THE MOVEMENTS OF THE WORM: The Cerebellar Vermis Through the Ages

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Köln, 16 June 2001

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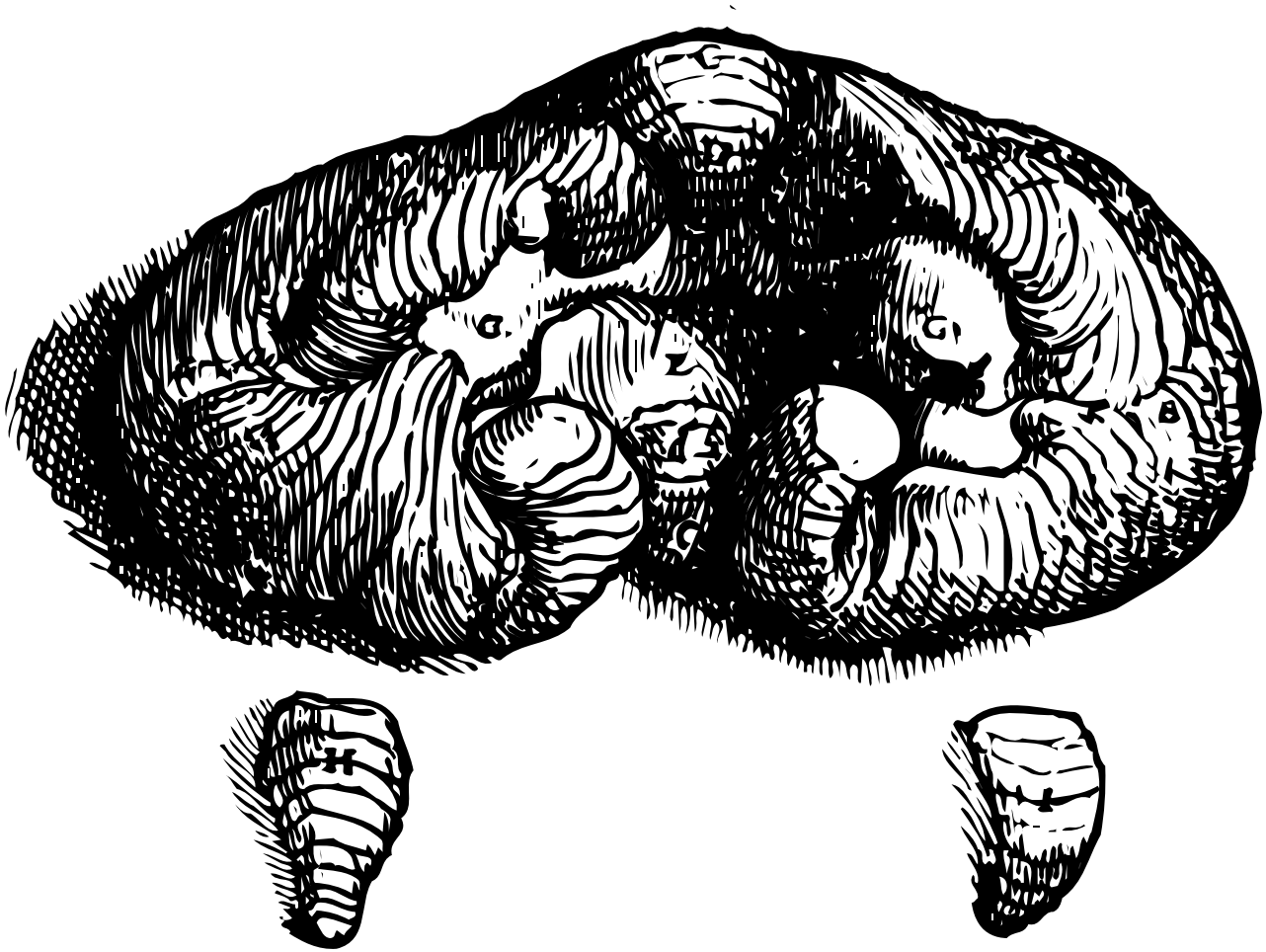
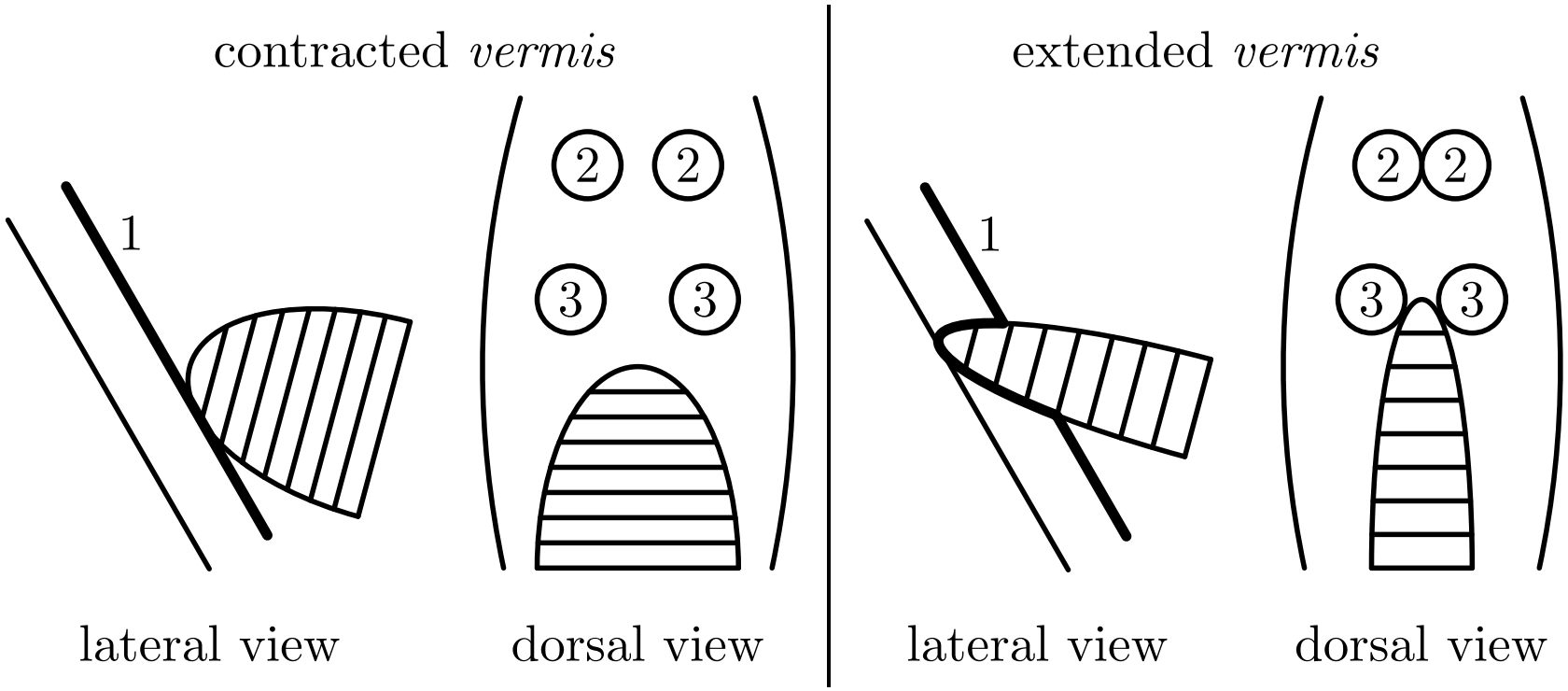
1 Galen on the Motions of the Cerebellar Vermis

2nd ct. Galen, *De usu partium* VIII: the 'worm-like appendage' [*vermis superior cerebelli*] can open and close the canal [aqueduct of Sylvius] between the middle [third] and posterior [fourth] ventricles in order to regulate the flow of *pneuma* between these ventricles.

The pineal gland does *not* regulate the flow of pneuma.



The *vermis superior cerebelli* (at **C**, **D**, **H**) according to Vesalius (1543).



Galen's theory. The aqueduct is open when the *vermis* is contracted (left) and closed when the *vermis* is stretched out (right).

1= superior medullary velum, 2 = superior colliculi, 3 = inferior colliculi.

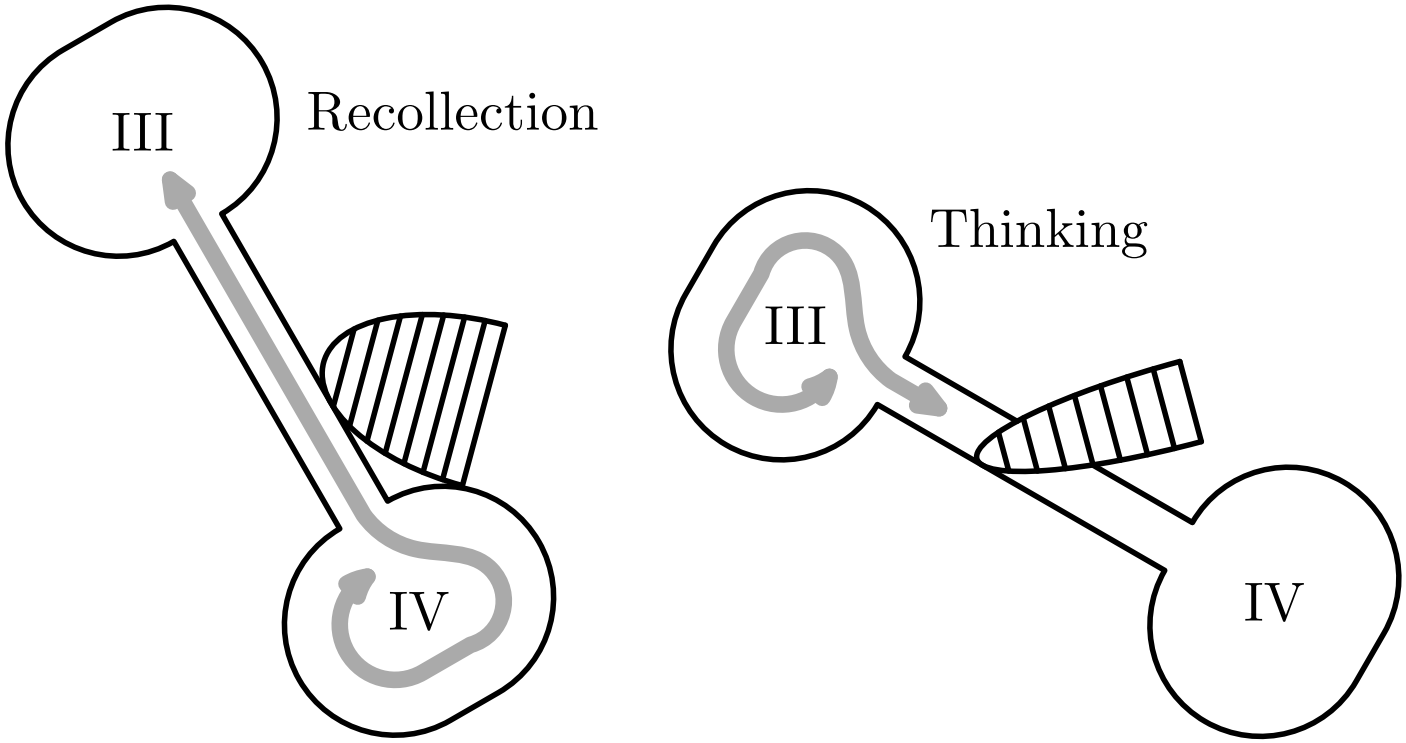
2 Extensions of Galen's Account

3rd–4th ct. Invention of ventricular localisation theory, according to which fantasy is located in the anterior ventricle [lateral ventricles], reason in the middle [third] ventricle, and memory in the posterior [fourth] ventricle.

Porphyry? (233–304), Posidonius of Byzantium (4th ct.), Nemesius of Emesa (ca. 400).

9th ct. Ḥunain ibn Isḥāq (809–873) mentions Galen's theory about the movements of the *vermis* and the ventricular localisation doctrine in one breath (*The Book of the Ten Treatises on the Eye, Second Treatise*).

10th ct. Costa ben Luca (864–923) regards the *vermis* as a valve that regulates the alternation between thinking and remembering (*On the Difference between the Spirit and the Soul*; translated into Latin around 1130; very influential).



Costa ben Luca's theory. Memories are stored in the posterior [fourth] ventricle. The passage between the middle [third] and posterior ventricles is open when one looks up (left) and closed when one looks down (right).

3 The Anterograde Movement of the Vermis

3.1 First Stage

Identification of the *vermis* with the pineal gland. The pineal gland was accordingly said to regulate the flow of pneuma between the middle [third] and posterior [fourth] ventricles.

9th or 11th ct. Ḥunain, *The Book of the Ten Treatises on the Eye, Second Treatise* (9th ct.) as translated in Constantine the African's *Liber de oculis*, ch. 5 (11th ct.): the passage between the middle and posterior ventricles is closed and opened by "an obstacle whose shape is similar to the cone of a pine, which the anatomists call the worm."

PROBLEM: The comparison between the *vermis* and the cone of a pine does not occur in Meyerhof's (1928) translation of the Arabic text.

10th ct. Ibn al-Jazzār (†980) says that "the worm, which the anatomists call the pineal gland," opens the passage between the middle and posterior ventricles when it is necessary to store and retrieve memories (*Treatise on Forgetfulness and its Treatment*).

11th ct. Constantine the African translates Ibn al-Jazzār's treatise into Latin (*Liber de oblivione*).

13th ct. Vincent of Beauvais (†1264) paraphrases the *Liber de oblivione* in his *Speculum naturale*, book 27, ch. 12, first printed in 1624.

1637– Descartes (1596–1650) says that the pineal gland regulates the flow of the *spiritus animales / esprits animaux* in the ventricles. (See Lokhorst & Kaitaro, *JHNS*, in press.)

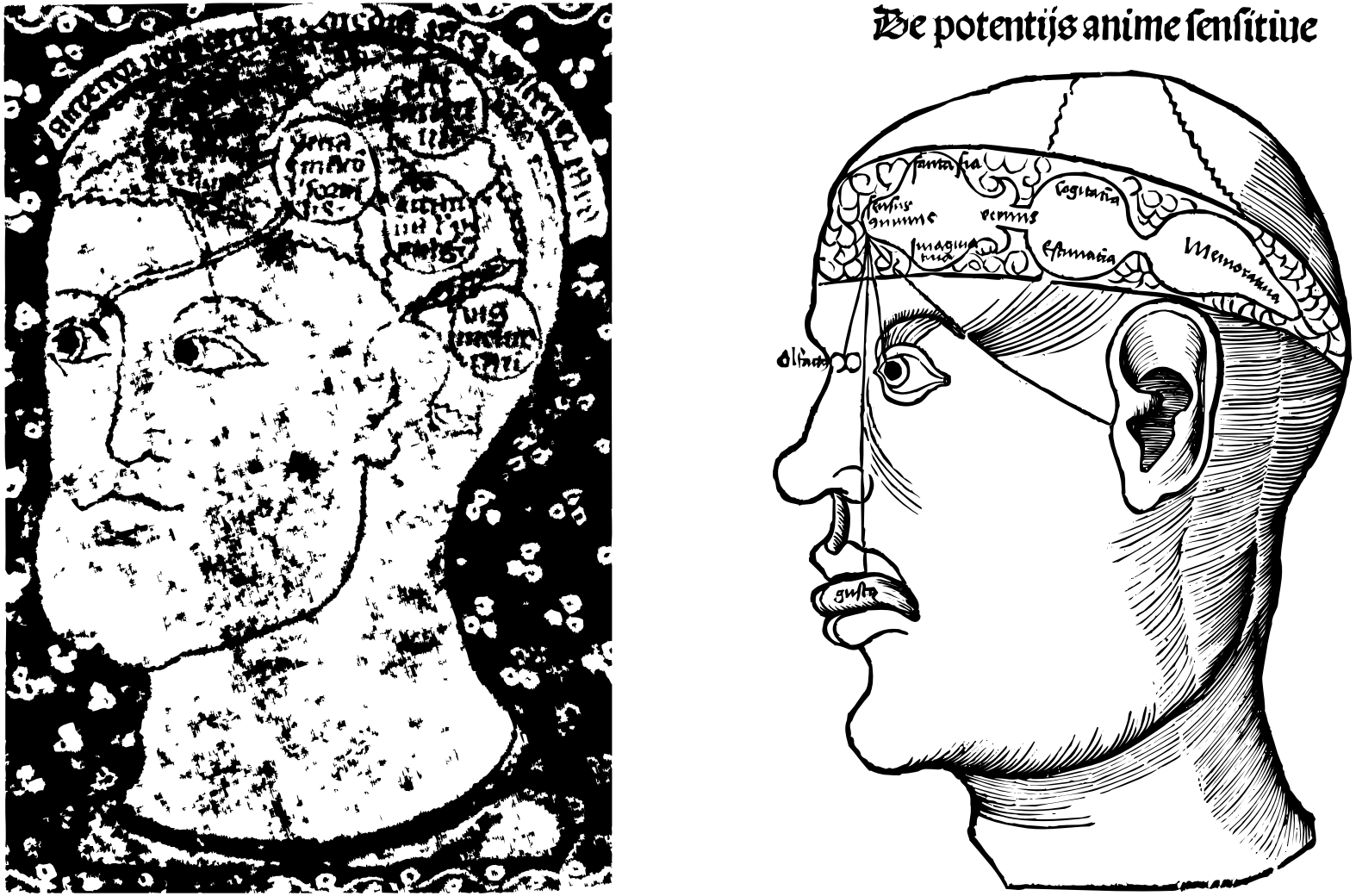
3.2 Second Stage

The *vermis* was said to regulate the flow of pneuma between the anterior and middle ventricles. It was later identified with the choroid plexuses in those ventricles.

11th ct. Avicenna, *Canon*, book 3, part 1, treatise 1, ch. 2: the *vermis* is located above the middle ventricle [third ventricle plus aqueduct].

11th ct. Idem, *De anima* I.5 and III.8: the *vermis* controls the flow of spirit between the anterior ventricle [lateral ventricles] and the middle ventricle [third ventricle plus aqueduct].

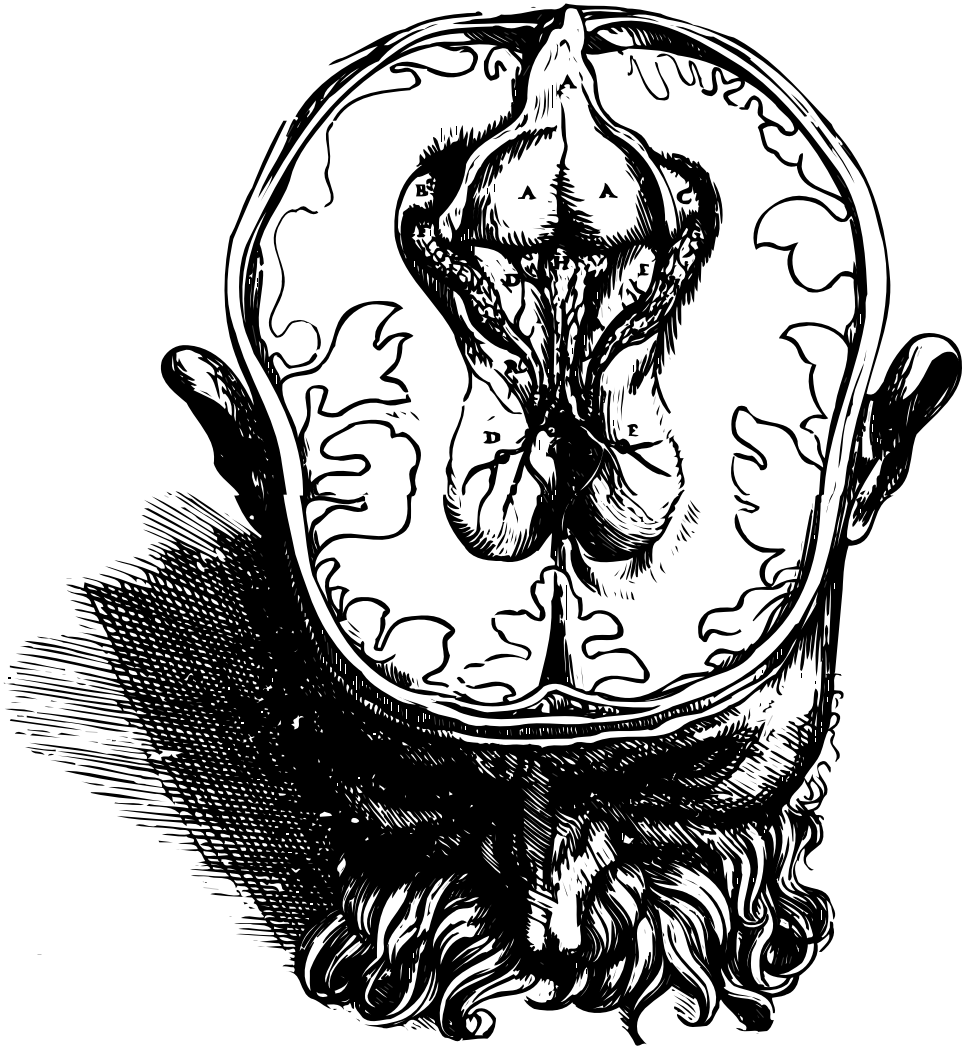
11th ct. The latter view is also to be found in Jūzjānī's (Sorsanus') Persian commentary on Avicenna's *Recital of Ḥayy ibn Yaqẓān*.



The posterior worm (Galen) and the anterior worm (Avicenna).

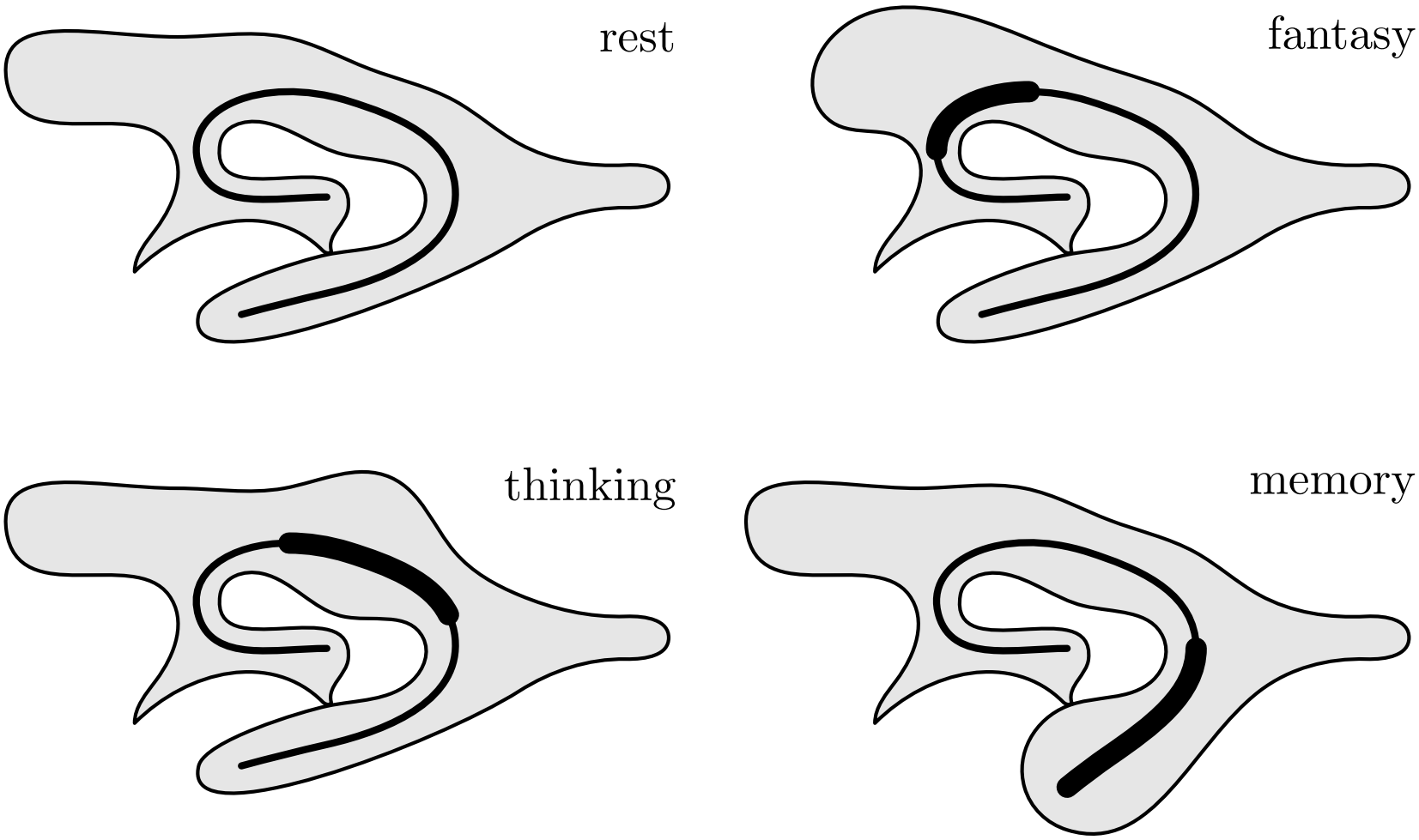
13th ct. Albert the Great, (*De spiritu et respiratione*, Book I, Treatise II, Chapter IV), Richard the Englishman (*Anatomia*): there are *two* interventricular worms, one between the anterior and middle ventricles (Avicenna), and another one between the middle and posterior ventricles (Galen, Costa ben Luca, "Haly Abbas," etc.).

1316 Mondino dei Luzzi (†1326) identifies the *vermis* as described by Avicenna with the choroid plexus in the lateral and third ventricles (*Anothomia*, 1316). This was the dominant view until the 16th century.



The choroid plexuses (**M**, **N**) of the lateral ventricles according to Vesalius (1543).

1521 Berengario da Carpi (†1530) locates all psychological faculties in the lateral ventricles and says that the two *vermes*, i.e., the choroid plexuses in the two lateral ventricles, regulate the alternation between fantasy/thinking/memory by contracting and extending themselves (*Commentary on Mondino*, 1521).



Berengario da Carpi's theory (1521).

4 Stopping the Vermis

1536 Niccolò Massa (1485–1569) points out that Mondino's *vermis* or *vermes* are different from the cerebellar *vermis* described by Galen. He does not say that any of these *vermes* move, maintains that the ventricles are filled with aqueous liquid rather than spirit, and does not present any ventricular localisation doctrine (*Introductory Book of Anatomy*, 1536).

1543 Vesalius rejects all ventricular localisation theories, criticises Mondino and his followers for having misunderstood Galen's account of the *vermis*, and rejects the idea that the cerebellar *vermis* functions as a valve (*Fabrica*, Book VII, 1543).

5 Recent Developments

The cerebellar *vermis* turns out to play a role in cognition and affect after all. The cerebellar *vermis* is a part of the "limbic cerebellum." Surgery that involves it leads to the so-called "posterior fossa syndrome." (See J. D. Schmahmann, "The role of the cerebellum in affect and psychosis," *Journal of Neurolinguistics* 13 (2000) 189–214, for references.)