

HISTORY OF THE STOMACH AND INTESTINES

"The stomach is lowest and has a hidden place in the body because of its uncleanness, as though nature had spared the principal members and had relegated the stomach or bowels farther away from the site of reason and of the mind and fenced it off with the diaphragm in order not to disturb the rational part of the mind with its importunity. These members serve the higher ones. Some of them concoct the food into juice, others digest it into various humors, others expel the superfluity." -- Alessandro Benedetti, 1497

Ancient and medieval anatomists had fairly accurate gross physiological knowledge of the structure of the stomach, colon, and intestines, dividing the later into six sections whose names are still retained today in modern anatomy. They recognized the importance of digestion as a key aspect of maintaining the humoral balance of the body, suggesting that, if the stomach and intestines' functions were impaired, other bodily functions would suffer. Initially medical practitioners viewed the stomach as an active, almost thinking agent in the body. Galen saw the stomach as an animate being that could feel its own emptiness and generate the sensation of hunger, writing: "[Nature] has granted to the stomach alone and particularly to the parts of it near its mouth the ability to feel a lack which rouses the animal and stimulates it to seek food." He additionally described it as a storehouse of nutrition that sorted the wheat from the chaff: "For just as workmen skilled in preparing wheat cleanse it of any earth, stones, or foreign seeds mixed with it that would be harmful to the body, so the faculty of the stomach thrust downward anything of that sort, but makes the rest of the material, that is naturally good, still better and distributes it to the veins extending to the stomach and intestines."

The intestines and colon, on the other hand, were more passive, relying on their physical attributes of length and thickness to absorb nutrients and contain waste. Galen further observed that the longer and varied size of the intestines was a sign of a higher being. He contrasted this kind of intestine to that of "voracious animals ... [that] both feed continually and as incessantly eliminate, leading a life truly inimical to philosophy and music, as Plato has said, whereas nobler and more perfect animals neither eat nor eliminate continually." The continued fascination with the shape of the human intestines as indicative of their special purpose is apparent in this early modern Islamic illustration:

In the early eleventh century, the medieval Islamic medical philosopher Avicenna was much less concerned about descriptive anatomy. Instead, he recognized the importance of nutrition and the vulnerability of the stomach to illness, giving copious advice about diet and some about digestion, writing primarily about the stomach and intestines in relation to these two factors. Very practically he observed, "Mental excitement or emotion; vigorous exercise; these hinder digestion." Later medieval and Renaissance medical practitioners built upon

these ideas by offering complexion theories of the stomach as a cold and dry organ that was among the principal organs of the body. In the Galenic tradition, it was the site of first digestion, since the body digested nutrients in multiple ways. Every aspect of its shape and texture -- even its location -- facilitated this process. Master Nicolaus in the twelfth century poetically wrote: "The stomach has the liver below it like a fire underneath a cauldron; and thus the stomach is like a kettle of food, the gall-bladder its cook, and the liver is the fire." The illustration above, from a medieval anatomy book, demonstrates this idea in the way both the liver and stomach are drawn. Similarly, the names of parts of the digestive system recalled their specific functions. Many thought that the colon was a colander that strained the feces.

Increased dissection led to more detailed descriptions of the organs involved in digestion, and to illustrations such as the one below reflecting this new approach to anatomy.

In 1497, Alessandro Benedetti lingered over its "denticulated or corrugated [appearance] with thick skin in the intestines in the manner of a blackberry." At the end of the fifteenth century, Berengario da Carpi wrote:

"The stomach's substance is predominantly sinewy. Its color is evident. Its form is round and arched like a Moorish gourd. It is connected to the heart by arteries, to the liver and spleen by veins, to the vein by descending nerves. It is attached to the anus by intestines and to the mouth by means of the gullet."

None of this new detail, however, fundamentally changed the image of the stomach. It was still a cold and dry organ, situated at the crossroads of the arterial and venal systems, that was literally roused to life within the body. In the age of Christopher Columbus, however, descriptions of the intestines borrowed from the world of commerce and exploration. Andreas de Laguna observed in 1535, "Indeed the intestines are rightly called ships since they carry the chyle and all the excrement through the entire region of the stomach as if through the Ocean Sea." He aptly compared them to "those tall ships which as soon as they have crossed the ocean come to Rouen with their cargoes on their way to Paris but transfer their cargoes at Rouen into small boats for the last stage of the journey up the Seine."

Renaissance anatomists continued to moralize the digestive system, associating the stomach and intestines with the impurities of the body, organs devoid of innate spirituality that were nonetheless essential to the proper functioning of the body. The body, it seems, needed to have both spiritual and natural members. The Renaissance artist and anatomist Leonardo da Vinci gives the most interesting reading on the gastrointestinal tract, as he believed the digestive system aided the respiratory system in its function. "The compressed intestines with the condensed air which is generated in them, thrust the diaphragm upwards; the diaphragm compresses the lungs and expresses the air," he wrote in his unpublished notebooks in the 1490s. Interestingly enough, the opening of the lungs is caused by the relaxation of the stomach muscles, which makes the

bowels descend, drawing down the diaphragm and then opening the lungs. In keeping with the Renaissance ideal of the "Great Chain of Being," in which all things of the world were connected to each other in a clear hierarchy, breathing was a process that could not be isolated only in the upper portion of the body. Respiration, in essence, was caused by intestinal air "which arises from the desiccation of the faeces which give off vapors." Digestion involved not only the organs but also the abdominal muscles, as they contracted and relaxed. Such ideas would have interested William Harvey and his contemporaries, if they had had access to Leonardo's unpublished manuscripts, though Harvey surely would not have agreed with this famous artist in all of his conclusions. Leonardo's drawing of the stomach and intestines is well worth looking at. Do you discern any traces of his ideas in the image?

In the early sixteenth century, the German healer and mystic Paracelsus would place special emphasis on the stomach as a chemical laboratory within the body, as part of his efforts to reintroduce alchemical theory into medicine. Very few physicians in his own lifetime subscribed to this idea, preferring a humoral account of digestion. In the mid-seventeenth century, a Flemish physician and follower of Paracelsus, Jan Baptiste Van Helmont, returned to this idea. He offered the first chemical account of digestion.

Eventually, medical practitioners came to see the stomach, colon, and intestines as important, yet base and natural organs. The Scottish medical student John Moir recorded the following joke in 1620 by his professor: the "intestines are comparable to a jester, who unless gravely insulted remains equatable." When Harvey wrote about these organs in *Lectures on the Whole of Anatomy* (1653), he no longer emphasized the animate qualities of the stomach and intestines, preferring instead to describe some of the quantitative features of these parts of the body such as his estimate that the intestines were approximately six times the length of the human body. He continued the process of refining descriptive anatomy. "Intestines are, therefore, made up of tunics, and these from fibers, flesh, parenchyma, veins, arteries, mesenterics, mucous crust, and fat." Do such descriptions suggest a certain loss of poetry in accounts of the body?

Sources

- Avicenna. *A Treatise on the Canon of Medicine of Avicenna*. Trans. O. Cameron Gruner (New York: AMS Press, 1973).
- da Carpi, Berengario. *A Short Introduction to Anatomy*. Trans. L. R. Lind and ed. Paul G. Roofe (New York: Kraus Reprint Co., 1969).
- Corner, George W. *Anatomical Texts of the Earlier Middle Ages* (Washington, D.C.: Carnegie Institute of Washington, 1927)
- Descartes, Rene. *Treatise on Man*. In *The Philosophical Writings of Rene Descartes*. (Cambridge, U. K.: Cambridge University Press, 1985), vol. 1, pp. 99-107.

Galen. Galen on the Usefulness of the Parts of the Body. Trans. Margaret Tallmadge May (Ithaca: Cornell University Press, 1968).

Harvey, William. Lectures on the Whole of Anatomy: An Annotated Translation of *Prelectiones anatomiae universalis*. Ed. and trans. C. D. O'Malley, F. N. L. Poynter and K. F. Russell (Berkeley: University of California Press, 1961).

Hippocrates. *Places in Man*. Ed. and trans. Elizabeth M. Clark (Oxford: Clarendon Press, 1998).

Lind, L. R., ed. and trans. *Studies in Pre-Vesalian Anatomy* (Philadelphia: American Philosophical Society, 1975).

Maimonides, Moses. *The Medical Aphorisms of Moses Maimonides*. Ed. and trans. Fred Rosner and Suesman Munter (New York: Yeshiva University Press, 1970). 2 vol

Moir, John. *Anatomical Education in a Scottish University, 1620: An Annotated Translation of the Lecture Notes of John Moir*. Ed. and trans. R. K. French (Aberdeen: EquiPress, 1975).

Steno, Nicolaus. *Lectures on the Anatomy of the Brain*. Ed. Gustav Scherz (Copenhagen: Arnold Busk, 1960).

da Vinci, Leonardo. *Leonardo da Vinci on the Human Body: The Anatomical, Physiological, and Embryological Drawings of Leonardo da Vinci*. Ed. J. B. de C. M. Saunders and Charles D. O'Malley (New York: Crown Publishers, 1982).

Vesalius, Andreas. *The Epitome of Andreas Vesalius* (New York: MacMillan, 1949).

de C. M. Saunders & O'Malley. *The Illustrations from the Works of Andreas Vesalius*. Ed. J. B. de C. M. Saunders and Charles D. O'Malley (New York: Dover, 1973).

Wharton, Thomas. *Adenographia* (London, 1656).

Willis, Thomas. *The Anatomy of the Brain and Nerves*. Ed. William Feindel (Montreal: McGill University Press, 1966), 2 vols.