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From Homer to Redi. Some historical notes about the problem of Necrophagous Blowflies' reproduction

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ABSTRACT

Some historical notes about the ideas of the reproduction of necrophagous blowflies are presented, including Homer's Iliad, Ancient Egypt and Near East, the Persian Vendidad, *William Shakespeare and the elegant experiments of Francesco Redi, who discredited the theory of spontaneous generation.*

Keywords: History; Necrophagous blowflies; Reproduction; Homer's Iliad; Ancient Egypt and Middle East; *Vendidad;* William Shakespeare; Francesco Redi.

INTRODUCTION

"I'll follow, Sir. But first, an't please the Gods, I'll hide my master from the flies, as deep as these poor pickaxes can dig"
(Shakespeare, *Cymbeline,* Act IV, Sc. 2)

"Habitat in Cadaveribus (…). Tres Muscae consumunt cadaver Equi, aeque cito ac Leo"
(Linnaeus, 1767: 990)

Centuries, if not millennia old, the idea that "lower" animals were generated spontaneously from decomposing matter, lasted from Antiquity (especially endorsed by Aristotle; see, for instance, Balme, 1962 and Lennox, 2001: 229-248) to the 17th century (and later).

Among those who rejected (at least in some cases) spontaneous generation, we may cite Sir Thomas Browne. In his *Pseudodoxia epidemica* (Browne, 1646, 1658: 153; see also Wilkin, 1835: 538) he wrote:

"Many more [tenets] there are whose serious enquiries we must request of others, and shall only awake considerations (…)

(…) Whether Mice may be bred by putrifaction as well as univocall production, as may be easily believed, if that receipt to make Mice out of wheat will hold, which *Helmont* hath delivered".

In 1651 appeared the *Exercitationes de generatione animalium* of William Harvey (Harvey, 1651). Thanks to it, a new motto was introduced in the biological

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sciences: *omne vivum ex ovo,* and the theory of spontaneous generation was again challenged. But, as pointed out by Locy (1905: 101-102, 1908: 200, 201):

"The aphorism *'omne vivum ex ovo',* though not invented by Harvey, was brought into general use through his works. It is not to be taken in its full modern significance. With Harvey it meant simply that the embryos of all animals, the viviparous as well as the oviparous, originate in eggs, and it was directed against certain contrary medical theories of the time. The first edition of his 'Generatione Animalium', London, 1651, is provided with an allegorical titlepage embodying his idea. [It] represents Jove in a pedestal, uncovering a round box – or ovum – bearing the inscription 'ex ovo omnia' and from the box issue all forms of living creatures including also man" [Fig. 1].

Curiously enough, in the Italian edition of this work (Harvey, 1666) a different engraving was added to the frontispiece, and the egg whence animals emerge lacks that inscription.

Both authors were furiously criticized by Alexander Ross (Ross, 1652, book II, chapter X, V), Sir Thomas Browne receiving a strong rebuttal:

"He [Thomas Browne] doubts *whether mice can be procreated of putrifaction.* So he may doubt whether in cheese and timber worms are generated; Or if Betels [beetles] and wasps in cowes dung; Or if butterflies, locusts, grasshoppers, shel-fish, snails, eels, and such like, be procreated of putrified matter, which is apt to receive the form of that creature to which it is by formative power disposed. To question this, is to question Reason, Sense, and Experience. If he doubts of this, let him go to *Aegypt,* and there he will finde the fields swarming with mice begot of the mud of *Nylus,* to the great calamity of the Inhabitants. What will he say of those rats and mice, or little beasts resembling mice, found in the belly of a woman dissected after her death, of which *Lemnius* is a witness, who thinks this generation might proceed of some sordid excrement or seminal pollution of those animals with which the womans meat or drink had been infested. I

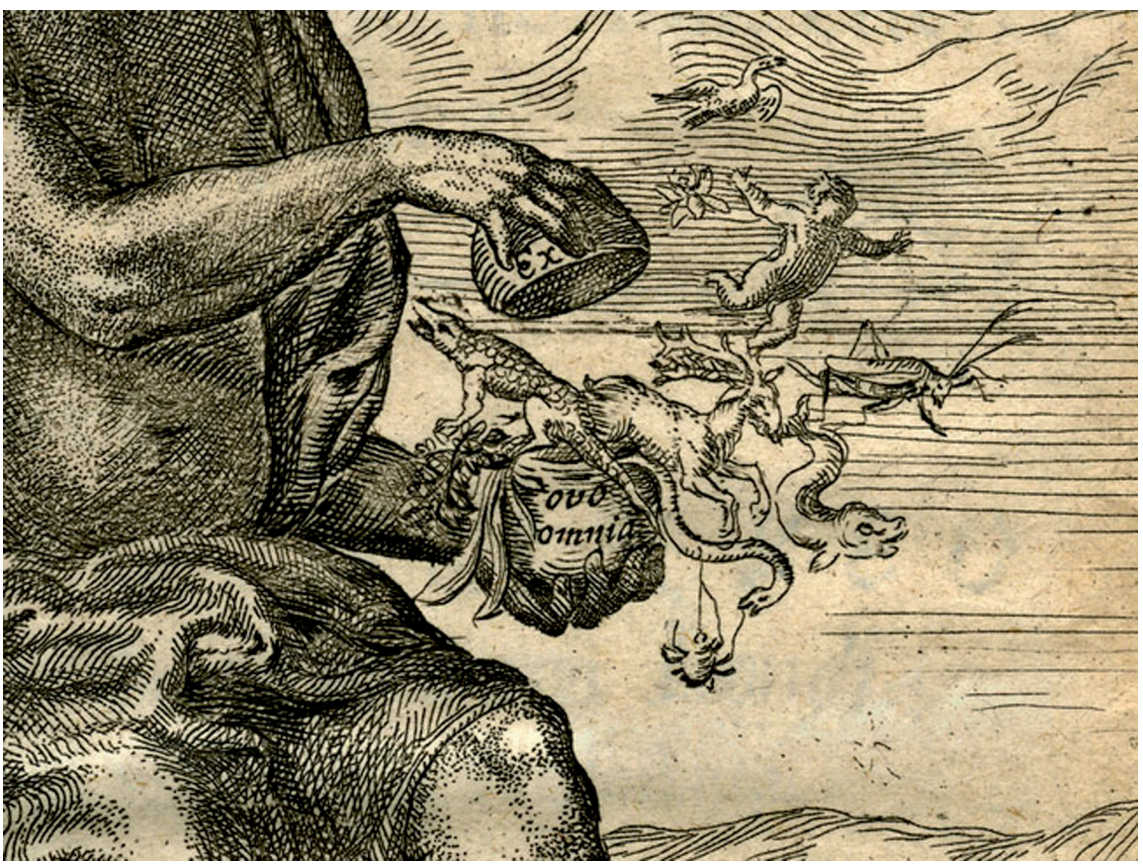

FIGURE 1: Detail of the engraving in the frontispiece of Harvey's *Exercitationes de generatione animalium* (1651), showing the egg in Jove's hands bearing the inscription 'ex ovo omnia'.

have seen one whose belly by drinking of puddle water, was swelled to a vast capacity, being full of small toads, frogs, evets, and such vermin usually bred in putrified water. A toad hath been found in a sound piece of timber".

The first solid evidence against spontaneous generation came in 1668 from Francesco Redi, with experiments made with blowflies.

In the sequence we shall examine some of the ideas about calliphorids and their reproduction, from Homer to the great seventeenth century Italian scientist.

Homer's *Iliad*

It is estimated that Homer's *Iliad* and *Odyssey* date from the last years of the 9th century b. C. or from the beginning of the 8th century b. C., the *Iliad* preceding the *Odyssey* by several decades (Vidal-Naquet, 2000).

Homer clearly admitted that blowflies were responsible for the presence of maggots in dead bodies. The goddess Thetis drove away their swarms from Patroclus' body and instilled into it, through the nostrils, "ambrosia and red nectar" to prevent the attack of the larvae. As far as known, this is the oldest record in Europe admitting the sexual reproduction of these flies, whence necrophagous maggots resulted:

"'Mother mine, the god hath indeed given arms, such as are fit to be works of immortals, nor that a mortal man could make. Truly now will I arm myself; but I very much fear least, in the meantime, **the flies, having entered the gallant son of Menoetius, by his spear-inflicted wounds, create maggots[1],** and pollute the corpse, (for life in it is destroyed), and all the parts of the body grow putrid'.

But him the silver-footed goddess Thetis then answered:

'My child, let not these things be a care to thy mind. **I will endeavour to drive away from him the fierce swarms, the flies which devour heroes slain in battle.** For although he lie an entire year, his body shall always be uncorrupted, or even better. But do thou, having summoned the Greek [Achaean] heroes to an assembly, having renounced thy wrath towards Agamemnon, the shepherd of the people, arm thyself quickly for war, and put on thy might'.

Thus, therefore, having spoken, she infused into him the most daring courage, and then instilled into Patroclus, through the nostrils, ambrosia and ruby [red] nectar, that his body might be uncorrupted".

(Iliad, XIX, 21-40; *cf.* Buckley, 1851: 357).

This passage would inspire Francesco Redi (see below) to undertake a series of very elegant experiments to prove this fact.

Ancient Egypt and the Near East

According to Bodenheimer (1960: 73):

"An old necklace from Palestine, exhibited at the Palestine Museum of Archaeology is composed of two golden flies flanking an object which resembles most the maggot of a fly [Bodenheimer gives an illustration of that object in his Plate XVIII, 1]. The knowledge of this metamorphosis is quite probable, and suggested by the text on a slip of paper, found in the mouth of an Egyptian mummy (*Papyrus Gizeh* no. 18026: 4: 14) saying: 'The maggots will not turn into flies within you!'".

Levinson & Levinson (2001: 65) add:

"Funerary priests had discovered that human mummies were frequently infested by necrophagous larvae which developed into blowflies (*Calliphora* spp.) and carrion beetles (*Dermestes* spp. and *Necrobia* spp.) in the corpse of the deceased (Levinson & Levinson, 1996). Fully grown larvae of the above genera usually left the body tissues and penetrated the resinous skin coating of the mummy. The priests, having observed larvae, pupae and adults of blowflies and carrion beetles being retained between the mummy's bandages, concluded the transformation of such larvae into adult insects (*cf.* Papyrus de Gizeh nb. 18026; Lieblein 1895). There is no doubt that the ancient Egyptians knew that a dung beetle larva undergoes metamorphosis (ḫprw) by moulting to a mummy-like pupa and subsequently to an adult dung beetle within the oval brood chamber. This assumption is corroborated by the terms nwt and nhpw (dung-made brood chamber) as well as ḫprw (transformation) which were currently used hieroglyphic words".

In both cases, however, we are left without any hint as to the origin of the maggots or larvae (from copula of the adults or by spontaneous generation?).

The *Vendidad*

The *Vendidad* (or *Vidēvdāt,* a corruption of Avestan *Vî-Daêvô-Dāta,* variously translated as "the law against demons" or "given against the demons") is the latest book of the *Avesta* ["or rather *Apasta,* which more nearly corresponds with *Apistak,* the Pehlevi form of the word, meaning 'text' or 'scripture'"; *cf.* Rose, 1867: 56], the scriptures of Zoroastrism. The *Vendidad* was written down between about 200 and 400 AD, either in the later years of the Parthian Empire or during the Sassanian Empire, the last Persian empire before the Islamic conquest. Even though its writing is late, compared to the rest of the *Avesta,* the material it contains is much more ancient; some of it may date back to pre-Zarathushtrian times, and much of it comes from the age of the Magi, during the Achaemenid Persian Empire, 600-300 BC. Most of the original Zoroastrian scriptures have been lost over the years due to destructive invaders such as Alexander, the Islamic Arabs and the Mongols. The *Avesta,* as it now stands, consists of what was salvaged from the scriptures, saved in the memories of priests who kept the sacred words in oral tradition. The *Vendidad* is a late compilation of such material, probably set down in writing by many different authors and edited into one book. It is in prose, and its language is Avestan, an ancient Iranian language, but a much later Avestan, a language then used by some priests that is no longer living. Most of the book is set forth in a structure of questions proposed by Zarathushtra (or Zoroaster) to Ahura Mazda, the Wise God, and Mazda's answers. The text is divided into 22 *Fargads,* or sections, each with subsections and numbered paragraphs. It is mainly an enumeration of various manifestations of evil spirits, and ways to confound them. The first *fargard* is a dualistic creation myth, followed by the description of a destructive winter on the lines of the deluge of mythology. The second *fargard* recounts the legend of *Yima,* the pre-historic king of Iran – he was warned that a deadly Ice Age would come upon the earth, and was instructed by Ahura Mazda to build a Utopian community called a *var,* isolated from the rest of the world; Yima brought there perfect breeding samples of each species of plant and animal along with a perfect community of people; here, protected from the dreadful ice, the best of Earth was preserved; a myth very much like the myth of Noah's Ark. The remaining *fargards* deal primarily with hygiene: care of the dead in particular (*fargards* 3, 5, 6, 7, 8, 9, 10, 16, 17, 19) as well as disease and spells to fight it (7, 10, 11, 13, 20, 21, 22). *Fargards* 4 and 15 discuss the dignity of wealth and charity, of marriage and of physical effort, and the indignity of unacceptable social behavior such as assault and breach of contract, and specify the penances required to atone for violations thereof.

One of the main concerns of the *Vendidad* is pollution. It may come from many sources: evil animals, known as *khrafstras,* which are part of Ahriman's creation; snakes, flies, ants, or destructive wolves. If may come from sickness, or from excrements, or from cast-off body waste such as cut hair or nails. Pollution also comes from women during their menstrual periods, a notion very common among several peoples all over the world.

The pollution of a corpse is personified in the demonic *Druj Nasu,* the hideous, fly-shaped female spirit of dead flesh. The *Vendidad* contains very detailed and elaborate instructions on how to protect against and purify human beings from polluting contact with corpses. The text also describes the *dakhmas,* the famous Towers of Silence where the bodies of dead Zoroastrians were placed to be consumed by vultures and other scavenger animals. Every contact with corpses is covered in almost obsessive detail: what to do if someone dies in wartime and snow and ice prevent access to the Tower; what to do if you find the body of a drowned person in river or lake water; how much pollution happens if a man dies in public surrounded by people; and how to purify land, clothing, wood, vessels, or even houses which have been in contact with corpses. Most of the purification rituals in the *Vendidad* consist of multiple baths or rubdowns with bull's urine, earth, and water, accompanied by the recital of the proper prayers. The most powerful ritual is the *barashnom* or *barashnûm* (*fargard* 9; *cf.* Darmesteter, 1880: 119-133), a rite that lasts nine days and nights, in which the person to be purified is isolated in a special enclosure and bathed nine times with the sequence of bull's urine, dry earth, and water, as he moves through a series of sacred patterns and spaces laid out on the ground. The ritual can take away the pollution of close contact with corpses, but is reserved for serious occasions due to its length and complexity (Shapiro, 1995).

In *fargard* VII (I, 1-6) (*cf.* Darmesteter, 1880: 74-76) we have the dialogue between Zarathushtra and Ahura Mazda, about "how long after death the Nasu falls upon the dead":

"1. Zarathustra asked Ahura Mazda: 'O Ahura Mazda, most beneficent Spirit, Maker of the material world, thou Holy One! When a man dies, at what moment does de Drug Nasu rush upon him?'

2. Ahura Mazda answered: 'Directly after death, as soon as the soul has left the body, O Spitama Zarathustra! The Dru*g* Nasu comes and rushes upon him, from the regions of the north [where Hell was located], in the **shape of a raging fly,** with knees and tail sticking out, all stained with stains, and like unto the foulest Khrafstras.

3. On him she stays until the dog has seen the corpse or eaten it up, or until the flesh-eating birds have taken flight towards it. When the dog has seen it or eaten it up, or when the flesh-eating birds have taken flight towards it, then the Dru*g* Nasu rushes away to the regions of the north in the shape of a raging fly, with knees and tail sticking out, all stained with stains, and like unto the foulest Khrafstras'.

4. O Maker of the material world, thou Holy One. If the man has been killed by a dog, or by a wolf, or by witchcraft, or by the artifices of hatred [by poison], or by falling down a precipice, or by the law [literally 'by men'], or by a murderer, or by the noose [if he has strangled himself; or possibly 'by want'], how long after death does the Dru*g* Nasu come and rush upon the dead?

5. Ahura Mazda answered: 'At the next watch after death [The day is divided into five watches or *ratu.* If the man dies a natural death, the Dru*g* comes directly; if the death be violent and unlooked for, the Dru*g* is taken unaware, and it requires time for her to be warned of it and to come], the Dru*g* Nasu comes and rushes upon the dead, from the regions of the north, in the shape of a raging fly, with knees and tail sticking out, all stained with stains, and like unto the foulest Khrafstras'."

We can speculate that the observation of blowflies [According to Khoobdel *et al.* (2008: 188), in Tehran, Iran, the following species associated with carrion occur: *Calliphora vicina* Robineau-Desvoidy, 1830, *Calliphora vomitoria* (Linnaeus, 1758), *Lucilia caesar* (Linnaeus, 1758), *Lucilia sericata* (Meigen, 1826) and *Chrysomyia albiceps* (Wiedemann, 1819)] approaching corpses originated the myth of the female demon *Druj Nasu,* a personification of the calliphorid fly.

A similar phenomenon of the personification of blowflies as a devil may have occurred in Greece, in relation to the demon *Eurynomus.* Pausanias (*ca.* 115-180 AD) mentioned that at Delphi, "beyond the fountain Cassotis there is a building which contains the pictures of Polygnotus"; and that one of the parts of the picture, on the left hand,

"represents Ulysses descending to Hades, that he may consult the soul of Tiresias about his safe return to his native country. The particular of the painting are as follows: – A river presents itself to the view, which is evidently Acheron. Reeds are seen in this river, and fishes whose forms are so obscure that you might conjecture they were rather shadows than fishes. There is a ship, too, in this river, and a ferryman standing by its oars. Polygnotus, as it appears to me, in this part of the picture had an eye to the poem called Minyas[2], in which there are the following verses upon Theseus and Pirithous:

'Old Charon in his vessel fill'd with shades

Refused these living heroes to admit'.

Hence Polygnotus has represented Charon as an old man. The person in this vessel cannot be clearly discerned. (…). On the banks of Acheron, an affair is represented, which deserves to be particularly noticed. A little below Charon, a son who had behaved unjustly to his father, is strangled by his father. (…).

In this picture of Polygnotus, near the man who injured his father, and is on this account punished in Hades, there is a man suffering punishment for sacrilege. A woman well acquainted with poisons, and other instruments of punishment, is represented tormenting him. (…). Above those which we have now enumerated is **Eurynomus,** who, according to the Delphic interpreters of sacred concerns, is one of the daemons belonging to Hades, and **who eats the flesh of dead bodies, so as to leave the bones quite bare.** However, neither Homer in the Odissey, nor the poetical composition which is called Minyas, nor the verses which are denominated *Nostoi*[3], or *the Return* (for in these there is an account of Hades and its terrors), make any mention of the daemon Eurynomus. I shall therefore describe the figure of Eurynomus as he appears in this picture. **His colour is between azure and black, and is like that of flies which infest meat.** He shows his teeth, and sits on the skin of a vulture". (*cf.* Taylor, 1824: 159-161).

Blowflies and Shakespeare

In Shakespeares's plays the verb *to blow* has been used with six different meanings (according

to Schmidt, 1971: 122-123): (i) to move an air (to drive a current of air upon; to drive by a current of air; to put in some state by a current of air or breath); (ii) to breathe, to pant, to puff; (iii) to inflate, to swell; (iv) to sound a wind-instrument; (iv) to throw up into the air; and (vi) to foul, to sully with ordure, applied to flies, or also to deposit eggs.

In the meaning of "to deposit eggs", *blown* was used by the Poet in the following passages:

(i) *Love's Labour's Lost* (written about 1594-1595)
"Tafetta phrases, silken terms precise,
Three-piled hyperboles, spruce affectation
Figures pedantical –These summerflies[4]
have ***blown*** *me full of maggot ostentation"*[5]
(V, 2, 409)

(ii) *Othello* (written about 1604-1605)
"Desdemona: *I hope my noble lord esteems me honest.*
Othello: *O ay, as summerflies are in the shambles,*
That quicken[6] *even with* ***blowing***"[7]
(*Othello* IV, 2, 65-67)

However, in other plays, *blown* was employed in the sense of "to sting", as already pointed out by Schanzer (1986: 224, under *blow*), a meaning not considered by Schmidt (*l. cit.*):

(iii) *Antony and Cleopatra* (written about 1606-1607)
"… rather on Nilus' mud
Lay me stark nak'd and let the water-flies[8]
Blow me into abhorring".
(V, 2, 57-58)

(iv) *The Winter's Tale* (written about 1610-1611)
"Autolycous: He has a son, who shall be flayed alive; then 'nointed over with honey, set on the head of a wasp's nest; then stand till he be three-quarters and a dram dead; then recovered again with aqua-vitae or some other hot infusion; then, raw as he is, and in the hottest day prognostication proclaims, shall he be set against a brick wall, the sun looking with a southward eye upon him, where he is to behold him with flies **blown** to death".[9]
(IV, 4, 779-787).

(v) *The Tempest* (written about 1611-1612)
"I am in my condition
A prince, Miranda; I do think, a king –
I would not so! – and would no more endure
The wooden slavery than to suffer
the flesh-fly[10] ***blow*** *my mouth"*
(III, 1, 69-73).
"I have been in such a pickle since I saw you last,
that I fear me will never out of my bones; I shall
not fear ***fly-blowing****"*
(V, 1)

It becomes clear from a passage in *Titus Andronicus* (written about 1593-1594) that Shakespeare admitted that blowflies were generated by sexual reproduction (they had "a father and a mother"):

"*Titus* – What dost thou strike, Marcus, with thy knife?
Marcus – At that that I have killed, my lord, – a fly.
Titus – Out on thee, murderer! Thou killest mine heart;
Mine eyes are cloy'd with view of tyranny.
A deed of death done on the innocent,
Becomes not Titus' brother. Get thee gone;
I see thou art not for my company.
Marcus – Alas! My lord, I have but killed a fly.
Titus – But how, **if that fly had a father and mother,**
How would he hang his slender, gilded wings,
And buz lamenting doings in the air?
Poor, harmless fly!"
(III, 2)

The females, after copulation, we may gather, would *blow* (lay eggs), from which maggots would emerge and feed upon decomposing animal and human bodies.

But later on, in *Hamlet* (written about 1599-1600), Shakespeare wrote:

"For if the sun breed maggots[11] in a dead dog, being a good kissing carrion"
(Hamlet, II, 2)

Most probably he was merely employing here a poetical license[12].

Francesco Redi

Ambroise Paré, reporting the horrible state of the dead after the battle of Saint Quentin in 1557 (Paget, 1910: 45; Packard, 1921: 242-243), wrote about the spontaneous generation of blowflies:

"We saw more than half a league round us the earth all covered with the dead; and hardly stopped there, because of the stench of the dead men and their

horses; **and so many blue and green flies rose from them, bred of the moisture of the bodies and the heat of the sun,** that when they were up in the air they hid the sun. It was wonderful to hear them buzzing; and where they settled, there they infected the air, and brought the plague with them".

Thomas Mouffet, a contemporary of Shakespeare, admitted two types of reproduction for flies (Mouffet, 1658: 932-933):

"**Flies are generated two waies, by coupling with their own species (which is done in the summer season, and in the winter if the weather be fair) or by the putrefaction of other things.** The Flies use copulation, some of them dispatch the work sooner, others after some space of time: the manner whereof (as *Arist.* affirms) is divers from most of the other Insects; for when the male ascends the female, he takes the member of the female (that is stretched forth to seek for seed) into his body, the which being accordingly received, he furnisheth with matter and strength to bring forth. Reverend *Pennius*[13] saw two Flyes at *Hedelberg* flying in the act of copulation, who (as it had been the son of *Mercury* or *Venus*) seemed to be of a mixed nature, and they did get up by turns. Somewhat a while after copulation they exclude or shoot forth little worms, as the Hen doth eggs; which afterwards by a strange *Metamorphosis* are again changed into Flyes. Although *Pliny*[14] contrary to experience doth without ground affirm that nothing else doth arise out them. Very rightly *Scaliger*[15] saith, that the Flyes at first do generate Insect unlike themselves, but yet in a capacity of becoming the same, (that is to say) white little worms, which afterwards being made like to Flies, have eyes hanging down by their sides; in reference to whose likeness there is a kinde of disease in the eye, called *μυιοκέφαλα, i.e.,* headed like a fly. Now a great number of Flyes, if not the more part of them, arise from dung, whence I have seen them to come perfect before they were begun. But in this kinde of generation we must note, that Flyes are not immediately procreated of dung, but of the little worms proceeding of digested dung, as the Philosopher writes in these words [citation in Greek]. Which Gaza[16] translateth thus: *Musca ex vermiculis fimi digesti in partes gignuntur, &c.* In English thus: *Flyes are begotten of dung digested into parts, therefore they that desire to meddle in this business, strive to distinguish the dung that is not digested, from that is mingled with that which is digested. Now these worms at the first are exceeding small, afterwards begin to be red, then as yet without motion as it were, cleaving by fibres they begin to move; then they become unmovable worms, afterwards they move again, then become they again to be without motion, and in conclusion by the assistance of air and sun there is begotten a living fly. Arist.* here, as it seems, spake rather from others observations than his own skill. For neither those worms that are generated by copulation; not those which are bred of putrefaction are subject to so many metamorphoses or transmutations, before they are transformed into Flyes. For they only grow to such a bignesse, afterwards are turned into a *Nymph* or young Fly, and so lie still, then at a certain time appointed by Nature the *Nymph* growth to be a Fly.

Neither are Flies begotten of dung only, but of any other filthy matter putrefied by heat, in the summertime, and after the same way spoken of before, as *Grapaldus*[17] and *Lonicerus*[18] have very well noted.

But yet the question would be, whether Flyes are not immediately generated of putrefaction, and not of those worms. For experience witnesseth that there are a certain kinde of Flies which are begotten in the back of the Elm, Turpentine-tree, Wormwood, and so perchance in other herbs and plants, without any preceding vermiculation, or being turned into little worms first. So that *Scaliger* that angelical man, and the most learned of this Age, writeth thus of their original: *Peradventure* (saith he) *they may seem not to arise from putrefaction, but from some certain principles changed as from some kind of liquid gum, or from some other matter concocted by Nature for this end.* Now whether concoction can be without putrefaction there is the scruple. Each part of mans body hath its conveyance for the expurgation of its excrements, called in Latine *Emunctoria.* But whether a living creature may be the excrement of a creature that never had life, let others determine; here my light fails me, or rather I am altogether blind. A third way how Flyes are begotten, Sir *Tho. Knivett*[19] an English-man, and of singular learning, did first of all inform *Pennius* of, and it was thus: The corrupted body of a Caterpillar or a little bruised, is converted into an imperfect *Aurelia,* then from that not a Butterfly, but three black eggs are cast out that are somewhat long fashioned, from whence proceed ordinary Flyes, or others like to them; and some times the *Aurelia* being putrefied, neither Butterfly nor eggs come forth of it, but white worms, (sometimes many) come forth whence are generated very small Flyes[20].

The which famous observations of natural History truth it self doth enjoyn us acknowledge received from the foresaid Knight; for no man before him did

ever observe the like. *Peter Martyr*[21] in his 3. *Decad,* and 6 *Book,* reports that he saw drops of sweat falling from the fingers of labourers, turned into Flyes, and so they write that in the marshy Countrey of *Parias,* by reason of the contagiousness and venomous quality of the air, the drops that fall from the hands of the labourers do bring forth Toads. But whether it be done immediately or mediately by some worm out of which the Fly should break forth, he doth not shew.

In the year 766, before the Nativity of *Christ, Rivallus* then being *K. of Britains,* there were showers of blood three daies together very great, very many, from whence came abundance of Flyes, and so poysonous, that with their stings they killed a great number of people: so saith the English History[22].

Now the Fly for the most part is not at the first a Fly, but a worm, proceeding either from the dead corpses of men, or the carcasses of other creatures, then it gets feet and wings, and so becomes a creeping creature, a flying; and begets a little worm which afterwards becomes a Fly. Take off the head of a Fly, yet the rest of his body will have life in it, yea it will run, leap, and seem as it were to breathe. Yea when it is dead and drowned, with the warmth of the sun and a few ashes cast upon it, it will live again, being as it were anew made, and a fresh life put into it, insomuch that *Lucians*[23] disciples were perswaded and did verily believe that the soul of them was indeed immortal. Forasmuch as it goes and comes, it owns its own body and raiseth it up, so that it drinketh, eateth, wipes its head and eyes, makes clean its snout, rubs its shanks and legs, claps is wings and flies: verifying the opinion of *Plato* concerning the immortality of the soul, and the fable concerning *Hermotimus Clazomenius*[24], whose soul would often go out of his body, wander up and down a great way by it self, and afterwards would return into the body, replenish and raise it up again. Some will put drowned Flyes into warm Ashes, or warm Bran, and in a quarter of an hour fostering them in their hands and breathing on them, they will bring them to life again".

Through a series of extremely careful and elegant experiments, a model of scientific method, the great Italian scientist and poet Francesco Redi demonstrated that the theory of spontaneous generation, as applied to blowflies, was completely wrong. Francesco Redi was born on February 18, 1626, in Arezzo. He studied at a Jesuit school in Florence and completed his studies of medicine in Pisa in 1647. After travelling to Rome, Naples, Bologna, Padua and Venice, he began practicing as a doctor in Florence. From 1657 until 1667, Francesco Redi was a member of the *Accademia del Cimento* (Academy of Experiment). Redi was named personal physician and director of the ducal apothecary by Grand Duke Ferdinando. When Cosimo III became the new Grand Duke, Redi retained his position, During his time in the office, he undertook a great number of experiments in order to improve medical and surgical practices. Furthermore, he was an active member of the *Accademia della Crusca* and supported the preparation of the Tuscan dictionay[25]. Redi taught the Tuscan dialect as a "lettore publico di lingua toscana" in Florence in 1666. He also composed many literary works, including his "Letters", the dithyramb "Bacco in Toscana" and "Arianna inferma". His most famous poetic work, "Bacco in Toscana", first appeared posthumously and is considered one of the best literary works of the 17th century. He died on March 1, 1698, in Pisa.

In 1668 he published his scientific masterpiece, *Esperienze intorno alla generazione degl'insetti* (Redi, 1668), a milestone in the history of modern science, where, in a very candid and captivating way, he described his experiments regarding the reproduction of blowflies. Bigelow (1909: 33-38) gave the following (somewhat free and abridged) translation of Redi's Italian text about that subject:

"These eggs made me think of those deposits dropped by flies on meats, that eventually become worms, a fact noted by the compilers of the dictionary [error, vocabulary, *vocabulario* in the original] of our Academy[25], and also well known to hunters and to butchers, who protect their meats in Summer from filth by covering them with white cloths. Hence great Homer, in the nineteenth book of the Iliad, has good reason to say that Achilles feared lest the flies would breed worms in the wounds of dead Patrocles, whilst he was preparing to take vengeance on Hector.

Having considered these things, I began to believe that all worms found in meat were derived from the droppings of flies, and not from the putrefaction of the meat, and I was still more confirmed in this belief by having observed that, before the meat grew wormy, flies had hovered over it, of the same kind as those that later bred in it. Belief would be vain without the confirmation of experiment, hence in the middle of July I put a snake, some fish, some eels of the Arno, and a slice of milk-fed veal in four large, wide-mouthed flasks; having well closed and sealed them, I then filled the same numbers of flasks in the same way, only leaving these open. It was not long

before the meat and the fish, in these second vessels, became wormy and flies were seen entering and leaving at will; but in the closed flasks I did not see a worm, though many days had passed since the dead flesh had been put in them. Outside on the paper cover there was now and then a deposit, or a maggot that eagerly sought some crevice by which to enter and obtain nourishment. Meanwhile the different things placed in the flasks had become putrid and stinking; the fish, their bones excepted, had all been dissolved into a thick, turbid fluid, which on settling became clear, with a drop or so of liquid grease floating on the surface; but the snake kept its form intact, with the same color, as if it had been put in but yesterday; the eels, on the contrary, produced little liquid, though they had become very much swollen, and losing all shape, looked like a viscous mass of glue; the veal, after many weeks, became hard and dry.

Not content with these experiments, I tried many others at different seasons, using different vessels. In order to leave nothing undone, I even had pieces of meat put under ground, but though remaining buried for weeks, they never bred worms, as was always the case when flies had been allowed to light on the meat. One day a large number of worms, which had bred in some buffalo-meat, were killed by my order; having placed part in a closed dish, and part in an open one, nothing appeared in the first dish, but in the second worms had hatched, which changing as usual into egg-shape balls [pupae], finally became flies of the common kind. In the same experiment tried with dead flies, I never saw anything breed in the closed vessel.

Hence I might conjecture that Father Kircher, though a man worthy of esteem, was led into erroneous statements in the twelfth book of 'The Subterranean World'[26], where he describes the experiment of breeding flies in the dead bodies of the same. 'The dead flies', says the good man, 'should be besprinkled and soaked with honey-water, and then placed on a copper-plate exposed to the tepid heat of ashes; afterwards very minute worms, only visible through the microscope, will appear, which little by little grow wings on the back and assume the shape of very small flies, that slowly attain perfect size'. I believe, however, that the aforesaid honey-water only serves to attract the living flies to breed in the corpses of their comrades and to drop their eggs therein; and I hold that it is of little use to make the experiment in a copper vessel heated by warm ashes, for without these accessories the worms would have bred in the dead bodies. I also frankly confess my inability to understand how those small worms, described by Kircher, could change into small flies without at first, for the space of some days, being converted into egg-like balls [pupae], now how those small flies could hatch out so small and then grow larger, as all flies, gnats, mosquitoes and butterflies, as I have observed many times, on escaping from the chrysalis are of the same size that they keep through life. But, oh, how this single, ill-considered experiment of Kircher must have delighted and elated persons who fondly imagine that they could re-create man from man's dead body by means of fermentation, or other similar or still more extraordinary processes! I am of the opinion that they might have used it as a base for their theories, and would have boastfully said:

'Thus do great sages openly proclaim

That Phoenix dies and is reborn the same.'[27]

Whereupon these same boasters would perhaps have bestirred themselves about that incredible undertaking, which has been attempted more than once, as I have heard but have not believed. The absurd tale is not worth the trouble of confutation, for as Martial says:

'Turpe est difficiles habere nugas,

Et stultus labor est ineptiarum.'[28]

Even Father Kircher, in the eleventh book of the 'Subterranean World', has nobly stood out against the folly of the charlatan, Paracelsus[29], who, impiously, would have us believe that there is a way to create mankind in the retort of alchemists. I am still more scandalized at the assertion of others, who make these lies a foundation for conjecture concerning the greatest mystery of the Christian faith, namely, resurrection of the body at the end of the world. The Greek, George Pisida[30], was one of those who exhorted people to believe in the Ressurrection, giving the phoenix as an example of it; and the famous chemist, Sir Kenelm Digby[31], tried to prove the same by re-creating crabs out of their own salts, by chemical means. The holy mysteries of our Faith cannot be comprehended by human intelligencer; unlike natural things, these are of the special workmanship of God, who is believed to be omnipotent, and therefore it is possible to believe blindly in all His works, for so they are best understood. In this sense a charming Italian poet wrote:

'Heaven's secrets he alone of men perceives,

Who shut his eyes and trustfully believes.'[32]

Leaving this long digression and returning to my argument, it is necessary to tell you that although I thought I had proved that the flesh of dead animals could not engender worms unless the semina of live ones were deposited herein, still, to remove all doubt, as the trial had been made with closed vessels into which the air could not penetrate or circulate, I wished to attempt a new experiment by putting meat and fish in a large vase closed only with a fine Naples veil, that allowed the air to enter. For further protection against flies, I placed the vessel in a frame covered with the same net. I never saw any worms in the meat, though many were to be seen moving around on the net-covered frame. These, attracted by the odor of the meat, succeeded at last in penetrating the fine meshes and would have entered the vase had I not speedily removed them. It was interesting, in the meanwhile, to notice the number of flies buzzing about which, every now and then, would light on the outside net and deposit worms there[33]. I noted that some left six or seven at a time there, and others dropped them in the air before reaching the net. Perhaps these were of the same breed mentioned by Scaliger, in whose hand, by a lucky accident, a large fly deposited some small worms, whence he drew the conclusion that all flies bring forth live worms directly and not eggs. But what I have already said on the subject proves how much this learned man was in error. It is true that some kinds of flies bring forth live worms and some other eggs, as I have proved by experiment. Nor am I in the least degree convinced by the authoritative testimony of Father Honoré Fabri of the venerable Company of Jesus, who asserts, in his book on the 'Generation of Animals', that flies always drop eggs and never worms[34]. It is possible (I neither affirm nor deny it) that flies sometimes drop eggs and at other times live worms, but perhaps they would habitually drop eggs if it were not for the heat of the season that matures the egg and hatches it in the body of the fly, which as a consequence brings forth live and active worms[33].

Johann Sperling[35], who is usually accurate in his statements, is also mistaken in writing in his 'Zoölogy' that worms are not engendered by flies, but arise from the dung of the same, and in explanation adds with false premises: *Ratio huius rei animis candidis obscura esse nequit; muscae enim omnia liguriunt, vermiumque materiam una cum cibo assumunt, assumptamque per alvum reddunt*' ["The reason of this may not be obscure to sincere spirits; flies lick everything and, together with food, ingest matter with worms, which is then expelled through the intestine"]. Sperling failed to observe what may be daily seen by everyone, namely, that flies have their ovaries divided into two separate cells which contain the eggs that are sent down through a single and common canal from which they are ejected, and, indeed, in such large quantities as would appear incredible, certain green flies being so fertile that each one would have in its ovary as many as two hundred eggs[36]. Hence Sperling erred in his belief that the maggots of flies are generated from the dung of the same. A friend of mine went equally wide in his conclusions, for having noticed that a fly, entangled in a web, dropped a worm whenever the spider bit it, he believed that the spider's bite had power to create worms in the bodies of flies[37]. Hence as I have shown, no dead animal can breed worms".

Redi's experiments were repeated and confirmed by Vallisnieri (1700, 1742).

NOTES

1 Literally "sons of flies" (υἱὸν μυιαι; *cf.* Clapp, 1899: 5, lines 24-25).

2 *Minyas* – An early Greek epic poem, probably dating to the sixth century BC, which is now lost and whose author in unknown. The very few fragments that survive, in Greek and English, were published by West (2003). It concerns the story of Theseus and Pirithous's descent into the Underworld (Hades). *Minyae* was one of the designations of the Argonauts (*e.g.,* in Ovid's *Metamorphoses*).

3 *Nostoi* (from *nostos,* "return home") – A lost epic of ancient Greek literature, which related the return home of the Greek heroes after the end of the Trojan War. Only five and a half lines of the poem's original text survive.

4 Summer flies – apparently the same as "blowflies"; see following note.

5 Hibbard (1998: 210) made the following comment: "Through an association process that leads from textile materials to the source of them, Shakespeare is now thinking of *sheep,* whose wool and flesh can become the breeding

ground for 'summer flies', which lay their eggs [*blown me*], that soon turn to *maggots,* in them".

6 *quicken* – In Bailey's *An universal Etymological English dictionary* (Bailey, 1675) we have: "To AN'IMATE [*animer,* F. *animare,* L.] to enliven or **quicken;** to hearten or encourage"; "To **QUICKEN** [cpiccan, *Sax. quicken,* Du] to make or become alive, as a Child in the Womb; also to hasten"; "To VIVIF'ICATE [*vivificatum,* L.] to vivify, to **quicken** or give Life"; "To VIV'IFY [*vivifier,* F.] to enliven or **quicken**".

From the Proto-Indoeuropean base **gwiwo-,* "to live"; in Old English *cwic,* 'living, alive'. From Proto-Germanic **kwikwaz* (*cf.* Old Frisian *quik,* Old Norse *kvikr* 'living, alive', Old High German *quec;* lively'. In Greek *βιβος,* afterwads *βιος*, Latin *vivus.*

7 *That quicken even with blowing* – "Othello is saying he believes Desdemona is as 'honest' as the most lascivious creatures, the flies that swarm in the slaughterhouses [shambles], who become pregnant as soon as they are newly born" (Ackerley & Gontarski, 2004: 524).

8 Water-flies – Odonata. "This little insect which, on a sunny day, may be seen almost in every pool, dimpling the glassy surface of the water (…). Johnson says it is the proper emblem of a busy trifler, because it skips up and down upon the surface of the water, without any apparent purpose" (Dyer, 1883: 248).

It is a well-known fact that in European folklore they are deemed to sting people, or to inject urine in their eyes. In the Geneve region, Switzerland, they are known as *tire-zyeux,* a name also occurring in France, in the regions of Mayenne and Doubs; in the latter they also receive the name *crèveóeil;* in the Rhône they are called *pisse-zyeux* and in Lyon *pisse-en-zyeux;* in Italy *cava-oci* and in Germany *Augenstecher* (Rolland, 1881). Brazil inherited this folkloric notions from European immigrants, and in the State of Santa Catarina dragonflies are called *fura-olho* ("eye-piercer") (Lenko & Papavero, 1997: 104). In English they are variously denominated *horse-stingers* (*e.g.,* Lubbock, 1874: 22), *devil's darner, devil's-darning-needle;* in Sweden they receive the designation *blindsticka* (Norwegian *öyenstikker*) ("blind stinger); in Germany *Teufelsnadel* ("devil's needle); also in Norway *ørsnildra,* because the dragonfly is believed to poke holes in ear-drums if it gets inside one's ears; etc.

9 Schanzer (1986: 223) remarked: "*He has a son… blown to death.* It is usually claimed that the description of these tortures is based on Bocaccio's story of Bernabò and Zinevra (*Decameron* II.9) which Shakespeare had read for the writing of *Cymbeline.* There the villain is tied together to a post in the sun, anointed with honey, and killed and devoured to the bone by flies, wasps, and gadflies (See *Elizabethan Love Stories,* edited by T.J.B. Spencer, Penguin Books, 1968, pages 161-75). It is possible that Shakespeare was drawing on memories of this incident, but quite as lately that what he had in mind were reports of the cruel tortures inflicted by the Spaniards upon Negroes and American Indians. 'Drake found a negro who had been sentenced to be whipped raw, set in the sun, and tortured to death by mosquitoes. An Indian was smeared with brimstone, fired, restored to health, anointed with honey, chained to a tree, 'where mosquitoes flocked about him like motes in the sun and did pitifully sting him" (*Shakespeare's England,* Oxford University Press, Vol. I, page 185).

10 Flesh fly [Fig. 2] – *Musca carnivora* in Moufet (1634: 58): "Carnivora musca est ferè omnium, si corpus respicias, maxima, capite rubente, corpore punctulis ex fusco albicantibus variegato: ventre crasso, caeruleo, pellucido, alis duabus nigris, hirta pilis, carnes avidè appétit. Solitaria plerumque volat, rarius multae simul conspiciuntur, nisi forte in Carnario, atque macello: ubi lanij lanistas agunt, muscario muscas continuò caedentes aut abigentes, ne illarum vermibus (…) obsonia scatentia pervilescant". Or, in English (Mouffet, 1658: 934): The Flesh-fly, in regard to his bignesse and bulk of his body is the biggest of all other, he hath a reddish head, his body full of gray spots, his belly thick, blew,

FIGURE 2: "Flesh fly" (*apud* Mouffet, 1658: 934).

transparent, having two wings, hairy, very greedy of flesh. He flies for the most part alone, unlesse it be perhaps in the flesh-market or Shambles; where the Butchers turn fencers, continually killing and beating them away with their Fly-flaps, lest with their fly-blowes (…) their flesh should be taunted"

11 "Carnivorarum muscarum vermes, Angli *Magots* vocant, & *gentles*" [flesh flies' larvae, the English call *maggots* & *gentles*] (Moufet, 1634: 72-73). "Gentle" was used, among others, in the 16th century, in the sense of "pliant, soft, mild".

12 Patterson (1838: 177) called attention to this passage: "Now it is not a little remarkable, that while he [Shakespeare] seems to suppose that maggots were generated by the sun, or that 'the sun breeds maggots in a dead dog', he was at the same time aware of the fact, that they are produced by a fly, who deposits on the decaying matter her eggs, or her larvae, It is curious that the two ideas could exist simultaneously – that the knowledge of the latter circumstance did not at once lead to the disbelief of the former. But in the history of human knowledge, we meet continually with such anomalies, and find the mind stopping short in the midst of error, just where one step farther would have placed it in the full effulgence of truth".

13 Pennius – Thomas Penny (1532-1588), English physician and entomologist. His works have not survived and he is primarily known through quotations from other sixteenth century biologists. He was partly responsible for the *Insectorum, sive minimorum animalium theatrum,* written jointly by Conrad Gesner (posthumously), Edward Wotton, Thomas Muffet and Thomas Penny (see Moufet, 1634).

14 Pliny – Mouffet was probably alluding to the followings passage in Pliny's *Natural History* (X, lxxxviii): "Quaedam ergo gignuntur ex non genitis et sine ulla simili origine, up supra dicta et quaecumque ver statumque tempus anni generat. ex his quaedam nihil gignunt, ut salamandrae, neque est in his masculum femininumve, sicut neque in anguillis omnibusque quae nec animak nec ovum ex sese generant; neutrum est et oestreis genus et ceteris adhaerentibus vado vel saxo. quae autem per se generantur, si in mares et feminas discripta sunt, generant quidem aliquid coitu, sed imperfectum ac dissimile et ex quo nihil amplis gignatur, ut vermiculos muscae", or, in English: "Consequently some creatures are born from parents that themselves were not born and were without any similar origin, like the ones mentioned above and all those that are produced by the spring and a fixed season of the year. Some of these are infertile, for instance the salamander, and in these there is no male or female, as also there is no sex in eels and all the species that are neither viviparous nor oviparous; also oyster and the other creatures clinging to the bottom of shallow water or to rocks are neuters. But self-generated creatures if divided into males and females do produce an off-spring by coupling, but it is imperfect and unlike the parent and not productive in its turn: for instance flies produce maggots" (Rackham, 1960: 412, 413).

15 Scaliger – Giulio Cesare della Scala (in Latin Julius Caesar Scaliger) (23 April 1484, 21 October 1558). Italian scholar and physician. Mouffet mentions Scaliger's book *Aristotelis liber qui decimus historiarum* [*animalium*] *inscribitur… latinus factus a J.C. Scaligero,* porthumously published in 1584 by his son Stephanus Sylvius Caesar Scaliger.

16 Gaza – Theodorus Gaza or Theodore Gazis (*ca.* 1400-1475), Greek, born in Thessaloniki, Macedonia. In 1430, when his city was captured by the Turks, he escaped to Italy. He became known as a great humanist and translator of Aristotle's work, among them the *De generatione Animalium,* alluded to by Mouffet.

17 Grapaldus – Francesco Mario Grapaldi (*ca.* 1465-1515). Under "Mvscarivm" Grapaldi (1541: 180) says: "Sunt & muscillae paruae musculae, quae in uinaceis per autumnum nascentes, & ueluti semiar pyulae [?] mustea pocula foedantes in mensa, ad brumam meritò non peruenium" ["There are also minute flies, born from unfermented wine during autumn, & [?], which produce repugnant excrescences upon the table, and do not survive during the winter"]. The little flies he mentioned are drosophilids. They were called *bibiones* by St. Isidore of Seville (Isidorus Hispaliensis; Cartagena, 560 – Seville, 4 April 636) in his *Etymologies* (Liber XII, viii (De minvtis volatilibvs), 16): *"Bibiones sunt in vino nascuntur, quo vulgo mustiones a musto*

appellant" [The *Bibiones* are born from wine, and are vulgarly called *mustiones* – from *mustum* (new, unfermented wine)] (*cf.* Lindsay, 1911).

18 Lonicerus – Adam Lonicer (or Lonitzer; in Latin Adamus Lonicerus) (10 October 1528, Marburg – 29 May 1586, Frankfurt am Main), German botanist, author of *Kräuterbuch* (1557).

19 P. Martyr – Pietro Martire d'Anghiera (2 February 1457 – October 1526), was an Italian-born historian of Spain and of the discoveries of its representatives during the Age of Exploration. He wrote the first accounts of explorations in Central and South America in a series of letters and reports, grouped in the original Latin publications of 1511 to 1530 into sets of ten chapters called "decades". His *De Orbo Novo* (published 1530) describes the first contacts of Europeans and native Americans.

20 "Three black eggs" – most probably puparia of tachinid flies. "Very small Flyes" – possibly parasitic Microhymenoptera of the caterpillar.

21 Sir Thomas James Knyvet, 1st Baron Knyvet (or Knevytt, Knyvett, Knevett, Knevvit) (1558 – 27 July 1622).

22 The story of the blood shower during Rivallus' reign was told by two Mediaeval historians:

(i) Geoffrey of Monmouth (12th century), writing about 1136, said: "Postremo, defunto Cunedagio, successit ei Rivallo filius ipsius, juvenis poacificus et fortunatus, qui regnum cum diligencia gubernavit. In tempo ejus tribus diebus cecidit pluvis sanguine, et muscarum affluentis: quibus moriebantur hominess" (*cf.* San-Marte, 1854: 29; Harper, 1910: 87); or, in English: "After the death of Cunedagius, his son Rivallo succeeded him, a peaceful, prosperous young man who ruled the kingdom frugally. In his time it rained blood for three days and men died from the flies which swarmed" (Geoffrey of Monmouth, 1966: 87; *cf.* also Tatlock, 1914: 443); and

(ii) Hardyng (1378-1465) ["Ryueall [Rivalle] his sonne that was pacificall,/ Crowned was than easye of gouernalle,/ In those tyme the greate tempest dyd befall,/ That days thre the flyes did hym assayle/ Enuenened foule vnto [the] death no faile;/ An rayned blooded the same. iii. dayes also,/ Greate people dyed, the lande to mykell woo" (*cf.* Hardyng, 1543; Ellis, 1812: 56; see also Harper, 1910: 87)].

It was variously repeated by later authors such as

(i) Robert Fabyan (d. 1513): "Capitulum. xix. RInallus, the sone of Cunedagus, was made Gouernoure of the Brytons in the yere of the worlde. iiii.M.CCCC. and xxxviii [4438]. The whiche of writers is called fortunate and restfull; this ruled ye Brytons with great sobernesse, and kept the lande in great welthe & prosperyte: Albeit that of hym is laste no specyall memory ar Acte done in his tyme, Except myne Auctour sayth that in ye time of his reygne it reyned blode by ye space of. iii. dayes continually within the lande of Brytaine. After the whiche Reyne ensued so great excedynge in nombre of multitude of Flyes, the whiche were to the people so noyous & contagious, that they slewe muche people: And after that, as sayth an olde Auctoure whose name in vnknowen, ensued great sykeness and mortalytie, to ye great disolation of this sayd lande" (*cf.* Ellis, 1811: 17);

(ii) Richard Grafton (d. 1572) (*cf.* Grafton, 1569; Harper, 1910: 87 gives this citation: "There was a rain of blood and then flies came. 'And after (as sayth an olde Aucthor) ensued great sickness and mortalitie, to the great desolation of this land'") (Harper, 1910: 87).

(iii) Raphael Holinshed (1529-1580): "The seuenth chapter. RIUALLUS, the sonne of Cunedag, began to to reigne ouer the Britaines in the yeare of the world 3203, before the building of Rome 15, Ioathan as then being kink of Iuda, and Phacea king of Israel. This Riuall gouerned the Iland in great welth and prosperitie. In his time it rained bloud by the space of three daies together; after which raine ensued such an exceeding number and multitude of flies, so noisome and contagious, that much people died by reason thereof" (*cf.* Holinshed, 1807: 449); and

(iv) John Stow (*ca.* 1525 – 6 April 1605): "Rivallus, sonne of Cunedagius, succeeded his father, in whose time it rained bloud 3 dayes: after which tempest ensued a great multitude of venemous flies, which slew much people, and then a great mortality throughout this lande, caused almost desolation of the same" (Stow, 1592: 15) (*cf.* Stow, 1631; Cowan, 1865: 217; Harper, 1910: 87).

For a very good article on Mediaeval rains of blood see Tatlock (1914).

23 Lucian of Samosata (Latin *Lucianus Samosatensis* (*ca.* 125 AD, Samosata, Roman Empire [nowadays Turkey] – after 180 AD, probably Athens), a rhetorician and satirist who wrote in the Greek language (*cf.* Francklin, 1880).

24 Hermotimus Clazomenius – Pliny (*cf.* Wernerian Club, 1849: 242), in his *Natural History* (VII, lii) says: "We read in Chronicles, that the Soul of *Hermotimus Clazomenius* was accustomed to leave his Body, and wandering to a great distance, brought him backs News of such things as could not possibly have been known unless it had been present there; and all the while his Body lay half Dead. This manner he continued, until the Cantharidae, who were his Enemies, took his Body and burnt it to Ashes; and by that means disappointed his Soul when it came back again to his Sheath".

25 Here is meant the *Vocabolario degli Accademici della Crusca* (Accademia della Crusca, 1623). The Accademia della Crusca (*crusca* means *bran* or *chaff*) began in Florence, in 1582, when some intellectuals decided to form a small society or club for their own amusement. The symbol of the Academy was the sieve, because, as the sieve serves to separate the useful grains from the chaff or bran, that learned body was created to refine or purify the Tuscan language and compile an authoritative dictionary of the language. Leonardo Salviani, who joined the Crusca shortly after its founding, became the most conspicuous member and had the distinction of drawing up its code of laws and supervising its first serious undertaking – the preparation of its *Vocabolario.* The first edition of the *Vocabulario* was published in Venice in 1612. It went through several editions and influenced many other language dictionaries abroad, as in France and England. For a history of the *Vocabulario,* see Beltrami (2004).

Redi (1668: 25) said: "le quali uova mi fecero sovvenire di quei **cacchioni, che dalle mosche son fatti, o sul pesce, o sulla carne, che divengono poi vermi;** il che fu benissimo osservato da' compilatori del **vocabolario della nostra Accademia**". In the second edition of the *Vocabolario* (see Accademia della Crusca, 1623: 138) it is said: "CACCHIONI diciamo anche a quell'uóua, che le mosche generano, o nella carne, o nel pesce, che diuengon poi vermicelli" [We also call CACCHIONI those eggs generated by flies either on meat or fish, that later become small worms].

26 Athanasius Kircher (2 May 1601 or 1602, Geisa, Buchonia, near Fulda, currently Hesse, Germany – 27 or 28 November 1680, Rome). Kircher's text on spontaneous generation appeared in his *Mundus subterraneus* (Kircher, 1664a-b). See Hirai (2006) about this subject.

27 "Così per gli gran saui si confessa,/ che la Fenice muore, e poi rinasce" (Dante Alighieri, *Divina Commedia, Inferno,* Chant XXIV, 106-107).

28 Martial (Marcus Valerius Martialis, between 38 and 41 AD – between 102 and 104 AD); the verses are from his *Epigrammaton Libri XII* (book II, lxxxvi, 9-10) and mean: "'Tis a folly to sweat o'er a difficult trifle,/ And for silly devices invention to rifle".

29 Paracelsus – Redi refers to Paracelsus' book *De natura rerum libri novem,* published in 1537. The passage alluded to by the Italian scientists has been translated thus by Waite (1894: 124-125): "But neither must we by any means forget the generation of homunculi. For there is some truth in this thing, although for a long time it was held in a most occult manner and with secrecy, while there was no little doubt and question among some of the old Philosophers, whether it was possible to Nature and Art, that a man should be begotten without the female body and the natural womb. I answer hereto, that this is in no way opposed to Spargyric Art and to Nature, nay, that is perfectly possible. In order to accomplish it, you must proceed thus. Let the semen of a man putrefy by itself in a sealed cucurbite with

the highest putrefaction of the *venter equinus* for forty days, or until it begins at last to live, move, and be agitated, which can easily be seen. After this time it will be in some degree like a human being, but, nevertheless, transparent and without body. If now, after this, it be every day nourished and fed cautiously and prudently with the Arcanum of human blood, and kept for forty weeks in the perpetual and equal heat of a *venter equinus,* it becomes, thenceforth a true and living infant, having all the members of a child that is born from a woman, but much smaller. This we call a homunculus; and it should be afterwards educated with the greatest care and zeal, until it grows up and begins to display intelligence. Now, this is one of the greatest secrets which God has revealed to mortal and fallible man. It is a miracle of God, an Arcanum above all arcane, and deserves to be kept until the last times, when there shall be nothing hidden, but all things shall be made manifest. And although up to this time it has not been known to men, it was, nevertheless, known to the wood-spirits and nymphs and giants long ago, because they themselves were sprung from this source; since from such homunculi when they come to manhood are produced giants, pigmies, and other marvelous people, who are the instruments of great things, who get great victories over their enemies, and know all secret and hidden matters. As by Art they acquire new life, therefore Art is incorporated in them and born with them, and there is no need for them to learn, but others are compelled to learn from them, since they are sprung from Art and live by it, as a rose or a flower in a garden, and are called the children of the wood-spirits and the nymphs, because in their virtue they are not like men. But like spirits".

30 George Pisida (*Georgios Pisides* in Greek, of which *Pisida* is the Latin form; sometimes called *The Pisidian*) was a Byzantine poet, born in Pisidia – a region of ancient Asia minor located north of Lycia and bordering Caria, Lydia, Phygia and Pamphylia (now Southern Anatolia, Turkey).

31 Sir Kenelm Digby (Gayhurst, Buckinghamshire, 11 July 1603 – 11 June 1665), English courtier and diplomat. Mouffet's citation refers to Digby's posthumous work *A choice collection of rare secrets* (see Hartman, 1682).

32 "I segreti del Ciel sol colui vede,/ Che serra gli occhi, e crede", in the original.

33 These two passages must have baffled Redi, after so many experiences trying to prove that all flies laid eggs. The larviparous flies observed by him were representatives of the family Sarcophagidae.

34 Honoré Fabri (*Honoratus Fabrius* in the latinized form) (Ain, France, 1607 – Rome, 8 March 1688), French Jesuit theologian, mathematician, physicist and controversialist. In his book *Tractatus duo* (Fabri, 1666: 192, Propositio LXXV. *Omnia ferè sponte nascentia sive ex putri, sive ex plantis, sive ex animalibus, generant deinde per coïtum* [All that is born almost spontaneously, be it from from putrid things, be it from plants, be it from animals, later engender by coition"]) Fabri says: "Patet experientiâ in omni muscarum genere, quae coïre videntur, pariúntque, non vermem, ut aliqui putant, sed ovum" ["Experience teaches that in all the genera of flies, which are seen to copulate, they give birth not to worms, as some think, but to eggs"].

35 Johann Sperling (12 July 1603, Zeuchfeld – 12 August 1658, Wittenberg), German physician, zoologist and physicist. Mouffet's quotation refers to the book *Zoologia physica* (Sperling, 1661).

36 The rigorousness of Redi's experiments and observations is impressive. Clift & McDonald (1973), for instance, say: "The internal female reproductive system [of *Lucilia cuprina*] consists of paired ovaries, **each containing about 100 polytropic ovarioles** ["200 eggs" of Redi], paired lateral oviducts, a common oviduct, 3 spermathecae and one pair of tubular accessory glands".

37 This passage refers again to a Sarcophagidae, laying larvae in the spider's web.

RESUMO

Apresentam-se algumas notas históricas sobre a reprodução de varejeiras necrófagas, incluindo a Ilíada de Homero, o Antigo Egito e o Oriente Médio, o Vendidad *persa, William Shakespeare, e os elegantes experimentos de Francesco Redi, que desacreditou a teoria da geração espontânea.*

PALAVRAS-CHAVE: História; Varejeiras necrófagas; Reprodução; A Ilíada de Homero; Egito Antigo e Oriente Médio; Vendidad; William Shakespeare; Francesco Redi.

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