

The Pam & Rolando Del Maestro Family William Osler Medical Student Essay Awards

October 12th, 2020

Colourful Innovations in Neuropathology

Robert Hooper & the shift in portrayal of the morbid brain in the nineteenth century

Minahil Khan

M.D.,C.M. Candidate, 2023

McGill University

With the gracious mentorship of Dr Richard Fraser

Introduction

In 1826, Dr. Robert Hooper (1773-1835), an English physician and pathologist, published *The Morbid Anatomy of the Human Brain*. This was a coloured atlas on neuro-pathology and featured highly detailed illustrations of “tubercles” of the brain, various forms of meningitis, inflammation, and rare conditions such as metastatic melanoma. The volume was widely sold and highly popular, and Hooper published a second edition with an expanded introduction in 1828. He would also go on to produce an atlas on uterine pathology. Ultimately, he planned to produce a great atlas of pathology of the various organ systems, but his early death would prevent this achievement (Courville, 1945).

Hooper’s *Morbid Anatomy* is considered to be the first neuropathological atlas in colour. Before Hooper, the most well-known illustrated volume on pathology was Matthew Baillie’s *A Series of engravings* (1799), which includes a chapter on diseases of the brain with accompanying black-and-white engravings. In fact, Baillie admits in the opening of his chapter that, due to the idiosyncratic texture of the brain and the complexity of neurological diseases, some of its pathologies “cannot be represented at all by engravings, and others will admit a less distinct representation” (Baillie, 1799). Later, black-and-white illustrations of morbid anatomy fell out of favour due to their drawbacks in accuracy, and there was a shift in the visual representation of pathology towards the use of colour (Meli, 2018). Marking this shift, Hooper’s *Morbid Anatomy* was amongst the pioneer coloured pathology atlases that were published and widely circulated in the second quarter of the nineteenth century, along with authors such as Richard Farre and Thomas Fawdington (Meli, 2018), though Hooper was among the first to illustrate the brain. These works would pave the way for larger, more ambitious pathological atlases, such as John Cruveilhier’s *Anatomie pathologique du corps humain* (1829-1842).

There is some controversy as to the technique used by Hooper to achieve these illustrations. He relied on painters George Kirtland, J. Howship and John Stewart Jr. and engravers J. Wedgewood and John Stewart Sr. Historians have claimed that the illustrations used in the book were produced by colour lithography, an innovative printing technique developed in the late 1700s (Royal Society; Courville, 1945). However, one author has recently suggested that they were in fact hand-coloured stipple engravings (Meli, 2018). Hooper himself refers to them as “coloured engravings” in the second edition (Hooper, 1828).

Regardless of the exact technique, Hooper’s illustrations were strikingly different from prior neuropathological plates – notably, Baillie used woodcut engravings, which had been the standard for three-dimensional anatomical drawings since the time of Vesalius and Da Vinci (Del Maestro, 2006). The accuracy and bright colours used in the illustrations of *Morbid Anatomy* were instrumental in opening new avenues in neuropathological illustration. Hooper acknowledged the vivacity and uniqueness of these illustrations, writing in his preface:

“To the accuracy of the delineations, and the faithfulness of the colouring, the greatest attention has been given; and the result is so satisfactory as to afford those who have not had the opportunity of investigating diseased parts, the means of becoming acquainted not only with their structure, but also with their appearance

on examination, and of thus possessing a museum, in some respects more useful than the preparations themselves.” (Hooper, 1826)

Thus, with its accuracy, *Morbid Anatomy* allowed the medical community of the time to observe, and thereby better understand, a variety of neurological diseases that would not have otherwise been visually accessible to them. This paper seeks to demonstrate how a selection of Hooper’s illustrations opened new possibilities in the depiction of neuro-pathological disease, particularly with respect to their innovative use of colour and detail.

- (1) For infectious diseases, the detailed use of colour allowed for a remarkably precise depiction of inflammation (including “morbid vascularity”) and an accurate representation of the various appearances of purulent exudates. It also allowed Hooper to capture the macroscopic morphological changes of the various stages of abscess formation and depict the texture of granulomas in tuberculosis.
- (2) For cerebrovascular diseases, the medium allowed Hooper to display the deformation and staining of the lateral ventricle secondary to haemorrhage, and the appearance of old and new infarcts.
- (3) In neoplastic diseases, Hooper’s technique allowed him to represent the textural and vascular properties of various types of tumours that helped to differentiate tumours based on location (meningiomas, gliomas) and origin (primary, secondary).

My artistic analysis of the plates is accompanied by a pathological analysis, to demonstrate how Hooper’s contemporaries may have conceptualised the highly realistic images. The plates will be compared with the most well-known prior pathological volume containing neurological diseases, namely Matthew Baillie’s *A Series of Engravings*, to demonstrate the innovative features of his illustrations.

Pathological analysis of the plates was done with the gracious assistance of Dr Richard Fraser and Dr Jason Karamchandani. Dr Richard Taws of the History of Art Department at the University College of London and Dr Mary Hunter of Art History and Communications Studies Department at McGill University generously helped analyse the art medium used by Hooper. Osler librarian Dr. Mary Hague-Yearl kindly provided remote access to digital copies of Hooper and other pathological works, since the COVID-19 pandemic restricted the ability to observe the illustrations in person. Finally, sincere gratitude is given to the Del Maestro family who made the exploration of this topic possible by supporting the Medical Student Essay Awards.

Infectious diseases

As examples of infectious disease, Hooper illustrates meningitis (Plates I-IV), brain abscesses (Plate V and IX) and lymph node tuberculosis (Plate XI). His illustrative medium allowed for the vibrant and accurate depiction of various components such as purulent exudates, inflammation, abscess formation, and granulomas.

Firstly, colour allowed Hooper to innovatively illustrate purulent exudates with great accuracy and vibrancy. For instance, in the second figure of Plate II (*Illustration 1*), which portrays inflammation of the dura mater, he describes a “considerable quantity of solid, partly organized albumen”. In the illustration, the artist outlines the purulent exudate in fine, fibrinous tendrils, which emphasizes its nature as a partly free-flowing material that has partially solidified into a membrane. The brightness of the greenish colour communicates the opacity of the exudate, along with the small specks of reactive engorged vessels on the internal surface. Importantly, his meticulous use of various shades of green to portray the exudate allows the modern interpreter to confirm that the pathology is neutrophil-mediated, most likely bacterial meningitis. This plate is directly comparable to an illustration in Baillie’s *A Series of Engravings*, which also portrays inflammation of the dura mater in a similar setting (*Illustration 2*). Like Hooper, Baillie describes a “layer of coaguable lymph on the inner surface” of the dura. Though he can portray the three-dimensional structure of the solidified exudate, the woodcut cannot provide detail of the free-flowing texture of the material, nor the colour to identify its mechanism.



Illustration 1. Hooper, *Morbid Anatomy*, plate II, figure 2. Inflammation of the dura mater. Drawn by J. Howship; engraving by J. Wedgewood. The exudate is indicated by label B.

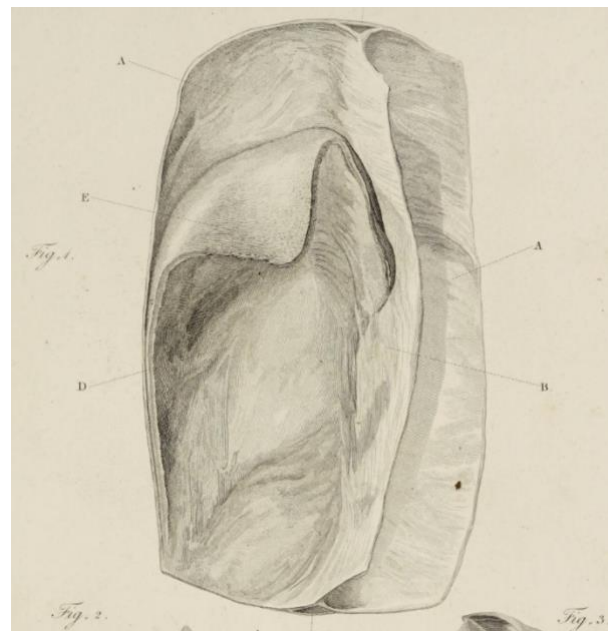


Illustration 2. Baillie, *Series of Engravings*, plate IV, figure 1. Drawn by W. Clift; engraved by J. Basire. The exudate is indicated by label E.

Hooper shows a similar exudate in Plate IV (*Illustration 3*). Although the colour is similar, it is made to appear more gelatinous and transparent; therefore, the artist is able to show in detail that the exudate is closely associated with specific anatomical structures at the base of the brain, such as the cranial nerves (*Ill. 3; F*) and basilar arteries (*Ill. 3; K*). This distribution provides a classical picture of basilar meningitis, most likely due to tuberculosis.

Secondly, the detailed use of various colour gradients allows for an accurate and thorough picture of inflammation and, as Hooper calls it, “morbid vascularity”. This is most apparent in Plate I, in which he shows the internal surface of an inflamed dura mater (*Illustration 4*). In Baillie’s woodcut engraving of the inflamed dura

(*Illustration 1*), the appearance of prominent vascularity and redness, both typical characteristics of acute inflammation, is of course absent. In *Illustration 4*, Hooper’s technique allows him to arrange various shades of pink into soft gradients, providing an almost photorealistic portrayal of the *rubor* element of inflammation. The masterful shading also provides form to the superior sagittal sinus (*Ill. 4; B*), which indirectly makes it appear thrombosed. The artist uses fine and delicate red specks to delineate engorged vessels, which are most prominent in Plates I, VIII, X and XIV (*Illustration 5*, and see digitized version in References). For example, the photorealistic portrayal of *rubor* is again present as inflammation surrounding the abscess in Plate V (*Illustration 6*)

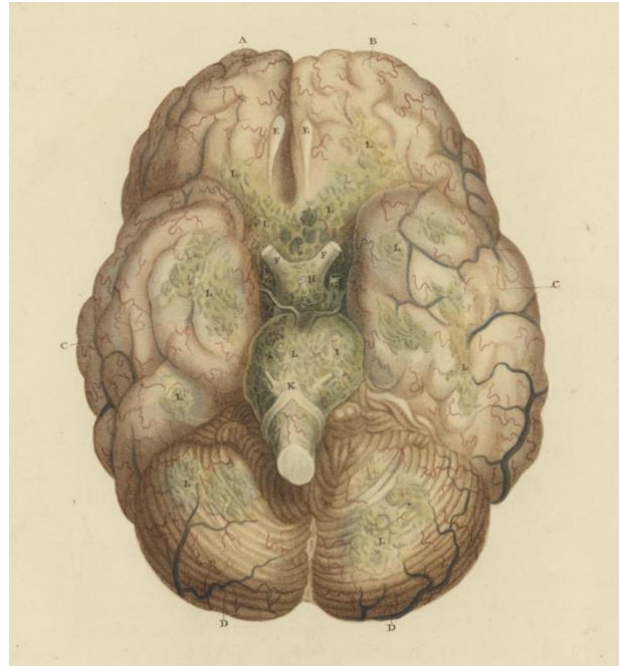


Illustration 3. Hooper, *Morbid Anatomy*, 1826, plate IV. Inflammation of the pia mater. Drawn by J. Howship, engraving by J. Wedgewood. The exudate is indicated by label L

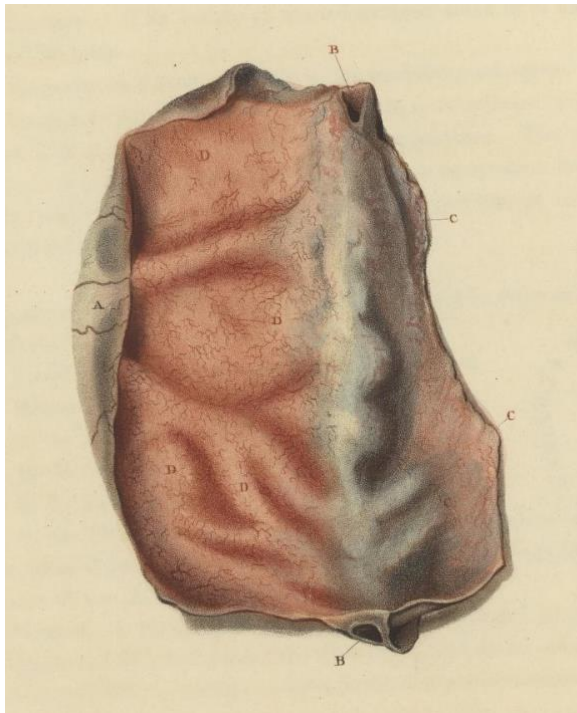


Illustration 4. Hooper, *Morbid Anatomy*, 1826, plate I. Inflammation of dura mater. Drawn by J. Howship, engraved by J. Wedgewood. Sagittal sinus is indicated by label B.



Illustration 5. Close-up of Illustration 4, depicting the specks of engorged vessels. A similar pattern is seen in many other plates.

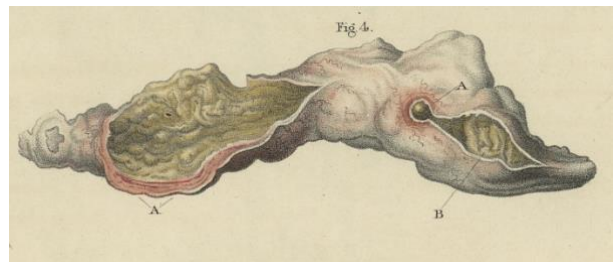


Illustration 6. Hooper, *Morbid Anatomy*, 1826, plate V, figure 4. Abscess in lateral sinuses. Drawn by J. Howship, engraved by J. Wedgewood.

In the illustrations of abscesses on Plate IX (*Illustration 7*), colour allows the reader to better differentiate between the stages of abscess formation by understanding their respective textures. In Figures 1 and 5 (*top right, bottom right*), the detailed use of various shades of gold and brown gives the internal surface of those abscesses an uneven, rough texture, likely indicating an early stage. By contrast, the surface of the abscess in Figure 3 (*centre*) is smooth, with a defined form and specks of engorged capillaries suggesting that it is a partly organized abscess with a more established blood supply. The texture of Figures 2 and 4 (*top left, bottom left*) is not quite as smooth but much less rough than the early abscesses, and darker shades of brown provide depth and indicate cavitation. These are possibly organizing abscesses, as Hooper indeed describes that some sides appeared like a “delicate membrane”. In the accompanying description to the plate, Hooper classifies the abscesses into a “well-circumscribed” type and a “purulent” type, not realizing that these are stages of the same process. Nonetheless, these highly textured images would have been very educational to his contemporaries with less access to pathological specimens.

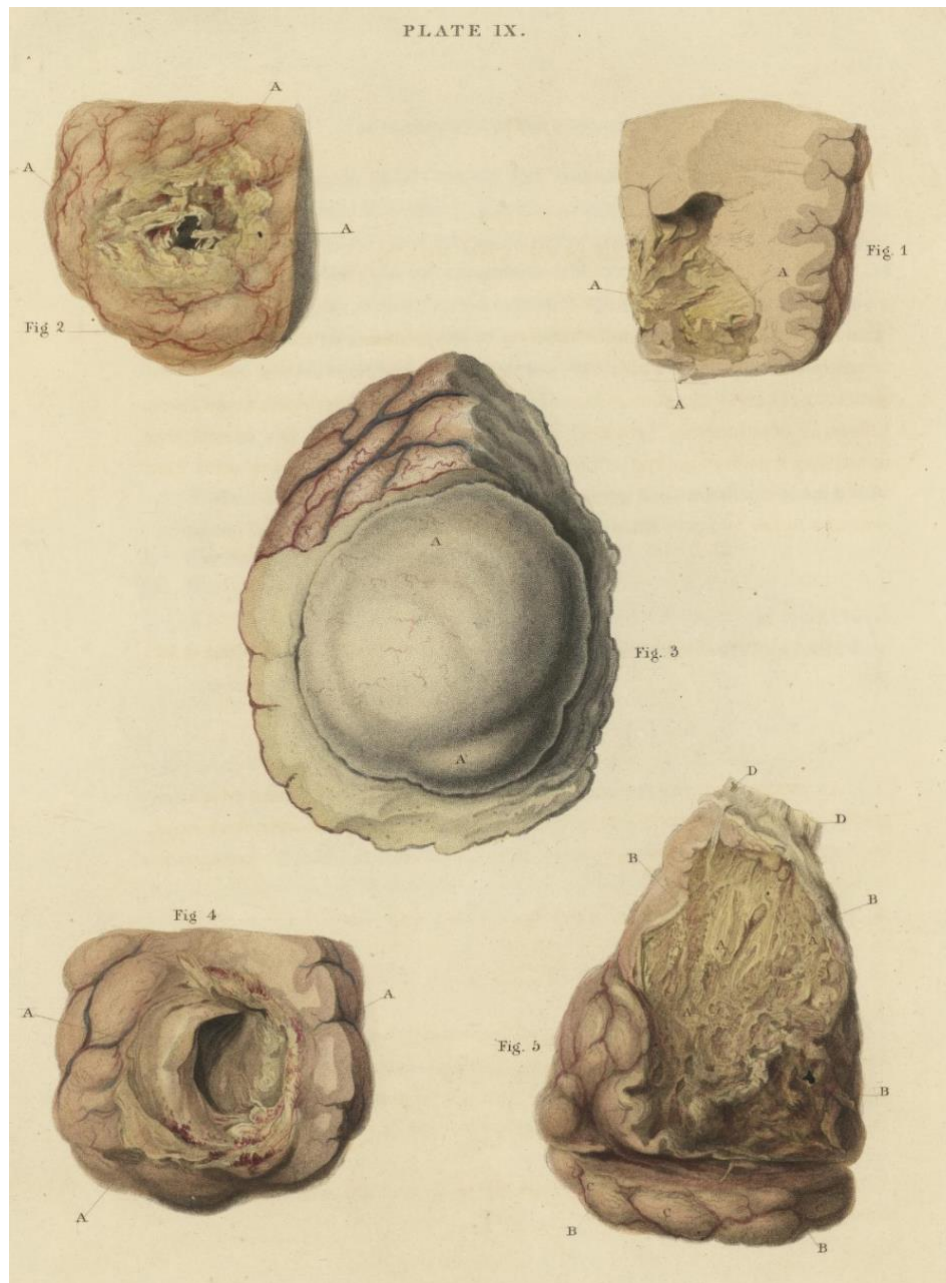


Illustration 7. Hooper, *Morbid Anatomy*, 1826, plate IX. Abscesses of the brain. Drawn by J. Stewart Jr, engraved by J. Stewart Sr.

Finally, in Plate XI (*Illustration 8*) Hooper depicts granulomatous inflammation in a lymph node in the neck due to tuberculosis, which he refers to as a “Scrofula of the Cerebellum”. He begins the accompanying description by stating that many other tumours in the brain are “erroneously considered as scrofulous”. He states that the most common alterations in the brain due to tuberculosis are “increased thickness of the membranes with an appearance of inflammation” and the appearance of a “hard, firm structure”. The former was illustrated as the classical presentation of basilar meningitis (previously noted in *Illustration 3*). The firm structure most likely refers to the granuloma. Distinguishing granulomas from neoplasms is very difficult without colour and textural detail - indeed, Baillie also illustrates scrofulous masses on the inner surface of the dura (*Illustration 9*), but the black-and-white woodcut fails to represent the distinctive cheese-like appearance. Of course, since he does not describe a thickening of membranes, it is likely that Baillie misdiagnosed these lesions as scrofulous,

thus embodying the confusion that Hooper tries to mitigate. Unlike Baillie, Hooper's illustration provides a faithful depiction of the characteristic caseous necrosis seen in *Mycobacterium* granulomas, with the pale-yellow colour and matte texture. The reader can contrast these characteristics with the irregular gliomas and smooth meningiomas seen in his neoplasm plates, and thus learn to better differentiate them. Thus, Hooper's realistic illustrations and astute descriptions helped him clarify the difference between granulomas and brain tumours, which were commonly confused with each other at the time.



Illustration 8. Hooper, *Morbid Anatomy*, 1826, plate XI. Scrofula of the cerebellum. Drawn by J. Kirkland, engraved by J. Stewart.

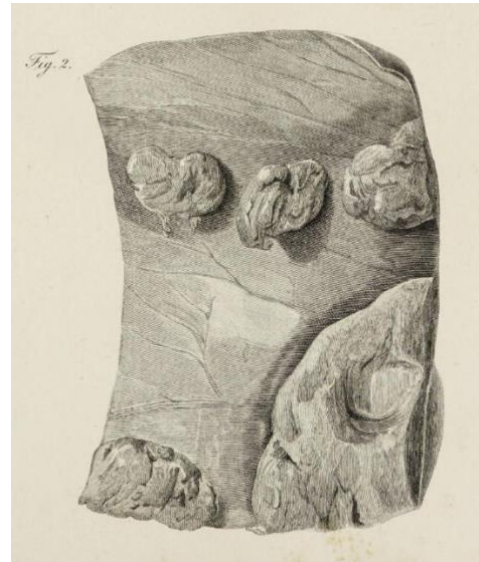


Illustration 9. Baillie, *Series of Engravings*, 1799, plate V, figure 2. Drawn by W. Clift, engraved by W. Skelton.

Cerebrovascular diseases

Hooper did not create a specific classification for cerebrovascular diseases, most likely because he did not realize the vascular aetiology of some of the lesions he illustrated. Nonetheless, he illustrates possible infarcts in Plate VIII, and intraventricular haemorrhage in Plate XV.

Though Hooper does not necessarily note it in his descriptions, his illustrations help differentiate inflammation secondary to infarction from inflammation due to infectious aetiologies. For example, Plate VIII is vaguely titled “Inflammation of the brain”, and the specific and contrasting colours used in each figure suggest an infarct. On the left, the colour of the lesion is bright yellow with golden specks, very different from the greenish exudates in the infectious disease plates. However, the yellowish hue and consolidated texture of the structure points the modern interpreter towards an old infarct. This strongly contrasts with the lesion the right, which uses darker grey and pink colours. Though Hooper refers to this lesion as pus, the colours are far more dispersed and fade into the white matter of the brain, which does not match the sharply delineated green pus in the meningitis plates. The disorganized appearance points to the possibility of another, more recent infarct. Although Hooper did not state the separate aetiologies of infectious and ischemic inflammation, a contemporary reader would have been able to differentiate their appearances and clarify the distinctive colour of the purulent exudate in meningitis.

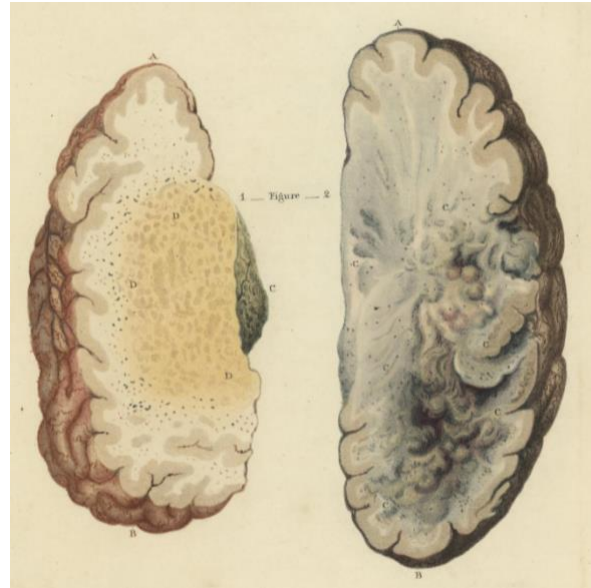


Illustration 10. Hooper, *Morbid Anatomy*, 1826, plate VIII. Inflammation of the brain. Drawn by G. Kirkland, engraved by J. Wedgewood.

Finally, on the left side of Plate XV (*Illustration 11*), Hooper illustrates an intraventricular haemorrhage, with the coagulated blood removed from the ventricle. This can be directly compared to Baillie's Plate VIII (*Illustration 12*), which also portrays an extravasation of blood (Baillie in fact mentions that the preparation was shown to him by Hooper). Though Baillie's illustration shows the coagulated texture of the extravasated blood, the damage to the ventricular tissue itself, which would help distinguish the illustration from an abscess, cannot be shown without colour. The use of a variety of reddish hues, from contrasting dark brown to pink, allows Hooper to accurately portray the stained tissue of the ventricle secondary to a haemorrhage. These hues are also used to provide depth to the structure and communicate the distended shape of the ventricle after the extravasation of blood. Finally, the artist organizes these colours into soft and fine strokes, portraying the internal nature of the damaged ventricle.

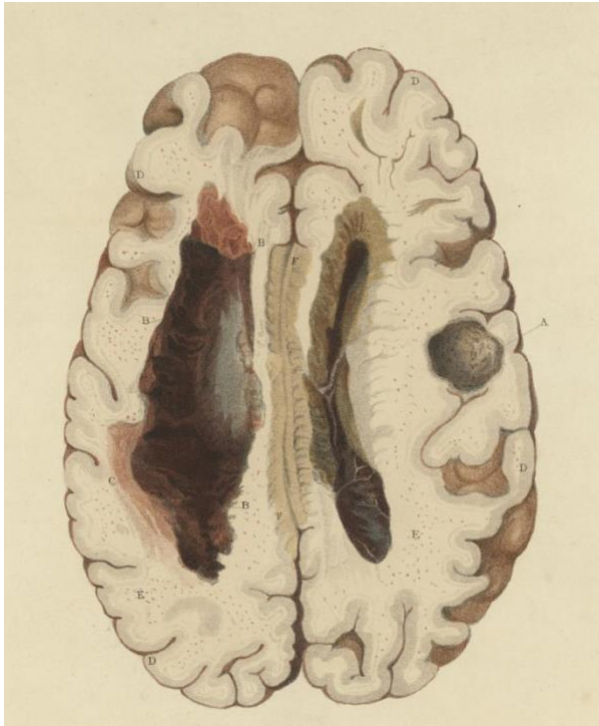


Illustration 11. Hooper, *Morbid Anatomy*, 1826, plate XV, Extravasation of blood in the brain. Drawn by G. Kirtland, engraved by J. Wedgewood.

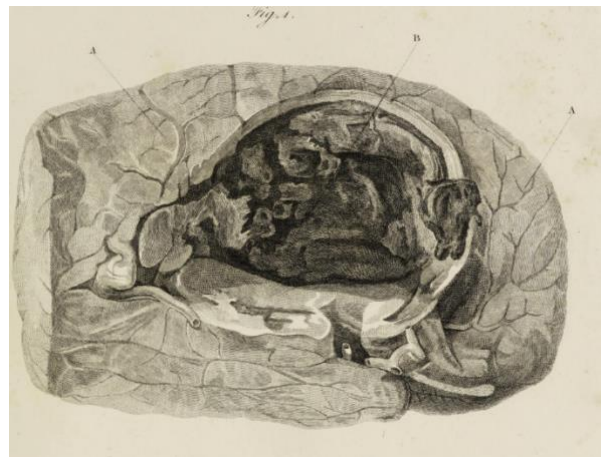


Illustration 12. Baillie, *Series of Engravings*, 1799, plate VIII. Engraved by P. Basire.

Neoplasms

The vibrancy and realism of colour also allows Hooper to illustrate the various properties of different types of neoplasms, such as texture, consistency, and vascularization. In his classification, He was the first to separate meningiomas and gliomas (Del Maestro, 2006). His illustrations help highlight the properties that may differentiate the origins of these tumours, even if he did not point them out explicitly.

In Plate VI, (*Illustration 13*) he depicts and differentiates between two types of tubercles, namely a “soft, fungous tumour” and a “white, hard tubercle”. For the latter, he employs various shades of grey and a soft gradient to give the appearance of a smooth surface and a “firm texture”. The softer tumour is illustrated with darker shades, with faint pinkish cracks along its surface. This effectively gives the tumour a spongier appearance, suggesting that it is more vascular. Though Hooper abandons the idea that these tumours are of the same origin, the simultaneous appearance of numerous soft and hard tumours suggest a diagnosis of type II neurofibromatosis, in which the initial soft lesion may become ossified.

Plate VII, most likely a meningioma, is titled “Fungoid tumour of the dura mater” (*Illustration 14*). For comparison, Baillie also portrays an apparent meningioma (*Illustration 15*). Though he writes that the texture was “fibrous”, the woodcut illustration cannot communicate tumour properties such as vascularity, border irregularity and invasiveness. In Hooper’s illustration, the use of various shades of reddish brown on the surface, as well as the pinkish “reticular” pattern on the cross-section, portrays the vascularity of the tumour. The spindle-like strokes on the surface suggest an invasive, irregular border. These properties strongly contrast with the smooth spherical masses around the peripheral portion of the dura – from their sheer number, they are probably metastases. Though he does not incorporate these into his formal classification, the textural detail of Hooper’s illustrations helps him distinguish the properties of certain subtypes of meningiomas.

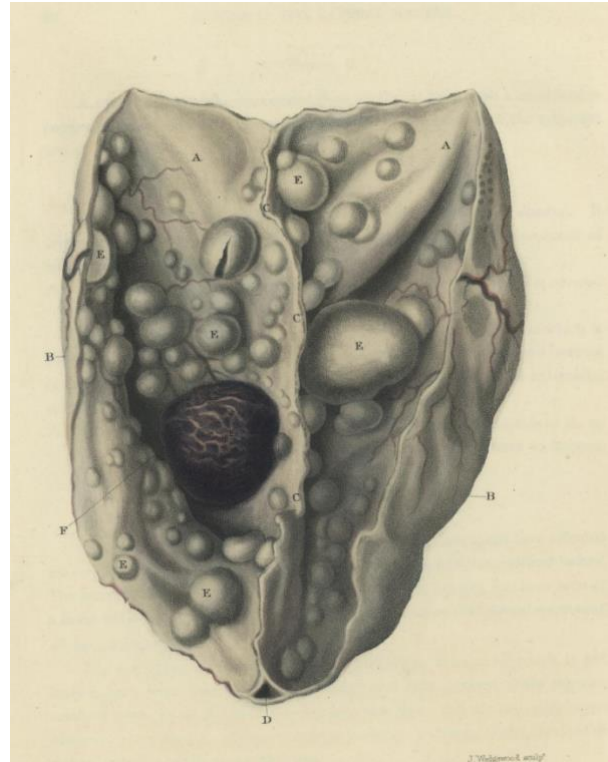


Illustration 13. Hooper, *Morbid Anatomy*, 1826, plate VI, *Tubercles of the dura mater*. Drawn by G. Kirtland, engraved by J. Wedgewood.

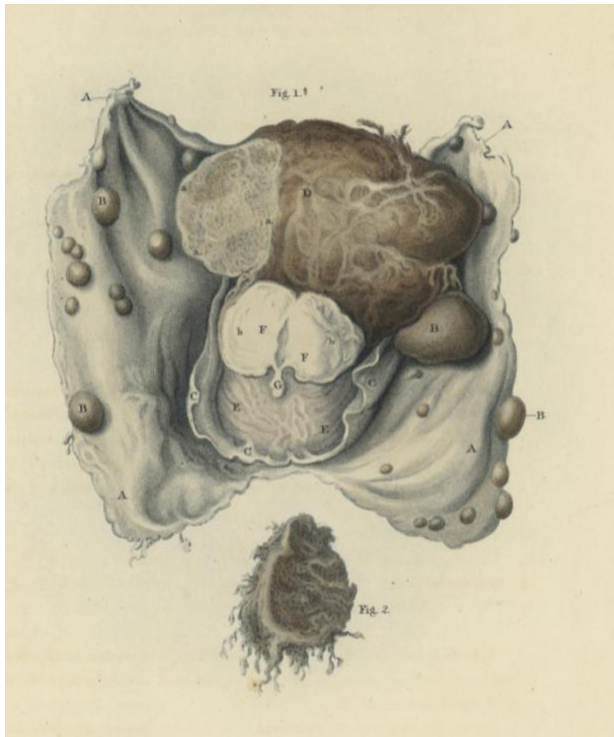


Illustration 14. Hooper, *Morbid Anatomy*, 1826, plate VII, *Fungoid tumour of the dura mater*. Drawn by G. Kirtland, engraved by J. Wedgewood.

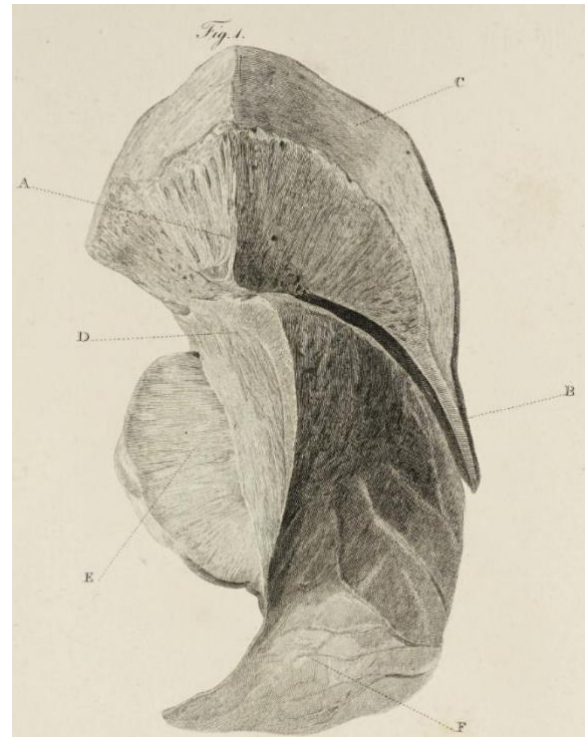


Illustration 15. Baillie, *Series of Engravings*, 1799, plate V, figure 1. Drawn by C. Clift, engraved by W. Skelton.

Illustration 16 represents Hooper's most complex illustration, depicting seven figures showing different types of tumours. Once again, the engravings use colourful minute detail to inform the vascular and textural properties of these masses, helping to distinguish between tumours of primary and secondary origin. Figure 1 shows a smooth spherical mass that is largely avascular with a very similar colour to the surrounding pale-yellow medulla – this suggests an intraparenchymal primary tumour. By contrast, the sharply delineated and vascularized black lesions in Figures 2 and 3 suggest a metastatic melanoma – these would in fact be the first known illustrations of “melanosis” in the brain. The use of colour is crucial to portray melanomas, and textural properties of the tumour are also given attention. For example, the artist also uses subtle gradients of white and grey to provide a glossy appearance, which he describes as a “very thin delicate membrane” surrounding the lesions. The remarkable detail of Figure 3 provides even more information on the nature of the tumour. In it, the artist has traced the hollow cavity from which the tumour is falling out, indicating its sharp borders; the thin string-like attachment is its blood supply. The reader can directly compare this to the irregular borders and reticular vascularization of the tumour in Plate VII, which is more characteristic of the cut surface of primary tumour. Thus, through his portrayal of the colour, texture and cut surface of metastatic melanomas, Hooper provides an excellent description and illustration of the distinguishing properties of secondary brain tumours.

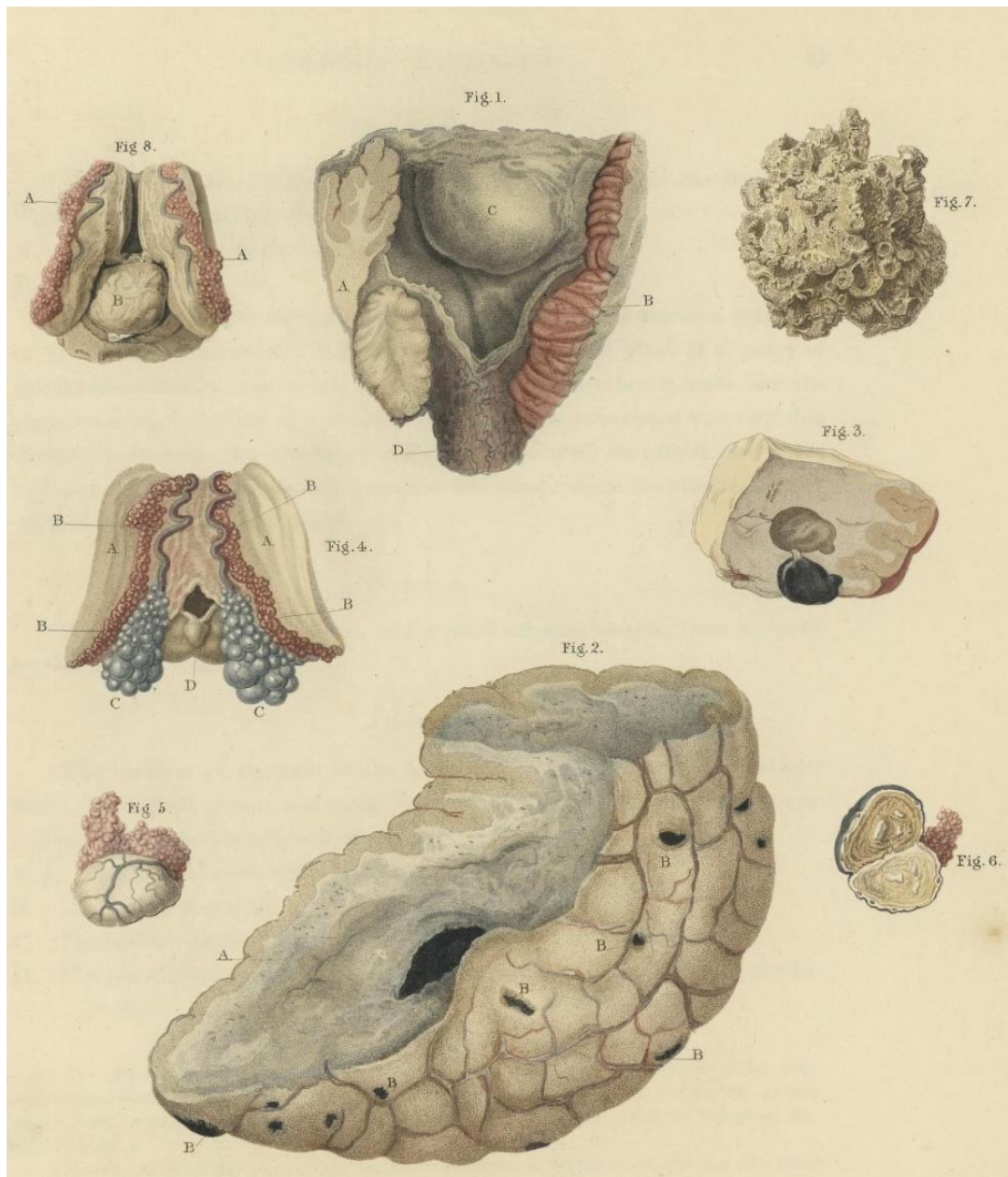


Illustration 16. Hooper, *Morbid Anatomy*, 1826, plate XII, Tubercles of the brain. Drawn by J. Howship, engraved by J. Stewart.

Impact

In the second edition of *Morbid Anatomy*, Hooper writes that nearly all of the copies of the first edition had sold out, and he had received “many gratifying encomiums [...] from the Professors of Anatomy and others” (Hooper, 1828). Hooper is referenced by several other authors who produced pathological works, such as John Howship and John Cruveilhier, as well as Matthew Baillie himself. One of the most notable of these authors is Richard Bright, who dedicated the second volume of his *Reports on Medical Cases* to diseases of the nervous system five years after the publication of Hooper’s first edition of *Morbid Anatomy*. This was preceded by a first volume that illustrated diseases of various parts of the human body but did not include the brain. In *Reports of Medical Cases*, Bright used both engravings and lithography to illustrate diseases of the human brain and, unlike Hooper, also provided the symptoms and case reports of the associated pathologies. Bright mentions Hooper in his acknowledgements and references an illustration in Hooper’s *Morbid Anatomy*. While citing possible causes of intracranial pressure, he lists, “the enlarged vascular cysts, so frequent of a smaller size, attached to the choroid plexus, of which Dr Hooper has represented a striking instance in his work.” (Bright, 1831). He is referring to Figure 8 of Plate XII, a probable choroid plexus papilloma in the fourth ventricle that would have caused hydrocephalus (*Illustration 16, top left*). Although Hooper had provided no mention of the patient, the detail of the figure allowed Bright postulate the symptoms associated with the lesion and incorporate it into his own theoretical framework.

While his own work was limited to diseases of the brain (and later, some uterine pathologies), Hooper paved the way for the incorporation of neuropathological illustrations within larger works of pathology. Like many of his contemporary authors, Hooper wished to publish a global atlas of morbid anatomy covering all parts of the human body, much like Matthew Baillie’s earlier volume, but in colour. However, producing faithful coloured illustrations of diseased structures was difficult – artists and engravers had to be available at short notice to produce pictures of morbid specimens when they were still fresh, and most coloured printing techniques – whether they were lithography or stipple engravings – were expensive (Meli, 2018). Therefore, it would not be until 1835 that the first global coloured atlas of pathology was published, when John Cruveilhier completed his *Anatomie pathologique du corps humain*. In his introduction, Cruveilhier provides a short history of the illustration of morbid anatomy and praises Hooper for his remarkably detailed illustrations on the brain (Cruveilhier, 1835). He also refers to the abscess illustration in Hooper’s Plate V (*Illustration 6*) and challenges Hooper’s assertion that this abscess originated in the brain, suggesting that the temporal location may indicate that the infection started in the ear and penetrated the temporal bone (possibly otitis media progressing to mastoiditis). Though Hooper interacted with the actual specimen, Cruveilhier never saw it in person. Thus, it would be difficult for him to challenge Hooper’s assertions and make alternative diagnoses without a vivid illustration - this demonstrates that the accuracy of the images allowed for a richer exchange of knowledge among Hooper’s contemporaries.

Conclusion

To conclude, Hooper's *Morbid Anatomy of the Human Brain* was a pioneer work that opened new avenues in neuropathological illustration with highly detailed colour. Though the technique used for the drawings is contested, the medium allowed for accurate depictions of certain properties in infectious, cerebrovascular, and neoplastic diseases. The volume was widely circulated among contemporaries, who would derive inspiration and use it to inform their own works. As the classification of diseases was becoming an emerging priority in medicine, the photorealistic quality of the plates was essential to allow contemporaries to incorporate the illustrations into their own theoretical frameworks. By portraying pathological specimens in more comprehensive detail than ever before, he increased the standard for illustrations in this field, thus fueling further innovation. Indeed, as Hooper predicted in his preface, his landmark illustrations truly did become "more useful than the preparations themselves." (Hooper, 1826)

References

Baillie, Matthew. *A series of engravings, accompanied with explanations, which are intended to illustrate The morbid anatomy of some of the most important parts of the human body*. W. Bulmer & Co, 1799. Retrieved from:

https://archive.org/details/b24924453_0001/page/n359/mode/2up

Bright, Richard. *Reports of medical cases selected with a view of illustrating the symptoms and cure of diseases by a reference to morbid anatomy*. Longman, 1827. Retrieved from:

<https://archive.org/details/34725085.5943.emory.edu/page/n7/mode/2up>

Cruveilhier, John. *Anatomie pathologique*. J-B Ballière, 1829-1842. Retrieved from:

https://archive.org/details/BIUSante_00642x01/page/n5/mode/2up

Del Maestro, Rolando. *A History of Neuro-oncology*. DW Medical Consulting Inc, 2006. Retrieved in print.

Hooper, Robert. *The Morbid Anatomy of the Human Brain*. Longman, Rees, Orme, Brown and Green, Paternoster-Row, 1826. Retrieved from:

https://archive.org/details/BIUSante_08222/page/n34/mode/1up

Hooper, Robert. *The Morbid Anatomy of the Human Brain*. Longman, Rees, Orme, Brown and Green, Paternoster-Row, second edition, 1828. Retrieved from:

<https://archive.org/details/b20265293/page/n7/mode/2up>

Meli, Domenico Bertoloni. *Visualizing Disease: The Art and History of Pathological Illustrations*. Chicago Scholarship Online, 2018. DOI:

10.7208/chicago/9780226463636.001.0001

Rifkin, Benjamin; Ackerman, Michael; Folkenberg, Judith. *Human Anatomy: Depicting the Body from the Renaissance to Today*. Thames & Hudson, 2006. Retrieved in print.

The Royal Society. 'Inflammation of the Brain'. Royal Society Picture Library. Image number RS.10090. Retrieved from: <https://pictures.royalsociety.org/image-rs-10090>