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ORGYN

SPECIAL REPORT
THE HUMAN FACE OF INFERTILITY

THE GENDER OF SCIENCE

FAMILY PLANNING IN EGYPT

THE EMERGENCE OF A SUBSPECIALTY

ON FAILURE TO

In addition to being the founding father of zoology, Aristotle (384-322 BC) can also be considered one of the world's first truly scientific students of human fertility and reproduction. It is only recently, however, that Aristotle's extraordinary studies on human fertility and gynaecology have been translated into English

Aristotle contemplating the bust of Homer. **Painting by Rembrandt van Rijn (1653), Metropolitan Museum of Art, New York**

TEXT ROBERT TEMPLE

ARISTOTLE'S TREATISE SPECIFICALLY DEVOTED TO the subject of human fertility is known as *On Failure to Generate*.[1] It is obvious from the treatise that Aristotle must have personally carried out extensive gynaecological examinations. His father had been a distinguished medical doctor, so Aristotle had the necessary background for this kind of work. It is also well established that Aristotle was friendly with a number of midwives. There can thus be little doubt that he carried out his investigations with the same indefatigable determination with which he carried out hundreds of dissections of both animal and human bodies. Aristotle's precise comments on women's internal anatomy further suggest that he had visually examined uteri and cervixes after dissection.

The treatise is wholly concerned with the questions of how and why women conceive, and mentions males only incidentally. The main point of contention between Aristotle and the prevailing wisdom of his time had to do with the woman's contribution to conception. Aristotle insisted that women as well as men "contributed seed", and that children were the product of the mingling of male and female seed. Most Greeks held the view that the

GENERATE

woman was merely the nutritive receptacle for the child, which was entirely the creation of the male's seed. Even Aristotle's teacher Plato held this view. In his book the *Timaeus*, Plato described conception as "sowing in the womb, as in a field, animals unseen by reason of their smallness and without form; these again are separated and matured within; they are then finally brought out into the light". The woman was thus regarded as a combination of a greenhouse and a wheat field, nourishing the tiny animals planted in her by the man. Despite the resemblances often seen between children and their mothers (a point which Aristotle makes), most Greeks insisted that there was no "descent" from the mother.

When Seeds Collide

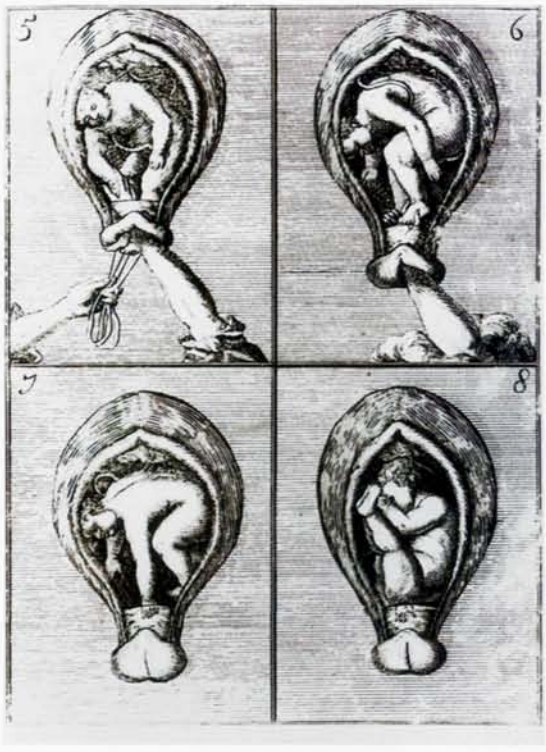
Aristotle also opposed the prevailing notion of "pangenesis", a theory which stated that male sperm came from all parts of the body. Section 14 of the Hippocratic treatise *On Airs, Waters and Places* states: "[...] for the semen comes from all parts of the body, sound from the sound parts, and unhealthy from the unhealthy parts."[2] Aristotle proves that this is impossible by an ingenious argument: "[...] if several come from one mating, as is seen to happen sometimes in the case of pigs and twins, clearly the seed does not come from all of the body, but was divided into parts in the case of each fetus." If the seed can be divided like this, Aristotle reasons, it clearly cannot come from all parts of the body since that would mean that one twin would be all feet and legs and the other would be all arms and hands. Since each is a complete entity, however, the sperm must not be divided into sections from different body parts but must rather be divided into equivalent portions.

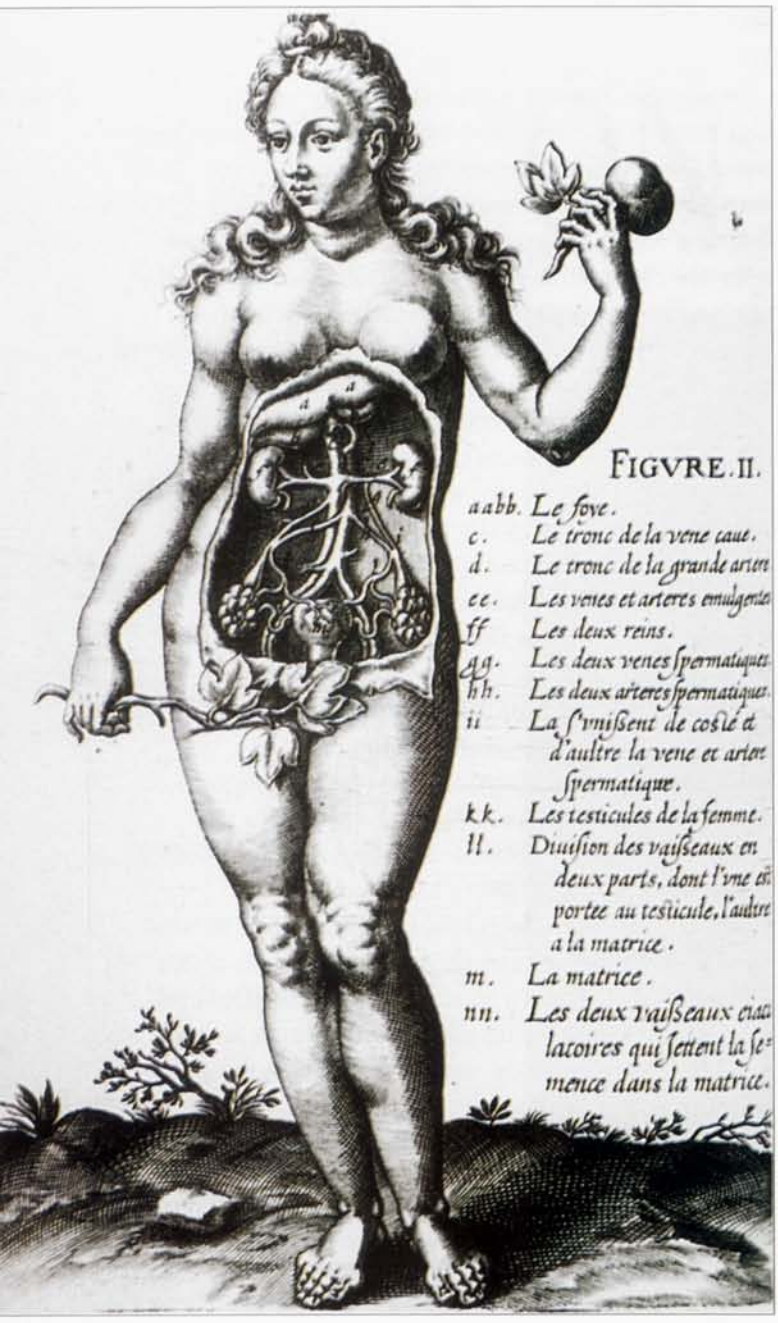
Aristotle had been preceded in his belief that both males and females contributed to the formation of the child by the mystic poet-philosopher Empedocles. Empedocles, who was extraordinarily eccentric in most of his views, maintained that each parent contributed part of the heritage of the child because the two portions had been "torn asunder", and the jumble of reunited bits of the child was reassembled in the womb. The need for these disjointed elements to recombine was the source of the procreative urge. Aristotle ridicules these ideas, pointing out that Empedocles was indulging in mythological fantasy. Aristotle was in agreement with Empedocles, however, that "the differentiation between male and female takes place during conception". Aristotle is also inclined to favour the notion that "the same semen is able to be formed into either male or female" (*Generation of Animals*).

Democritus, another of Aristotle's predecessors, suggested that both male and female contributed seed. But as with Empedocles, his reasoning was bound up with some rather eccentric presuppositions. Democritus compared sexual intercourse to an epileptic fit and, since he viewed the world as being made up of atoms that collide and unite at random, he suggested that human generation was similarly due to a "collision of seed". Democritus also stated that the embryo was nourished through its mouth by sucking on a lump of flesh, a view which Aristotle was at pains to disprove. So although Democritus did not view the woman as a mere "receptacle" of male seed like Plato and the Hippocratics, his theory that males and females both produced "colliding seeds" was so quirky that he cannot really be considered as Aristotle's predecessor in this area.[3] More typical of prevailing opinion at the time were the views of Anaxagoras, who believed that only males produce seed and that women are "the breeding ground". He did not, however, repeat Democritus' mistake of thinking that embryos sucked on lumps of flesh; he maintained that they take their nourishment through the umbilical cord.[4]

Aristotle was perhaps the earliest practitioner of painstaking empirical observation and comparison, or what is known today as pure science. A striking instance of this in *On Failure to Generate* is his discussion of parthogenetic grasshoppers to illustrate his point that the female has seed. In this extreme instance, it could be proven that the female could breed without any male seed at all. He had, according to his usual habit, befriended a peasant woman →

Illustrations of a fetus being extracted by hand, with the aid of a cord looped around the feet of the infant. Illustration taken from J.D. Siegemund's 1691 instruction book for midwives *Spiegel der Vroed-vrouwen*





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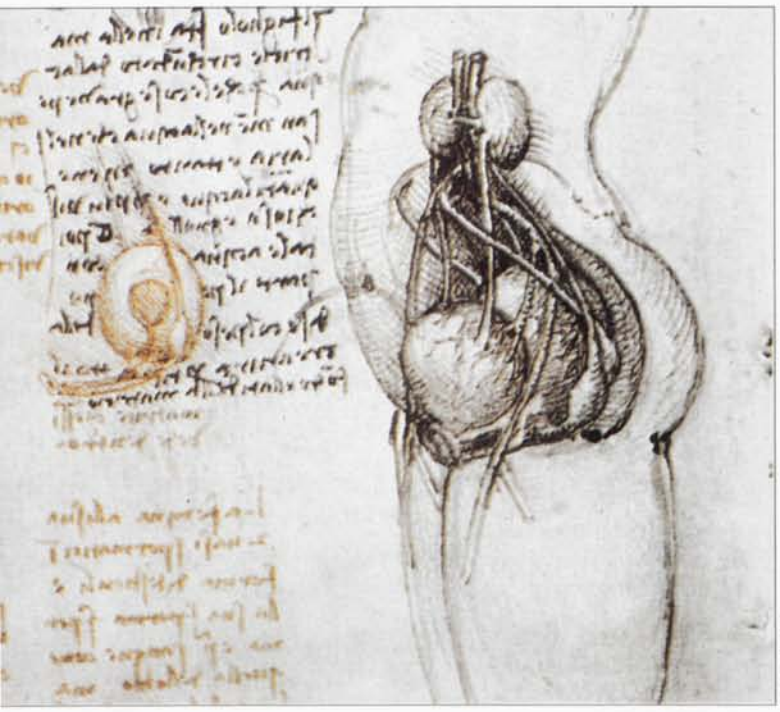

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Above: a 17th-century drawing by Jourdain Guibelet of a woman with abdomen exposed for anatomical analysis. Left: Leonardo da Vinci's anatomical studies, often based on Aristotle's treatises, are impressive in their accuracy. Scholars believe that knowledge of human anatomy would have developed earlier if Da Vinci's *Atlas of Anatomical Studies*, now in the Royal Library at Windsor Castle, had been available to the researchers who came after him

and records the crucial information as follows: "[...] a woman [...] made trial of the singing grasshoppers which she reared after catching them while still tender: and when they had grown they became pregnant spontaneously. It is clear from these things, then, that every female contributes to the seed."

Unfortunately, not all of Aristotle's remarks on parthenogenesis survive. We know this from a curious fragment preserved by the Byzantine scholar Constantine Porphyrogenitus. The fragment deals with an epitome of a zoological work by Aristophanes of Byzantium (not the playwright Aristophanes), who had quoted a lost passage of Aristotle's: "Woman alone of creatures that bring forth live young (rather than eggs) produces offspring without being impregnated. Theophrastus bears witness that Aristotle said that the so-called Osiris is produced without intercourse." This tantalizing fragment indicates that Aristotle believed that, in exceptional cases, a woman could have a virgin birth; or he may merely have said that this is what the Egyptians claimed. All that we know for certain is that Aristotle discussed this matter. As many Christian ideas are known to have arisen from the Egyptian cult of Osiris, this aspect of the virgin birth is curious. What the fragment seems to state is that the Egyptians called a virgin birth "an Osiris", and that Aristotle had taken this phenomenon seriously.

The Wandering Uterus

Aristotle was extraordinarily candid about the details of coition. Although this treatise was not circulated publicly, news of Aristotle's studies leaked out, if only through the gossiping of his various midwife informants. As a result, he was a highly controversial person in his own time. It is interesting to note that the Epicurean philosopher of Roman times, Philodemus, attacks Aristotle for having studied and taught knowledge of aphrodisiacs.[5] Thus, superstitious fear of Aristotle's studies into fertility became mingled with political and philosophical attacks against him for several centuries.

Aristotle also theorized that a retrograde uterus was an impediment to conception. Unlike Plato and the Hippocratics, who believed in a "wandering uterus", Aristotle insisted that the uterus must have a fixed position, though some movement was possible within essential parameters. His abandonment of the prevailing theory that the uterus floated about was most likely due to his anatomical investigations made by dissection. Aristotle's teacher Plato wrote of the uterus that it "gets discontented and angry, and wandering in

Aristotle stressed that menstruation should occur "at proper intervals and not irregularly, if the body is healthy"

every direction through the body, closes up the passages of the breath, and by obstructing respiration, drives them to extremity, causing all variety of disease [...]" (*Timaeus*). Similar views were expressed in the Hippocratic treatise *On the Nature of Women* , thought to have been written by a Hippocratic physician named Euryphon of Cnidus. But in such matters Aristotle takes no notice of Plato, who was no scientist. Aristotle is most emphatic in stating: "Now in males the seminal passages must have a fixed position and not stray about, and the same is true of the uterus in females [...]" (*Generation of Animals*).

Aristotle discussed menstruation and the menstruum at great length. He stressed that menstruation should occur "at proper intervals and not irregularly, if the body is healthy". He also investigated different types of menstruum and their relation to different states of health, and insisted that improper menstruation is not due to the uterus alone but rather to "the state of the body" and its general health. In order to arrive at such general conclusions, Aristotle must have held detailed conversations with various midwives.

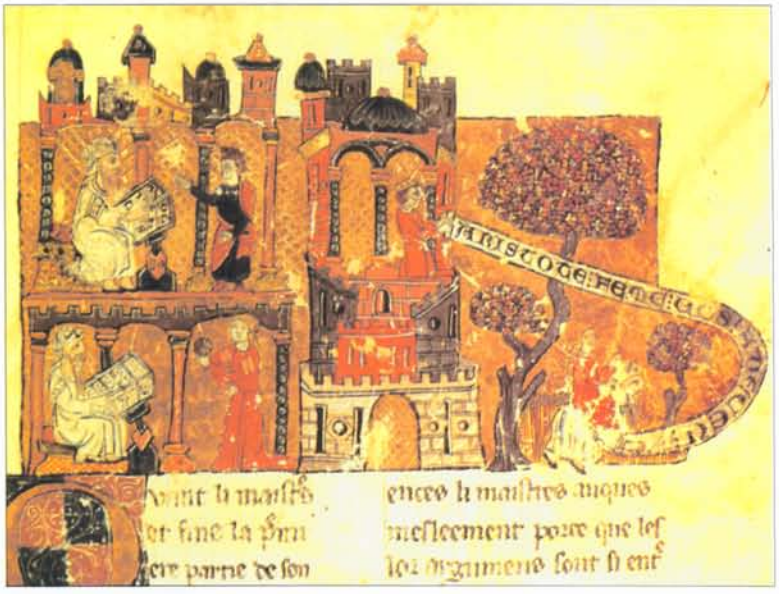
Aristotle was also aware of the fetal position, probably from dissections or midwives' lore. He wrote of the fetus that it "is bent up, and has the nose between the knee, eyes on the knees, ears outside them" (*History of Animals*). As the fetus grows, he describes the cotyledons in the uterus: "[...] the cotyledons become progressively smaller as the embryo grows, and finally disappear. The umbilicus is a sheath around blood vessels which originate from the uterus (from the cotyledons ...). [...] the growth of all animals that have an umbilicus is obtained through the umbilicus [...] the umbilicus is attached to the cotyledon [...]." Of embryos, he writes: "They are enclosed partly by membranes, partly by a chorion. And first the embryo develops within the inmost chorion, then another membrane develops around this one, mostly growing onto the womb but partly standing away and holding water. In between is fluid that is watery and serous or sanguineous, what the women call 'the forerunner'".

Aristotle provided fairly extensive descriptions of both labour and birth. Of women in labour, he writes: "Those whose pains are severest around the belly are the quickest to deliver; those who have preliminary pain in the loins have a difficult delivery, while those who have it in the lower abdomen are quick. [...] the pains occur with more strength [...] in sedentary women and those who are weak in the chest and unable to hold their breath. Labour is in fact more difficult if they let their breath go just when they are trying to exert force with the breath. Now first to come out is a watery discharge, when the embryo is being born and the membranes are rupturing, and then the embryo while the uterus is being everted and the afterbirth brings outside what was within."

The importance to Aristotle of the details of human birth, suckling and infant life are highlighted by the fact that his lengthy account of all these matters represents the culmination of his entire nine-volume *History of Animals*. One poignant detail given by Aristotle is that the ancient Greeks did not give names to babies until they had been alive for seven days, due to extremely high infant mortality rates. Aristotle's very lengthy treatise *On the Generation of Animals* relates to much of what has been discussed here. It too considers matters of fertility, gestation and birth throughout the animal kingdom. But the treatise *On Failure to Generate*, which has been largely unknown and inaccessible until recently, provides new insights into Aristotle's thought in this area. ■

Robert Temple is a film and television producer and contributor to scientific and scholarly journals

16th century illumination from the *Book of Treasure* by Brunetto Latini. Aristotle is depicted teaching Alexander the Great on morality



References

1 Aristotle. *History of Animals (Historia Animalium)* Vol. III, Books VII-X. Ed. and translated by David J. Balme. Prepared for publication by Allan Gotthelf. Cambridge, Massachusetts: Harvard University Press, 1991. (This volume in the Loeb Library Series is the final volume to appear in the complete works of Aristotle with text and facing translation. In this article, I have slightly improved the translation for the sake of clarity (such as using the word "cervix" rather than "mouth" when the cervix is clearly meant).

2 *The Genuine Works of Hippocrates*. Translated by Francis Adams. Vol. I, p. 208. London, 1849.

3 Freeman K. *Companion to the Pre-Socratic Philosophers*. Oxford: Blackwell, 1966; pp. 306-7.

4 Ibid.; p. 272.

5 Chroust AH. Aristotle's Earliest "Course of Lectures on Rhetoric". In: *L'Antiquité Classique*. Vol. 33, p. 61, 1964.