Max Brödel (1870-1941), a pioneer in neurosurgical illustration

A. García-Molina[1,2,3,4], A. Enseñat-Cantallops[1,2,3]

[1]Institut Guttmann. Universitat Autònoma de Barcelona, Badalona, Barcelona, Spain.
[2]Fundació Institut d'Investigació en Ciències de la Salut Germans Trias i Pujol, Badalona, Barcelona, Spain.
[3]Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain.
[4]Laboratorio de Neurociencia Cognitiva y Social. School of Psychology, Universidad Diego Portales, Santiago, Chile.

ABSTRACT

This study reviews the role of the German illustrator Max Brödel (1870-1941) in the field of neurosurgical illustration. His illustrations are characterised by meticulous planning, exquisite topographical accuracy, and astounding neuroanatomical realism. In 1894, Brödel moved to Baltimore to work at Johns Hopkins Hospital with the gynaecologist Howard Kelly. There he became a close friend of Harvey Cushing, the father of modern neurosurgery, with whom he worked regularly. In 1911, Brödel created the Department of Art as Applied to Medicine at Johns Hopkins University, training nearly 200 medical illustrators over three decades. Dorcas Hager Padget, one of Brödel's best students, worked with neurosurgeon Walter Dandy for over a decade. Other students, including Mildred Codding, William McNett, and Ralph Witherow, also worked for Cushing and Dandy. The department's only British student, Audrey Juliet Arnott, worked with the neurosurgeon Hugh Cairns.

KEYWORDS

20th century history, brain, Max Brödel, medical illustration, neurosurgery, photography

Introduction

Medical illustration is a key element in neurology and neurosurgery training. It demonstrates ideas and concepts that are difficult to express in words or capture in photographs. One of the first neurological texts to include illustrations is *Anathomia designata per figures* by Guido da Vigevano (1280-1349).[1,2] Published in 1345, this book includes 24 anatomical plates, with neuroanatomical descriptions of such procedures as trepanation with a hammer and scalpel to expose the brain and meninges. Another precursor of medical illustration was Jacopo Berengario da Carpi (1460-1530), a surgeon and member of the medical school of Bologna.[3]

Jan Stefan van Calcar (1499-1546), a student of Titian, illustrated the well-known treatise *De humani corporis fabrica* by Andreas Vesalius (1543). Book 7 includes 25 illustrations, engraved on wood, of different neuroanatomical structures. Shortly after its publication, in the mid-16th century, wood engraving (xylography) was progressively replaced by copper engraving. This favoured the proliferation of illustrations in academic publications.[4] One such example is Thomas Willis' *Cerebri anatome* (1664), the first major treatise on neuroanatomy. The treatise was drafted with the participation of several members of the Oxford Experimental Philosophy Club, such as Robert Boyle, who explored new methods of preserving and hardening brains, and Richard Lower, who was largely responsible for the dissections

Corresponding author: Dr Alberto García-Molina
E-mail: agarciam@guttmann.com

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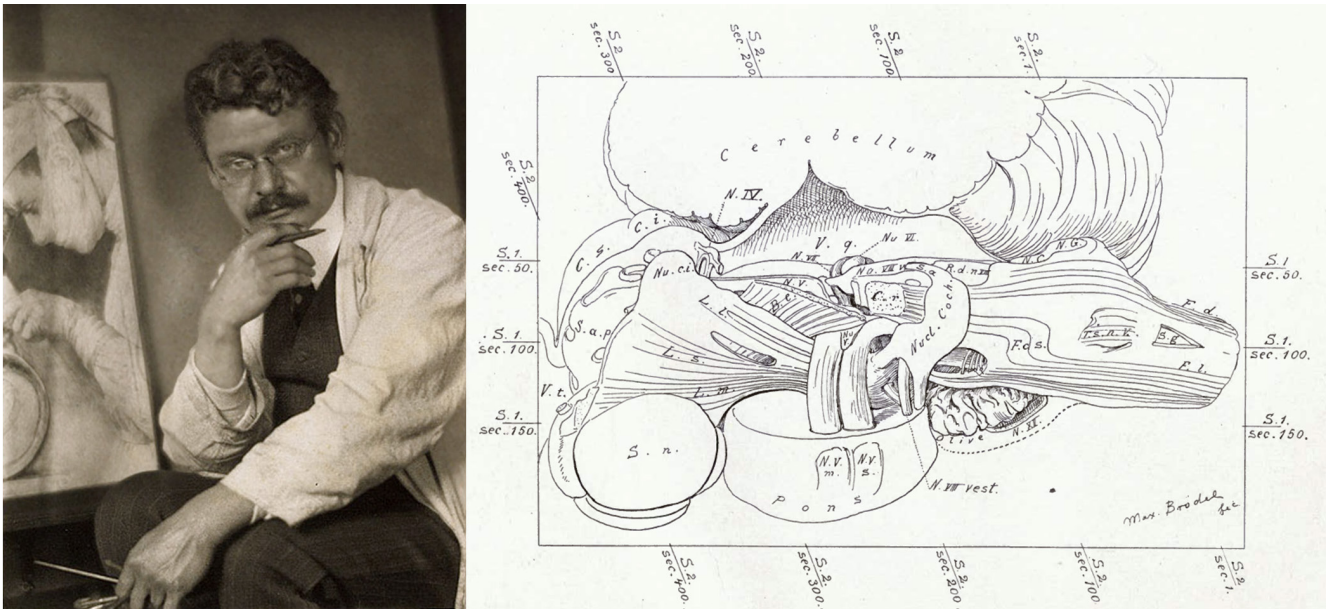

Figure 1. Left: Paul Heinrich Max Brödel (1870-1941). Right: sketch made by Brödel for plate I of *An atlas of the medulla and midbrain* (Sabin, 1901)

described in the treatise. The illustrations were made by Christopher Wren (1632-1723)[5,6]; these were prints from copper engravings, which provided greater detail than traditional woodcuts.

The field of neurology in 19th-century Europe included numerous researchers and clinical neurologists with remarkable artistic talents: Charles Bell (1774-1842), Henry Gray (1827-1861), Henry Vandyke Carter (1831-1897), Christian Wilhelm Braune (1831-1892), Jan Evangelista Purkyně (1787-1869), Jean-Baptiste Marc Bourgery (1797-1849), Nicolas Henri Jacob (1782-1871), Jean-Martin Charcot (1825-1893), and Santiago Ramón y Cajal (1852-1934) are some examples. In the early 20th century, the creation of specialised training centres led to the appearance of professional medical illustrators.[7,8] In this context, neurosurgeons recognised the potential of medical illustration for unravelling the complexities of neuroanatomy and surgical techniques applied to the treatment of neurological diseases.

This study delves into the relationship between medical illustration and neurosurgery in the first half of the 20th century through the works of Max Brödel and his Department of Art as Applied to Medicine.

Development

Max Brödel and his Department of Art as Applied to Medicine

Paul Heinrich Max Brödel (Figure 1) was born in Leipzig, Germany, on 8 June 1870.[9-11] In 1885, he enrolled at the Academy of Arts in his home town. Three years later, aged just 18 years, Brödel began to work as an illustrator for the German physiologist Carl Ludwig (1816-1895), who directed the Physiological Institute at the University of Leipzig. Ludwig's reputation attracted researchers from different countries, such as Franklin P. Mall (1862-1917), who directed the first anatomy department at Johns Hopkins University in Baltimore, Maryland. Mall was fascinated by the young artist's skills, and invited him to join his department. On 18 January 1894, Brödel moved to the United States and joined the recently founded Johns Hopkins University School of Medicine. There he met the "Big Four" physicians: pathologist William Henry Welch (1850-1934), surgeon William Steward Halsted (1852-1922), physician-in-chief William Osler (1849-1919), and gynaecologist Howard Atwood Kelly (1858-1943).

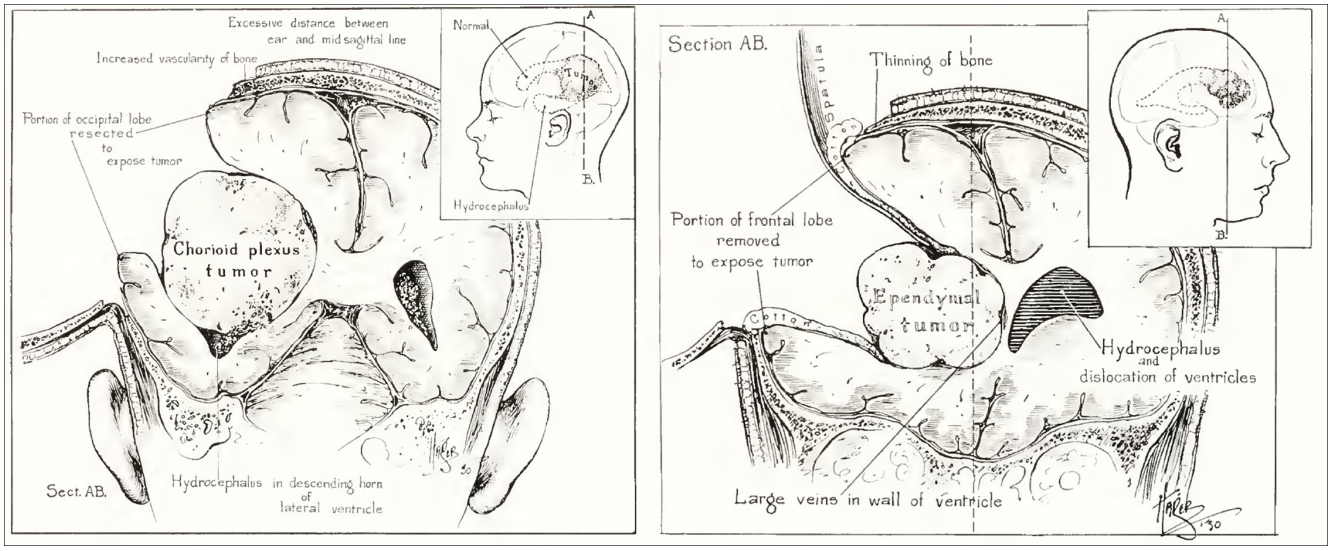

Figure 2. Left: sketch of an anteroposterior view of a tumour in *Benign encapsulated tumors in the lateral ventricles of the brain*, by Dandy (1934; p. 111). Right: sketches showing the position of the tumour (box) and the surgical approach through the frontal lobe (p. 87)

During his early years at Johns Hopkins University, Brödel made over 360 illustrations for Kelly's *Operative gynecology*. At the same time, he started studying anatomy and pathology, and attended numerous surgical interventions to deepen his understanding of the human body with the end goal of improving his illustrations. In 1910, Kelly began to plan his retirement, and Brödel was invited to join the Mayo Clinic in Rochester, Minnesota. Kelly's assistant Thomas S. Cullen, a friend of Brödel's, contacted the philanthropist Henry Walters to request the necessary funds to keep Brödel in Baltimore and to create a medical illustration department at Johns Hopkins University. The Department of Art as Applied to Medicine was created in March 1911.[12] Brödel ran the department until his retirement in 1940, training nearly 200 medical illustrators over that period. He died on 26 October 1941.

Brödel trained his students in the use of such painting techniques as *chiaroscuro* (to emphasise elements through the use of contrast in light and shading) and *sfumato* (to create a greater impression of depth), and such materials as Wolff's carbon pencils (which combine the advantages of graphite pencils and charcoal) and Ross board (special drawing paper with a stippled texture).[13] Ross board provides depth, precision, and a texture that cannot easily be achieved with other materials.

The creation of the Department of Art as Applied to Medicine constitutes a major landmark in the history of medical illustration. This was the first university medical illustration department, and contributed to the professionalisation of medical illustrators, changing the way the medical community perceived anatomical illustrations, as exemplified by Harvey Williams Cushing (1869-1939), the father of modern neurosurgery.[14] While working as a surgeon at Johns Hopkins Hospital (1902-1912), Cushing had the opportunity to see Brödel's work and realised that medical illustrations were an effective tool for transmitting knowledge; his students George Julius Heuer (1882-1950) and Walter Dandy (1886-1946) were of the same opinion. Dorcas Hager Padget, one of Brödel's most brilliant students, worked as Dandy's medical illustrator for over a decade. Other students, including Mildred Codding, William McNett, and Ralph Witherow, also worked for Cushing and Dandy.

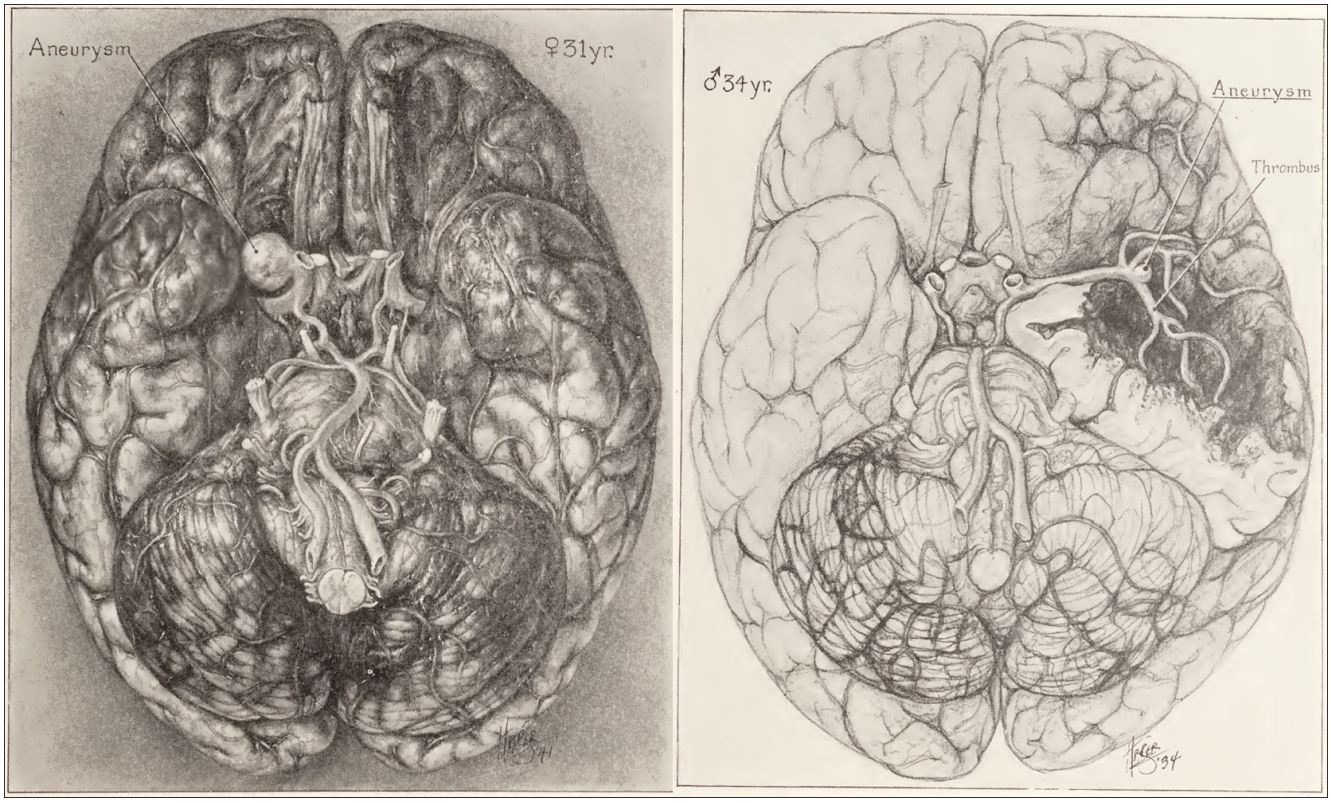

Figure 3. Left: aneurysm in the internal carotid artery (*Intracranial arterial aneurysms*, Dandy, 1945; p. 37). Right: extensive haemorrhage secondary to rupture of a small aneurysm in the middle cerebral artery (*Intracranial arterial aneurysms*, Dandy, 1945; p. 55)

Max Brödel's students

1. Dorcas Hager Padget

Dorcas Hager Padget (1906-1973) studied at Brödel's department from 1926 to 1929. Under Brödel, she learnt different drawing techniques and furthered her training on human anatomy. In June 1929, she finished her training and started working full-time as an illustrator for neurosurgeon Walter Dandy, with an annual salary of $2000.[15] In the 1930s, Padget became one of the most important medical illustrators in the United States (Figure 2). On 28 March 1932, in a letter to Cushing, Brödel wrote: "Some day I also want you to meet Dorcas Hager [Padget], who has done Dandy's illustrating all these years. [...] That girl is really a genius."[16]

In parallel to her career as a medical illustrator, Padget developed an interest in neuroembriology.[17] Encouraged by Dandy, she studied several embryos from the Carnegie Institution and described the normal and pathological development of the circle of Willis. The chapter "The circle of Willis: its embryology and anatomy" in *Intracranial arterial aneurysms*, edited by Dandy in 1944, was written and illustrated by Padget (Figure 3). After Dandy's death in 1946, Padget became a full-time researcher at the Department of Embryology of the Carnegie Institution, putting her career as an illustrator on the back seat.

2. Mildred Codding

Less well-known is Mildred Codding (1902-1991), a student of Brödel's who graduated in 1928-1929.[18-20] In 1912, Cushing left Johns Hopkins Hospital and started a new chapter of his career at the Peter Bent Brigham Hospital in Boston, Massachusetts. By the end of the 1920s, the hospital requested a part-time illustrator,

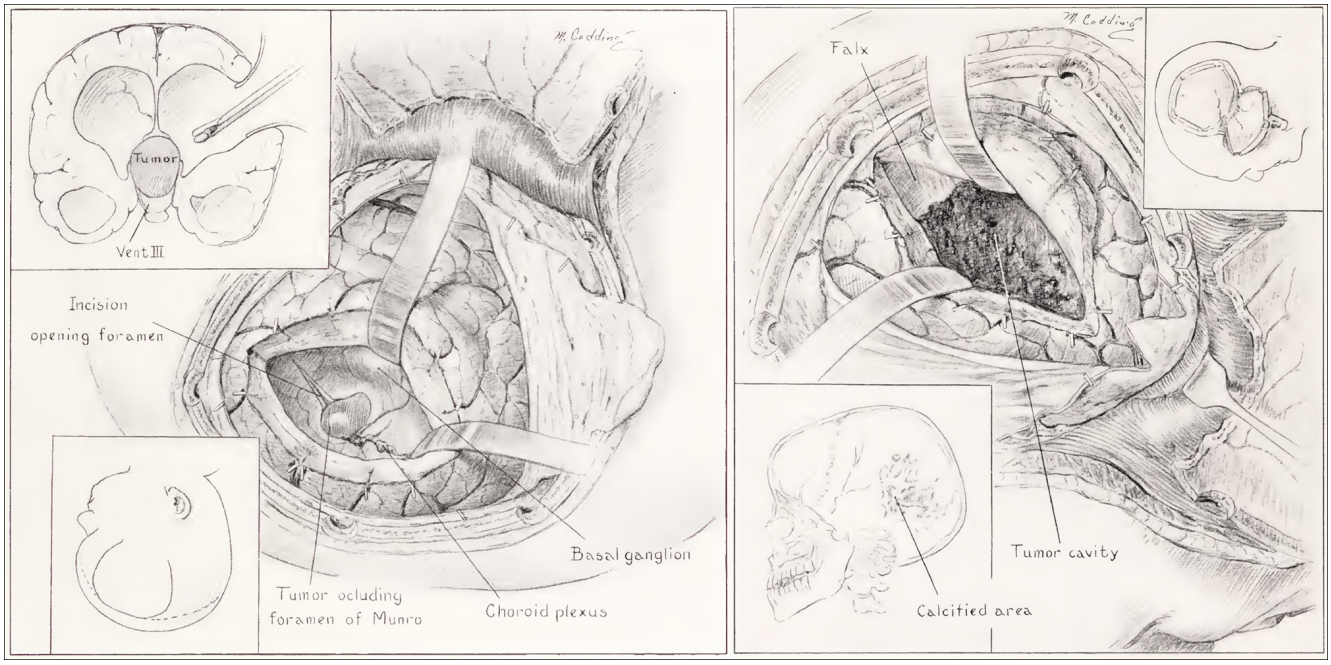

Figure 4. Left: sketches of a surgical procedure showing the transcortical approach to expose a tumour in the third ventricle (*Intracranial tumours*, Cushing, 1932; p. 47). Right: sketches of a surgical procedure showing the cavity left after removal of a large oligodendroglioma (*Intracranial tumours*, Cushing, 1932; p. 52)

and Brödel recommended Codding, who worked for Cushing for three years from 1929 to 1932. Interestingly, her illustrations have not received the recognition of those made by other students of Brödel's (Figure 4). In fact, Codding is not mentioned in a 2012 study on the medical illustrators working for Cushing and other contemporary neurosurgeons.[21]

3. Audrey Juliet Arnott

Audrey Juliet Arnott (1901-1974),[22] another of Brödel's most brilliant students, travelled to Baltimore in 1932 to further her artistic training thanks to the funds raised by neurosurgeon Hugh William Bell Cairns (1896-1952). Cairns had become a staunch defender of the pedagogical value of medical illustrations after his stay at the Peter Bent Brigham Hospital, where he worked as Cushing's assistant in 1926. Cushing emphasised the importance of working with professional medical illustrators. Arnott returned to London after 6 months of training at Brödel's department and shared her knowledge with Margaret McLarty (1908-1996)[23] and Dorothy Davison (1890-1984)[24]. Together with these two illustrators and Clifford Shepley (1908-1980), Arnott founded the Medical Artists' Association of Great Britain in 1949.

Discussion

Until the mid-19th century, medical texts usually included illustrations made by professional artists, who interpreted human anatomy to differing degrees of accuracy. On 7 January 1839, Louis Jacques Mandé Daguerre (1787-1851) presented his "daguerreotype" at the French Académie des Sciences. His invention, based on the work of Joseph Nicéphore Niépce (1765-1833), was revolutionary as it constituted an objective instrument, independent of the artist's subjectivity, and provided a new visual medium for scientific communication.[25] For example, at the Hôpital de la Pitié-Salpêtrière in Paris, Jean-Martin Charcot (1825-1893) incorporated photography into routine clinical practice to document his patients' symptoms.

When Brödel arrived at Johns Hopkins University, photography was unquestionably the preferred tool for illustrating neurological publications. In this context, Brödel stressed that unlike photography, medical illustration was the product of analysis and interpretation, and a powerful training tool.[10] He therefore insisted that illustrators should have a deep understanding of anatomy: "… no illustration can be made without anatomic and histologic knowledge, the student begins in the dissecting room, doing the work with his (or her) own hands, slowly and thoroughly."[10(p670)] Brödel was also of the opinion that photography resulted in dramatic, non-scientific images, since it rarely shows more than what the photographer is able to see; medical illustrators, in contrast, transmit ideas and concepts that are difficult to express in words or photographs.

Conflicts of interest

The authors have no conflicts of interest to declare.

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