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FROM MYTH TO SCIENCE  
A SHORT SURVEY ON HEREDITY AND ITS CAUSES IN  
ANCIENT GREECE

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SUMMARY

*In this contribution, I deal with the notion of “cause” concerning hereditary diseases in ancient Greece. A notion of hereditary disease is already foreshadowed in myths, where guilt is often depicted as a pathologic contamination (miasma) affecting both the individual and his offspring (ghenos). The notion of miasma especially concerns diseases whose signs are not visible: in such cases, either gods or maleficent daemons were believed to harass human beings and inflict them punishments that took the shape of diseases. Contamination mainly spreads itself by means of blood-shedding: the slaughter of kinsmen (especially the murder of one’s parents) was widely considered as a main cause of mania (for instance, in Aeschylus’ Oresteia).*

*The Hippocratic treatise On the Sacred Disease traces the boundaries between science and the notion of the daemonic origin of diseases, even if both are presupposed by some Vth century authors (for instance, Herodotus). In the Hippocratic medicine, humors seem to be the actual vehicle of heredity, while on the other hand, likenesses between parents and children find an explanation in the doctrines of bisexual semen and panspermia (De genitura pueri). Therefore, some features of both parents can be found in their children, and affect their health as well. This explanation is no longer acceptable if the existence of a female semen is denied, as by Aristotle (De generatione animalium). For Galen (De semine), likenesses between children and parents are due to the prevalence either of the father’s semen,*

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*or the mother's one, when female and male semen mix together in the womb. The mixture will cause the likeness of each part in the child's body to the parent whose semen is prevalent. On the other hand, the development of the embryo is strongly dependent on the parents' conditions, and on diseases affecting the mother's womb.*

The notion of heredity<sup>1</sup> can be analysed in different kinds of literary texts (from poetry to medical treatises), for what concerns both the troubles involved in generation (either the possibility or the impossibility of generating, the latter to be considered as a “deviation” from the norm), and the “products” of generation itself, which clearly show some features of their parents, and in some cases even the same health conditions as them.

### *Miasma and Heredity*

Already before the birth of “scientific medicine” with the Hippocratic texts, a notion of hereditary disease is foreshadowed in myths, where guilt is often depicted as a pathologic contamination (*miasma*) affecting both the individual and his offspring (*ghenos*). The notion of *miasma* especially concerned diseases whose signs were not visible: in such cases, either gods or maleficent daemons were believed to harass human beings and inflict punishments on them that took the shape of diseases<sup>2</sup>.

Within the notion of *miasma*, the issue concerning the hereditary causes of diseases can be considered under at least two different points of view. In the first case, individuals have to cope with the impossibility of generating as a clear and extremely dangerous sign of epidemic diseases. In the second one, the shedding of blood - especially parental blood - defiles the slayer as a *miasma* that manifests itself as a real - tangible - disease.

The impossibility of generating is represented for instance in the λοιμός (“plague”)<sup>3</sup> in Sophocles’ *Oedipus Tyrannus*. This plague

tangibly represents the “genetic” guilt of Oedipus, the unwitting murderer of his father, his mother’s husband, by whom he in turn generates some children. The tragedy begins with a plague afflicting Thebes, which not only spreads death, but the impossibility of generating as well. Actually death replaces life: the women’s childbirths are - oxymoronically - “childless” (τόκοισίτε / αγόνος), and everything becomes unfruitful<sup>4</sup>. Later on (171-174), the earth is said to be unfruitful, and the women’s labours are in vain, since either they give birth to stillborn children, or they die themselves (according to the meaning associated with τόκος)<sup>5</sup>. Mourning and labour pains are mixed together in a singular way to signify that generation leads to death, and society seems unable to come up with a solution.

However, contamination mainly spreads itself by means of bloodshedding: the slaughter of kinsmen (especially the murder of one’s parents) was widely considered as a main cause of *mania*. In Aeschylus’ *Choephoroi* (278-296), Orestes claims that an oracle has ordered him to avenge his father’s slaughter brought about by Clytemnestra, Orestes’ mother. If Orestes refuses to murder his mother, Apollo’s wrath will reward him with “the stormy bewilderments of blindness” (272, δυσχειμέρους / ἄτας). The Erinyes of paternal bloodshed will show themselves in the frightful evils that will harass the son who withdraws himself from revenge: “diseases assailing the flesh with fierce jaws (leprous eruptions)” (279-280, νόσους, /σαρκῶν ἐπαμβατήρας ἀγρίαις γνάθοις), “ulcers devouring all that once was the body; white strips rising from the disease” (281-282, λιχῆνας ἐξέσθοντας ἀρχαίαν φύσιν<sup>6</sup> / λευκάς δὲ κόρσας τῆδ, ἐπαντέλλειν νόσῳ, ed. West)<sup>7</sup>.

Defilement shows itself in the shape of frightening and repulsive sores that completely destroy the person affected by them, after driving him away from society. The word λιχῆν can also be found in *Eumenides* (785): the Erinyes, defeated by Athena, state that they will let a poison flow from their hearts, which will make the

earth unfruitful (782-784, μεθείσα καρδίας /σταλαγμὸν χθονὶ / ἄφορον). This poison will generate “a leafless, childless sore” (785, λιχὴν ἄφυλλος ἄτεκνος). Human laws have deprived the Erinyes of the honours bestowed upon them by the divine law that establishes the guilt-defilement-curse sequence, one after the other, so that such demons make both plants and animals unfruitful. This stain also spreads to human beings.

Family is the clot of both every evil stemming from guilt against itself, and every remedy (Aeschyl. *Ch.* 471-475, “treating tents are within the house; they can find a remedy themselves by means of raw, bloody fight, without any other bringing it from the outside”, δώμασιν ἔμμοτον /τῶνδ’ ἄκος<sup>8</sup>, οὐδ’ ἀπ’ ἄλλων /ἔκτοθεν, ἀλλ’ ἀπ’ αὐτῶν, /δι’ ὠμᾶν Ἔριν αἵματηράν). It is a painful treatment, that heals the family from within.

The wound or sore is opposite to generation: it only gives birth to evil, both in its metaphorical and in its proper meaning, as it also appears in medical texts. For example, in Hippocrates’ treatise on *De morbis mulierum* (133), an illness is described that is marked by swelling of the belly and breasts, and a duration of seven or eight months, which would make it similar to a pregnancy; one of the symptoms is the appearance of growths in the breasts that do not suppurate, causing hardening, followed by the rise of occult ulcers (καρκῖνοι κρυπτοί).

Agamemnon’s blood, that has been shed on the earth (*Ag.* 1018-1021), turns out as defiling in the *parodos* of *Choephoroi* (66-73), since it must be avenged by means of further defiling bloodshed. The shedding of consanguineous blood appears as an exception to the rules of nature: it neither flows away, nor seeps into the earth, but forms a clot (67, πέπηγεν οὐ διαρρύδαν) and remains visible, crying out for vengeance. At the same time, the guilty person is upset, for his guilt takes the shape of a persecution and a disease that cannot be healed. These verses in *Choephoroi* also foreshadow generation,

since the blood does not seep into the earth, instead forming a clot that will cause further defilement.

*The Hippocratic treatise De morbo sacro*

The notion of guilt as the cause of the inheritance of evil disappears with the Hippocratic treatise *De morbo sacro*, which traces the boundaries between science and the notion of the daemonic origin of diseases. The treatise grounds the aetiology of diseases in Hippocratic medicine itself, strongly denying that diseases have a divine and supernatural origin, and stating that their causes are uniquely natural ones. The sacred disease is considered by the author as the paradigmatic disease, so that an entire book is devoted to it, in order to establish the methodological and gnoseological assumptions on which the physician can ground his enquiries on every kind of disease. The sacred disease is not different from other diseases: a “sacred” disease is one whose cause cannot be explained, but if the physician thinks that it is really so, his approach cannot be considered a rational one, and he appears in no way different from the *ἀγύρται καὶ ἀλαζώνες* strongly criticized by the author.

Hippocrates states that epilepsy – like any other disease – is hereditary (“depending on *ghenos*”, § 2, ἄρχεται δὲ ὡσπερ καὶ τᾶλλα νοσήματα κατὰ γένος) and congenital (5, 1, “it rises when the embryo is in the womb”, ἄρχεται δὲ φύεσθαι ἐπὶ τοῦ ἐμβρύου ἔτι ἐν τῇ μήτρῃ ἐόντος). It is caused by an excess of phlegm in the brain, which prevents air getting to it (§ 7).

The place of the illness seems to reveal an interesting connection with its hereditary aspect, through a probable connection with the theory of the encephalic origin of semen, conceived by Alcmaeon of Croton (24 A13 DK = Aët. V 3, 3)<sup>9</sup>. Therefore, semen produced by a brain with this affection must in turn be the carrier of the illness producing a brain that is also affected. The hereditariness of the sacred disease is also explained on the basis of the pangenetic theory,

according to which semen is produced by each part of both parents' bodies<sup>10</sup>, sound from the sound parts of the body, and ill from the ill parts<sup>11</sup>. Semen conveys the genetic and hereditary stuff of the parent's whole body, presupposing a strong connection between the genital-reproductive apparatus and the venous system<sup>12</sup>, and therefore between semen and blood. Therefore, the hereditary causes occur again in the product of the generation itself as a reproduction of the causes of the parent's disease, in a linear transmission consistent with the pangenetic theory of the origin of semen.

Epilepsy has natural causes, namely an excess of phlegm in the brain. This means that people suffering from it are "phlegmatic" and moreover, since semen is produced by each part of the body, parents with such features can transfer them to their child<sup>13</sup>, by means of semen. Hence the hereditariness of the sacred disease may be connected to the hereditariness of humours, which come from semen<sup>14</sup>; hence in the humours there lie the causes of hereditary diseases.

#### *Heredity in Herodotus' Historiae*

The notion of *miasma* is linked with that of congenital disease in a passage from Herodotus' *Historiae* (III, 33) concerning Cambyses, who was suffering from the sacred disease (epilepsy) ἐκ γενεῆς ("since birth"). Yet Herodotus does not rule out the possibility that this disease could have been a consequence of defilement, since the Persian king murdered his sister-wife and his brother, after having killed Apis, the sacred ox of Memphis, an incarnation of the god Ptah<sup>15</sup>.

In Herodotus' opinion, if a person suffers from a serious bodily disease, his or her mind too will be unhealthy. Like the Hippocratic physician, Herodotus replaces the religious cause of the murder performed by Cambyses with a natural one: he does not deny the events in any way – stating that Cambyses goes mad and murders his brother and sister-wife after having slaughtered the ox – but rather

replaces the religious explanation with a naturalistic one, stating that the king had suffered since birth from a disease called sacred.

Actually, the two aetiological levels - religious-ritual and scientific-genetic - seem to overlap in the tale, but Herodotus gives a further explanation, linked with the hereditary and congenital disease afflicting the Persian king, as if to tell us that the slaughter was inevitable since Cambyses had inherited his disease from his family (γένος)<sup>16</sup>. Herodotus distinguishes what occurs ἐκ γενεῆς (“because of ghenos”) from the features that become manifest since childhood (ἀπὸ παιδίων): for what concerns the bones of the head of the Egyptians, that are thicker than in other populations (the Persians), he states that the cause for this is the custom of shaving the head, since it involves more exposure to the sun, by which thicker bones are caused (III, 12, αὐτίκα ἀπὸ παιδίων ἀρξάμενοι ξυροῦνται τὰς κεφαλὰς καὶ πρὸς τὸν ἥλιον παχύνεται τὸ ὀστέον). For the same reason (*aition*), the Egyptians do not go bald (τὼντὸ δὲ τοῦτο καὶ τοῦ μὴ φαλακροῦσθαι αἰτιὸν ἐστί). Moreover, at IV, 187, 2-3, Herodotus tells us that the Libyans are the healthiest people, since they are accustomed to cauterize the veins (φλέβες) at the top of the head or in their children’s temples, in order to hinder the flowing of phlegm or mucus down from the head. Unlike what happens with the hereditary diseases, we can notice here a *nomos* to which parents resort on behalf of their children’s health. The success of such a *nomos* does not become *physis* in Herodotus, but this is just appearance, since it is widely acknowledged that the Libyans are the healthiest people<sup>17</sup>. This is due to an efficacious and healthy *nomos*.

Herodotus’ remarks are echoed in the Hippocratic treatise *De aeribus, aquis, locis* (14), in which the case of the Macrocephalians further exemplifies a *nomos* that becomes *physis*. The Scythians use bandages and other artifices specially prepared by them (δεσμά τε [...] καὶ τεχνήματα ἐπιτήδεια) to render their newborn children’s heads oblong, since for them an oblong head is a sign of birth from

a noble stock. Therefore the Scythians' heads take an oblong shape through external intervention, becoming a *nomos* that characterizes them; this is a “natural” feature at the same time, since it is transmitted: all Scythians have oblong heads, and no other people exists with this characteristic. Therefore, if at first the *nomos* was deemed responsible for the oblong shape of the head, subsequently it happens that the *physis* “contributes” to the effects of the *nomos* (νῦν δὲ καὶ ἡ φύσις ξυμβάλλεται τῷ νόμῳ) with hereditary transmission of this feature.

### *Likeness and heredity*

The most immediate manifestation of heredity is thus represented by the similarity of children to their parents, easily observed in daily experience. Likeness (especially with the father) is considered as the visible sign of both the legitimacy of the child and the moral and social stability in which the well-ordered state must be grounded: in Hesiod's myth of the races (*Op.* 109-201), the gradual degradation of these does not lead to an interruption of the chain of generations, but to alteration of similarities, so that, in the “iron race” (176, γένος [...] *σιδήρεον*), the father will not resemble the children, nor will the opposite happen<sup>18</sup>.

The derivation of peculiar features from the parents is sometimes elucidated by means of key-words, such as μητρῶος/πατρῶος (“inherited maternal/paternal features”). As concerns μητρῶος, for instance, the author of *De natura pueri* (30) states that women inherit abundance of menstruation from their mothers<sup>19</sup>. The Hippocratic physician explains the similarities between parents and children on the basis of the doctrine of double semen, i.e. through the mixture of male semen and female semen in the formation of the embryo<sup>20</sup>. The semen of both sexes has a bisexual power: that is to say, in the man female semen is also present, and the woman likewise also possesses male semen. Since male semen is stronger (ἰσχυρότερον), the birth



of a male is connected to secretion of male semen from both partners, while the birth of a female is due to secretion of female semen, which is weaker (ἀσθενέστερον). The principle that determines the sex is that of the “prevalence” (ἐπικράτεια) of male or female semen in the mix<sup>21</sup>. The doctrine of bisexual semen and panspermia explains the similarities of children to their parents, that is to say, the existence of male children that resemble their mother in certain parts of the body and, vice versa, of daughters like their fathers: since semen is produced in every part of the parents’ bodies, the part of the child’s body in which the father’s semen prevails resembles the father; if, instead, in a given part of the body the mother’s semen prevails, this part will be like the same part in the mother<sup>22</sup>.

This explanation is no longer acceptable if the existence of female semen is denied, as by Aristotle<sup>23</sup>, who considers the sex of the embryo as exclusively connected with the male generative contribution, i.e. with its ability to effectuate coction (πέψις) of female matter (ύλη): the warmest and best concocted semen<sup>24</sup> succeeds in making its own characteristics prevail. The “matter” with which the woman contributes to generation consists in menstrual blood (καταμήνια), on which the male impresses the principle of movement (ἀρχή τῆς κινήσεως)<sup>25</sup> contained in his semen (σπέρμα)<sup>26</sup>. These considerations introduce the theme of the similarities between parents and children and of malformations<sup>27</sup>: Aristotle believes that the birth of a female is the outcome of bad coction of the semen<sup>28</sup>, while the child’s similarity to the mother is an aspect of “degeneration” (ἐξίστημι) in the opposite direction, as the element that generates and causes a change – the male semen – has not prevailed<sup>29</sup> (*De Gen. Anim.* 768a 5, οὐκ ἐκράτησε τὸ γεννῶν καὶ κινούν). The birth of a female from a female is therefore considered in the same way as that of impaired children (πεπηρωμένα) from impaired parents, since the female can be considered an impaired male because of the characteristics of her secretion, menstrual blood, which is semen, but not pure (τὰ καταμήνια σπέρμα, οὐ καθαρόν δέ): just

as from such parents healthy children can also be born, likewise males are also born from a female<sup>30</sup>.

The possibilities that male or female children will resemble one or the other of their parents, or even their grandparents<sup>31</sup>, are connected by Aristotle with different ‘impulses’ (κινήσεις), which undergo resizing or strengthening within the formation of κύημα and can also determine similarities in single parts of the body: in opposition to the theories of the “Ancients” (οἱ ἀρχαῖοι), who considered semen a “product of decomposition” (σύντηγμα) of nourishment, Aristotle affirms that, as a residue (περίττωμα) of nourishment, it does not originate from all parts of the body (ἀπὸ παντὸς ἀπιόν), but instead “goes towards every part” (πρὸς ἅπαντ’ ἰέναι)<sup>32</sup>. Hence children resemble their parents because “the residue that is distributed to the parts is similar to that which is held back” (*De Gen. Anim.* 726b 15, ὁμοιον γὰρ τὸ προσελθὸν πρὸς τὰ μέρη τῷ ὑπολειφθέντι), and therefore, for instance, the semen coming from the hand is the hand itself, since it is potentially (δυνάμει) what the hand is actually (ἐνεργεία)<sup>33</sup>.

Concerning the mutilations that occur in the child – that is to say in the “incomplete”, or “maimed” being – Aristotle harks back to the same principles on which the similarities between parents and children are founded: mutilated parents can produce both mutilated (κολοβά) children, and children that have all the complete parts of the body<sup>34</sup>.

Returning to the doctrine of double semen, in the treatise *De semine*<sup>35</sup> Galen effects a synthesis between the Hippocratic notion of bisexual semen and the Aristotelian one relating to the generative contribution of menstrual blood, for which he contemplates a nourishing function<sup>36</sup>. According to Galen, the woman contributes to generation with her own semen and with blood, a vehicle of form and matter like male semen<sup>37</sup>. In *Definitiones medicae* (vol. XIX, p. 450 K.), the child’s resemblance to its mother is considered the most important proof of the production of female semen: the fact is that one cannot

explain the similarities to the mother on the basis of the Aristotelian theory according to which she only offers nourishment<sup>38</sup>.

The female element, characterized by dampness (ὕγροτης) and cold (ψυχρότης), needs the male element, characterized by heat, for the sake of generation. The sex of the baby is determined, for Galen, by the prevalence (ἐπικράτεια), respectively, of cold and heat, i.e. of female or male semen<sup>39</sup>. A foetus that develops in the right part of the uterus has greater heat, and it is male; if the development happens, instead, in the left part of the uterus, which is cold, a female is produced<sup>40</sup>. Hence, in addition to semen, a major role is played by the womb, which appears decisive with the delineation of real *metagamic causes* for the determination of the sex of the embryo. Likenesses between children and parents are also due to the prevalence either of the father's semen, or the mother's one, when female and male semen mix together in the womb. The mixture will cause the likeness of each part in the child's body to the parent whose semen is prevalent<sup>41</sup>. If some parts are dominated by the movement (κίνησις) of the male element, while others are instead dominated by the movement of the female one, semen shall not appear as homogeneous (ὁμοιομερές)<sup>42</sup>, but some parts will resemble the mother, while others will resemble parts in the father's body<sup>43</sup>.

A further development of the study of the notion of heredity concerns the relationship between the inheritance of some of the parents' features and the accidents occurring in the process of generation, until birth, for some features of both parents can be found in their children (likenesses), and affect their health as well. The development of the embryo is then strongly dependent on the parents' conditions, and on diseases affecting the mother's womb. We have to consider that a generative process diverging from the rules produces defective offspring. Defective genetic stuff (semen - as far as the pangenetic theory is concerned - and blood, according to other theories) and reproductive organs with pathologies hinder generation. A mutilation

(πήρωσις), for instance, is considered as a cause of impotence<sup>44</sup>; on the other hand, for instance as far as teratology is concerned, Galen attributes the deformities of the products of generation to defective characteristics of the matrix, as happens in *Definitiones medicae* (vol. XIX, p. 453 K.), in which this process is described through the simile of warm lead irregularly poured<sup>45</sup>.

Already the Hippocratic theory on human generation binds together preformationist considerations (according to which there is a perfect correspondence in the transmission of healthy parts and sick parts from parents to children), and epigenetic ones, so that weak and slender children can also be born from strong and healthy parents, for instance either because of the structure of the mother's womb, or because of diseases manifesting themselves during pregnancy (*Nat. Puer.* 9). Therefore, the unhealthy conditions of the woman (a vagina that is either wider or narrower than usual, or alterations in the menstrual period) can hinder the reception of semen and the subsequent conception, in the same way as more or less serious impairments affecting the male genital apparatus are considered as causes of sterility<sup>46</sup>. Yet one can notice that disabled human beings can also generate healthy children<sup>47</sup>.

This short - and necessarily incomplete - survey just aims at providing a frame to the study of the notion of heredity in ancient Greece. Through this frame, we can catch a glimpse of the social importance of this notion, since children are a "product" of their parents, and their social legitimacy is grounded on their resemblance to them (especially to the father). On the other hand, likeness is also linked with the genetic and hereditary predisposition to certain diseases. Therefore one generation conditions the other both in a social and in a physiological sense, in a continuity of life that itself represents the reason for the inheritance of diseases that only in a very few cases can be controlled by means of therapy.

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1. Generation and heredity are dealt within LESKY E., *Zeugungs- und Vererbungslehren der Antike und ihr Nachwirken*. Mainz, Akademie der Wissenschaften und der Literatur, 1951. On the notion of heredity in ancient medicine see also GRMEK M.D., *Ideas on Heredity in Greek and Roman Antiquity*. *Physis* 1991; 28(1): 11-34; FÖLLINGER S., s.v. *Vererbung*. In: LEVEN K. H. (Hrsg.), *Antike Medizin*. Ein Lexikon. München, Beck, 2005, pp. 894-895.
2. The representation of illnesses and the delineation of the very notion of illness seems to be worked out in ancient Greek culture, and particularly archaic Greek culture, according to what has been defined by KUDLIEN F., *Der Beginn des medizinischen Denkens bei den Griechen*. Zürich, Artemis Verlag, 1967, pp. 16 and 21-22) as a distinction between traumatic illnesses (*traumatische Krankheiten*) and non-traumatic illnesses (*nicht-traumatische Krankheiten*). Man was deemed able to remedy traumatic illnesses through medicine, taking care of the evident signs of them, such as wounds; in the case of “non-traumatic” illnesses that did not show evident signs or showed ones whose origin appeared mysterious, the solution was only considered possible after divine intervention. The polemic against the demonic origin of illnesses is expressed both in medical texts – one thinks of the Hippocratic treatises, and in particular of *De morbo sacro* - and outside this sphere (cf. e.g. Plut. *De superst.* 170e). Hippocratic medicine radically discredits magic-religious treatment, depriving the notion of catharsis of its ancient meaning of purification from a *miasma* - a contamination that also has repercussions on the moral plane and represents

- the consequence of a transgression - and makes reference, instead, to processes of purification of the body (to mention only a very small number of cases, one can consider, for instance, *Morb.* II, 38, in which reference is made, speaking of the treatment of jaundice, of a φάρμακον [...] ὑφ' οὗ χολὴν καθαρεῖται; *Morb. Sacr.* 5, in which it is affirmed that the illness in question is caused by a lack of catharsis of the brain from the excesses of phlegm even before birth). Catharsis can be induced through the use of medicines (on pharmacologically induced catharsis and the qualities of the different medicines suited to this purpose cf. e.g. Ps.-Arist. *Prob.* 864a 23-b 11) or, according to the circumstances, it is attributed to nature itself (cf. e.g. Gal. *In Hipp. Epid. VI comment.* Vol. IV, p. 219, 2-4 Wenkebach (Berlin 1956<sup>2</sup>), CMG V 10, 2, 2 [vol. XVII/2, 167 K.]). For a treatment relating to catharsis in *Corpus Hippocraticum* see VON STADEN H., *Purity, Purification, and Katharsis in Hippocratic Medicine*. In: VÖHLER M. - SEIDENSTICKER B. (Hrsg.), *Katharsiskonzeptionen vor Aristoteles. Zum kulturellen Hintergrund des Tragödiensatzes*. Berlin - New York, De Gruyter, 2007, pp. 21-51.
3. For the definition and the characteristics commonly attributed to the pathological manifestation of λοιμός cf. Ps.-Arist. *Prob.* 859b 15-20; PARKER R., *Miasma. Pollution and Purification in Early Greek Religion*. Oxford, Clarendon Press, 1983, pp. 257-258.
  4. Soph. *OT* 25-27, Πόλις γὰρ [...] / φθίνουσα μὲν κάλυξιν ἐγκάρποις χθονός, / φθίνουσα δ' ἀγέλαις βουνόμοις τόκοισί τε / ἀγόνους γυναικῶν [...] (ed. Dain), “actually the city fades away in the fruitful seed-vessels of the earth, fades away in the herds of grazing oxen as well as in the women’s childless childbirths.”
  5. Soph. *OT* 171-173, [...] οὔτε γὰρ ἔκγονα / κλυτὰς χθονός αὔξεται οὔτε τόκοισιν / ἠϊῶν καμάτων ἀνέχουσι γυναῖκες, “neither newborn beings shall strengthen this noble land, nor women shall find in delivery any relief from their grievous pains.” The construction is unusual; everything is anomalous: the sentence, indeed, lends itself to a double interpretation, since τόκος means both “son”, seen as the “product” of generation (τίκτειν), and “birth.” In the latter case, the feared extinction of the Theban population appears to derive from death in childbirth of all the women able to produce, the toils of labour being confused with the symptoms of the plague. The lack of newborns in the city, however, points to the first interpretation, i.e. the generation of stillborn children, which in fact thwarts all possibility of renewal and development, condemning the city to extinction.

6. The syntagm ἀρχαία φύσις indicates the “aspect of the past”, the “sometime body”, and it is a medical expression: cf. e.g. Pl. *Smp.* 191d, 192e, 193c 5, 193d 4 (with regard to the androgyne); *Grg.* 518d (ἀρχαία σάρξ); *R.* 611d; Gal. *De tumor. praeter nat.* vol. 7, p. 708 K. (referring to the skin); *Aët.* V, 95, 26.
7. The face is wearing away because of leprosy. Κόρση does not stand for κόρση, but appears to be connected to Homer’s κρόσσαι (protrusions placed stepwise on a stick, cf. *Il.* XII, 258; 444): the skin wears away and is covered with white vesicles that bursting continue to cling to the skin like fringes (cf. VON WILAMOWITZ-MOELLENDORFF U. (Hrsg.), *Aischylos. Orestie, Griechisch und Deutsch.* Berlin, Weidmann, 1896., *ad loc.*; LAPINI W. e CITTI V. (a cura di), *Eschilo. Le Coefore.* UNTERSTEINER M., testo, traduzione e commento, Amsterdam, Hakkert, 2002.
8. Μοτοί are bandages that cover purulent sores and keep them open until they recover from inside, after having festered (cf. Hipp. *ap. Vuln* 14; *Morb.* II, 47). The treatment is painful, because ἄκος the “remedy” manifests itself δὲ ὠμὸν Ἔριν αἰματηράν: the house of the Atrides cannot receive care from the outside; it is affected by an illness that festers from the inside towards the outside and can only be improved through a bloody struggle inside the house. Matricide is therefore inevitable. The very idea of ἄκος seems in reality to be “wishful thinking” on the part of the chorus (cf. GARVIE A. F., *Aeschylus. Choephoroi, with introduction and commentary.* Oxford, Oxford University Press, 1986, p. 172); the remedy will only be found at the end of the trilogy.
9. Alcmaeon appears to have affirmed that semen is “part of the brain” (ἐγκεφάλου μέρος), and is produced in both the male and the female. The part of the child that is formed first in the maternal womb appears to be the head, since in it the authoritative principle (τὸ ἡγεμονικόν) resides. In the same fragment the existence of bisexual semen is affirmed. In the doxography on the Pythagoreans, semen - which is a “drop of brain” (Alex. Polyhist. *FgrHist* 273 F 93 *ap.* D. L. VIII, 28, τὸ δὲ σπέρμα εἶναι σταγόνα ἐγκεφάλου) - has its origin in bone marrow (cf. Hippo of Metapontum, 38 A12 DK = Censorin. V, 2); this theory is also found in Plato’s *Timaeus* (91a-b), in which it is affirmed that σπέρμα is “condensed marrow” (μυελὸς συμπεπηγώς), that goes down from the head along the neck and through the backbone; cf. also *Ti.* 74a (all the semen is guarded by a wrap of bones that surrounds the brain, and in the vertebrae, which contain the marrow of the neck and the back). The myelogenetic origin of semen is also attested in Diocles of Carystus (fr. 41a = Ps.-Gal. *Def. Med.* 439 [Vol. XIX, pp. 449-450



K.]; fr. 41b van der Eijk = *Codex Marcianus* 521 f. 100<sup>r</sup> DGs, p. 233 Diels). Hippocratic medicines mixes the theory of the encephalic origin of semen with the myelogenetic one: from the head, semen flows through the veins behind the ears to the spinal cord, and then it reaches the testicles (cf. *Nat. Puer.* [*Genit.*] 2, 2; *Nat. Hom.* 11; *Aër.* 22 [on the sterility of the Scythians]). For an explanation of the theory of the encephalic-myelogenetic origin of semen, see LESKY E., ref. 1, pp. 9-30.

10. The idea of the existence of female semen would explain the birth of male and female individuals, in addition to hereditariness of characteristics like, for instance, the physical features that determine similarities to one or the other of the parents. This idea, in addition to being present in Alcmaeon, is found in Parmenides (28 B18 DK), Empedocles (31 B63 DK = Arist. *De Gen. Anim.* 722b) and Democritus (68 A142 DK). Hippocratic medicine gives a further value to the notion of female semen: in *Nat. Puer.* (*Genit.*), 6, it is affirmed that semen is bisexual, that is to say each of the sexes has both male and female semen, and the birth of a male or a female is connected with the quantitative prevalence of one of the two (ὀκότερον δ' ἂν κρατήσῃ κατὰ πλῆθος, ἐκείνο καὶ γίνεται).
11. The pangenetic theory of semen is found in Anaxagoras (59 B10 DK = *Schol. in Gregor.* Vol. XXXVI, p. 911 Migne) and Democritus (68 A141 DK = Aët. V, 3, 6), and is expressed in Hippocrates' treatises, particularly in *De natura pueri* (*Genit.* 8, 1: male semen and female semen, coming from the whole body, weak from the weak parts, and strong from the strong ones, is collected in the uterus; so it "is of necessity transmitted to the issue" [τῷ τέκνῳ οὕτως ἐστὶν ἀνάγκη ἀποδίδοσθαι]); *De morbo sacro* (2, 2); *De aeribus aquis locis* (14: because of likenesses between parents and children - due to the origin of semen from each part of the body - it is not impossible that a macrocephalic person can generate a macrocephalic). This theory is strongly criticized by Aristotle (*De Gen. Anim.*, 723a-b; 764b 10): according to him, semen is a unique substance that does not come from every part of the body.
12. Considering the close relationship between venous system and diffusion of semen, the pangenetic theory and the encephalic-myelogenetic theory would not appear to be radically alternative to one another: both are found in the Hippocratic treatises, where they do not appear to contradict one another (cf. e.g. *Aër.* 22; and the examination of pangenesis in *Nat. Puer.* [*Genit.*] 3). According to Hippocratic medicine (cf. e.g. *Vet. med.* 22) the head, which is hollow, attracts fluids, like the uterus; thus, beginning precisely from this, semen coming from all the parts of the body is propagated through the body itself

to the genital organs. Cf. in this connection THIVEL A., *Die Zeugungslehren bei Hippokrates und den Vorsokratikern*. In: WITTERN R., PELLEGRIN P. (Hrsg.), *Hippokratische Medizin und antike Philosophie*. Verhandlungen des VIII. Internationalen Hippokrates-Kolloquiums (Kloster Banz/Staffelstein, 23-28 September 1993), Hildesheim - Zurich - New York, Olms Weidmann, 1996, pp. 3-13; JOUANNA J., *La naissance de la science de l'homme chez les médecins et les savants de l'époque d'Hippocrate: problèmes de méthode*. In: LÓPEZ FÉREZ J. (ed.), *Tratados Hipocráticos*. Estudio acerca de su contenido, forma y influencia, Actas de VIIème Colloque International Hippocratique (L'Antiquité Classique; 64), Madrid, UNED, 1992, pp. 91-111, esp. pp. 107-108).

13. Cf. *Morb. Sacr.* 5 (if a phlegmatic parent has a phlegmatic child [...] what prevents someone whose father and mother are suffering from an excess of phlegma from suffering from it himself and someone in his offspring as well?). Epilepsy passes on from father to child as well as likenesses, for semen comes from the whole body.
14. Cf. *Nat. puer. (Genit.)* 3. Illnesses are connected to a lack of equilibrium between the humours: book IV of *De morbis* (esp. chap. 1; cf. also *Hum.* 12, [vol. V, p. 492 L.] presents a thorough treatment in this respect, while the theory of humours is formulated in the treatise *De natura hominis* (health depends on a balance of four humours: phlegm, blood, yellow bile and black bile). The principle of *isonomy* of the humours as an essential condition for health is expressed by Alcmaeon of Croton (24 B4 DK = Aët. V 30, 1; 24 A3 DK = Arist. *Met.* A 5, 986 a 22; Plat. *Symp.* 186d 5-e3; cf. THIVEL A., ref. 12, regarding the influence exerted by Alcmaeon's doctrine of the humours on the Hippocratic treatises, particularly on *De veteri medicina*).
15. ταῦτα μὲν ἐς τοὺς οἰκησιώτατους ὁ Καμβύσης ἐξεμάνη, εἴτε δὴ διὰ τὸν Ἄπιν εἴτε καὶ ἄλλως, οἷα πολλὰ ἔωθε ἀνθρώπους κακὰ καταλαμβάνειν. Καὶ γὰρ τινα [καὶ] ἐκ γενεῆς νοῦσον μεγάλην λέγεται ἔχειν ὁ Καμβύσης, τὴν ἰσὴν ὀνομάζουσι τινες· οὐ νῦν τοι αἰετικὸς οὐδὲν ἦν τοῦ σώματος νοῦσον μεγάλην νοσέοντος μηδὲ τὰς φρένας ὑγιαίνειν (ed. Medaglia), "Cambyses performed such mad actions against his own nearest kinsmen, both because of Apis, and because of other reasons, since many are the evils that usually befall men. Actually people tell that from his birth Cambyses was suffering from a strong disease that some people call 'the sacred disease'. Therefore it is not strange in any way that, when the body suffers from a serious disease, the mind is not healthy as well."

16. LLOYD G. E. R., *The Revolutions of Wisdom*. Studies in the Claims and Practice of Ancient Greek Science, Berkeley, University of California Press, 1987, pp. 23-24, n. 73, considers both sacrilegium and epilepsy as causes of the murder on the same level. As far as Cambyses' madness is concerned, cf. esp. MUNSON R. V., *The Madness of Cambyses (Herod. 3.16-38)*. *Arethusa* 1991; 24: 43-65.
17. Cf. THOMAS R., *Herodotus in Context: Ethnography, Science and the Art of Persuasion*. Cambridge, Cambridge University Press, 2000, pp. 44-45: "The ethnography of health is concerned with *physis* and sameness, general human characteristics and processes of human health and disease, rather than with ethnic difference for its own sake." The "barbarians" in Herodotus share in the same nature as the Greeks.
18. In Aeschin. in *Ctes.* 111, children not resembling their fathers are said to be "monsters" (τέρατα). Galen (*De meth. med.* X, 35) states that legitimate children show "striking likenesses" with their fathers (πατρὶ τέκνα γνήσια τὰς τερατώδεις ἐκείνας κοινότητας).
19. εἰσὶ τῶν γυναικῶν, αἱ μὲν ἀρκέοντα τὰ καταμήνια ἀποκαθαίρονται, αἱ δὲ ἐλάσσονα· τοῦτο δὲ ἦν αἰεὶ γίνηται, ἐν φύσει καὶ ἐν γένει μητροφῶν σφὶν ἔστιν (ed. Giorgianni).
20. Cf. *Nat. Puer.* [*Genit.*] 5, μίσγεται ὁμοῦ τό τε ἀπὸ τοῦ ἀνδρὸς ἐλθὼν καὶ τὸ ἀπὸ τῆς γυναικὸς.
21. Cf. *Nat. Puer.* [*Genit.*] 6. This doctrine goes back to Democritus (68 A143 DK.); cf. in this connection the enquiry by DE LEY H., *Pangenesis versus Panspermia. Democritean Notes on Aristotle's Generation of Ani-mals*. *Hermes* 1980; 108: 129-153.
22. Cf. *Nat. Puer.* [*Genit.*] 8.
23. Cf. *De gen anim.* 729a 30-31, "to the semen of the male, the female does not add semen, but matter" (εἰς τὴν τοῦ ἀρρενος γονὴν τὸ θῆλυ ἂν συμβάλλοιτο οὐ γονὴν ἀλλ' ὕλην).
24. Cf. *De gen anim.* 726b 1-2.
25. Cf. *De gen anim.* 732a 3-6; 734b 22-24.
26. Actually σπέρμα is also the term used for the product of female secretion (cf. *De gen anim.* 716a 8-13; 728b 21-32; *Hist. anim.* 489a 11-12). This double designation does not appear contradictory in the light of the consideration of both male semen and menstrual fluid as residues of coction of blood, the final aliment that in the female, receiving less heat, forms a more abundant residue with a lower degree of coction (726b 30-727a 2); cf. in this respect HENRY

- D., *Generation of Animals*. In: ANAGNOSTOPOULOS G. (ed.), *A Companion to Aristotle*. Leiden - New York, Brill, 2009, pp. 368-383.
27. On the hereditariness of malformations see esp. BIEN Ch.G., *Erklärungen zur Entstehung von Missbildungen im physiologischen und medizinischen Schrifttum der Antike*. ("Sudhoffs Archiv Beihefte", 38), Stuttgart, Franz Steiner Verlag, 1997 pp. 41-65.
  28. Cf. *De gen anim.* 766a 18-21, in which semen is, in fact, ἀρχή; it necessarily changes into its opposite (ἀνάγκη εἰς τὸναντίον μεταβάλλειν) - i.e. into the female - when it does not succeed in taking the material itself to its proper form (εἰς τὸ ἴδιον εἶδος) through a defect of coction; 766b 12-26. In 775a 15 the female is considered a "natural deformity" (ἀναπηρία φυσική).
  29. Cf. also *De gen anim.* 770b 15-16, in which the failure of form to predominate over matter causes *monstrum* (τέρας), and appears as a phenomenon "against nature" that occurs, in reality, "according to nature" (καὶ τὸ παρὰ φύσιν εἶναι τρόπον τινὰ κατὰ φύσιν, ὅταν μὴ κρατήσῃ τὴν κατὰ τὴν ὕλην ἢ κατὰ τὸ εἶδος φύσις); Ps.-Gal. *Ad Gaur.* 12, 6: *terata* are "against nature", even if nature itself must be considered as responsible for them, since it has not been successful in hitting the target of generation that proceeds straight (τὰ τέρατα, ἃ καίπερ ὄντα παρὰ φύσιν φύσεως ἦν ἀστοχούσης τοῦ κατὰ λόγον γεννήματος).
  30. Cf. *De gen anim.* 737a 25-30.
  31. For an overview of this aspect cf. DEAN-JONES L. A., *Women's Bodies in Classical Greek Science*. Oxford, Oxford University Press, 1994.; LESKY E., ref.1, pp. 1372-1382.
  32. Cf. *De gen anim.* 725a 21-24.
  33. Cf. *De gen anim.* 726b 15-19.
  34. Cf. *De gen anim.* 724a 3-6. For Aristotle, birth of healthy children from κολοβοί parents is one of the proofs against the pangenetic theory of the origin of semen: the fact is that semen does not originate from missing parts, and therefore that specific part should not form in the child (721b 17-19). Impairments are also dealt with in 771a-b; cf. also *Hist. anim.* 585b 28-36.
  35. For a thorough analysis of the work see ACCATTINO P., *Galeno e la riproduzione animale. Analisi del De Semine*. ANRW II 37.2, Berlin - New York, De Gruyter, 1994, pp. 1856-1886.
  36. The Galenic doctrine relating to the process of generation is carefully analyzed in BOYLAN M., *Galen's Conception Theory*. *Journal of the History of Biology* 1986; 19(1): 47-77.
  37. Cf. Gal. *De sem.* 2, 2, pp. 164, 11-166, 15 De Lacy.

38. Cf. *De sem.* II, 1, p. 158, 2 - 19 De Lacy.
39. Cf. *De sem.* II, 5, p. 182, 14-16 De Lacy, τὸ μὲν ἄρῳρον γίνεσθαι ζῶον ἐπικρατεία γονῆς ἄρῳρονος, τὸ δὲ θήλυ θηλείας.
40. Cf. *De usu part.* 14, 7 (vol. II, pp. 302, 1 - 310, 7 Helmreich); *De sem.* I 5, pp. 180, 19-186, 26 De Lacy.
41. Cf. *De meth. med.* X, 35, in which it is affirmed that legitimate children show “prodigious similarities” to their fathers (πατρὶ τέκνα γνήσια τὰς τερατώδεις ἐκείνας κοινότητας).
42. Cf. *De sem.* II, 5, p. 178, 17-22 De Lacy.
43. Cf. *De sem.* II, 5, p. 180, 11-18 De Lacy.
44. Cf. for instance *Hipp. Nat. Puer. [Genit.]* 11, in which πηρωθέν hints at defects in the quantity of semen; on this passage see BIEN Ch. G., ref. 27, pp. 47-53).
45. “Beings with teratologic features are generated - as somebody says - because of a deviation in the womb; actually semen that flows irregularly and excessively produces *terata*, just as hot lead that is poured out irregularly produces irregular artifacts (τέρατα γίνεται, ὡς μὲν τινες λέγουσι, κατὰ παρέγκλισιν τῆς μήτρας· τὸ γὰρ σπέρμα παρεγχεόμενον ἀνωμάλως ποιεῖ τὰ τέρατα, ὄν τρόπον καὶ τὸν μόλιβδον θερμοῦ ὄντα, ἐπειδὴν καταχυθῆ ἀνωμάλως, ἀνώμαλον ποιεῖ τὸ δημούρημα).” See also Gal. *Ad Gaur.* 12, 6 (*supra*, n. 29).
46. See respectively *Hipp. Mul.* I, 8; *Nat. Puer. [Genit.]* 2.
47. See for instance *Hipp. Nat. Puer. [Genit.]* 11, πεπηρωμένων ἀνθρώπων, ὑγία γίνονται τὰ παιδιά, ὡς ἐπὶ τὸ πλεῖστον συμβαίνει.

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