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EXPERIMENTS IN GALEN'S WORKS

Galen accomplished various experiments so as to have a personal opinion for the examined subject. Characteristic is what he formulates in his work «*De semine, Cap. I*», «*I confess my passion, which I had through out my life, not trusting anyone, who simply says something, I myself have experiment that*»ⁱ.

Similarly he emphasizes in «*Hippocratis, De humoribus, commentarium A*», «*In Medicine, it simply mustn't be believed what the elders have said, but first try to check by experimenting and rationalizing and seeing if it is true or false*»ⁱⁱ. Also Galen in his work «*De sanitate Liber V, Cap XI*» emphatically notes «*The mind finds what is demanded and the trial reaffirms the truth*»ⁱⁱⁱ. Moreover in his work «*De placitis Hippocratis et Platoni, Liber II*» he remarks that «*Having exercised scientific methods we are able to know and distinguish true and false statements*»^{iv}.

Furthermore we present a few experiments of what is contained in Galen's books, which we intend to put together in a later study.

1. An experiment by which it is demonstrated that the heart is the source of the arteries' expansive power.

Galen experiments to prove that the heart is the source of the arteries' expansive power. Specifically in his work «*An in arteries natura sanguis contineatur, Liber, Cap. VIII*»^v, writes that when an artery is made visible by an incision so as to be able to bind it, a cut is made along it so that a tube can be inserted. Galen notes that the pulse of the arteries maintained even after the inserting of the tube, where as if you bind the wall of the arteries in the section where the inserted tube was, pulses will not be present in the outer part of the artery.

And Galen explains that if the ability of the pulse derived from the arteries then they would have pulse even after the binding. He further adds that from the heart power is dispatched to the walls of arteries, which creates the pulse and is not the outcome of substance which is sent through the cavity of arteries.

The same experiment is described in his work «*De anatomicis administrationibus, Liber VII, Cap. VI*»^{vi}.

2. By blowing into the trachea artery of a dead animal so as to prove the function of its cartilage and bonds.

Galen in his work «*De usu partium corporis humani, Liber VII, Cap. IV*»^{vii} mentions about the construction of trachea artery for which he notes that nature provide alternative cartilage not in full circles and membrane. He points out that if the trachea artery was only of cartilage it would not be possible with the inhaling and exhaling to move, to make smaller or bigger, condition which is due to the membrane part of trachea.

Galen points out that the above can be proven by simply blowing air into the trachea artery and observing its movements on an animal, which has just been killed. He would note then that the bonds of cartilage expand during the entrance of the air, whereas the bonds loosen up and fold during the expiration and the cartilage come closer.

3. Experimental evidence of Hippocrate's phrase that «Nature isn't taught anything by anyone».

Galen in his work «*De locis affectis, Liber VI, Cap. VI*»^{viii} writes that he experimented so as to see the truth of the supported opinion «*nature forms and perfects the body organs, without training them and puts them*

in operation». Specifically he writes that he operated pregnant goats and took the baby-goats without seeing their mother. He later placed them in an area where many bowls containing different contents such as wine, oil, honey, milk and other liquids and other with grain products and fruits.

They noted that the baby-goats after supporting themselves on their feet, shook of their birth liquids and then directed themselves to the bowls and smelled the contents but stayed at the one that contained the milk and therefore drunk it. And Galen characteristically writes that all observers cried out Hippocrates' phrase «Nature isn't taught anything by anyone» «*φύσις ζώων αδιδακτοι*», which is from Hippocrates' work «*De l'aliment 39*»^{ix}.

We further add another similar case, that Galen has in his work «*De usu partium corporis humani, Liber I, Cap. III*»^x.

4. The experimental approval of the medicine «Theriaca».

To find the therapeutic action of the medicine «Theriaca», which was believed to protect people from snake bites Galen followed his experimental tactic to have the proof. Up to then he notes that no human case had been recorded to have used theriaca as an antidote and to have died from snake bites. But because it was not possible to experiment on humans for the results of theriaca for snake bites, he experimented on animals.

Specifically Galen in his work «*Ad Pisonem de theriaca Liber*»^{xi} writes that he took roosters, and to some he gave theriaca and not to others he brought them in contact with snakes. He observed that the ones

that were not given theriaca diet immediately, where as the others which had been given theriaca, survived.

Galen further adds that the experiment which he applied can be used in the cases where one wants to make sure whether theriaca is in its natural form or has been tempered with, because at that time fraudulence of medicine was easy due to fact that medication was mainly made of herbs.

5. The experimental approval of the function of the ureterovesical junction.

Galen in his work «*De naturalibus facultatibus, Liber I*»^{xii} notes that Doctor Asclepiades (1st century B.C.) did not accept the function of the kidney in the transport of the urine through the ureter to the bladder, but supported that the urine as steam concentrated in the bladder. Galen disproves this belief with his experiments.

Specifically Galen recommends that one will note that the bladder is empty when one touches and bonds the ureters. In continuation if he unbinds the ureters the bladder will be filled with urine and if he binds the urethra and applies pressure on the bladder he will note that the urine does not return back to the ureters and kidneys. He continued his experiments and he noted that when he bonds the one of the ureters it is full of urine whereas the one that is left free brings the urine to the bladder. After that he made a cut to the swollen ureter and he noticed that the urine spurred out and filled the abdominal area.

Galen concludes, the cause as to why the urine does not return from the bladder to the ureters is that the ureters are inserted sideways in the wall of the bladder, as he has mentioned in his work «*De usu partium corporis humani, Liber V, Cap. 13*»^{xiii}.

6. Dissection of hogs after 3-4 hours of having been given flour and water to be able to see the content of its stomach.

Galen in his work «*De naturalibus facultatibus, Liber III, Cap. IV*», «*Περί φυσικῶν δυνάμεων, Βιβλίον Τρίτον, κεφ. δ'*»^{xiv} notes that many times he experimented on hogs by dissecting so as to see the condition of the food, flour and water which he had given three to four hours before. It was observed that the given food was in the stomach, adding also if the readers do the same they will find in the stomach the given food.

Galen adds that the food in the stomach is transformed according to the quality of the body which receives them. The pylorus of stomach is closed while there is peristalsis of the walls of the stomach and he continues that when digestion is complete the pylorus opens up to become the entrance of the food to the intestines.

7. Experiment in order to prove that the heart is independent from the brain.

Galen in his work «*De placitis Hippocratis et Platonis, Liber II, Cap. VI*», «*Περί των καθ' Ιπποκράτην και Πλάτωνα δογμάτων, Βιβλίον Δεύτερον, κεφ. στ'*»^{xv}, researches the relation of the heart to the brain which is carried out by arteries, veins and nerves of the neck. And to prove the independence of the heart from the actions of the brain he binds the vessels and nerves of animals' necks. He notes that the heart of the animal continues to function and all the arteries of the body have a pulse except the arteries which are above the binding.

Conclusion: From the above mentioned experiments it is ascertained that Galen made use of experiments in order to prove the physiological events and therefore he has been named the father of medical experiments.^{xvi}

- ⁱ C.G. Kuehn, Claudii Galeni, *Opera Omnia*, Lipsiae 1822, reprinted Georg Olms Verlag Hildesheim- Zuerich-NewYork, 2001, vol. 4, p. 513.
- ⁱⁱ C.G. Kuehn, ..., vol. 16, p. 77.
- ⁱⁱⁱ C.G. Kuehn, ..., vol. 6, p. 368.
- ^{iv} C.G. Kuehn, ..., vol. 5, p. 254.
- ^v C.G. Kuehn, ..., vol. 4, pp. 732-733.
- ^{vi} C.G. Kuehn, ..., vol. 2, pp. 646-647
- ^{vii} C.G. Kuehn, ..., vol. 3, p. 524.
- ^{viii} C.G. Kuehn, ..., vol. 8, pp. 442-443.
- ^{ix} E. Littre, *Oeuvres completes D'Hippocrate*, volume IX, p. 112.
- ^x C.G. Kuehn, ..., vol. III, p. 7.
- ^{xi} C.G. Kuehn, Claudii Galeni, *Opera Omnia*, vol. XIV, p. 215.
- ^{xii} C.G. Kuehn, , ..., vol. II, pp. 36-38.
- ^{xiii} C.G. Kuehn, , ..., vol. III, pp. 390.
- ^{xiv} C.G. Kuehn, ..., vol. II, pp. 155-156.
- ^{xv} C.G. Kuehn, ..., vol. V, pp. 263-265.
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