

Greek anatomist herophilus: the father of anatomy

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Abstract: One of the most stirring controversies in the history of Anatomy is that Herophilus, an ancient Greek anatomist and his younger contemporary, Erasistratus, were accused of performing vivisections of living humans. However, this does not detract from the fact that Herophilus has made phenomenal anatomical observations of the human body which have contributed significantly towards the understanding of the brain, eye, liver, reproductive organs and nervous system. It is notable that he was the first person to perform systematic dissection of the human body and is widely acknowledged as the Father of Anatomy. He has been hailed as one of the greatest anatomists that ever lived, rivaled only by Andreas Vesalius who is regarded as the founder of modern human anatomy.

Key words: Father of anatomy, Vivisection, Human body dissection, Controversy

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Introduction

The city of Alexandria, Egypt, founded by Alexander the Great and established by the mighty Ptolemaio Pharaohs, was home to many renowned philosophers and medical practitioners of that time. Alexandria housed the largest book repository in the world, with approximately 700,000 scrolls, many of which were libraries of prominent philosophers.

With a wealth of intellectual property residing in the libraries, it is little wonder why the famous Greek geographer, Strabo, termed the city as the 'greatest emporium in the world'. Of the Alexandrian texts, several were written by some of the finest anatomists of that time. Herophilus, in particular, was considered among the great physicians of Antiquity (Dobson 1925) and acknowledged by many as the Father of Anatomy (Wiltse & Pait, 1998).

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Background

Born in 335 B.C. in the town of Chalcedon, Asia Minor, Herophilus (Fig. 1) is believed to have lived till 255 B.C. Little is known about the early phases of Herophilus' life, other than the fact that he took flight to Alexandria at a youthful age, to commence his education. Herophilus was thought to have been under the tutelage and guidance of Praxagoras of Cos (von Staden 1992), who had made significant contributions to Aristotelian anatomy by differentiating arteries from veins. He would subsequently continue his mentor's curiosity in the arterial pulse.

Having learnt from Praxagoras, Herophilus began practicing medicine in the city of Alexandria during the reign of the first two Ptolemaio Pharaohs. Through his fervent interest in the subject, his discoveries led him to become an acclaimed medical practitioner. Apart from plying his trade, he penned down at least eleven treatises, which unfortunately, were lost during the course of history. There was a great fire in the Alexandrian Library where his works were believed to be stored in 391 A.D. (Wills 1999). However, his anatomical



Fig. 1. A sketch of Herophilus redrawn from an original painting by Joseph F. Doeve (which is in the collection of the Houston Academy of Medicine-Texas Medical Center Library and available at <http://clendening.kumc.edu/dc/pc/h.html>).

knowledge has been passed down the generations, providing vital input towards understanding the brain, eye, liver, reproductive organs and nervous system.

Anatomical Discoveries of the Human Body

Herophilus is recognized as the first person to perform systematic dissection of the human body predating even Andreas Vesalius, (often regarded as the founder of modern human anatomy) (Prioreshi 1996; Wills 1999) despite the taboos that prevailed regarding desecration of the human body at that time (Prioreshi 2001). Since the time of Plato, it was believed that the body harbors a soul which upon death “is imprisoned in the body” (Tredennick 1954). In fact, dissection of the human body was permitted for only 30 to 40 years during the days of Herophilus before it was abandoned for the next 1800 years, restarting only in the mid-16th century (Wiltse & Pait, 1998). In established universities such as Oxford University, human anatomy was not taught until 1624; in the statutes of the University drawn up in 1636, one of the requirements for a license in surgery was that the person must have performed two anatomical dissections (Chaplin 1919). Even then, dissection was perceived as a “violent impulse” associated with “disemberment of people” and interestingly, the ‘Murder Act’ of 1752 in England

allowed for the bodies of those executed for committing murder to be dissected by surgeons in place of a public display of the executed criminal being hanged on a gibbet (Sawday 1995).

Herophilus was also the earliest person to carry out the first known autopsies for characterizing the course of disease (Lassek 1958; Persaud 1984). He has made many phenomenal observations of the human body, some of which are listed below.

Cardiovascular system

Alcmaeon of Croton was the first person to observe that arteries and veins in his animal dissections appeared dissimilar (Khan *et al.*, 2005). Aristotle perceived the human heart as having three “ventricles” or cavities and considered the right atrium as a venous dilatation (Van Praagh & Van Praagh, 1983). However, Herophilus, who had earlier confirmed that the arteries had thicker walls than the veins in his human cadaveric dissections, maintained that the atria were parts of the heart although it was not universally accepted at that time (Harris 1973; Khan *et al.*, 2005). It was again Herophilus who refuted his mentor’s (Praxagoras) misconception that the pulse was not associated with the heart beat (Smith 2010).

Nervous system

Herophilus is believed to be one of the first to differentiate nerves from blood vessels and tendons (Wiltse & Pait, 1998; Smith 2010) and to realize that nerves convey neural impulses (Longrigg 1972). Although Charles Bell and François Magendie, have both claimed the honor of discovering that dorsal spinal roots mediate sensation and ventral spinal roots carry motor fibres, it is believed that ancient anatomists such as Herophilus and Erasistratus had already appreciated the separate neural pathways during their time (Tomey *et al.*, 2007). It is suggested by Rufus in *De anatomia partium hominis* that both of them knew of the existence of “two kinds of nerves,” that could either induce “voluntary motion” or are “capable of sensation” (Rocca 2003). It was Herophilus who made the point that damage to motor nerves induced paralysis (Persaud 1984). Herophilus named the meninges and ventricles in the brain, appreciated the division between cerebellum and cerebrum and recognized that the brain was the “seat of intellect” (Rose 1994) and not a “cooling chamber” as propounded by Aristotle (Wills 1999). He is also credited with describing the optic, oculomotor, motor

division of the trigeminal, facial, vestibulococlear and hypoglossal nerves (von Staden 1989; Wills 1999).

Digestive system

Herophilus described the salivary glands and named the first part of the small intestine, duodenum (von Staden 1989). He made the first accurate description of the liver and had extensive knowledge of its conformation (Dobson 1925; McClusky *et al.*, 1997). He performed the first investigation of the pancreas (Potter 1976; von Staden 1992).

Reproductive system

Herophilus has been credited with giving the best description of the reproductive system up to that time of the Middle Ages (Wiltse & Pait, 1998). He showed that the uterus is a hollow organ and described the ovaries and uterine tubes. He recognized that spermatozoa were produced by the testes and was the first to identify the prostate gland (von Staden 1989).

Eye

He described the cornea, retina, choroid, iris, ciliary body and vitreous humor in the eye (Potter 1976; Wiltse & Pait, 1998).

Controversy

The life of Herophilus as an anatomist, as successful as it were, was not short of controversy. Later physicians such as Cornelius Celsus and Galen charged both Herophilus and his contemporary, Erasistratus, with performing vivisection on condemned criminals awarded to them by the rulers of Alexandria (Magner 2005). Celsus, who did not witness the vivisections wrote 250 years after the death of Herophilus (Robinson 1931) that the criminals were dissected alive and "while they were yet breathing" (Scarborough 1976). Tertullian, writing in the next century, called Herophilus a "butcher" and implied that he cut up living people (Dobson 1925). It has been theorized that accusations of vivisections is the main reason why Herophilus has not received as much recognition for his scientific investigations of the human body as Hippocrates, Galen or Vesalius (Wiltse & Pait, 1998).

Conclusion

Herophilus' achievements have had ramifications up till this day, in which his works as an anatomist during that era have left him to be lauded as the 'Vesalius of Antiquity' (Magner 2005). Some of the terminologies attributed to him such as *calamus scriptorius* and *torcula herophili* are still in modern usage (Wills 1999). His aphorism, "Wisdom is indemonstrable, art uncertain, strength powerless, wealth useless and speech impotent if health be absent" (Dobson 1925) is a guiding principle in the management of diseases and development of health policies in prevailing times (Folch *et al.*, 2003). As an anatomist, he may not even have reached the eminence of Leonardo da Vinci, the gifted painter whose scientific drawings of the human body have set him apart from any other artist (Bay & Bay, 2010). Nevertheless, the anatomical work of Herophilus is said to be rivaled by only that of Vesalius who produced the well-acclaimed *De Humani Corporis Fabrica* (Vesalius 1543; Wiltse & Pait, 1998). Herophilus well deserves to be called the Father of Anatomy.

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References

- Bay NSY, Bay BH. (2010). Da Vinci's anatomy. *J Morphol Sci* 27: 11-13
- Chaplin A. (1919). The history of medical education in the universities of Oxford and Cambridge, 1500-1850. *Proc R Soc Med* 12(Suppl): 83-107
- Dobson JF. (1925). Herophilus of Alexandria. *Proc R Soc Med* 18: 19-32
- Folch E, Hernandez I, Barragan M, Franco-Paredes C. (2003). Infectious diseases, non-zero-sum thinking, and the developing world. *Am J Med Sci* 326: 66-72
- Harris CRS. (1973). The heart and the vascular system in ancient Greek medicine, from Alcmaeon to Galen. Oxford, Clarendon Press
- Khan IA, Daya SK, Gowda RM. (2005). Evolution of the theory of circulation. *Int J Cardiol* 98: 519-521
- Lassek AM. (1958). Human dissection: its drama and struggle. Springfield, Charles C. Thomas
- Longrigg J. (1972). Herophilus. In Gillespie C, ed. Dictionary of scientific biography. Vol. 6. New York, Charles Scribners Sons,

- 316-319
- Magner L. (2005). *A history of medicine*, 2nd ed. Boca Raton, Taylor & Francis
- McClusky DA 3rd, Skandalakis LJ, Colborn GL, Skandalakis JE. (1997). Hepatic surgery and hepatic surgical anatomy: historical partners in progress. *World J Surg* 21: 330-342
- Persaud TVN. (1984). *Early history of human anatomy: from antiquity to the beginning of the modern era*. Springfield, Charles C. Thomas
- Potter P. (1976). Herophilus of Chalcedon: an assessment of his place in the history of anatomy. *Bull Hist Med* 50: 45-60
- Priorreschi P. (1996). *A history of medicine*, Volume II, Greek medicine, 2nd ed. Omaha, Horatius Press
- Priorreschi P. (2001). Determinants of the revival of dissection of the human body in the Middle Ages. *Med Hypotheses* 56: 229-234
- Robinson V. (1931). *The story of medicine*. New York, Tudor Publishing Co
- Rocca J. (2003). *Galen on the brain: anatomical knowledge and physiological speculation in the second century AD (studies in ancient medicine)*. Boston, Brill Academic Publishers
- Rose FC. (1994). The neurology of ancient Greece--an overview. *J Hist Neurosci* 3: 237-260
- Sawday J. (1995). *The body emblazoned: dissection and the human body in renaissance culture*. London, Routledge
- Scarborough J. (1976). Celsus on human vivisection at Ptolemaic Alexandria. *Clio Med* 11: 25-38
- Smith CU. (2010). The triune brain in antiquity: Plato, Aristotle, Erasistratus. *J Hist Neurosci* 19: 1-14
- Tomey MI, Komotar RJ, Mocco J. (2007). Herophilus, erasistratus, aretaeus, and galen: ancient roots of the bell-magendie law. *Neurosurg Focus* 23: E12
- Tredennick H. (1954). *Plato, The last days of socrates. The apology, crito, and phaedo translated with an introduction*. West Drayton, Penguin Books
- Van Praagh R, Van Praagh S. (1983). Aristotle's "triventricular" heart and the relevant early history of the cardiovascular system. *Chest* 84: 462-468
- Vesalius A. (1543). *De humani corporis fabrica, libri septum*. Basel, Ioannis Oporini
- von Staden H. (1989). *Herophilus, The art of medicine in early Alexandria*. Cambridge, Cambridge University Press
- von Staden H. (1992). The discovery of the body: human dissection and its cultural contexts in ancient Greece. *Yale J Biol Med* 65: 223-241
- Wills A. (1999). Herophilus, Erasistratus, and the birth of neuroscience. *Lancet* 354: 1719-1720
- Wiltse LL, Pait TG. (1998). Herophilus of Alexandria (325-255 B. C.). The father of anatomy. *Spine (Phila Pa 1976)* 23: 1904-1914