THE POWER OF SEMEN.
ARISTOTLE AND SOME GALEN'S FALLACIES

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ABSTRACT. In this paper, I try to demonstrate how critical empiricism and philosophical reasoning intertwine with each other and affected the development of medicine. It is a case study considering the problems of generation and semen in the writings of Aristotle and Galen *via* relationship between such concepts as matter, form, movement, change, causes and some others. The main question addressed in the paper is the reason of Galen's return to Hippocratic paradigm of two-semina (male and female). I argue that the reason is two-fold: 1) Different philosophical reasoning and erroneous understanding of some aspects of Aristotle's embryological model by Galen. 2) Empirical discoveries, which proved to be wrong. I demonstrate that Galen's understanding of form/matter relationship, and his view on matter as an underling principle conditioned his understanding of the notion of physical change, that allowed him to speak about conception only as quantitative mixture between equal substrata. Finally, I show that Galen's view on teleology and his limited understanding of formal/final *vs* efficient causes and their relationship forced him to claim the inadequacy of Aristotle's biology and necessitated Galen to introduce emendations in definitions of seminal faculties of genders and reproductive fluids.

KEYWORDS: Aristotle, Galen, semen, cause, teleology, biology, medicine, *foetus*.

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Introduction

Generation[1] is a process that, allows limiting (at least from one side) the scope of any kind of being, which comes-to-be and passes-away; and makes relevant any plausible philosophical account of that being. The question of how everything

[1] By generation, I mean the notion of *beginning*, widely used in ancient thought, e.g. by Aristotle (γένεσις) or Hippocrates (γονή); so for the purposes of simplification one can replace the word generation in this text with the word *genesis*.

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comes about, being primarily the issue of cosmology, evolved during the classical period into the attempt to provide a coherent account of the universe. The problem of *living* beings' generation in ancient physics and biology hinges largely on the attempts to trace the *arche*, which leads to the notion of semen as the source of a new life. It thus might be stated that to describe the process of a living being's generation in antiquity simply meant to answer the question: what is the nature of the semen?

The focus of the present paper is the problem of the *power* of semen and the conflict between Galen and Aristotle's understanding of this power within the discourse of ancient philosophy and medicine. By the *power* here I mean a range of notions that all serve to help to answer questions about the generation of species, heredity, offspring's resemblance to parents etc. To answer the question about the semen's power is thus to clarify the following issues: 1) In which manner is the offspring present in the semen? 2) What is the corporeal origin of the semen? 3) What is the role of parents in supplying the semen?[2]

The problem of semen had a long tradition in antique thought, and the most fecund period was that period containing the "debates" between Aristotle and Hippocrates. Since then, the Aristotelian model of demarcating functions of male and female in conception, and attributing the term semen only to male was widely accepted and had been dominant for some five centuries. Galen of Pergamon, in second century AD, at the outset of his treatise *Peri Spermatos* inquires: is it accurate to reckon the power of semen either as two principles (the material and the active) as Hippocrates supposed or only as efficient principle as Aristotle suggested?[3] Before I start considering this opposition and analyzing Galen's response, it is worth mentioning that though modern terminology allows us to speak about the semen only for male seminal fluid, in antiquity the term "semen" according to some authors (Hippocrates, Galen) could have been correctly applied to both male and female fluids. The discovery of ovum had happened only in the 19th century, before that understanding of conception was an elusive issue for medicine and philosophy. But the period of antiquity gave a deep insight into the comprehension of the nature of semen and conception. The supporting evidence and reasoning used in order to advocate one or another point of view provides fertile ground for philosophical investigation. The present paper is a case

[2] James Wilberding (2008, 407) states in his paper that the problem of semen (and, consequently, the formation of the living being) in antiquity can be confined to these three questions.

[3] Galen (1992) 65. I.1,1. Galen here deliberately gives a reduced definition of semen presented by Aristotle. Of course, he was aware of formal and final principles as attributes of the semen. I will deal with this issue later on.

study considering the problems of generation and semen *via* relationship between such concepts as matter, form, movement, change and some others.

1. An overview of Galen's critique

The overall drift of Galen's treatise *On Semen* can be summarized as a critique of Aristotle's concept of semen, followed by establishment of Galen's own doctrine. The conclusion of Galen's doctrine suggests that there are two kinds of semen: male and female; while the power of both *semina* is defined by material principal and efficient one as well. The reasoning in favor of the existence of the female semen and of return to *two-semina* theory in the works of Galen is two-fold. It consists of (a) empirical evidence and (b) philosophical argumentation

The philosophical argumentation represents two important issues for my further analysis. One of them is a novel (compare to Aristotle) understanding of *physical change*; the second issue was less articulated by Galen, but it is of a bigger importance and consequence for marked abruption with Aristotelian tradition – it is an erroneous understanding of *four causes* discourse in the Aristotelian embryology.

As for the empirical evidence, Galen holds an imperative that something exists only if it is observed, while plausible arguments for the existence of something are of a secondary importance.[4] Such a strategy was a product of a long development process when in the course of the classical period philosophical theories of human nature initially informed medical discussions, and then at a certain point medical empiricism reciprocally provided natural philosophy with new factual background. This superiority of empiricism for understanding of man was justified by historical development. Admittedly, even philosophers in late antiquity reached out to the help of medical empiricism simply because medical knowledge was much more developed than philosophical in questions of physiology. Owing to Hippocrates, and his divorce with merely philosophical speculations on the question of "ho ti estin anthropos" medicine in antiquity started to be considered as *techne* as opposed to *tyche,* where therapy and empiricism played a crucial role, inasmuch as *techne* necessarily requires the achievement of success only due to a certain deliberate procedure. Obviously, there were some objective reasons for such an approach to human nature, i.e. besides the speculative interest, philosophical curiosity, and heuristics, it was pain, diseases and death that actually forced physicians to tackle the problems of human body. The opposition to a purely speculative view of nature triggered the processes, which in the following centuries changed the entire understanding of the problem of

[4] Galen (1992) 65. I.1,2.

man thanks to the authors of the Hippocratic corpus, Diocles of Carystus (375–295 BC), Herophilus (335–280 BC), Erasistratus (304–250 BC) and others. After all, the discovery of ovaries by Herophilus had a great deal of impact on Galen's theory of female semen.

Galen seeks to define the power of semen through demonstration taken from experiments, and he attacks Aristotle in the following three directions:

1) The Aristotelian approach supposes that the roles of male and female are different and while female reproductive fluid provides matter, the male semen provides no material principle. Owing to the statement about the lack of material contribution from male, one might conclude in this case that the matter of semen is useless and it renders into redundant the presence of the semen in the uterus after copulation. However, Galen relying solely on observations during dissections states that male semen is neither excreted from the uterus after coition, nor remains there and evaporates[5] as Aristotle supposed.[6] Dissecting just impregnated animals, Galen saw that the uterus appeared to be wrapped tightly around the "foetus" and not inflated as was supposed to have happened in case of evaporation. Thus, material substratum of semen stays within the uterus.

2) Another batch of Galen's arguments and evidences aims to show that semen as material is more suitable for construction of arteries, veins and nerves but not blood (menstrual blood) as was suggested by Aristotle, therefore, the foetus cannot come from blood only.

3) Aristotle associated male and female with semen and nutriment, respectively. Galen, on the other hand, bearing in mind an example of plants and earth as nutriment suggested that the nutriment is not able to bring any creative modification, but only sustain, it can regenerate but it cannot produce vital organs. Therefore, Galen concludes there must be material contribution from male semen, and consequently he addresses the question about the status of female semen. Galen came up with the conclusion that both males and females produce semen which supply material and the formal principle for conception, and therefore the entire mechanism of generation of a living being, the question of heredity, formation of the individual are explained through the equal co-influence of both male and female.

The question at stake here is why did Galen, who had at his disposal rich observational data cast doubts on theory of Aristotle and refute it? I am by no means close to any positivist view on history of medicine, but it is clear that Aristotle's concept of semen and his model of male as an active principle which launches the process of gestation was much closer to modern embryological the-

[5] Ibid. 69-73.

[6] *GA* 737a 7-16.

ory (which says that the sperm is considered to be an active principle which penetrates passively awaiting ovum) than two-semina model of Galen. The modern theory of male contribution of nucleus and contribution of cytoplastic structure together with nucleus by the egg was foreshadowed by Aristotle in his determination of the roles played by male and female in conception. However, in the second century AD it was supplanted by a more "obsolete" theory of equal contribution of material principles. Why? My provisional answer is – because of a different philosophical reasoning and erroneous understanding of some aspects of Aristotle's embryological model by Galen. In what remains I am going to analyze these two issues in details.

2. Ancient theories of semen

Aristotle's views on the nature of semen and embryogenesis were motivated by puzzles ancient thought faced around the fourth century BC. These puzzles appeared insurmountable until Aristotle – with his developed philosophical discourse and having tackled such categories as change, entity (*ousia*), nature (*physis*), soul – forayed into the problem of seminal faculty and embryology, and produced more suitable solution for the problem of semen. It stands to reason to demonstrate this.

Anthony Preus claims that, "before the time of Aristotle, there was no one generally accepted theory of generation."[7] There was no coherent theory indeed, but the questions raised are worth considering, because they worked as an impetus for the arrangement of the powers which conditioned the formation of well-established theories. In general, our knowledge about ancient theories of the nature of semen comes from the first book of Aristotle's *Generation of Animals*, where he, in line with his well-known method, criticizes everything previously written in order to build something genuinely new.[8]

One of the oldest ideas about conception and the development of the body depicts the process through the analogy of the seed sown in the earth; in the secondary literature it usually appears as 'furrowed field theory'.[9] The earliest can be attributed to Aeschylus (*Eumenides*) and Euripides (*Orestes*), who compare

[7] A. Preus (1977) 65.

[8] A famous collection of pre-Socratic texts issued by Hermann Alexander Diels later revised several times and eventually published in 1934-1937 after another revision by Walther Kranz is another source of knowledge of ancient theories of semen. See: H. Diels, W. Kranz (2004). In terms of the secondary sources, earlier theories of the nature of seed and conception were best presented by Erma Lesky (1950), and Joseph Needham (1959). Two short overviews of ancient conception theories were presented also in M. Boylan (1984) 83-112; and in the aforementioned article by Preus.

[9] See: M. Boylan (1984) 85-87.

the mother to a field where seeds are sown. Anaxagoras seems to have supported this theory as well.[10] The extreme version of this view was the theory of preformationism, arguing that the complete body of the foetus is already assembled in the male seed. On the other end of the scale was the concept of parthenogenesis.[11] The obvious drawback to both theories was the difficulty to explain the resemblance of the offspring to the opposite gender.

Another theory proposed by ancient thinkers, which better explained the nature and source of the semen, suggested that both female and male provide semen, and whole parts of the body are involved in the process of generation. In accordance with this theory, the seed comes from virtually all parts of the body. The best known followers of such theory were Empedocles and Democritus. This view in modern science known as pangenesis, had become a well established concept after it was widely promoted by Hippocrates in his work *On Seed*.[12] He introduces the concept as follows:

"The semen comes from all humours, which is in man, and the strongest (τὸ ἰσχυρότατον) parts are separated from it,"[13] and then adds that "the semen is secreted from the whole body, both from hard and soft parts, and from the humours."[14]

There are several items of note on this passage. This pangenetic theory literally implies that all part of the body participate in the production of semen. The reason for such presupposition is a desire to explain the inheritance of acquired characteristics: the similar in elemental structure must come from similar. A would-be argument of a proponent of this view might look as follows: the hair come from hair and nails from nails, thus semen in order to generate is supposed to be everything at once: nails, vessels, arteries, bones; they are small and invisible, but they grow during gestation and become bigger.[15]

Of course, the lack of observational data required certain theoretical inference and it is this scientific intuition that eventually advances knowledge in its

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[10] *GA* IV.1, 763b30.

[11] Parthenogenesis is a form of asexual reproduction in which growth and development of embryos occur without fertilization. In animals, parthenogenesis means the development of an embryo from an unfertilized egg cell of the female.

[12] Term pangenesis was at first offered by Charles Darwin in the concluding chapter of his book *The Variation of Animals and Plants under Domestication* as a hypothetical mechanism for heredity. The pangenesis theory implies that the whole of parental organisms participate in heredity. He posited that atomic sized gemmules formed by cells would diffuse and aggregate in the reproductive organs.

[13] References to the original Greek text are made to the following edition: Hippocrate (1970).

[14] Hippocrates (1970) J3.1.

[15] For a similar argument see: H. Diels, W. Kranz (2004) 59B10.

historical evolution, but at this point, the proposed account suffers from a sometimes too incoherent character, and displays practical and methodological weakness. There are mostly two objections: 1) how do two complete organisms (one in each semen) become a single one after the mixture; 2) how do particles of the soft and hard parts of the body come together in liquid semen.

In an attempt to answer the first question, Democritus and Empedocles proposed that the bodies existing in the semina are torn asunder in order to mix halves in conception. The long-term consequences of this view are quite obvious; one is the difficulty to form the gender of the future foetus; another obstacle is that if two bodies were torn asunder in order to make one, there would be extra unused parts, which either should be of use for something or will be wasted. The waste of parts is something that goes against the general ancient understanding of nature and was not accepted.[16] The second question implies another difficulty: assuming that the semen comes from tissues and bones its transfer should be corpuscular, but if, on the contrary, the semen comes from humours, it means that it is formed in a liquid milieu. According to Hippocrates semen is matter and it transmits the information from parents to offspring by this matter. Bearing in mind three common embryological questions mentioned in the introduction to this paper, Hippocratic responses to them would state that: 1) the offspring is present in the semen in material way; 2) all parts of the parent's body are the source of the semen; 3) parents equally contribute to generation.

The point of equal material contribution raises relevant questions about mechanisms of heredity, resemblance to one of the parents and the choice of gender. The possible answers articulated by the authors of the Hippocratic corpus, Democritus, Empedocles and others, – suggesting the all these features of the individual are formed either due to the semen's location on the left/right side in testicles, or during gestation by the foetus' location on the left/right side in the womb, or influence of cold and heat – are inconsistent and controversial by themselves. Moreover, I argue that all theories covered by the term *pangenesis* are preformationist in their character. In order to be coherent, anyone postulating that the semen comes from all parts of the body should agree that this presupposition implies the idea that all parts are assembled in a shape of that body and that allows the further growth but no change, nor modification. The assertion that the parts are present in the body in a sort of potential form and then unfold gradually puts that theory in a different category.

[16] Some witnesses say that during his stay in Alexandria (where there was no prohibition for the dissection of corpses) Galen in order to prove or disapprove this point dissected wombs in his search of wasted parts of the body.

3. Aristotle

The person who boldly challenged the antinomy was Aristotle. Admittedly, he changed the course of scientific and medical thinking on the question of the nature of semen for at least five centuries. The major advantage that bolsters Aristotelian theory was the combination of scientific inference and observational data.

Within the broader critique of Hippocratic embryology and ancient pangenetic theory, which assumes that each part involved in the creation of semen comes from its perspective particular organ and contains the nature of that organ or its part,[17] there is one objection by Aristotle that Preus (1977, 77) concisely summarizes as follows: "it goes too far and not far enough". On one hand, the argument of Hippocrates asserts that the wide variety of materials must be present in the semen, and in this sense Hippocrates goes very far; on the other hand, however, he does not really explain how these "parts" are present in the material, or in other words, "it does not go far enough in asserting the degree to which a nature may be present in a particular material".[18] To be more specific: a body, when subdivided, consists of heterogeneous parts. For example: a head, limbs, a heart, a liver etc. are heterogeneous parts of the body; however, the further division of those parts produces certain parts, which remain the same even after the subdivision – homogenous parts (*ta homoiomere*). The next stage of this subdivision is the four elements (earth, water, fire, air) or humours (blood, phlegm, yellow and black bile). Hippocrates does not go far enough in explaining how a range of homogenous parts, impressive in its diversity can fit into the nature of liquid semen. While, according to pangenetic theories resemblance of un-like parts (of parents and offspring) is caused by use of the same like parts (homogenous), Aristotle in his dialectical refutation in the first book of *The Generation of Animals* proposed another explanation: the offspring's resemblance to parents is not so much of a material character but of a formal one. Simply speaking, it is the resemblance in the disposition of like-parts, that really makes the son's appearance similar to the father; usage of the same like-parts does not really make any similarity between parents and offspring. Aristotle says:

> And yet without this [assemblage] (ταύ της [τῆς συνθέσεως]) the parts would not have the resemblance (ὅμοια); so if there is something which sets to work later on to bring

[17]Regardless of the Hippocratic proponents, several Aristotelian objections always remain the same. If all parts of the body are scattered about in the semen how do they remain alive? If they are connected, there should be a tiny animal, which is, according to Aristotle, absurd. Even if we assume that this is true, Aristotle asks why the female does not produce female children on her own. See: Aristotle, *GA* 722b5-10.

[18]Ibid.

this assemblage about, then surely this something (τοῦτο), and not the drawing of the semen from the whole of the body will be the cause of resemblance.[19]

The use of the same skin and muscles does not necessarily make the face of Socrates similar to his father's face but it puts certain limits on what the face may look like. For example, it cannot look like a face of horse, because human face skin is hairless (to a known extent of course), it cannot look like a face of man with dark skin, because the skin of Socrates' father (presumable) was more pale, but what really makes the similarity of faces between Socrates and his father more justifiable is the assemblage of the skin in a certain inherited form; which is the disposition of muscles, tendons etc. This assemblage is not a material thing in effect because the disposition or the order of like-parts does not require a material factor. To be more precise, disposition of things requires some material for the things itself but not for their disposition. This disposition might be defined as a power, the power to arrange these like-parts. The power which carries this information requires limited material support, that is why Aristotle asks why one part of the living being cannot provide this power, the power to develop the simple substrate into a complete new individual. Such a substrate for Aristotle is blood, which as soon as concocted into semen possesses that disposition for arranging like-parts.[20]

Aristotle is credited for elaborating philosophical aspects of embryology and physiological as well. He considers blood to be the source of both female and male seminal fluids, and the formation of these fluids as a result of a succession in digestive processes. To be transformed into blood, digestive material (food) must pass three stages of digestion (πέψις): first in the stomach, second in the liver and finally in the heart. During the process of the third pepsis, food is transformed into blood in the heart. After that, blood goes into the brain, and upon cooling it is directed around the body circulating for various functions and needs. Michael Boylan, in a brief glossary of medical terms used by Aristotle, thoroughly describes the role and importance of the pepsis in Aristotle's understanding of digestive and reproductive systems, and points out two main results of pepsis: nourishment (τροφή) and side-product (περίσσωμα).[21] The περίσσωμα is the residue which can be either useful or useless. In case of a useful residue it goes to the gonads in order to be transformed into seminal fluids, which is the goal of this

[19]ἀλλὰ μὴν ἄνευ γε ταύτης [τῆς συνθέσεως] οὐκ ἂνεῖη ὅμοια. ταύτην δ' εἴτι δημιουργεῖ ὕστερον, τοῦτ' ἂν εἴη τὸ τῆς ὁμοιότητος αἴτιον ἀλλ' οὐτὸ ἀπελθεῖν ἀπὸ παντός. *GA* 722a35-b3. All translations of *GA* are adapted from Aristotle (1943).

[20]Semen is "either blood or the analogous substance or something formed out of these." (ἤ τοι αἷμα ἂν εἴη ἢ τὸ ἀν ἄλογον ἢ ἐκ τούτωντι.) *GA* 726b5.

[21] M. Boylan (1984) 95.

secretion.[22] All of the περίσσωμα is transformed into either the male seed or the female reproductive fluid (καταμήνια). As has been already stated according to Aristotle, only the male gonad is capable to produce the semen, whereas the female one produces καταμήνια, which certainly is involved in the formation of the foetus but has a slightly different function.

I believe that further understanding of the Aristotelian argument depends on a much broader context than just biology. The underlying philosophical concept for differentiation of male and female in terms of seminal faculty is the concept of physical change. The notion of natural change studied in his physical works is integral to the notion of generation in the species/genus sense. The equal status of similar seminal fluids presupposed by the Hippocratic corpus, according to Aristotle, puts certain limitation on what the influence of one seminal fluid upon another is like. If there is A and there is B, which both have equal status in terms of essence, quality, disposition etc., then it is less than obvious how they act upon each other in the mixture, and therefore when we deal with semen the question of heredity becomes acute. The like cannot exert influence on the other like, for it equates to exerting the influence upon itself. The starting premise, Aristotle takes for granted in his view on change is that, at least if only one of the objects is active but another is passive the change can happen. But what happens when one object acts and the second is acted upon? The answer we can find in the treatise *On Generation and Corruption* where Aristotle deals with problem of change. One object may cause the change in the other object if only they are un-like, for, similar objects are always unaffected by similar. At the same time, essentially diverse objects are also deprived of the possibility to act and to be acted upon each other, as for example, a straight cannot act upon a blue. In order an interaction to happen, the objects must be similar in one sense and different in the other, namely: they are supposed to belong to the same genus but to differ in species.[23] The straight and the curved can act upon each other, since they differ in characteristics but both belong to the same genus of geometrical objects. By the same token, male and female reproductive fluids according to Aristotle belong to the same genus of fluids, both are produced from the blood, but in order to perform the change (conception) should be demarcated in some way. Given that in relation to the species the genus is a shared ground of matter, therefore the opposite objects capable for change are the object of a similar matter but of a different form. In view of the identity of matter, the passive and exposed to the

[22] "The semen is a part of a useful residue (χρησίμου ἄρα περιττώματος). The most useful (χρησιμώτατον) of residues it that which is the last [produced] and from which each from the parts comes about directly." *GA* 725a11-13.

[23] *GC* I, 7, 323b 33-35.

change is able to take the form of the active. Therefore, the point of any interaction resulting in the change is the formation of the passive according to the form imposed by the active.[24]

I would eschew any comments on why Aristotle got settled with such a distribution of roles, but he does ascribe the passive role to female and the active role to male, and considers the mixture of seminal fluids as asymmetrical change where male semen is an active principle and female *katamenia* is a passive principle.[25] This conception for Aristotle is a paradigm case of idea of change, what is more, generation of a living being is a paradigm case of the general concept of generation where the principle of four causes (efficient, material, formal and final) together with his notion of hylomorphism are two components which are difficult to dispense with in a discussion on such an issue. Conception is a process of coming to be and a type of change, so Aristotle accommodates his view on conception to: a) his discourse of change as influence of an active principle upon a passive; b) his discourse of how a thing comes into being, i.e. due to the causes (an immanent material, form or pattern, source of change, end for the sake of which the thing is).[26]

In this sense, I agree with Anthony Preus who says that in conception and embryogenesis "the end [final cause] is continued existence of the species, and the species [an individual] is the form (*eidos*) present potentially in the matter from the female [material cause], actively [efficient] in the semen from the male [formal cause]."[27] To this point Aristotle says:

> However what happens, is just one would reasonably expect, since the male provides the form and the source of change (τό τε εἶδος καὶ τὴν ἀρχὴν τῆς κινήσεως),[28] the female provides the body and the matter (τὸ σῶμα καὶ τὴν ὕλην), just as in coagulation of milk, the milk is the body, and fig-juice or the curd is that which carries the source for assembling…[29]

Importantly, I do not think that Preus thinks that the material cause of the foetus – female reproductive fluid – does really provide any formal cause ("the species [an individual] is the form (*eidos*) present potentially in the matter"). This simply should be equated with what can be further inferred from Aristotle's view on physical change. When the fire warms up, it imparts to an object to be

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[24] *GC* I, 7, 324a 10-11.

[25] Probably the following papers might be of interest for those who would like to know more about this problem: M. Horowitz (1976) 186-213; J. Morsink (1979) 83-112.

[26] Aristotle, *Metaphysic* 1013a 24-32.

[27] A. Preus (1977) 78.

[28] I translate the word κίνησις as a *change* but not a *movement* deliberately. See hereafter.

[29] *GA* 729a 9-13.

warmed the form of heat, which the fire possesses by definition, as a result, owing to the form of heat, that which initially was cold becomes warm, i.e. it switches from one state to the opposite one.[30] This is rather distant example, but I have included it to show that the cold adopts the form of heat only because it itself possesses that form in potentiality, the active implements in the passive the possibility of acquiring the form. Similarly, the female reproductive fluid, being a passive matter, receives the source of change from the semen, together with the form inherent to the source of this change, but only that type of form which female *katamenia* can potentially accept. The fact that a woman cannot conceive from a horse[31] is explained in this sense by inability of *katamenia* to adopt the form from horse's semen. This form is not potentially in the female seminal fluid. On the contrary, a mare can be fertilized not only by a horse but also by a donkey, because the form of donkey is potentially in mare's menstrual fluid.

The generation of the human being can be presented in this sense as a movement which brings the power of form to the matter, and the union of the form with the matter brings about energy (*energeia*) which is a real living being. This energy is a foetus, driven by a vegetative soul, and the foetus from this point onwards develops epigenetically, forming first essential organs and evolves gradually into mature foetus resembling the species. Again, this epigenetic development is caused by: the vegetative soul, previously formed parts of the body, and environment (female *katamenia*).[32]

Summing up this part, Aristotle introduced new understanding of conception aiming to overcome the difficulties leading the pre-Socratics and the authors of the Hippocratic corpus to an impasse. In order to avoid the difficulty of how two batches of matter (which are basically preformed organs) act upon each other; how they form one individual out of two preformed organisms; and how all range of materials which is in the human body can fit into a liquid substratum of semen Aristotle suggested:

1) a foetus is developed gradually from simple material source which carries the information about the species and the individual,

2) this information is not only matter but primarily some power,

3) these acting principles of male and female seminal fluids should be differentiated substantially, female is a passive matter and male is an active principle that activates the change and supplies the form of the species (the form that matter is potentially able to take). Owing to the difference in functions

[30] *Phys*. I, 5, 188b 22-24; 7, 191a 12–15.

[31] Although centaur is quite a phenomenon.

[32] Ibid 734a20.

Aristotle calls only one of the reproductive fluids as semen and the other as only nutriment.

4) The inheritance of some specific personal traits is due to pneuma which is supplied to the form (male) and matter (female) in reproductive organs.[33]

The theoretical basis or such conclusions is the concept of physical change and four causes discourse. Both of these principles were not shared completely by Galen.

4. Galen's critique of Aristotle

In addition to what had been said in the introductory and the first part of the paper, – that the reasons to return to two-semina model, and to restore the importance of matter for male semen in Galen's thought were some observational data and physiological arguments – there are two philosophical reasons which have not been scrutinized in literature so far.

To fill out Galen's theory of semen and embryology, I must say that he clearly sides with epigenetic model of Aristotle and confirms that the semen is produced from the blood after *pepsis*. There are four periods of *epigenesis*: 1) a compound semina with prevailing physical features of semen as substratum ; 2) a foetus with some organs such as, heart, brain, liver unshaped but already present in a certain solidity and considerable size 3) the foetus in which these three organs have been formed and some of the others appear 4) a child, with complete physical structure.[34] Galen is not happy with Aristotelian point that semen does not provide matter, but just form and source of change; because from this logic the conclusion stems that physically everything in the foetus is formed from the *katamenia* which essentially is blood. As has been mentioned earlier Galen insists that blood, due to its elemental characteristic, is not able to produce three vital organs from which everything begins: arteries, veins and nerves. Essentially they resemble the matter of semen, and have to be produced from the semen.[35] This insistence on the necessity of something's coming about only from something of a similar type is a starting point of diversity between Galen and Aristotle. For Galen, the similarity between physical characteristics of semen such as white, thick and viscous and physical traits of these three organs, which are bloodless,

[33] I have not considered the phenomenon of pneuma and its role in Aristotle's account because a detailed examination of this would take us too far afield to pursue here. So, it is best to have recourse to what is brief but relevant: the movement of pneuma in mens and semen resemble the movement in the parents and when they meet, one gains mastery and the other is defeated. Hense, the resemblance of the offspring to parents is due to the "pieces" of mastered pneuma.

[34] Galen (1992) 93-95, I,9,2-10.

[35] Ibid 105, I,11.

thick, hollowed out and advancing to a great length without breaking, immediately suggests that arteries, veins and nerves can be produced from the matter of semen only.[36]

Supporting reasoning of this argument is that similarity between a produced and a producing does not stem only from formal disposition, which was one of the innovations of Aristotle, but it happens also due to the use of the same matter. For the sake of experiment Galen accepts Aristotelian model, he concedes that the power of semen, the form/disposition of matter is a source of similarity but, as to the question about resemblance to mother, he, contrary to Aristotle, does not see any other way than to suggests that it is caused by the matter:

> Is it the nature of the power that mould the foetus to make the eye and nose and eyebrow and each of the other parts, but the nature of the matter to make the nose aquiline or snubbed?...[37]

and then he answers

> the nose is made by the artisan but the straight nose is produced by the matter.[38]

Thus, contrary to Aristotle, Galen argues that similarity can also be due to the matter but not only form. In this sense similarity comes from the same parts, dissimilarly comes from different parts. The difference in parts (ἡ δὲ κατὰ τὰ μόρια διαφορὰ)[39] makes someone sub-nosed or hook-nosed. The conclusion about material difference in parts might be justified by the use of the word *to morion* which bears the meaning of a material substratum. Well, to do justice to it I must admit that the phenomenon of snub-nose is a material object which has a snub form. Yes, form. Then, one would wonder why Galen says that it is due to matter? Unlike Aristotle who stepped on a way of "idealism" arguing that the form is not only a creative principle towards the matter, but also a superior one, Galen committed himself to a more moderate position. This example of matter that causes similarity of form demonstrates that form for Galen is an inherent attribute of matter and cannot act without the matter. For Aristotle, in embryology, the definition of form must counterpredicate with what it defines, although not everything what predicates the phenomen (matter) is its definition. Galen adds an amendment to the second part. The matter for Galen predicates form and defines it. The matter is a superior source for change, though it acts together with the form.

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[36] Ibid 83, I,5,16-17.

[37] Ibid 157. II,1 52-53.

[38] Ibid 159. II,1 55.

[39] Ibid 158. II,1 56.

Having done these modifications in the concept of seminal fluid, that it is both matter and form, Galen additionally holds that offspring resemble each of the parents by virtue of a cause common to both. This cause, common to both should affect each other somehow and in the mixture generates a foetus. Categorically this syllogism tells that similarity to both is conditioned by the same source shared by both parents. In this way it seems to be logical to say that in order to present a coherent account of conception, the change has to be done in one of the Aristotelian premises:

a) Semen is only from father,
b) menstrual fluid is only from mother.

Even the boldest would hesitate to argue that not only female excrete the menstrual fluid. Galen concludes both male and female provide semen. It means the semen, which is as male as female and which is a power and a matter at once.

In this way, contra Aristotle, conception for Galen is a physical process which would be less than obvious for Aristotle. Namely, the female and male semina for Galen possess a number of principles, which strike by their equality. They come from the same genus, species, essence, quality. Thus, contrary to Aristotle, for Galen conception is a type of change which occurs between substantially same types of sources. Yes, their form can be different; female sub nose can meet with aquiline nose, but owing to the similarity of the rest of traits is not clear how they will affect each other. For Galen there is no problem in a possibility of A to be influenced and changed by B which is equal to A and considers the mixture of two seminal fluids not as a qualitative change but as quantitative one, where both the male and the female undertake equal roles. Therefore, given the reasoning Galen uses, and a type of physical change that he admits, it remains unclear how he copes with the problems of heredity which become pressing.

Another point of divergence which made Galen to claim the existence of female semen is Galen's treatment of the Aristotelian doctrine of four causes in respect of embryology. There are several places in *Peri Spermatos* where Galen expresses rather interesting interpretations of Aristotle's concepts. Galen points out, that on the one hand Aristotle attributes too much power to the semen (male), and defines its role as an agent which molds the matter and shapes the foetus, then as Galen mentions, a little later Aristotle having forgotten these things fails to notices that he gives to the matter (female) as many power as earlier gave to semen.[40] In other words, on the one hand Aristotle overloads the male semen with functions and leaves the female the role of passive receiver, but on the other hand, according to some other places from the text, it is actually

[40] Ibid. 155, II,1,58.

female who does everything. What is the hidden meaning behind this critique of Aristotle by Galen? The first possible explanation is again the insistence on matter as the only creative principle of generation and formation. Aristotle says that male is an agent but the lack of matter renders the male into an inadequate agent to perform such a change as conception and to provide further growth of the embryo in the course of gestation. I will try to show that Galen here speaks about something different; namely such a view of him is caused by a failure to grasp the point of the Aristotelian teleology.

Accompanied by a search across the works of his successors, the further analysis of the Aristotelian treatises reveals a certain inconsistency in his understanding, and underpins two basic approaches to the application of causalities to embryology. The material contribution of the female is something that has been clearly stated in biological oeuvre of Aristotle. The crucial role attributed to the female seminal fluid should not be underestimated because it contains potentiality, and actuality is directly restricted to the nature of this matter. As opposed to this, the nature of the male semen may seem less clear, even within the short definition in the passage already quoted from *GA* 729a 9-13.[41] The phrase τό τε εἶδος καὶ τὴν ἀρχὴν τῆς κινήσεως evokes certain confusion, because formal and efficient causes coincide and are present in one place simultaneously. How close they are and what does this proximity mean for us? Efficient cause acts, and formal cause defines how this efficient cause acts.

Things that come to be, come to be either by nature, by art or spontaneously. A human being comes about not accidentally, but due to causes. Biologically speaking, the cause of conception is fertilization of ovum by semen, which triggers epigenetic process of development. In terms of Aristotle, conception is a mixture of active semen and passive *katamenia*. As Devin Henry claims that for ancient people, the self-organization of a foetus was a source of unceasing wonder.[42] One of the questions of this curiosity is why after all we have got a human being? Why does something unpredictable not happen? Why is it that a puppy will not be born to a man and a woman? Why does man (as a parent) predicate a new born man?

The question of predication of one thing of another is a question about causes. It is a question about final cause! For Aristotle the end accompanied by the active agent and passive agent are three canonical invariants of any kind of physical change. If nothing interferes the process of change invariably would reach the

[41]"However what happens, is just one would reasonably expect, since the male provides the form and the source of change (τό τε εἶδος καὶ τὴν ἀρχὴν τῆς κινήσεως), the female provides the body and the matter..." *GA* 729a 9-13.

[42] D. Henry (2005) 1-2.

only possible outcome. The same with generation, if no external or internal powers interfere, a human being will be generated. I like how Mohan Matthen puts it: "Final causes are not additional influences over and above power, but are built right into the specification of powers".[43] In Aristotle's physic every cause is teleologically specified, but they are specified in different degrees.

Let us take recourse to the material cause. As has been said, predication of one thing of another is a question about causes, then as to the matter, the question is why the matter is some definite object. A pile of matter itself, owing to its characteristics can limit the scope of the definition, because if there is a pile of tissues, tendons, bones, etc. the present object is not a tree or a table, because both of them are wooden, and the matter which was at disposal does not allow having a wooden object. At the same time, from the pile of the very same matter (tissues, tendons, bones) it would be difficult to ascertain the essence of the object, since it can be a man or an animal. In the second part of this paper I demonstrated that for Aristotle, the matter can be affected by the form which it is capable to adopt. Therefore, when we try to define the end we deal with form.[44] Consequently, the formal cause is much more teleologically specified than the material one, and even more than efficient.

In my description of coming to be of a living being as a paradigm case of generation I used the words of Preus that the final cause is a continuation of species, and a formal cause is a concrete species.[45] The formal cause bears the source of this continuation of species and a concrete species is a link in the chain of this continuation. Thus, the final cause is coupled with the formal one in the male semen and they both rule over the efficient cause,[46] while all of them are of supreme nature to material cause, for it is much more important what is produced than from what material it is produced.

The gathering of three out of four causes in male semen makes Galen to assert that Aristotle does attribute too much power to the semen (male), as an agent which starts the change in the matter and moulds in accordance with the final (already carried in the semen) form. Then why does Galen accuse Aristotle of limiting the actual authority and responsibility of male semen and of giving to the matter (female) as much power as earlier Aristotle gave to the semen? The key to answering this question is in the embryological model, which Galen uses to describe the Aristotelian view on gestation. The Aristotelian concept of

[43] M. Matthen (2007) 161.

[44] *Physics*, 1041b 4-9.

[45] A. Preus (1977) 78

[46] *On the Parts of Animals*, 639b11-13.

generation resembles, according to Galen, a model of a puppet, where the semen triggers the process that then is able to move on its own.

And yet Aristotle does not permit the menstrual blood to share in the quality from the semen, he always concedes only a beginning of motion, as though to puppets (ὥσπερ τοῖς θαύμασιν), which, while preserving their own structure from the mere receipt of that sort of beginning are able to continue moving for a very long time.[47]

As I see it, this puppet is an example of some entity that is able to perform mechanical moves sequentially, and which in the course of this further move is devoid of any external object of applied force. The problem of analogy between mechanical puppets and embryological models in antiquity and late antiquity was notably studied by Devin Henry. He points out three main types of puppets which were of use in the classical understanding of self organization during embryogenesis: 1) marionettes (limbs are moved independently by manipulation of strings); 2) mechanical puppets (motion is generated externally by pulling a single cord); 3) self-moving *automaton* (an external movement triggers the chain of physical gears, which then move).[48] For example Simplicius adopted the model of a mechanical puppet, obviously Byzantine theologians would vote for the marionettes, but further readings of Aristotle commentators who lived at the same time roughly as Galen did reveals that the self-moving *automaton* was a widely accepted view on Aristotle's embryology. Alexander of Aphrodisias is one of representatives of such understanding. According to this model of self-moving *automaton* the development of embryos is a succession of connected movements where the source of the current link of the chain is the change in a preceding link. Once this process was launched but then it moves on its own and initial external power is only a source of movement for the first gears but not for the following. Projection of such model onto embryology means that male semen does not carry the whole information about the species but only initial set of information. Devin Henry advocates this view and as a supporting evidence brought the quotation from Simplicius who in turn quotes Alexander:

> But when the initial principle has been implanted in the matter which is receptive of both the principle and the things that are to come into being by its agency and from it, this thing (the principle that was implanted first) produces of itself that which is itself productive of something determinate, while what comes to be from it in turn produces another thing; for each of them is itself both productive of, and capable of setting in motion, the thing which comes after...[49]

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[47] Galen (1992) 83-84, I,5, 24-25

[48] D. Henry (2005) 3-4.

[49] Alexander *ap.* Simplicius *in Phys.* 310,36-311,19, 29-30. Taken from: D. Henry (2005) 11-12.

Unlike this model, the analogy of the mechanical puppet does not confine the role of sperm to a starting point but also allows it to account for the motion up to the end of the development of the embryo. Galen, from the outset of his treatise, notes that as to his view Aristotle holds that the semen provides a beginning of motion and does not qualify the semen to form any part of the animal.[50] They are formed by other parts of the body with the support of *katamenia* and guidance by a vegetative soul. This point that, according to Aristotle, semen 'has nothing to do' with further development of the foetus goes all the way down in *Peri Somatos*. This for Galen means that foetus does not come from the semen, but actually from *katamenia*, which takes the principle of movement from semen. Therefore, Galen concludes that there is a conflict of efficient and final/formal causes in Aristotle: on the one hand Aristotle delegates many tasks to semen due to his treatment of formal and final cause, on the other hand he limits the role of the semen excessively, stating that it is just an impetus and grants too much authority to female reproductive fluid. It is this conflict, I am convinced, which was the second philosophical motivation that forced Galen to return to two-semina model. Aiming to restore the balance Galen states that male semen also possesses matter and doing this he extends the authority (efficiency) of semen throughout the whole period of gestation, at the same time he argues that there is female semen, which also supplies the matter and form, thus he alleviates the load of female, and makes it equally responsible for gestation as male semen.

The irony is that Galen ventured upon his argumentation and critique of Aristotle with partly false partly dubious interpretations of Aristotle. First, to the excessive limitation of the role of male semen, there is a difference in understanding of self-moving *automaton* between Galen (together with Alexander) and Aristotle himself. On this occasion I again refer to the paper of Henry, who points out that Aristotle does not think that the development from fertilized *katamenia* up to an adult embryo is a causal sequence. It is not a sum of changes but one continuous change. Based on analysis of *GA*[51] D. Henry shows that for Aristotle, "the movement of each part owes its existence to the execution of a single developmental programme and not to the agency of each other".[52] In a word, the semen is an agent, which although being chronologically a distant cause of formed in late periods of gestation organs still is their source and efficient cause.

[50] Galen (1992) 65. I,1.

[51] For example: *GA* 734a25-33.

[52] Henry (2005) 40.

Second, Galen is reticent on this point, but it seems to me that his understanding of the primacy of the final/formal cause is dubious. The teleological account of Aristotle does imply priority of causes in terms of sense, but not in terms of sequence. For Aristotle, the point of teleology is that the goal is not perceived as a final form in the course of the development, it is not a Platonic Form. Indeed, it is supposed to be reached but temporally it is not of primary character. I suggest that Galen got confused on this sense and took logical priory for temporal one and assumed that semen carries from the very begging the original plan (already implemented) and at the same time it is only initial movement. So, male is credited with everything but actually provides nothing except a single blow.

Conclusions

In this paper I tried to demonstrate how critical empiricism and philosophical reasoning intertwine with each other and affected the development of medicine and biology. The period of late antiquity is considered to be the time when, after a prolific period of development of medical empiricism, medical science started to provide natural philosophy with new factual grounding that in turn sparked fecund philosophical discussions. Galen frequently appeals to dissection and anatomical observations as to a legitimate source of knowledge; however, some such discoveries were wrong. It is true that in case of the seminal faculty problem new discoveries led Galen astray, for the moisture discovered in ovaries was wrongly taken for ovum. But I do not think that it was the only source of his confusion.

Despite his preference of empirical demonstration to plausible arguments Galen does support his physiological observations with pertinent philosophical arguments. It is Galen who is credited for reconciliation of philosophy with medicine among the classical physicians. In this paper first, I demonstrated that Galen's understanding of form/matter relationship, and his view on matter which is an underling principle conditioned his understanding of physical change,[53] what allowed him to speak about conception only as quantitative mixture between equal substrata. Importance of matter and the conviction that equal material contribution of genders is a must in embryogenesis resulted in Galen's assertion that females supply not only semen but also *katamenia,* which is the source of germ's nutriment in the course of gestation.

Second, Galen's view on teleology and his limited understanding of formal/final – efficient causes and their relationship forced him claim the inadequa-

[53] Galen's view on matter is pretty much stoicized, but this is an issue to be addressed in a separate paper.

cy of Aristotle's biology and necessitated Galen to introduce emendations in definitions of seminal faculties of genders and reproductive fluids. The fact that Galen was not alone in supposing that for Aristotle embryogenesis is a causal sequence (I mean that Alexander, his contemporary, was of the same delusions) only supports my reasoning that in was difficult for Galen to dispense with philosophy while making final conclusions about physiology.

References

Primary sources

Aristotle (1965) "De generatione animalium," in H. J. Drossaart Lulofs, *Aristotelis de generatione animalium*. Oxford: Clarendon Press, 1-204.

——— (1943) *Generation of animals*, with an English translation by A. L. Peck. Harvard University Press.

——— (1966) "De generatione et corruptione," in C. Mugler, Aristote. *De la génération et de la corruption*, 1-74. Paris: Les Belles Lettres.

——— (1964) "Historia animalium," in P. Louis, *Aristote. Histoire des animaux*, vols. 13. Paris: Les Belles Lettres.

——— (1956) "De partibus animalium," in P. Louis, *Aristote. Les parties des animaux*. Paris: Les Belles Lettres.

——— (1924) "Metaphysica," in W. D. Ross, *Aristotle's metaphysics*, 2 vols. Oxford: Clarendon Press.

——— (2000) *Metaphysics,* translated by W. D. Ross. Adelaide: University of Adelaide Library.

——— (1950) "Physica," in W. D. Ross, *Aristotelis physica*. Oxford: Clarendon Press.

Diels, H. and W. Kranz (2004) *Die Fragmente der Vorsokratiker, griechisch und deutsch*. Zürich: Weidmann.

Galen (1992) *On Semen*, edition, translation and commentary by Phillip de Lacy. Akademie Verlag GmbH, Berlin.

Hippocrates (1970) "On Semen," in Robert Joly, *Hippocrate*. T. 11, *De la génération; De la nature de l'enfant; Des maladies IV; Du foetus de huit mois.* Paris: Les Belles Lettres.

Secondary literature

Boylan, M. (1984) "The Galenic and Hippocratic Challenges to Aristotle's Conception Theory," *Journal of the History of Biology* 17, 1, 83-112.

Henry, D. (2005) "Embryological Models in Ancient Philosophy," *Phronesis* 50.1, 1-42

Horowitz, Maryanne C. (1976) "Aristotle and Women," *Journal of the History of Biology* 19, 186-213.

Lesky, E. (1950) *Die Zeugungus- und Vererbungslehre der Antike und ihre Nachwirkung*. Mainz.

Matthen, M. (2007) "The four causes in Aristotle's Embryology," *Apeiron* 22, 159-179.

Morsink, J. (1979) "Was Aristotle's Biology Sexist?" *Journal of the History of Biology* 12, 83-112.

Needham, J. (1959) *A History of Embryology*. New York.

Preus, A. (1977) "Galen's Criticism of Aristotle's Conception Theory," *Journal of the History of Biology* 10.1, 65-85.

Wilberding, J. (2008) "Porphyry and Plotinus on the Seed," *Phronesis* 53, 406-32.