of the time, it is to von Helmholtz that the science of ophthalmoscopy must owe its inception. . . . "

Von Helmholtz constructed his ophthalmoscope in 1850 and published his description of it in 1851.15,25 It did not enjoy immediate popularity because of its crude construction and because few practitioners had
enough background to comprehend the mathematics and physics involved. However, during the following decade technical improvements allowed many original observations of intraocular pathology to be made, chiefly by ophthalmologists. Among these original observations was the description by von Graefe of papilledema in association with intracranial tumor.

Friedrich Wilhelm Ernst Albrecht von Graefe was born in Berlin in 1828. As a young man he became interested in ophthalmology, and shortly became an exceptionally fine eye surgeon. As such he introduced iridectomy in the treatment of glaucoma and devised a special knife for his modified linear extraction of cataracts. In 1854, when von Graefe was 26 years old, he founded the Archiv für Ophthalmologie. During the subsequent years before his untimely death in 1870, von Graefe applied the newly-introduced ophthalmoscope to the study of glaucoma, embolism of the retinal artery, and various cerebral diseases. In the course of these studies, von Graefe noted the occurrence of papilledema (called optic neuritis or choked disc until 1908) in patients with brain tumors. He advanced the explanation that this was due to mechanical hyperemia, and he correctly predicted that other causes of increased intracranial pressure would also be found to result in papilledema.

Although von Graefe and others made many important observations with the ophthalmoscope, the value of this instrument in the study of affections of the nervous system was stressed most effectively by John Hughlings Jackson. Jackson was born in 1834 in Yorkshire, England, and received his early medical training in York. After considering a career in philosophy, he was persuaded by Jonathan Hutchinson and Charles-Édouard Brown-Séquard to enter the field of neurology. Jackson’s subsequent studies of focal epileptiform fits, involuntary movements, hemiplegia and speech disorders, as well as his philosophical interpretations of the functions of the nervous system, were of vital importance to the development of neurology and neurosurgery.

In 1863, 1865 and 1866, Jackson published four papers on ‘Defects of sight in diseases of the nervous system.’ These papers are of surpassing interest in that they set forth the slow unravelling of the truth with regard to the nature and cause of optic neuritis of intracranial origin. He urged that routine ophthalmoscopic examination should be made in all cases of severe cerebral disease, whether the patient complained of defect of sight or not. He described the association of headache, vomiting and optic neuritis in cases of cerebral tumour, and laid great stress on the fact that the chief disease in a cerebral case, in which amaurosis is a symptom, rarely involves the optic nervous system. ‘It is just as important,’ he adds, ‘to determine whether a patient’s blindness depends on choroiditis, apoplexy of retina, or neuritis; as whether his bad talking depends on incoherence, defect of the faculty of language, or paralysis of the tongue.’

Today the ophthalmoscope is a virtually indispensable instrument for the evaluation of patients with intracranial disease. Its widespread use is due mainly to the pioneering efforts of von Helmholtz, who introduced the ophthalmoscope; von Graefe, who first used it to identify papilledema in association with brain tumors; and Jackson, who popularized its use in the diagnosis of neurological diseases.

References

5. BRAIN, R. The neurological tradition of the London Hospital or the importance of being thirty. Lancet, 1959, 2: 575–581.