

## WHERE DID THE VENTRICULAR LOCALIZATION OF MENTAL FACULTIES COME FROM?

CHRISTOPHER D. GREEN

During the Middle Ages it was widely believed that the various mental faculties—sensation, cognition, memory, and so forth—were each located in a specific part of the three ventricles that were thought to be housed in the brain. The origin of this scheme was commonly attributed to the ancient scholars, but it was rare for a specific individual to be identified as the originator. Modern researchers sometimes attribute it to Galen, but Galen was clear in his contention that the mental faculties were located in the substance of the brain rather than in the ventricles. It was only later scholars who, using Galen's anatomy as their basis, placed the mental faculties in the ventricles themselves. The system came together piece by piece over a period of centuries, probably not appearing fully in the form known to the Medieval world until the Middle Ages themselves. This article traces the development of the theory of ventricular localization of the mental faculties from the Ancient world to the early part of the Middle Ages. © 2003 Wiley Periodicals, Inc.

Medieval scholars in both Europe and the Islamic world believed that in addition to the five “outer” or “external” senses (i.e., touch, taste, smell, hearing, and sight), there also was a set of “inner” or “internal” senses. These inner senses were widely believed to be housed in the ventricles of the brain. There was no completely “standard” version of the theory that was universally accepted in detail everywhere from Ireland to Persia throughout the whole era. The exact form of the theory differed somewhat from time to time and from place to place. The general outline of the theory, however, was widely accepted. Normally, the *sensus communis* or “common sense” (as Aristotle used the phrase) was believed to be housed in the frontmost ventricle. This was the place in which the “imprints” of the various external sense organs were presumably combined into a unified perception. At the rear of this same ventricle, or in the worm-shaped passage thought to connect the front ventricle to the middle one known as the *vermis*,<sup>1</sup> was positioned a kind of storage place for representations of previously perceived objects. Usually it was called the faculty of “imagination,” sometimes the faculty of “representation.” This faculty was occasionally divided into two subfaculties, the first simply to collect images of previously perceived objects, and the second one serving to recombine stored images into representations of never-before seen objects (e.g., a man with wings or a building not yet built). When so-divided, the resulting faculties were sometimes called the “passive” and “active” imaginations or occasionally the “fantasy” and the “imagination.” Located in the middle ventricle was a faculty called “estimation.” The standard example of estimation involved sheep who were said to know innately that wolves are dan-

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1. The *vermis* seems to have been first described by Galen, and was said by him to connect the middle and rear ventricles (*On the Usefulness of the Parts of the Body*, VIII, 14), but by the Middle Ages had somehow become transported in thought to a position between the front and middle ventricles.

CHRISTOPHER D. GREEN is the coordinator of the History & Theory of Psychology Program at York University. He co-edited (with M. Shore and T. Teo) *The Transformation of Psychology: Influences of 19th-Century Philosophy, Technology, and Natural Science* (APA, 2001), and he is the founding editor of the *History & Theory of Psychology Eprint Archive* (<http://prints.yorku.ca>). He can be contacted at the Department of Psychology, York University, Toronto, Ontario, M3J 1P3, or via e-mail at [christo@yorku.ca](mailto:christo@yorku.ca).

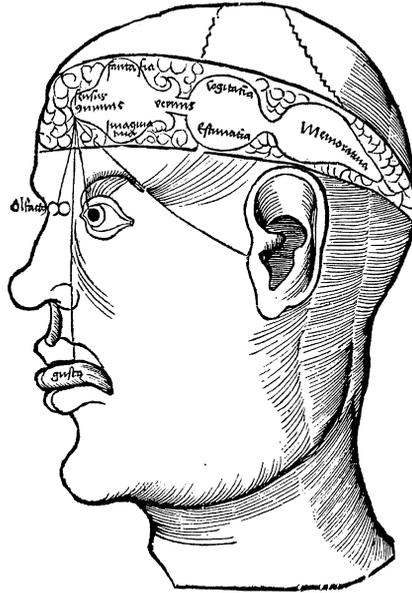


FIGURE 1.

Woodcut exemplifying one version of the ventricular theory of the inner senses from Gregor Reisch's (d. 1525) *Margarita Philosophica*. This work went through many editions beginning in the 1490s. This particular one is from 1517. Note that each of the four outer senses depicted (touch is left out) is connected by a line to the *sensus communis* in the front ventricle. From there the content of the sensation passed through the various inner senses: *fantasia* and *imaginativa* in the front ventricle, then through the *vermis* to *cognitiva*, *estimativa* in the middle ventricle, and finally *memorativa* in the rear ventricle. For many more examples, see Magoun (1958, pp. 12–15), Finger (1994, pp. 19–20), and Clarke and Dewhurst (1996, chapter 3).

gerous, and this knowledge was said to be the result of the sheep's estimative faculty. Estimation was believed, in effect, to be able to read the "meaning" or "intention" of the wolf off of the image of it transferred there from the front ventricle. Humans and sometimes higher animals were credited with an additional faculty to account for their ability to transcend instinct and make original judgments on the basis of past experience. This faculty was called "cognition," also said to be located in the middle ventricle. After the estimations and cognitions had been made, the results were thought to be transferred to the rear ventricle for storage with the faculty of memory. Memory differed from the faculty of representation in that it was thought to store the results of estimation and cognition, whereas representation was thought to store only the "uninterpreted" images provided by the common sense. Occasionally a faculty of "volition"—the will, so to speak—was placed at the rear of the third ventricle, or even in a presumed fourth one. One famous diagram of this system, by Gregor Reisch, is shown in Figure 1. Although it was composed just after the period in question (1517), it is particularly valuable because of its clarity. Many of the surviving depictions from before the 1490s are virtual scribbles.

One of the earliest and best-known Medieval accounts of the ventricular theory can be found in the following *Kitāb al-najāt* of Ibn Sīnā (980–1037, "Avicenna" in the Latin tradition):

One of the animal internal faculties of perception is the faculty of fantasy, i.e., *sensus*

*communis*, located in the forepart of the front ventricle of the brain. It receives all the forms which are imprinted on the five [external] senses and transmitted to it from them. Next is the faculty of representation located at the rear part of the front ventricle of the brain, which preserves what the *sensus communis* has received from the individual five senses even in the absence of the sensed objects. . . . Next is the faculty which is called the ‘sensitive imagination’ in relation to the animal soul, and the ‘rational imagination’ in relation to the human soul. This faculty is located in the middle ventricle of the brain near the vermiform process, and its function is to combine certain things with others in the faculty of representation, and to separate some things from others as it chooses. Then there is the estimative faculty located in the far end of the middle ventricle of the brain, which perceives the non-sensible intentions that exist in the individual sensible objects, like the faculty that judges that the wolf is to be avoided and the child is to be loved. Next there is the retentive and recollective faculty located in the rear ventricle of the brain, which retains what the estimative faculty perceives of the non-sensible intentions existing in individual sensible objects. (Avicenna, 1952, p. 31)

As mentioned above, the details of the arrangement of the inner senses differed somewhat from one Medieval writer to another. The general picture, however, was widely accepted without much controversy. What is rather more difficult to discover, and what has been the source of some confusion, is the *origin* of the ventricular theory of the inner senses. In many learned books and articles it is attributed to “the Ancients” — sometimes specifically to Galen (129–199)—but locating the exact source turns out to be a trickier question than one is usually led to believe. The literature on this topic, whether from history of psychology textbooks or from the articles and monographs of professional Medievalists, is fraught with errors and half-truths. The aim of this research is to track down the actual origins of the ventricular theory in the Ancient world. What was discovered, however, is that the origin of the *complete* system repeated so often in the Middle Ages may itself have been Medieval; in the full form described above, it was held by virtually no one in the Ancient world. Instead, it appears that bits and pieces of it were developed here and there in the Ancient world, gradually accumulating into the full Medieval version.<sup>2</sup> Thus, what is presented here, rather than a direct answer to the question, “Who first proposed it?” is more of a “genealogy” of the Medieval ventricular theory. In addition, this research can be seen as a kind of case study of the challenges involved in the sort of historical study in which one attempts to establish lines of influence with respect to widely held positions, especially when the researcher is faced with a very partial historical record and a rather unreliable collection of transcriptions and translations of the documents that are available.

#### MODERN ACCOUNTS OF THE ORIGINS OF THE MEDIEVAL THEORY

One of the most popular and influential books in Medieval studies in the last decade or so has been Mary Carruthers’s *Book of Memory* (1990). It may be the definitive book on the topic of how memory was understood and used in the Middle Ages. Of the ventricular theory, Carruthers wrote that Aristotle’s “threefold classification of mental activity was authoritatively fixed by Galen’s immensely popular medical compendium in the anterior, medial, and posterior ventricles of the brain, as described by ancient anatomists” (p. 52). As support for

2. A reviewer of this article argued that there is no *proof* that the theory was developed piecemeal in Ancient times; it might be that we only have the work of copyists who wrote down only parts of the fully developed version from which they worked. This is, of course, possible, but it seems to me that the “inference to the best explanation” is that there was no one complete source. The parts of the full Medieval theory that we find in Ancient sources often do not even agree with each other even in those places where they describe the same mental function or same ventricle. If they were all copying from a “master document,” one would expect better agreement.

this claim, Carruthers cited Ruth Harvey's earlier influential book, *Inward Wits* (1975), and Harry A. Wolfson's classic article, "The Internal Sense in Latin, Arabic, and Hebrew Philosophic Texts" (1935).

It is not clear, however, that Carruthers's interpretation is what Harvey (1975) intended, although it is easy enough to see why someone not familiar with the Galenic literature might think so. What Harvey actually wrote was the following:

Razes, on Galen's authority, says that [the ventricles] are four in number, and that the first two form a pair in front, and the two others lie behind them, one behind the other. . . . A passage connecting all the ventricles can be closed and opened by organs designed for the purpose. The power of *imaginatio* is located in the two front ventricles, *cogitatio* is in the next one, and *memoria* inhabits the hindmost. (p. 10)

It is unclear from this passage whether the Islamic physician al-Rāzī (864–930, "Razes" or "Rhazes" in the Latin tradition) wrote all of this on Galen's authority or just the basic anatomy given in the first sentence. Harvey probably intended the latter, although Carruthers seems to have assumed the former. The confusion is heightened a couple pages later where Harvey writes, "The three powers, *imaginatio*, *cogitatio*, and *memoria*, housed in four ventricles, can be affected all together as in apoplexy, or they may be damaged separately. Galen mention various particular cases . . ." (p. 12). The reference she gives in the subsequent footnote, however, is to a text by al-Rāzī, not to Galen himself, and the examples given describe cases of madness, but do not specifically mention damage to the ventricles.

Carruthers's other source, Wolfson (1935), is a "classic" of the field, although now somewhat dated. It is cited not only by Carruthers but also by Harvey (1975, pp. 69, 71), and even by some history of psychology textbook writers [e.g., Murray (1988, p. 57)]. Wolfson (1935) noted that the term "internal sense" first appeared in Latin in the work of St. Augustine (354–430), but there it referred only to Aristotle's "common sense," not to the full set of mental faculties that would eventually be grouped under that name. Nearly a century later, the term was still being used in this way by Pope Gregory the Great (540–604). More than 200 years after that, however, the famed Greek translator John Scotus Erigena (c. 810–c. 877) used it to refer only to thinking (*dianoia*). Not until the ninth century did the various faculties proposed by both Aristotle and the Stoics begin to be grouped together under this term by Arab<sup>3</sup> scholars, later still in the West (Wolfson, 1935, pp. 71–73). In connection with this history, Wolfson makes the following, apparently definitive, claim with respect to ventricular theory:

It is indeed true that Hunain [ben Ishāk] and Rāzī . . . make mention of Galen in the threefold classification of the post-sensory faculties, but upon a close examination of their statements it will be discovered that their references to Galen are only in connection with the localization of these three faculties, in the anterior, middle, and posterior ventricles of the brain, respectively, rather than in connection with the enumeration of these faculties. (Wolfson, 1935, p. 73)

The reference Wolfson (1935) gave in support of this claim was Galen's *On the Affected Parts* (1976, Book III, Chapter 9), but an examination of that passage reveals, surprisingly,

3. Arab is not an entirely correct term here, but neither is any other single term. I use it instead of the main alternative, "Islamic," to mark the fact that many medical scholars from the Medieval Islamic world were in fact Christian, usually Nestorian. Many of these individuals, however, were not actually Arab but Persian, or from points even further east. Using "Arab or Persian" at every instance, however, seemed cumbersome, and so I have used the term "Arab" in a very broad sense.

Galen describing the putative cause of epilepsy (viz., “thick humor obstructing the outlets of the cerebral cavities,” p. 86) and not a localization of mental faculties in the ventricles. However, Galen reiterates a claim, first made in his earlier work, *On the Doctrines of Hippocrates and Plato*, that “it appears reasonable to us, since we follow the evidence obtained by dissection, that the soul [*psuchē*] itself resides in the substance [as *opposed* to the ventricles] of the brain where the thought process takes place and where the memory of sensory impressions is deposited” (1980, vol. 1, p. 87). Interestingly, Wolfson’s (1935) “close examination” does not even seem to have been his own, for he credits the Galen reference to de Koning’s (1903) *Trois Traités d’Anatomie Arabes* that contains translations of a section of al-Rāzī’s book *Al-Mansūrī* (c. 900), al-’Abbas’ (d. 994, “Haly Abbās” in the Latin tradition) *Al-Malaki* (c. 950), and Ibn Sīnā’s early eleventh-century *Canon of Medicine*. Indeed, the exact passage of De Koning (1903) that Wolfson cites (1935, p. 9, n. 2) contains a direct translation of Galen’s claim (cited above) that the *psuchē* is to be found in the brain’s *substance* rather than in its ventricles.

Also, it is not entirely clear that al-Rāzī credited Galen with the ventricular theory. De Koning (1903) translates al-Rāzī as follows

*L’encephale, outre qu’il est la source de la sensibilité et du mouvement, est encore, selon l’opinion de Galien, le siège [De Koning’s footnote: “Littéralement: la mine, la gîte d’origine.”] de l’imagination, de la pensée et de la mémoire. L’imagination réside dans les deux ventricules antérieur [De Koning’s insertion: “(latéraux)”] de l’encephale, la pensée dans le ventricule moyen et la mémoire dans le ventricule postérieur. (p. 9)*

The brain, in addition to being the source of sensation and of movement, is also, according to the opinion of Galen, the seat [De Koning’s footnote: “literally: the mine, the original home” or “lair”)] of imagination, or thought, and of memory. Imagination resides in the two anterior [De Koning’s insertion: “(lateral)”] ventricles of the brain, thought in the middle ventricle and memory in the posterior ventricle. (translation by author)

The second sentence may have been intended as a continuation of the exposition of “the opinion of Galen,” but it may also have been an elaboration added by al-Rāzī himself. The passage is unclear. Also, contrary to Wolfson’s claim, this is not al-Rāzī’s only reference to Galen. Chapter 7 of the same text, for instance, specifically credits Galen with having been of the opinion that the number of ventricles in the brain is four, and gives approximately the correct positions for them, unlike many of his future Western Medieval followers. There is no mention of the inner senses whatsoever at this point, however.

The other figure Wolfson (1935) mentions, Hunain ben Ishāk (808–873, “Johannitius” in the Latin tradition) was one of the first great translators of the Greek Medical corpus into Syriac and Arabic, specializing in the works of Galen (Djālīnūs, to the Arabs) and Hippocrates (Bukrāt). He was the son of a Nestorian Christian and became chief physician to the court in Baghdad. His special medical interest seems to have been ophthalmology [see, e.g., Lindberg (1976), O’Leary (1948), & Strohmaier (1971)]. Unfortunately, because few of his general medical works have been translated it is difficult for me to assess Wolfson’s (1935) claims about him but, for reasons discussed subsequently, we can be reasonably sure he did not find in Galen a specific localization of the inner senses in the ventricles of the brain.

#### ANCIENT ACCOUNTS OF THE VENTRICLES

So, what did Galen actually say? The most important statement of his beliefs on the matter are to be found in *On the Doctrines of Hippocrates and Plato*, a defense of the

proposition that our vital powers have three sources—the head, the heart, and the liver—against the claim that there is only one such source—the heart—as was argued by Aristotle and by the Stoic philosopher Chrysippus (c. 280–207 BC). In Book VII, Chapter 3, Galen argued that the head houses “imagination and memory and recollection, knowledge and thought and ratiocination, and in its relation to the other parts of the animal to guide the sensation of the sensory parts and the motion of the parts that move voluntarily” (1980, p. 440). The function of the heart, however, was thought to be “to provide the ‘tone’ of the soul,” and “in states of passion to provide the boiling, as it were . . .” (1980, pp. 440–441). He also mentions revenge and anger in relation to the heart. Finally, in the liver were thought to be housed the faculty of nutrition and the “enjoyment of pleasures.” Although Galen believed sensation, intellect, and volition to be located in the brain, he did not believe them to be in the ventricles. He wrote, “the *psuchē* dwells in the *actual body of the brain* [italics added], whatever its [the *psuchē*’s] substance may be . . . and . . . the *psuchē*’s first instrument for all sensations of the animal, and for its voluntary motions, as well, is the *pneuma*” (1980, p. 445).<sup>4</sup> The *pneuma* was a very important part of the Galen’s overall view of brain function. It was believed to be a special substance responsible for vital and psychological activity, but not in virtue of being in a particular ventricle.<sup>5</sup> For instance, Galen argued that cutting into the brain deeply enough to release the *pneuma* from one of the ventricles causes the animal to “lose sensation and motion” (1980, p. 443) but that “after the ventricles have closed up, the animal regains sensation and motion . . . ,” presumably once the *pneuma* has accumulated again in adequate amounts (1980, p. 445). Galen contended that injury to the posterior ventricle would be more damaging than would injury to the middle ventricle, which would be worse than damage to either of the frontal ventricles (Galen’s knowledge of physiology was superior to that of most of his Medieval followers—save al-Rāzī—in that he knew there to be two frontal ventricles). He did not, however, argue that different *faculties* would be affected by injury to different ventricles. In the later work, *On the Affected Parts*, Galen reiterated the point, as previously seen in the discussion of Wolfson (1935).<sup>6</sup> Also, in Book VII, Chapter 13 of *On the Usefulness of the Parts of the Body*, Galen argued that “the perfection of the intellect should be ascribed not to the quantity of the psychic *pneuma* but rather to its quality” (1968, p. 418). He also noted that “much psychic *pneuma* is contained throughout the substance of the encephalon and not just in its ventricles” (p. 418). In short, although Galen believed the *pneuma* to be intimately involved with psychological functioning and although he believed much of the *pneuma* to be in the ventricles, nowhere did he localize different mental faculties in different ventricles. To be entirely fair, there are a few passing exceptions to this generalization. He seems to have adopted from the third-century BC physician Herophilus the belief that the rear ventricle is more closely involved with voluntary movement than the other ventricles, primarily because it is closer to the spinal column. He

4. To maintain consistency with the usage above, I have replaced De Lacy’s “psyche” with the technically more correct “*psuchē*.”

5. “Vital [*zōtikon*] *pneuma*” was thought by Galen to be formed in the heart and then transported to the brain, where it was filtered into the ventricles through the *rete mirabile*, a network of blood vessels that exists in some mammals—particularly the pig and the ox, on which Galen did his dissections—but not in humans. This filtration process was thought to result in the production of “psychic *pneuma*” [rendered by some—e.g., Clarke (1962)—as “animal *pneuma*”] which was thought to be responsible for various psychological functions (*On the Doctrines of Hippocrates and Plato*, VII, 3).

6. In *On the Affected Parts* (IV, 3) Galen mentions that damage to the front part of the brain will affect the front ventricle and affect thought (Siegel translates it more loosely as “the mind,” but the term is *dianoētikas*). However, it is not at all clear that this was intended as a localization of thought in the frontal ventricle. If it was, this placing thought in this position would be virtually unique in the long history of the theory.

also says in *On the Affected Parts* (book III, chapter 15) that “the sensation of odors take place in the anterior ventricles” (but only because he believed the vapors themselves to pass from the nose into the front ventricles). In both cases, there is only the faintest hint of the strong localizationist doctrine that would come to prominence in later centuries.<sup>7</sup>

#### POST-GALENIC ANCIENT ACCOUNTS

So, if Galen was not responsible for “moving” the faculties of mind from the substance of the brain into the ventricles themselves, who was? Simon Kemp, a psychologist who has written extensively on Medieval psychology (1990, 1996) tells us that “a physician by the name of Posidonius has been suggested” (1996, p. 46). Although there is no citation with the passage, Kemp (personal communication, 1999) has told me that the suggestion came to him from Giuseppe Roccatagliata’s *History of Ancient Psychiatry* (1986), the index of which lists five entries for Posidonius of Apamea, a Stoic philosopher from the second-century BC. It is clear that he is not our man, but the last of the five passages cited turns out not to be about Posidonius the Stoic after all, but is rather a reference to an AD fourth-century man of the same name described by Roccatagliata (1986, p. 142), as the eclectic school’s “one great clinician” and as a man who “attempted to put psychiatry on a neurological and precise basis.” Very little is known of him,<sup>8</sup> and much of what is known comes from a Greek work now known under the Latin name of *De Re Medica*, authored by one Aëtius Amidensis (1935–1950)<sup>9</sup> (also called Aëtius Medicus), an early sixth-century Christian and one-time physician at the Imperial Court in Constantinople. Roccatagliata reports that on Possidonius’ account, “psychic symptoms were supposed to vary because they were connected with lesions of the cerebral front, middle and rear areas.” He goes on to say that “according to the epoch’s theory on the psychic functions of different portions of the brain, the front *lobe* was in charge of the imaginative life, the medium [*sic*] one of the intellectual life, and the rear one of the mnemonic functions” (Roccatagliata, 1986, p. 142, italics added). It is important to note that the focus here appears to be on “lobes” of the brain, not on the ventricles specifically. If one looks at Aëtius’ (1935–1950) account of Posidonius’ position closely, however, one finds the following relevant passage in Book VI, Section 2:

While the different kinds of phrenitis are numerous, the most important are the following three: there are those who have been harmed in the imaginative faculty alone, but their

7. Galen subscribed to a “hydraulic” theory of voluntary motion strikingly similar to that commonly attributed to Descartes. Pneuma was said to be forced through the nerves, which were envisioned as being tubular, causing the muscles to move. The reservoir of this pneuma was thought to be held in the cerebral ventricles, the rear one regulating the flow into the nervous system. So similar was Galen’s theory to that usually described as Cartesian that it even held the pineal gland to be the “guardian and housekeeper” of the system, controlling the flow of pneuma from the anterior three ventricles into the posterior one (*On the Usefulness of the Parts of the Body*, book XIV). Although it has been claimed by some [e.g., Clarke (1962, p. 88) & Pagel (1958, p. 101)] that the “dynamic” aspect of the ventricular theory did not come about until the ninth century, it seems to have been prefigured in Galen’s theory of ventricular anatomy.

8. According to Pauly and Wissowa (1866–1972, Bd. 20<sup>1</sup>), Posidonius was the son of one Philostorgios, a physician active during the reign of the Roman Emperor Valens (364–378). He was also said to be known personally to an (Arian?) Church historian also named Philostorgios (368–ca. 425), apparently not the same person as his father.

9. Amidensis means simply “of Amida,” a city that repeatedly changed between Roman and Persian hands on the site of present-day Diyarbakir in southeastern Turkey. The other information given here derives from Pauly and Wissowa (1866–1972). It is important not to confuse this Aëtius either with the enigmatic doxographer, Aëtius, who is said to have flourished around 100 AD, or with the fourth-century Syrian bishop of the same name who founded the radical sect of Arians known as the Anomoeans.

cognitive faculty and memory are preserved; or the cognitive faculty alone has been injured, but the imaginative faculty and memory are preserved; or there is harm to both the imaginative and cognitive faculties, but memory is preserved. But when memory perishes in the case of feverish afflictions, both the cognitive and imaginative are altogether destroyed. Thus, when the front part [*meros*] of the brain has been harmed, the imaginative faculty alone is injured, and when the middle ventricle [*koilia*] of the brain has been harmed, there occurs a perversion of the cognitive faculty, while when the back of the brain has been harmed below the occiput, the faculty of memory is destroyed, and with it the other two are also completely destroyed. (6.2)<sup>10</sup>

Here we find *one* mental function—cognition—being localized specifically in the middle ventricle; the front and rear ventricles are not explicitly mentioned. Whether this exclusion was intentional or just a product of the particular context in which it appeared, one can only guess.

Another person who has been suggested as a possible originator of the full ventricular theory is Nemesius of Emesa, a little-known late fourth-century Syrian physician and bishop. His main work, *On the Nature of Man*, written about 400 (often misattributed to Gregory of Nyssa) does not seem to have been widely known, even in the Ancient world. Kemp (1990, 1996), however, who recognizes that Galen never specifically localized the inner senses in the ventricles, has written that “in the Middle Ages, something like Nemesius’ version of the [ventricular] theory was practically universal among both scholars and physicians” [1990, p. 54; see also Clarke (1962), Kemp (1996, pp. 17, 46), & Pagel (1958)].

If one was to look only at the best-known English translation of Nemesius’ work, completed by William Telfer (Nemesius, 1955), this would seem to be an extravagant claim [see, however, Finger (1994, p. 18)]. According to Telfer’s rendering, Nemesius (1955) held that “as organs, the faculty of imagination has, first, the front *lobes* of the brain and the psychic spirit, then the nerves impregnated with psychic spirit that proceed from them, and, finally, the whole construction of the sense-organs” (p. 321, italics added). Later, however, when attempting to explain why the sense organs are arranged in pairs, he is said to have written, “For this reason [The Creator] made there to be two *ventricles* in the front, only, of the brain, so that the sensory nerves running from each *ventricle* should constitute the sense organs in pairs” (p. 332, italics added), that is, imagination was said to be housed in the frontal lobes, but sensation was said to be handled in the front ventricles specifically. Still later, the translation continues:

The organ of [memory] is the hinder *part* of the brain (called also the cerebellum and hinder-brain) and the vital spirit there contained. Now if we make this assertion, that the senses have their sources and roots in the front *ventricles* of the brain, that those of the faculty of intellect are in the middle part of the brain, and that those of the faculty of memory are in the hinder brain, we are bound to offer demonstration that this is how these things work . . .” (p. 341, italics added)

Nemesius then relates a story from Galen about a patient suffering from “inflammation of the brain,” but with no evidence that a particular part or ventricle of the brain was involved.

Later still, Nemesius is rendered as having said that “the soft nerves of sensation descend from the middle part and from the front *lobes* of the brain, while the harder motor-nerves proceed from the posterior *lobe* and the marrow of the spine” (p. 373, italics added).

In these translated passages from Nemesius, we see a basic cerebral localization of mental

10. My thanks to Rodney Ast of the University of Toronto for permission to use his translation of this passage.

function, but one that is apparently not strongly attached to the ventricles. Only sensation appears to have been explicitly localized in particular ventricles by Nemesius (1955), and even then, it was done so equivocally. It later appears to be attributed to the frontal “lobes” and the middle “part” rather than to the ventricles specifically. Imagination, being closely related to sensation in the Greek tradition, is also said to be in the front “part” or “lobes” of the brain. Intellect is said to be in the middle “part,” memory in the cerebellum, and motor function is said to emanate from the posterior lobe. At best, one can see an embryonic ventricular theory of the inner senses in the process of forming, but it had not yet reached maturity.

All of these conclusions, however, are mistaken. The mistake derives from Telfer’s (1955) loose translation<sup>11</sup> of the passages in question. In fact, the Greek term that is rendered as either “lobe” or “part” in the passages above is, in each instance, “*koilia*.” A *koilia* is, generally speaking, a hollow. In this particular context it refers to the hollows of the brain—the cerebral ventricles. Thus, we find in Nemesius a fully fledged ventricular theory.

Nemesius’ (1955) arrangement of mental faculties, however, is not identical with that found in the Middle Ages—there is no explicit mention of the common sense, of the vermis, or of estimation—but, as previously mentioned, there were many variations among Medieval scholars themselves. The more important problem is how Nemesius’ (1955) work might have been transmitted to the scholars of the Middle Ages. Almost nothing is known of the author, and both he and his work were only rarely mentioned in writings of the centuries immediately after his life, and even then primarily in relatively obscure Byzantine works. In later centuries, the substance of his work, along with that of the now-unknown sources on which he relied, was probably woven anonymously into the developing Arab corpus on medicine. His openly Christian orientation may well have made him a somewhat unpalatable figure to Islamic scholars of the ninth and tenth centuries, but not so much to the Nestorian Christians who were prominent translators and compilers of medical literature in the Arab world. It is unlikely that either he or his work were known in the West at all before the eleventh century [see Telfer (1955)].

Might there have been another pathway for the ventricular theory to follow from Rome to the Western Middle Ages? The answer is yes, and the individual who might have served as such a conduit, perhaps surprisingly, was St. Augustine. Augustine (1982) makes a very explicit statement with respect to the localization of mental functions in the ventricles in Chapter 18 of *The Literal Meaning of Genesis*, written in 401. It is perhaps best to quote all but the last two sentences of the (very brief) chapter:

Since there is no bodily motion following sensation without an interval of time, and since we cannot act spontaneously after a lapse of time except with the aid of memory, the medical writers point out that there are three ventricles in the brain. One of these, which is in the front near the face, is the one from which all sensation comes; the second, which is in the back of the brain near the neck, is the one from which all motion comes; the third, which is between the first two, is where the medical writers place the seat of memory. Since movement follows sensation, a man without this seat of memory would be unable to know what he ought to do if he should forget what he has done.

Now, the medical writers say that the existence of these ventricles has been proved by clear indications in cases in which these parts of the brain have been affected by some disease or pathological condition. For when sensation, motion, or memory of

11. One is tempted to say mistranslation, but we must remember that we are talking about what was likely regarded by Telfer (1955) as the minutia of brain anatomy in a translation of a text that is primarily *theological* in its general thrust.

motion were impaired, there was a clear indication of the function of each ventricle, and by applying remedies to these different ventricles physicians determined which parts needed healing. (Augustine, 401/1982, vol. 2, pp. 18–19)

He then briefly explains how the operation of the soul differs from these functions.

Augustine's view was not identical to the Medieval one, but it was clearly ventricular: sensation (rather than common sense or imagination) in the front ventricle, memory in the middle ventricle (excluding estimation and cognition from the scheme entirely), and motion in the rear (which would seem to derive from Galen). However, Augustine did not claim this theory for himself but attributed it to "the medical writers." The problem is to find out who those medical writers were. His contemporary, Nemesius might at first seem like an obvious candidate. Given, however, that Nemesius was in Syria and wrote in Greek, it is doubtful that Augustine knew even of his existence, much less the details of his theory. Communication between East and West was already beginning to break down by 400—a time of weak emperors and repeated "barbarian" invasions—and Augustine's knowledge of Greek is known to have been fairly poor, as evinced subsequently. Even if he did know of Nemesius, Augustine arranged the mental faculties, with respect to the ventricles, differently than had Nemesius. Augustine and he disagreed not only on *which* faculty was to be assigned to the middle ventricle but also on which faculties were to be considered at all.

Brown (1967), in his classic biography of Augustine, tells us that there was no science in Augustine's education, and that he was "the only Latin philosopher in antiquity to be ignorant of Greek" (p. 36). This effectively means that he *could not* have read the most important medical texts of his age. Instead, he would have had to depend on the superficial glosses provided in the available Latin texts.<sup>12</sup> Brown (1967) suggests Cicero as a possible source of basic scientific knowledge, but I can find no reference to information about the brain in Cicero's work.<sup>13</sup> Brown (1967) tells us further that Augustine did not bother reading even Christian Greek texts until 420, when he was challenged by the great Pelegian theologian, Julian of Eclanum, almost two full decades after *The Literal Meaning of Genesis* was written (p. 271).

In another influential biography of Augustine, Marrou (1958, chapter 2) is not quite so pessimistic about Augustine's Greek abilities as Brown (1967), but still he gives us little reason to hope that Augustine was reading Greek texts—whether medical, philosophical, or theological—in the original. Virtually all of his citations of Greek classical literature were of works that were available in Latin translation in his time, and there is no reason whatever to believe that translations of Nemesius or Posidonius were made this early.

One significant medical person with whom Augustine was acquainted when a young man was Avianus Vindicianus, Proconsul of Africa, apparently in the 360s or 370s. Marrou (1958, p. 43, n. 2) mentions him also as one "with whom Augustine had friendly relations" (translation by author), and Vindicianus is mentioned indirectly in Book IV, Chapter 3 of Augustine's *Confessions*, in which he bestowed an award upon Augustine for his poetry.<sup>14</sup> Vindicianus and his most important student, Theodorus Priscianus, wrote summaries of the medical thought of their era. Priscianus' influential *Euporiston*, although originally written

12. *De Medicina*, an extensive Latin medical compilation written by the (probably) second-century physician Celsus, was available in Augustine's time, but it makes no mention of the ventricles of the brain and only a passing mention of *pneuma*.

13. Thanks to Brad Inwood of the University of Toronto for his assistance on this point, among others.

14. See also the entry in Pauly and Wissowa (1866–1972, Reihe 2, Bd. 9A<sup>1</sup>).

in Greek, was translated into Latin by Priscianus himself. A Latin edition of Book III of the *Euporiston* and of Vindicianus' *Epitome Altera* was published by Rose (1894). The *Epitome* has a short section on the brain in which there is a brief account of the "tube theory" of perceptual nerve conduction, and a claim that too much motion in the brain can lead to insanity. There is also a section on the pituitary gland. There is no mention of the ventricles, however.

### CONCLUSION

So, we find ourselves at something of a dead end, although not without having found some of what we were looking for. There was a ventricular theory of (what would come to be called) the inner senses in the work of late fourth-century Eastern Empire physician Nemesius, although the set of faculties considered was not in complete accord with those that typically would be found in Medieval accounts. Then, in the very early fifth century in the Western Empire, we find Augustine attributing a ventricular theory—although one with idiosyncratic details—to the medical writers of his time. Perhaps the Latin medical doxographers had access to Greek documents that are no longer extant in which a fully ventricular theory was put forward. Perhaps the Latin medical doxographers themselves extended the occasional attribution of a specific mental function to a specific ventricle in their Greek sources to the general case.

It should be recalled, however, that the ventricular theory of the Middle Ages seems to have been adopted by Eastern Islamic and Nestorian writers long before it came to be generally accepted in the West. Combining this with the fact that Augustine was not nearly as influential among Eastern Christians, and later Muslims, as he was in the West, it seems likely that earlier precursors of the ventricular theory of inner senses that was ultimately adopted by the likes of Hunain ben Ishak in the late ninth century and al-Rāzī in the early tenth century are to be found in other Eastern sources, dating from as early as the fourth century.

It would seem, then, that the exact origin of the theory we cannot know with certainty. One thing that is certain, however, is that there was not a single "moment of discovery" with respect to the ventricular theory. The framework for the theory was established in the anatomical doctrines of Galen. It then gained its functional aspects gradually in the works of figures such as Posidonius, Nemesius, and Augustine. Indeed, it may not have been until much later—perhaps as late as the ninth century—that it first appeared *fully* in the Medieval form in which it is now best known.

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### REFERENCES

- Aëtius, A. (1935–1950). *Libri medicinales*. In A. Oliveiri (Ed.), *Corpus medicorum Graecorum*: Vol. 8. Berlin: Academiae Litterarum (original work written in the early sixth century).
- Augustine. (1982). *The literal meaning of Genesis* (J. Hammond Taylor, Trans.). New York: Newman Press (original work written 401).
- Avicenna. (1952). *Avicenna's psychology: An English translation of Kitāb al-najāt, Book II, Chapter VI, with historico-philosophical notes and textual improvements on the Cairo edition* (F. Rahman, Trans.). London: Oxford University Press.

- Brown, P. (1967). *Augustine of Hippo: A biography*. London: Faber and Faber.
- Carruthers, M. (1990) *The book of memory: A study of memory in medieval culture*. Cambridge: Cambridge University Press.
- Clarke, E. (1962). The early history of the cerebral ventricles. *Transactions and Studies of the College of Physicians of Philadelphia*, 30, 85–89.
- Clarke, E., & Dewhurst, K. (1996). *An illustrated history of brain function* (2nd ed.). San Francisco: Norman.
- De Koning, P. (Ed.) (1903). *Trois traités d'anatomie Arabes*. Leiden: E.J. Brill.
- Finger, S. (1994). *Origins of neuroscience: A history of explorations into brain function*. New York: Oxford University Press.
- Galen. (1916). *Galen on the natural faculties* (A. J. Brock, Trans.). Cambridge, MA: Harvard University Press.
- Galen. (1968). *Galen on the usefulness of the parts of the body* (M. Tallmadge May, Trans.). Ithaca, NY: Cornell University Press.
- Galen. (1976). *Galen on the affected parts* (R. E. Siegel, Ed. & Trans.). Basel, Switzerland: S. Karger.
- Galen. (1980). *On the doctrines of Hippocrates and Plato* (3 vols., P. de Lacy, Trans.). Berlin: Akademie-Verlag.
- Harvey, E. R. (1975). *The inward wits*. London: Warburg Institute, University of London.
- Kemp, S. (1990). *Medieval psychology*. New York: Greenwood.
- Kemp, S. (1996). *Cognitive psychology in the Middle Ages*. New York: Greenwood.
- Lindberg, D. C. (1976). *Theories of vision from Al-Kindi to Kepler*. Chicago: University of Chicago Press.
- Magoun, H. W. (1958). Early development of ideas relating the mind with the brain. In G. E. W. Wolstenhome & C. M. O'Connor (Eds.), *CIBA Foundation symposium on the neurological basis of behavior in commemoration of Sir Charles Sherrington, O.M., G.B.E., F.R.S. 1857–1952* (pp. 4–22). London: J. & A. Churchill.
- Marrou, H.-I. (1958). *St. Augustin et la fin de la culture antique* [St. Augustine and the end of ancient culture]. Paris: Éditions E. de Boccard.
- Murray, D. J. (1988). *A history of Western psychology* (2<sup>nd</sup> ed.). Englewood Cliffs, NJ: Prentice Hall.
- Nemesius. (1955). *On the nature of man*. In W. Telfer (Ed. & Trans.), *Cyril of Jerusalem and Nemesius of Emesa* (Library of Christian Classics, vol. IV). Philadelphia: Westminster Press.
- O'Leary, D. D. (1948). *How Greek science passed to the Arabs*. London: Routledge & Kegan Paul.
- Pagel, W. (1958). Medieval and Renaissance contributions to knowledge of the brains and its functions. In F. N. L. Poynter (Ed.), *The history and philosophy of knowledge of the brains and its functions* (pp. 95–114). Springfield, IL: Charles C. Thomas.
- Pauly, A. F., & Wissowa, G. (Eds.). (1866–1972). *Realencyclopädie der classischen Altertumswissenschaft*. Stuttgart: Alfred Drunkenmüller Verlag.
- Roccatagliata, G. (1986). *A history of ancient psychiatry*. New York: Greenwood.
- Rose, V. (Ed.) (1894). *Euporiston libri III cum physicorum fragmento et additamentis pseudo-Theodoreis editi a Valentino Rose; accedunt Vindiciani Afri quae feruntur reliquiae*. Lipsia: Teubner.
- Strohmaier, G. (1971). Hunayn B. Ishak. In B. Lewis, V. L. Ménage, C. Pellat, & J. Schacht (Eds.), *The encyclopedia of Islam* (new ed., Vol. 3, pp. 578–581). Leiden: E. J. Brill.
- Telfer, W. (1955). General introduction. In W. Telfer (Ed. & Trans.), *Cyril of Jerusalem and Nemesius of Emesa* (Library of Christian Classics, Vol. IV, pp. 203–223). Philadelphia: Westminster Press.
- Von Staden, H. (1989). *Herophilus: The art of medicine in early Alexandria*. Cambridge: Cambridge University Press.
- Wolfson, H. A. (1935). The internal senses in Latin, Arabic, and Hebrew philosophic texts. *Harvard Theological Review*, 28, 69–133.