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The Alcmaeon's School of Croton: Philosophy and Science

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Abstract

Among the first physicians and physiologists at the pre-Hippocratic medicine with contradictions and oscillating doctrines was Alcmaeon from Croton in the 6th century BC. For many, he shared as the father of scientific medicine. Unfortunately, we have only eighteen texts written for him and only five fragments of texts written by him. This saved extracts and testimonies they refer mostly to physiology, epistemology and psychology. Was born in the city of Croton (Κρότων) in Magna Graecia (southern Italy) was a reference point for the activity of physicians and philosophers over the years. Furthermore, Herodotus tells us about the excellent practice quality of the physicians, "compared to all the others known in that period", among which Alcmaeon. But Croton is also famous as the centre of thought and activity of the philosopher Pythagoras of Samos (Πυθαγόρας ὁ Σάμιος, 580-500 BC) through his Pythagorean school around 530 BC.

A multifaceted character: Pythagoras

Pythagoras was one of the most important pre-Socratic philosophers. He was born in the Samos Island (Aegean Sea) and he leaves it around the 530 B.C., and he settles at Croton town. Must mention based on Herodotus Democedes (Δημοκήδης) of Croton as the most knowing physician of his time Croton had a medical school already present at the arrival of Pythagoras [1], [2], [3]. Pythagoras was a dynamic social personality which creates a private culture association where his members acted in the political, religious and philosophical fields, spreading his thinking to society as a whole. As we do with Thales and others pre-Socratics we have nothing written but through Aristotle, Herodotus, Plato and others. His thinking supported a pattern of the orderly entity in the universe (*κόσμος)* that came through a well defined the relationship with the numbers (the true nature of being of things). Famous are the Pythagorean table of opposites (a set of 10 pairs of contrary qualities). So his thought research focused mostly on mathematics and geometry, but also in astronomy and music, less on medicine. Anyway on medicine was the first he understood that good health is maintained through physical exercise for the body. We must not omit that Pythagoras himself came to this concept because it was also one that applied to the athletics world. In fact, through his philosophical, medical school, he proposes a proper physical activity, balanced diet and recreation through music and reading. The balance between body and soul (*ψυχή*) is maintained through these rules and opposes the thought that the illnesses are from the ones. This is also because the Pythagoreans followed a similar religious model or if not the same as the religion of Orphism. They developed the thought that the soul does not die but moves to another living body. However, Pythagoreans differ according to their philosophical ideas. Some prefer the mathematical reasoning of numbers (learners: Μαθηματικοι), but

others teach and study ritual and religious subjects (listeners: Ακουσματικοι) [4], [3].

Alcmaeon lived in the time of Pythagoras culture. Is ambiguous if was Pythagorean or not. That's because his activity in some respects was particularly isolated from Pythagorean thought. According to Aristotle (*Metaphysics: "τὰ μετὰ τὰ φυσικά" A.5)* he lived when Pythagoras was old: *"…καὶ γὰρ ἐγένετο τὴν ἡλικίαν Ἀλκμαίων ἐπὶ γέροντι Πυθαγόρᾳ,ἀπεφήνατο δὲ παραπλησίως τούτοις…" (as for the age Alcmaeon was young when Pythagoras was old ....). H*e appears in the Pythagorean school. He is therefore regarded as an integrated member of the Pythagorean School, however, with the specific competence on medical thought. Also demonstrates that his thinking is influenced by the Pythagorean concept of *harmony* (*αρμονία)* and we know that some of them offered not only numbers and that the first of them that had orientation mostly towards a naturalistic thought and towards medicine, physiology as Menestor and others later. That because society so marked by the dynamic Pythagorean thought it was not possible that it was not influenced. Aristotle notes this ambiguity and writes *"Speaking like that of the Pythagoreans; he said that duplications are mostly things about the man. But unlike the Pythagoreans, he did not define what oppositions were (oppositions), but he named what was happening: white-black, sweet-bitter, good-bad, great-small. However, from the Pythagoreans and Alcmaeon, it can be seen that controversies were for them the principles of things that are"* [5], [6], [7].

As we mentioned Pythagorean theory, according to which only ten elements are ordered according to opposites *(των εναντίων)* are principles of things: limit and unlimited, odd and even, one and many, right and left, male and female, mobile and not mobile, straight and curved, light and dark, good and bad, square and rectangle. Alcmaeon of Croton has similar doctrine: *"είναι δύο τα πολλά* των *ανθρωπίνων"* (*most human things are dual)* but puts the oppositions randomly: big-little, black-white, good-bad, sweet-bitter. Certainly, every one of the Pythagoreans has founded his school of philosophic thought as did Parmenides and others but he did not. If we only consider its empirical research towards medicine and physiology can differentiate it from Pythagoreans. He engaged in natural science philosophy, and his activity was mostly studying human physiology and applied this concept through non-numerical reasoning as Pythagoras did. Alcmaeon, in his only book "*Περί φύσεως" (On Nature),* mentioned the Pythagorean Brotinus: *"Ο Αλκμαίων ο Κροτωνιάτης, γιός του Πειρίθοου, είπε τα ακόλουθα στους Βροτίνο, Λέοντα και Βαθύλλο…" (Alcmaeon of Croton, son of Peirithous, said the following to Brotinus, Leon and Bathyllus…),* and Aristotle despite having written a separate book for him in another his monographic work "*The Pythagoreans"* included him among them. Also, we can recall that beyond some writers such as Diogenes Laertius on *"Βίοι καὶ γνῶμαι τῶν ἐν φιλοσοφίᾳ εὐδοκιμησάντων"* (Lives of Eminent Philosophers, *III BC)* writes: *"Ἄλκμαίων Κροτωνιάτης καὶ οὗτος Πυθαγόρου διήκουσε"* consider as Pythagorean. Later other writers as the philosopher Iamblichus and Aristoxenus (4th century), recognised the Pythagorism of Alcmaeon [8], [9], [10], [1].)

Alcmaeon developed activity mainly in the area of medicine and natural philosophy with Pythagorean affinity. This empiricist epistemology orientation influences Hippocrates and was the beginning separation of medicine from the supranational religion. Consequently, it will lead to the evolution of the healing temples (Asklepieions) as medical schools that physician learn and transmit knowledge through a professional ethics [4], [10].

Alcmaeon, the philosopher

Alcmaeon did not teach any religious or ritual arguments, indeed Diogenes Laertius and Aristotle on *Περί ψυχῆς (On the soul, 1.2, p.405, 350 BC*) describes that he supports the immortality of the soul that was always in motion as celestial objects in the universe and that it is it moves continuously like the sun. Indeed Diogenes Laertius on "*Βίοι καὶ γνῶμαι τῶν ἐν φιλοσοφίᾳ εὐδοκιμησάντων,* (Lives of Eminent Philosophers, book H, VIII§83) he writes on Alcmaeon: *"περὶ τῶν ἀφανέων, περὶ τῶν θνητῶν σαφήνειαν μὲν θεοὶ ἔχοντι, ὡς δ' ἀνθρώποις τεκμαίρεσθαι* καὶ τὰ ἐξῆς ἔφη δὲ καὶ τὴν ψυχὴν ἀθάνατον, καὶ κινεῖσθαι αὐτὴν συνεχὲς ὡς τὸν ἥλιον. - *…Of the invisible things and visible things only the gods have certain knowledge, a human can only deduce…the soul moves continuously like the sun…".* Thus Alcmaeon said that the *"Experience is the foundation of knowledge"* (πειρα *μαθήσεως αρχή*), that is distinguishes between the absolute experience knowledge of gods (*σαφές* = clear understanding) but the human knowledge comes through *proves experiences* (*τεκμήρια)*. For this separates human reasoning (φρονεῖν) and the animals feeling (αἰσθάνονται): *"Man differs from the other living because he only understands, while others feel but do not understand".* Indeed for him, the knowledge and the feeling are two different things (not the same thing as for Empedocles). This will be related to the sense doctrine: *"is heard through the ears ... they feel it smells with the nose ... the flavours are distinguished with the tongue ..."*. All the senses are transmitted and controlled by the brain. The human being perceives with reasoning and welcomes with imagination for his actions. So what distinguishes humans and animals are the intellectual fantasy on the one hand and the other can transmit knowledge to evolve. Thus comes to the concept of separating Anthropos (ἄνθρωπος, human being) and animal as an intellect of perception.

But using the word soul does not intend to give a sovereign religious concept but wants to distinguish the intellect's ability and brain function to control feelings and behaviours. According to to *Theophrastus* (a Greek philosopher of the Peripatetic school), Alcmaeon was the first Greek thinker to distinguish between the sensory perception of intellect [11], [12].

Another topic which comes from the texts there is a coincidence between medical and political analogy on terms, precisely the derivation of medical language from the political language. Alcmaeon *On Nature* refers to the idea of equal distribution of strengths called *isonomia* (ἰσονομία). Alcmaeon will say: *"….health is tough as long as the various elements, wet-dry, cold-hot, bitter-sweet have equal rights and that diseases come when one of the opposites prevails. The prevalence of either element tells you to be the cause of destruction. Health is the harmonious mix of opposite qualities".* That conceptual thought, demonstrate the coincidence between medical terms and political terms, precisely the derivation of the medical from the political thought. Indeed "*So health and isonomy*" (isos + nomos = Democracy: Δημοκρατία) it applies mainly to democratic regimes but also moderate oligarchs. Instead, the dominance (Μοναρχία: monarchy) of one of them or part of them generates sickness (νόσος) because pre-eminence and the predominance of opposite on the other must have a dynamic solidarity balance between the constitutive and opposing powers of the body. With this theory sets the bases of the metabolic process of substances in the body that give the physiological balance. So this keeps the balance of the healthy body in contrast to that the numbers are the principle of harmony. So there is no universe ordered by the essence of the number but tension between opposing forces that tend to balance. As we have said Alcmaeon said "*most of the human things are twofold",* that is human problems appear to be contradictory and heterogeneous. But such an equilibrium cannot be guaranteed indefinitely it can only be helped to persist or be rediscovered because all reality appears to men as ruled by couples of opposites who find a momentary but not indefinite equilibrium [13], [14].

Finally, Alcmaeon about the phenomenon of death advances a double explanation, both physically *"Sleep is produced by pretreatment of blood from the veins…"* and philosophically *"Humans die for this because they cannot reunite the beginning* (Αρχή) *with the end* (*Τέλος*) *of the life".* This concept through a mathematical and astronomical form as the circle (κύκλος)who tends to explain the mortality of the body because the circle is precise and eternal as describes Philo of Alexandria, as the structure and movement as in the planets. It is not clear if he presented a cosmological model regarding opposing forces, but we still have a testimony about his views on Astronomy. His spiritual impact on Greek philosophical tradition has been considerable. Alcmaeon has probably influenced at a cosmological theory by Anaximander. From the testimonies offered by Aetius there is also an astronomical interest in Alcmaeon, but more than original hypotheses would have welcomed some interpretations of his time, for example by Heraclitus and Antiphon of Athens shared that the lunar eclipse comes from the different inclination of its cavity as the stars [5], [13].

Alcmaeon, the physician

As we have mentioned for Alcmaeon, the human being has a thought that could interpret rational sensations. Thus Alcmaeon was first considered the brain (Ἐγκέφαλος) as the vital centre of all this, and any alteration of the brain causes turbidity and an impediment to the sensation and our thoughts, so laying the foundations of neuropsychiatric sciences. Aristotle, Plato and Philolaus adopted his reasoning about the soul and the idea that intelligence is based in the brain. This encephalocentric theory of Alcmeon is in contrast with the cardio-centric equilibrium which supports the conception between the heartbeat, the blood flow thus between the body and the universe. He studies these perceptions and their reasonable interpretation of the brain and how they could be transmitted to the brain through the sensory organs by seeing, hearing, tasting, and smelling. Different sensations are explained based on the duality of the principles. So, for example, we perceive the odours because the nose as an organ of smell dissolves the smells contained in food or air with its heat and absorbs them with its humidity. The ear has an inner void that vibrates with the vibration of the inner air. Then there are two realities the outside world which stimulates perceptions and an interior that processes perceptions to understand and act to have the balance through the brain. Anyway, as we mentioned, human knowledge, both for things that do not directly experience that for things has a direct perception, can only come to hypotheses, approximations. But never to an absolute and truthful knowledge [15], [16].

To confirm his ideas used a method of direct observation and experimental testing dissections on animals (as others later: Aristotle, Diocles, Praxagoras, Erasistratus, Herophilus). He is the first anatomically observing the Eustachian tubes which are the ducts between the middle ear and nasopharynx. Thus he seeks to understand the anatomical paths of the nerves that bring the sensations to the brain that will call poroi *(Πόροι)* and makes a discrete description of the anatomy of the eye to understand the transmission of the image from its external path to internal path. These passages are merely transmitting sensations or other information

from the periphery of the body to the centre of the beard, and so he discovers the concept of the nervous system [17], [18], [19], [20].

Conclusions

Alcmaeon was one of the most important characters of the VI century BC. Multifaceted thinker, he improved the medicine offering a new point of view to understand the mechanisms determining the health status and the disease. He dealt a variety of physiology issues about the sleep, diet, death, and pregnancy. From the testimonies of Aristotle, Aetius and Rufus it seems that Alcmaeon had attention and played a particular role to the development of life in humans and animals not only for the period of puberty but also on the beginning of their life, especially for their nourishment, for example, the embryos in the uterus. Indeed, another singular thesis of Alcmaeon on the fetus is that it nourishes from all over the body like a sponge. Reported by Aetius, it turns out that Alcmaeon also connected the brain to the brain sperm formation.

Censorinus, a Roman grammarian, which refers to Alcmaeon about the explanation for determining the gender difference of the unborn reiterates the equality between male and female seed: the sex of the unborn depends on who has been received seed more abundant, if the father is born male, if the mother is born female [21], [16].

At last, Alcmaeon is also considered an inspirator of the Roman medicine, because of the influence of his thoughts on some medical school of that time [22].

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