The Classical and Medieval Neuroscientific Traditions

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It is a common tenet that we have become aware of the role and importance of the human brain only recently. According to this opinion, in Antiquity cognitive and affective faculties were directly ascribed to the soul, and many mental diseases were simply considered the outcome of magic manipulations due to the devil or witches.

However, this holds true only partially, since we know that in some ancient cultures Natural Sciences, especially Medicine and Surgery actually developed, reached a surprisingly deep knowledge on the meaning and role of the brain in higher mental functions. For example, the Edwin Smith Surgical Papyrus, dated to the 16th century BC and probably based on documents written in the third millennium BC, describes different types of brain injures, with their corresponding physical consequences, such as paralysis and sensory deficits[1]. However, at the same time, it was also a commonly shared and widespread opinion in ancient cultures like the Egyptian or Greek, that the heart was the center and origin of many psychical faculties, like passion and affection. In Ancient Greece, a new brain-centered medicine received a strong impulse from Hippocrates (5th century BC). This well-known physician, under Alcmeon of Croton's influence, conceived the brain as the central organ of corporeal senses and cognition. For Hippocrates, epilepsy was caused by brain damage, not by gods. "And men ought to know that from nothing else but (from the brain) come joys, delights, laughter and sports, and sorrows, griefs, despondency, and lamentations. And by this, in a special manner, we acquire wisdom and knowledge, and see and hear, and know what are foul and what are fair, what are bad and what are good"[2].

The great Alexandrian physicians (Herophilus of Chalcedon and Erasistratus of Ceos), who shared the thesis that the seat of the soul was the brain, not the heart (unlike Aristotle, but in

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[1] Reeves, C. (1992), *Egyptian Medicine* (Buckinghamshire: Shire Publications). For the topics of these pages, see also Finger, S. (2001), *Origins of Neuroscience* (Oxford: Oxford University Press).

[2] Hippocrates, *On the Sacred Disease*, in Darwin Adams, Ch. (1868), ed., *The genuine Works of Hippocrates* (New York: Dover), 366.

agreement with Plato), expanded this medical tradition. The same theory, enriched by many new brain findings, belonged also to the other famous ancient physician, Galen (129-200 AD). The Galenic tradition developed the theory of a correlation between the Aristotelian psychic functions (senses, perception, imagination, memory and reason) and the brain ventricles (or "cells")[3].

The ancient 'neuroscientific' account, a legacy from the Hellenist wisdom (Plato, Aristotle and Galen), was transmitted to early Christian scholars, like Nemesius (4th century), Bishop of Emesa (Syria). As a physiologist, Nemesius developed a theory of mental functions being localized in the ventricles. According to this theory, sensory perception (the Aristotelian *sensus communis*), imagination, reason and memory were found in different cerebral ventricles[4]. This assumption was successively transferred to the Medical Science of Islamic origin (Avicenna, *The Canon of Medicine,* 11th century) and, later on, to the Latin representatives of the Western Culture, particularly to the Salerno School of Medicine, and the Universities of Naples and Montpellier.

St. Albert the Great[5] and St. Thomas Aquinas, the two famous Dominican Theologians and Philosophers of the 13th century, incorporated this neurological vision of man into their Anthropology. For Thomas Aquinas, the brain was the organ and seat of higher sensitive faculties, each with its own precise localization, although the universal reason remained incorporeal in his view[6]. Dysfunctions in cognitive, appetitive, emotional or behavioral capacities were due and explained by cerebral lesions. Even some aggressive or insane sexual

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[3] Green, C. D. (2003), "Where did the ventricular localizations of mental faculties came from?", *Journal of the History of the Behavioral Science*, (**39**), 131-142, published on-line, 23 April 2003. See also Manzoni, T. (1998), "The cerebral ventricles, the animal spirits and the dawn of brain localization of function", *Arch. Ital. Biol.*, March (136/2), 103-152; Crivellato, E. and Ribatti, D. (2007), "Soul, mind, brain: Greek philosophy and the birth of neuroscience", *Brain Res. Bull.*, January (71/4), 327-336.

[4] Van der Eijk, P. (2008), "Nemesius of Emesa and early brain mapping", *The Lancet*, (**372**), 440-441; Bennett, M. R. and Hacker, P. M. S. (2002), "The motor system in neuroscience: a history and analysis of conceptual developments", *Progress in Neurobiology*, (**67**) 1-52.

[5] Albertus Magnus, *Physica*, ed. P. Hossfeld (Aschendorff, 1993); *De Anima*, ed. Stroick, Cl. (Aschendorff, 1968).

[6] Sancti Thomae de Aquino, *Summa Theologiae*, ed. Paoline (Milano, 1988), I, q. 77, a. 4; q. 85, a. 7; q. 91, a. 3, ad 1. For this theme, see also Kemp S. and Fletcher, G. J. O. (1993), "The medieval theory of the inner senses", *The American Journal of Psychology*, (**106**), 559-576.

actions were attributed by Aquinas, not to an immoral behavior but to a specific pathology[7]. In fact, he believed in the existence of physiological predispositions for some virtues or vices[8].

From the 13th century onwards, and till the Renaissance period, there take place a robust neuroscientific development in human anatomy, particularly in some Italian Universities (Bologna, Rome, and Padua). Among very famous scholars, we can mention Mondino de Luzzi (*Anathomia Mundini*, published in 1316), Berengario da Carpi (15th and 16th century), Andrea Vesalio (16th century), and Costanzo Varolio (16th century). Gradually, the new neuroscience, based even more upon anatomical observations and discoveries, undermined Galen's authority.

In the 17th century, thanks to the works of Thomas Willis (*Cerebri Anatome*, published in 1664) and Niels Steensen (1638-1686, also known as Steno or Stenonius), this field showed a significant progression and the above mentioned scientists can therefore be considered as protagonists of pre-modern Neuroscience. Steenses, a Catholic convert (beatified by Pope John Paul II in 1987), was a precursor of the discovery of the cerebral convolutions, which he correctly correlated to higher cognitive functions[9]. In this trajectory, Descartes occupies a special place (16th century as well). Although Descartes possessed some new neuro-physiological insights, his main role in history is attributed to his introduction of a radical dualism, betraying the unified view of traditional physiology. In this sense and in relation to the "mind-body problem", Descartes can be considered the father of the modern Philosophy of Science.

This brief historical overview is in agreement with three poorly known issues:

a) There is a fundamental continuity between Ancient, Medieval and Pre-modern Neuroscience. From its beginning, the Hellenistic neuroscientific knowledge was passed on to the Christian culture, whose milieu prepared the great discoveries of the 19th century. The most important breakthrough, which allowed Modern Neuroscience to begin, was the abandonment of the scientifically unfounded Galenic 'ventricular' theory. Therefore, we may conclude that the roots of Modern Neuroscience are to be found in the Sciences and Humanities of Christian origin

[7] See *S. Th.*, I, 84, a. 7; *In VII Ehicorum*.
[8] See *S. Th.*, II-II, q. 155, a. 4, ad 2; q. 156, a. 1.
[9] See Scherz, G. (1968), ed., *Steno Nicolaus and Brain Research in the Seventeenth Century* (Oxford: Pergamon Press).

and in its many contributions originating from the Greek and Islamic scientific culture's connections.

b) The theory of the localization and correlation between psychic functions and cerebral regions, at least at the level of principles, is not a modern acquisition but it is in continuity with Ancient and Medieval traditions.

c) The Aristotelian insight that sees the soul as the 'substantial act' of the human body, together with Aquinas' intuition of the brain as the organ of higher cognitive functions, provided we acknowledge the importance of a philosophical interpretation going beyond mere science, seems to be more in the line of the current neuroscientific view of man than Descartes' extrinsic dualism.

According to these principles, it can be said that acts like feelings, emotions, perceptions, choices, thoughts, are not purely psychic or mental acts that can be simple associated to physical phenomena (brain events), but are rather a single psychosomatic act integrated by several dimensions, just as a smile is physiological, psychological, behavioral, spiritual and personal. Of course, to illustrate this point a more elaborated philosophy of mind is needed.