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Special Article

How the Brain Got Its Names and Numbers

James H. Scatliff [1] and Jonathon K. Clark[2]

The amazing development of magnetic resonance (MR) imaging has made it possible to show the living brain from almost any anatomical perspective. The images have sent many neuroradiologists to Gray's Anatomy or the pathology laboratory to learn specific brain details, including names of the anatomy seen. Over the past 5 years, as we have begun to work with MR, it has been interesting to learn and speculate how the brain got its names.

We have done this for several reasons. One is to better remember the anatomy. Another is that words and their origins can be intriguing. Lastly, much of brain etymology is conjecture. Many of our suggestions for brain or skull naming cannot be documented. However, science fiction, without the burden of proof, can be stimulating and promoted much of this endeavor.

During the last 2,500 years, humans have been in the process of discovering the brain inside and out. The ancient Greeks in their animal dissections were attracted to the center of the brain and especially the ventricular system. The focus of brain anatomy for two millennia was ventriculocentric. Sixteenth century anatomists, including Vesalius, shifted some attention toward the cortex, but even then, and for the next two centuries, central brain structures, including the ventricles, were thought to be the center of all cerebral activity.

Aristotle probably first described the ventricles stating, "In the great majority of animals it [the brain] has a small hollow in its center" (1). Aristotle is thought of as a philosopher and a disciple of Plato. Equally important was his interest in the natural sciences. He was the son of a physician. He had been a tutor of Alexander the Great. When Aristotle opened his Lyceum, in 4th century BC Athens, for the study of natural sciences, Alexander kept him well supplied with the flora and fauna of his empire.

The human ventricular system was well known to Herophilus and Erasistratus. These 3rd century BC Alexandrian anatomists had the benefit of human dissection. Herophilus (2) placed the soul in the ventricles and thought the fourth ventricle was most important. Erasistratus (2) said soul fluid was in all four. Galen in the 2nd century AD, working only with animal brains, described the ventricles and gave credit to Herophilus for their presumed importance in intellectual activity. He believed the three constituents of intellect were imagination, reason, and memory.

Galenic observations by the time of the 4th and 5th centuries AD had been widely accepted by the Christian church (3). In this era, the early church fathers promulgated the "Cell Doctrine of Brain Function." The lateral ventricles were thought to be one cavity or the first cell. This cell received information from the special senses and was known as the cavity of "common sense" (sensis communis). Images from this cell went to the second cell (3rd ventricle) and were incorporated into reasoning (cogitiva). The 3rd cell or 4th ventricle was used for memory (memoritiva).

This concept prevailed until the early 16th century. Figure 1 from a 1503 wood cut (Reisch) shows three cells with their designated functions enveloped by choroid plexus. Numbers for the cell-ventricles (I-III) from front to back appear (Fig. 2) in a 1490 edition of the works of Albertus Magnus (13th century). In all probability, with human dissection resuming and the need to account for the septum pellucidum, 16th century anatomists made the cell doctrine cell count anatomically correct. Vesalius enumerates a right,

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Fig. 1. Cells of brain function are depicted in the Reisch figure of 1503. Note lines of taste, hearing, smell, and vision directed to the anterior cell. This cell seems to have some anatomical recognition of the lateral ventricles. The cells are invested by choroid plexus. (Figure used with permission, from Clarke and O'Malley (2).)

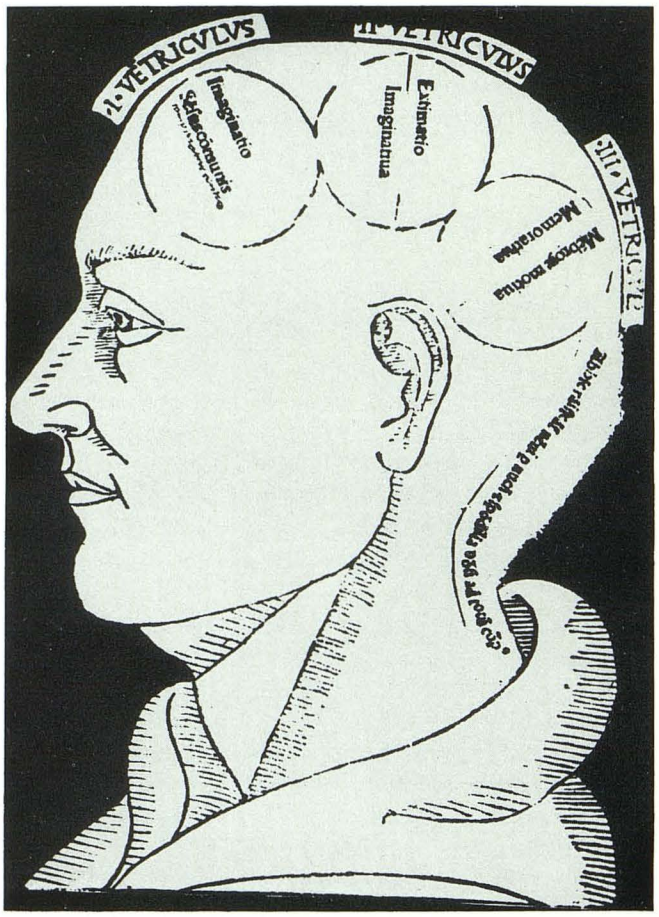


Fig. 2. Circles denote the 1st, 2nd, and 3rd ventricles. Each ventricle has designated properties. The figure is attributed to Albertus Magnus, the 13th century scholastic. (From *Brescia, B. philosophia pauperum sine philosophia naturalis*, 1490.)

left, 3rd, and 4th ventricle and remained noncommittal about intellect and soul residing in them (4).

Although the majority of anatomical names for the brain were recast in Latin during the 16th century, some Greek terminology remains. "Choroid" is Greek for membrane. It is fascinating to contemplate Aristotle and his pupils likening the chorion of a fetus to the choroid plexus. The tissue is similar (Figs. 3A and 3B). Galen, staying with Greek nomenclature, and looking into the ventricles of apes and pigs, described the "choroid concatenation, taking the name from the outer membrane of the fetus"(5).

The darker color of the thalamus and its central position must have been compared to the inner or bed chamber of the Greek house of antiquity. An epithalamium is a song or poem for a bride and groom on their wedding night. Hypothalamus may have come from "thalamite." The Greek triremes that beat the Persians at Salamis had three tiers of oarsmen. From the top down they were the thranites, zygites and thalamites, the lowest in the "chamber" of the hull (6).

The origin of "carotid" is probably from the Greek word to "stupefy" or "throttle." Rufus of Ephesus (100 AD) said, "The ancients called the arteries of the neck 'carotids' because when these were pressed hard the animal became sleepy". Rufus observed this also worked in humans (7).

There may be an alternative explanation. The walls of the Aristotelean Lyceum were thought to have annotated anatomical drawings. The term "carotid" may have been inscribed on the wall by Aristotle or one of his followers after a morning spent on the Acropolis. The Erechtheion, a much

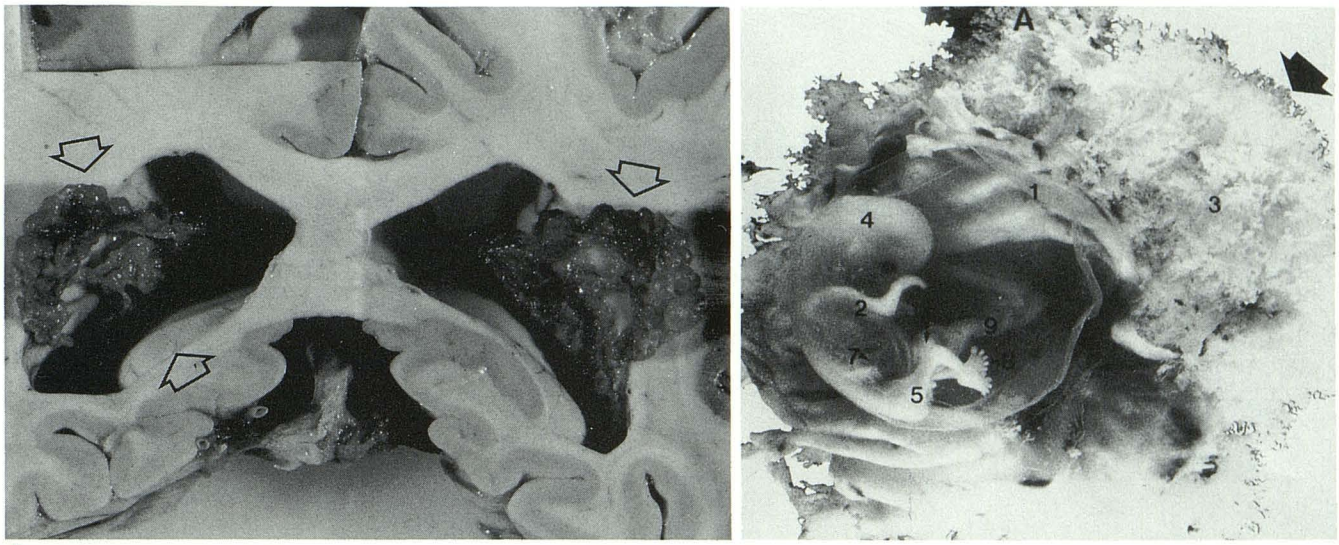


Fig. 3. *A* and *B*, The choroid plexus, *A*, (*upper arrows*) is similar in appearance to the fetal chorion in *B* (*arrow*). The lower arrow in *A* points to the calcar avis on the floor of the trigone. (Figure 3B used with permission, England, MA. *A color atlas of life before birth.* London: Wolfe Publishing Limited, 1983.)

smaller temple than the Parthenon, had been built to honor the legendary king of Athens, Erectheus (8). It was finished a century before the time of Aristotle. The south side of the temple has six sculptured pillars of young women, the caryatids (Fig. 4). Their names supposedly were derived from a village near Sparta where women were noted for their upright posture. Aristotle and his pupils may have seen a similarity between the vertical pillar-like carotid arteries in the neck and the caryatid figures. The caryatids were holding up the temple roof as the carotids, the head.

Ancient Greek temple architecture has several terms that were transferred to the skull and brain. The metope (Fig. 5) just below the isosceles triangle of the pediment at the front of a temple may well be the origin of metopic suture. Galen states the arch-like configuration of the fornix (a Roman term) was similar to arches in domed buildings called in Greek "Spharoeides" (5). "Spharoeides" is the origin of "sphere." If one opposes two fornices in a saggital plane, the result is nearly a hemisphere, making Galen's observation sound. He also used an architectural analogy in describing the septum pellucidum. He said, "Light shines through the septum like translucent stone cut in thin layers put in windows" (5). The Latin "calvarium" has found its way into Christian hymns as "calvary." The Hebrew designation for the site is "Golgotha" or the "place of the skulls."

The impetus for Latin brain naming started with Vesalius. In his "Epitome" of the *Fabrica*, the first work showing how anatomy really looks, Greek terms appear at the margins of the Latin text (9). It would have been a lexicographer's dream to be in Padua in the mid-1500s. To name the brain in Latin was a must. Latin was the language of the church and the emerging science of the renaissance. The anatomists also probably wanted to stay on the good side of the Vatican because of their human dissection and Latin was the way to do it.

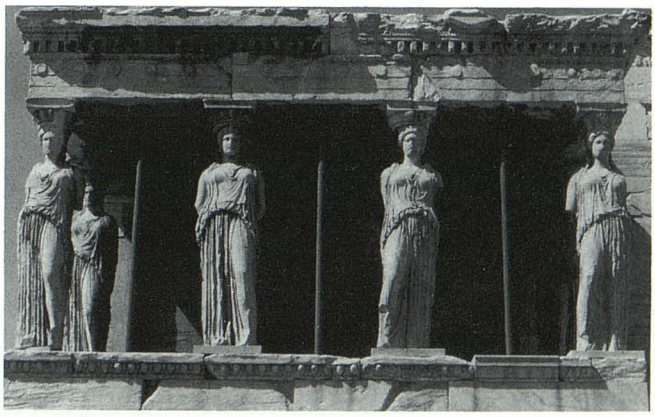


Fig. 4. The sculptured pillars, the caryatids in the Erechtheion on the Acropolis, may have been compared to the carotid arteries by Aristotle and his followers. (Figure used with permission, Professor M. Sturgeon, University of North Carolina, Chapel Hill, Department of Art.)

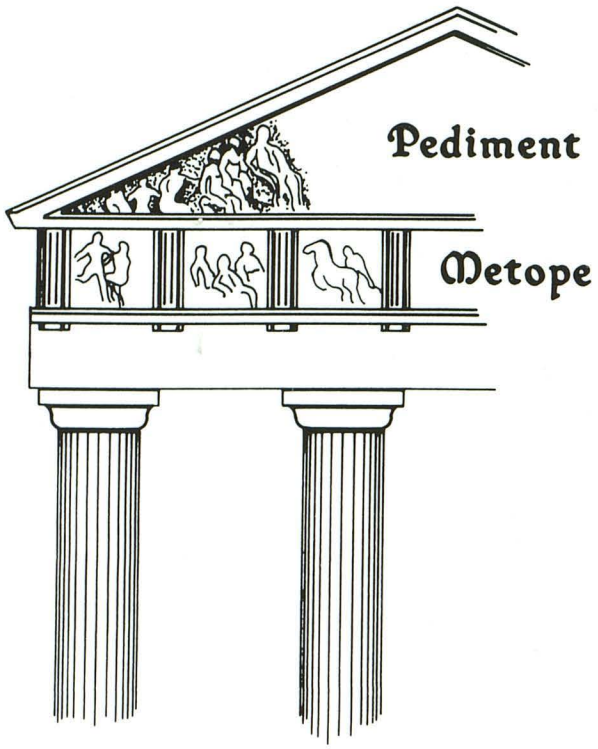
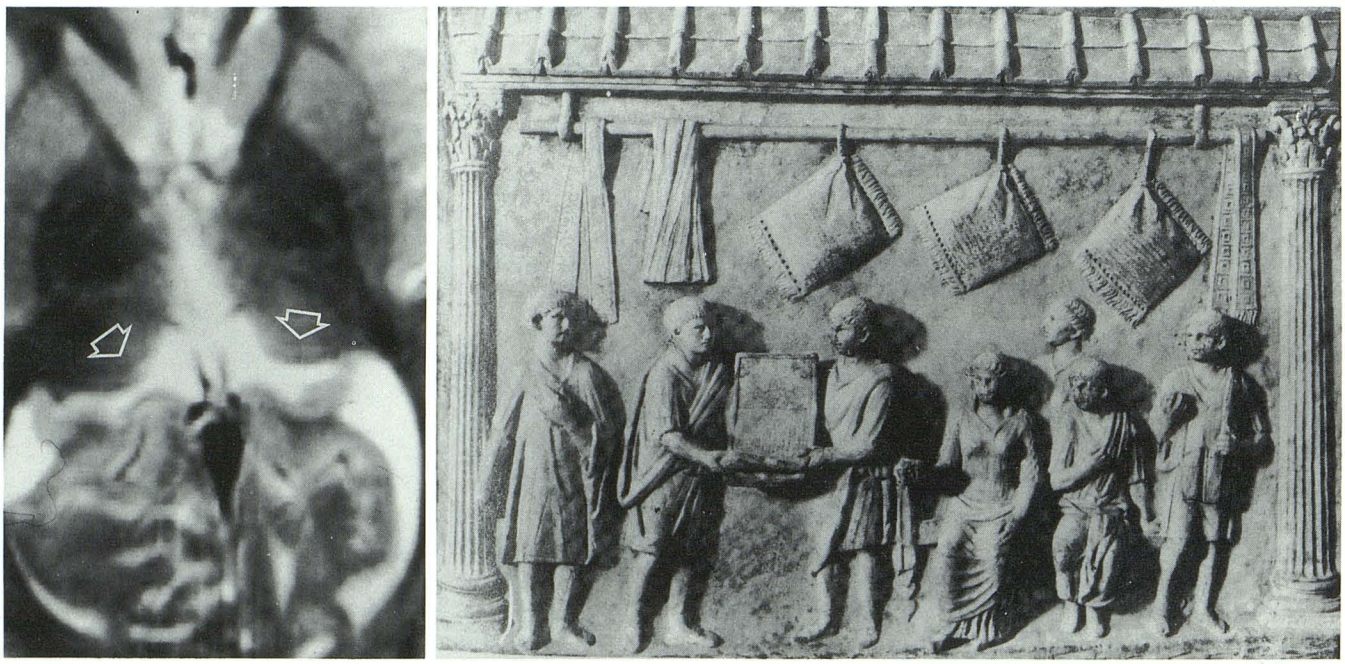


Fig. 5. The metope with carved figures is seen at the front of a stereotypical Greek temple.

Let us imagine Vesalius and his friends at their descriptive work finding appropriate Latin for what they dissected. The posterior margin of the thalamus did look like a cushion or pulvinus (10) (Figs. 6A and 6B). They also may have been thinking about the emperor's box or pulvinar in the Circus Maximus. Amygdala means "almond" in both Greek and Latin and the transition was easy. Why Aranzi, who knew Vesalius, decided the hippocampus looked like a sea horse or sea monster is unknown (Figs. 7A and 7B). It may have come in a dream after a day at the shore and a night of chianti. The detailed anatomy in and around the hippocampus, including the alveus (trough), dentate gyrus, and subiculum (layer) needed a new mind set of Latin.

Wine must have been on the anatomists' minds when they named the pituitary stalk the "infundibulum." It means "funnel." The huge leather bag (and its infundibulum) used to transport wine in the Roman era is shown in Figure 8. Sixteenth century anatomists, although professionally refined, probably knew the Rabelasian technique of an over the shoulder wine skin with its infundibular spout. Interestingly, Vesalius thought brain "phlegm" flowed through the infundibulum (11)



A B

Fig. 6. *A* and *B*, The thalamic pulvinar *A* (*arrows*) shown by axial MR (TR 2600 TE 80) resembles the pulvina or cushions on display in a Roman shop (*B*). (Figure 7B used by permission of author, Baade, E. in *First year Latin.* Boston: Allyn and Bacon, 1970.)

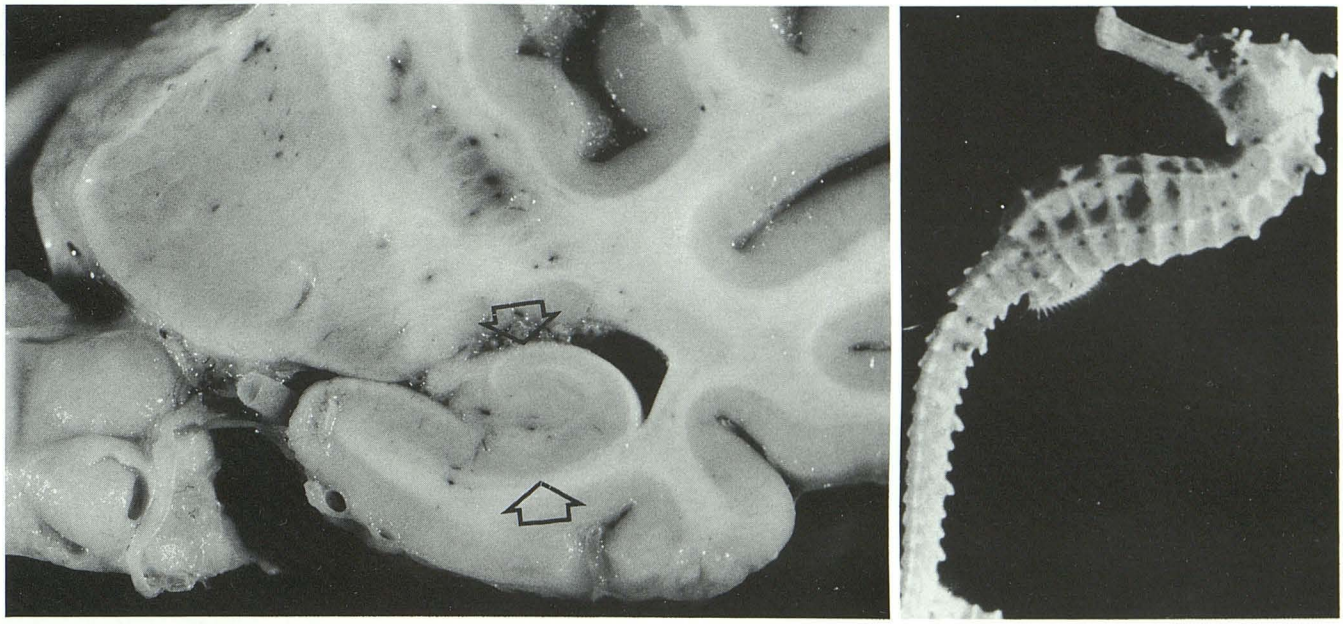


Fig. 7. *A* and *B*. The hippocampus in coronal section (*arrows*), *A*, is named after the seahorse (*B*). (Photo of keystone from *International wildlife encyclopedia.* London: McDonald, 1970.)

Fig. 8. A Roman frieze shows the transport of a large leather wine container. The infundibulum (*arrow*) made for easier pouring. (Photo from Artaud-Paul, in Grimal, P. *The civilization of Rome.* New York: Simon and Schuster, 1963.)

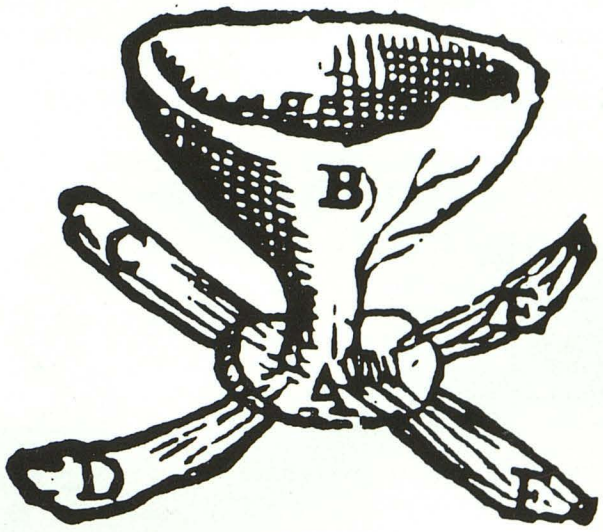


Fig. 9. A drawing from Vesalius shows the inferior aspect of the 3rd ventricle, hypothalamus, and infundibulum. The optic nerves, chiasm, and optic tracts are included. Vesalius thought brain "phlegm" flowed through the infundibulum to the nose. (Figure used with permission from Singer (11), Oxford University Press.)

to reach the nose (Fig. 9). The tuber cinereum ("ash like") with its ashen gray color may have been named in a difficult "morning after" dissection.

Could it be that "calcar avis" is a play on names? It is thought that Jan van Kalkar (12), a pupil of Titian and countryman of Vesalius, did many of the drawings for the *Fabrica*. When the elongated triangular mound on the floor of the trigone (Fig. 3A) needed a name, someone may have punned "calcar" (leg spur of a bird) for Kalkar. Was it Titian who came over to Padua from Venice for a day with Vesalius and Kalkar? Perhaps it happened over lunch as they ate Pollo ala Marsala.

We have Vesalius to thank for bowdlerizing the tectum. Anatomists of his time wanted to name the superior and inferior colliculi the Latin equivalent for testes and buttocks. The overlying pineal gland, which looked like a pine cone (Konari) to the Greeks, was mistaken for a penis (Fig. 10A). This was too explicit for Vesalius. He renamed the tectum the quadrigeminal plate, which if one considers the gemini as twins (Fig. 10B) is a misnomer. The aqueduct is straddled by two sets of twins, not four.

Along with the tectum, the cerebellum was at risk for overly graphic comparisons. The vermis and its wormwood appearance was safely named by the pre-Freudian Greeks. The lobules of the cerebellum, including the pyramidis with its copula, have greater potential for risqué association. The anatomists involved with naming the cerebellar parts are difficult to identify. They did not seem queasy, however, in noting "copulation" between the triangular pyramidis and the adjacent cerebellar tonsil. Finding the copular point and angle has been titillating for 20th century neuroangiographers. Perhaps regrettably, this technique of cerebellar tumor localization has been replaced by MR of posterior fossa structures.

The names of people applied to brain anatomy were slow in developing. Galen had his vein and it had been described for a long time. Before Galen, Herophilus said the confluence of the transverse, straight and saggital sinuses was like a wine press. Figure 11A shows a Roman olive press with its torcular bar that was excavated at Pompeii (10). A wine press had a similar appearance. The torcula Herophili, as outlined angiographically (Fig. 11B) does resemble the ancient device.

Franciscus de la Boe, known as Sylvius, was the first anatomist 1400 years after Galen to not only have the aqueduct named after him, but a major brain fissure as well. That didn't happen again for nearly 200 years, when the Italian anatomist Rolando became famous enough for his electrocortical studies to have the central sulcus put in his name. Competing for attention at about the same time, Johann Reil described the insula in detail and it became his island.

As anatomical and neurophysiologic interest moved toward the cortex in the 19th century, it is surprising that gyri did not acquire eponyms. English, Scottish, German, Italian, and French neuroanatomists of this time should be given credit for putting a typographical nomenclature for the gyri in place. In doing this they emphasized the relative constancy of gyral patterns. Prior to the 1800s, anatomical drawings of gyri resembled clouds or intestines. Rolando called them "enteroid processes" (13). Erasistratus 2000 years before thought so too (14). It seems fortunate that neuroradiologists, although eager enough to learn, don't have to know about a superior jejunal or an inferior strato-cumulus gyrus. Brain lobes

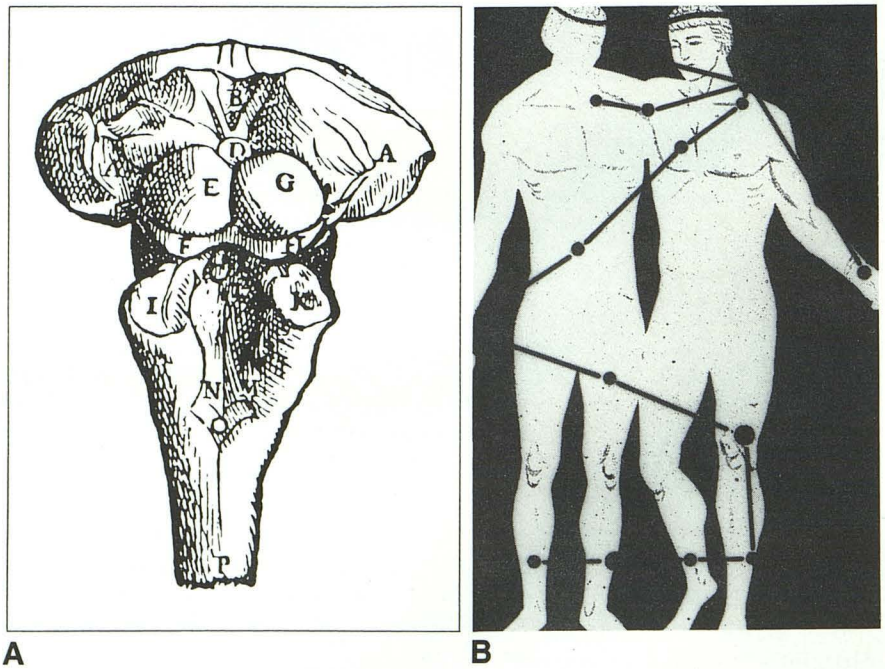


Fig. 10. *A*, This illustration from Vesalius shows the collicular plate. The pineal gland (*D*), superior (*E* and *G*) and inferior (*F* and *H*) colliculi were being called the penis, testes, and buttocks. (Figure used with permission from Singer (4), Oxford University Press.)

B, Vesalius thought quadrigeminal plate with two sets of gemini was more appropriate.

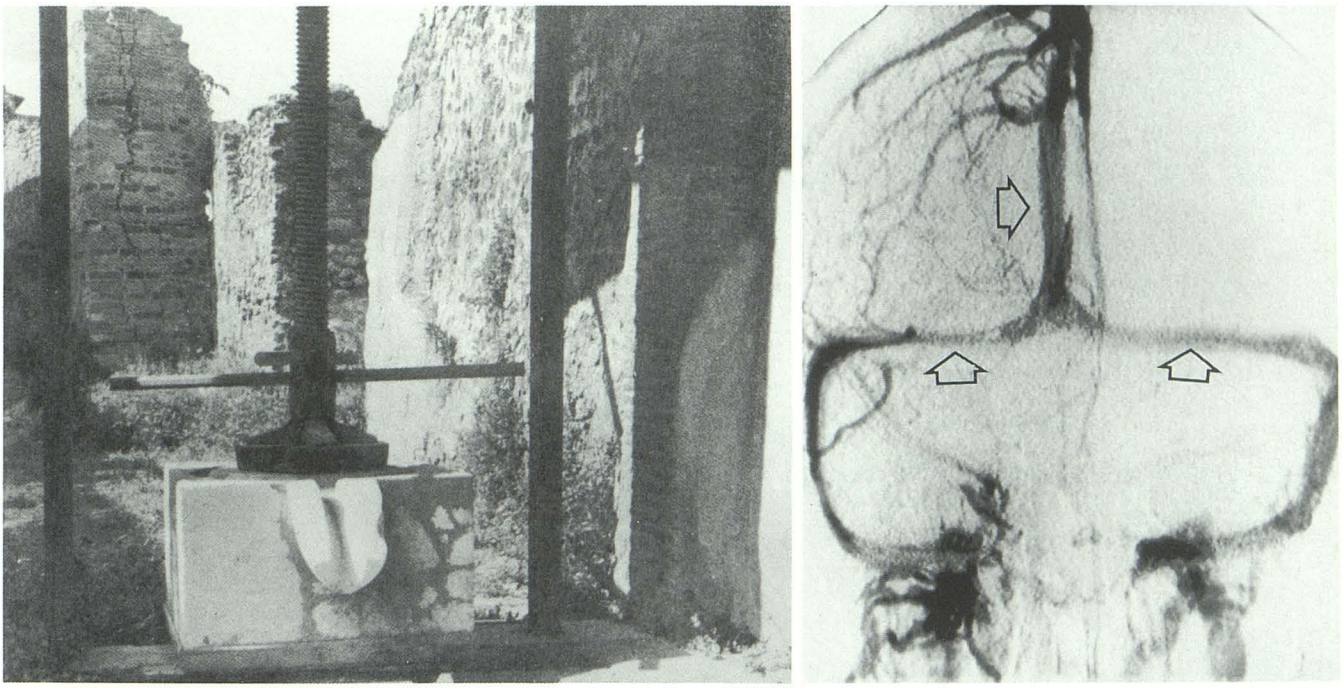


Fig. 11. *A*, A Roman olive press discovered at Pompeii is similar with its torcular bar to a wine press.
B, A digital subtraction angiogram outlining the torcular Herophilus. The superior saggital sinus (*upper arrow*) joining the two transverse sinuses (*lower arrows*) resembles Herophilus' comparison. (Figure 11B by permission of author, Baade, E. in *First year Latin.* Boston: Allyn and Bacon, 1970.)

with superior, middle, and inferior gyri ease memorization. Knowing that "cingulum" is Latin for "girdle" and "cuneus" for "wedge" makes gyri around the corpus callosum less difficult to remember.

In this largely speculative essay about how the brain got its names, much has been omitted. This is the case, because who named what and why just isn't known. It is suggested, however, that neuroradiologists now have a remarkable opportunity to make and record history as well as catch up with colleagues. The neuromicroscopists of the 19th century had a field day with Purkinje cells and Nissl bodies. A neurosurgeon, to facilitate microdissection of the cavernous sinus and Meckel's cave, has called these structures "an anatomical jewel box" (15). There appears to be a triangle (Glasscock, Parkinson, and Kawase) for every neurosurgeon who has published his experience with this area.

With the increasing perfection and smaller volumes of tissue assessed with MR spectroscopy, we can join our basic scientists in finding and naming areas of metabolic abnormality rivaling the discoveries of Broca and Wernicke. Each spectral peak or valley has the potential for our names. If modesty prevails, we could, as brain metabolic frontiers fall, rename the globus pallidus "Iron Mountain" or the neurohypophysis "Phospholipid Springs." The present decade and the next century will present opportunities for metabolic and microstructure brain naming. We may well play a large part in this exciting process.

Acknowledgment

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