

KINGS AND QUEENS OF THE BEES IN THE LITERARY AND THE SCIENTIFIC TRADITION

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The subject of this paper has its origins in the presentation two of the authors had made at the three-day conference on beekeeping held at Nikiti, Greece in 1996 in honour of Dame Eva Crane.

We had presented an excerpt from the *Synagoge* (Collection) by the 4th century AD mathematician Pappus Alexandrinus who, while discussing the isoperimetric problem, makes an extended reference to bees and the hexagonal cells that they construct. The fact that Pappus mentions a queen of the bees aroused the interest of Dame Eva Crane who wondered whether Pappus was implicitly contradicting Aristotle who, notoriously, speaks of a king of the bees. In our publication we claimed that Pappus was simply using a literary *locus communis*, the comparison of industrious people to bees, imitating classical authors and specifically Xenophon, and was in no way interested in the biology of bees¹.

In the present paper we wish to stress in more detail the difference between the literary tradition on the one hand and the scientific tradition within which Aristotle was working on the other. We argue that Aristotle attempted to describe the biology of bees as accurately as was possible with the restricted means at his disposal, and that he did not make any conjecture that was not based on the observations of the beekeepers who were his main sources. On the contrary, literary references to bees belong in a

1 Gousiaris, A. and M. Deliyannis, "Το ισοπεριμετρικό πρόβλημα και η μέλισσα. Πάππος ο Αλεξανδρεύς", in Η μέλισσα και τα προϊόντα της, Αθήνα, ΠΤΙ ΕΤΒΑ 2000, σ. 104-111. We sent a translation of our paper to Dame Eva Crane who graciously incorporated our conclusions in her book (Crane 2000, p. 569, 590).

tradition dating back to Homer and the writers who follow it are not interested in the biology of the bees but in the beauty and persuasiveness of their work. We claim that literary references to bees do not always reflect accurate scientific or practical knowledge but literary influences and should therefore not be taken at face-value as indicators of such knowledge. We try to corroborate this claim by tracing the most common literary *topoi* related to bees, with special reference to the gender of the queen, from Homer to classical literary prose-writers like Xenophon and Plato. We go on to discuss the rift between the scientific and the literary tradition that was made explicit in the Hellenistic period and which applies even to didactic poetry. Finally, we argue that the bee-related literary *topoi* of Greek literature were passed on to Virgil and through him to early modern authors such as Shakespeare who used them for literary purposes although they were at odds with contemporary knowledge of bees.

Bees in the literary tradition before Aristotle

Man's very ancient relationship to bees is attested by archaeological findings worldwide. The invaluable properties of honey and wax were appreciated early on and men soon turned from honey-gathering to beekeeping. However, the people who could handle bees were always a small minority. Non-beekeepers could only watch from a distance. What they saw was a disciplined community with a hierarchical organisation and division of labour, producing two invaluable goods.

The great usefulness of wax and honey induced people to ascribe divine properties to the bees. Greek mythology is full of stories with bees, the most well-

known being the bees that fed Zeus when, as an infant, his mother Rhea had hidden him on Mount Ida. Moreover, the order and productivity of the apian community was the origin of a rich literary tradition of metaphors relating the beehive to human societies. In the first extended simile of the *Iliad*, Homer (8th cent. BC) compares the Achaean warriors leaving the ships to attend an assembly to a swarm of bees leaving their hive in search of flowers:

From the camp the troops were turning out now, thick as bees that issue from some crevice in a rock face, endlessly pouring forth, to make a cluster and swarm on blooms of summer here and there, glinting and droning, busy in bright air.

Like bees innumerable from ships and huts down the deep foreshore streamed those regiments toward the assembly ground.

Iliad II 86-93, trans. Robert Fitzgerald

Hesiod (7th cent. BC), for whom women are descendants of Pandora (whose name he glosses as “she who received gifts from everyone” in *Works and Days* 81-82) compares them to drones, who live at the expense of the industrious bees:

For from her is the race of women and female kind: of her is the deadly race and tribe of women who live amongst mortal men to their great trouble, no helpmeets in hateful poverty, but only in wealth. And as in thatched hives bees feed the drones whose nature is to do mischief - by day and throughout the day until the sun goes down the bees are busy and lay the white combs, while the drones stay at home in the covered hives and reap the toil of others into their own - even so Zeus who thunders on high made women to be an evil to mortal men, with a nature to do evil.

Theogony 591-602, trans. G. Evelyn-White

Drones are mentioned again in *Works and Days*, as useless members of a community:

Both gods and men are angry with a man who lives idle, for in nature he is like the stingless drones who waste the labor of the bees, eating without working;

Works and days 303-306, trans. G. Evelyn-White; the passage is also cited by Plato, *Laws* 901a

It is clear from these passages that grammatical gender does not influence the poets’ use of bees in their similes. In the passages from the *Iliad* and the *Theogony* the (grammatically) feminine bees are compared to warriors or industrious men, whereas the (grammatically) masculine drones are compared to idle women. In the passage from *Works and Days* drones are compared to lazy men. The deciding factor is not grammatical or biological gender but the image of the swarming army in Homer’s case and the contrast between industrious and idle people, regardless of whether they are male or female, in Hesiod’s.

These two passages are also important because this is where we encounter for the first time the two commonest *topoi* referring to bees in ancient Greek literature: the bees as an army on the one hand, and the drones as useless and burdensome members of a community on the other².

We see soldiers compared to bees again in Aeschylus (525-455 BC). Now, however, the bees, just like the army, have a leader:

For all the men-at-arms, those who urge on steeds and those who march along the plain, have left the city and gone forth, like bees in a swarm, together with the captain of the host³.

(*Persae* 126-129, trans. Herbert Weir Smith)

The same simile of the Persian king as king of the bees is found in Xenophon (430-354 BC), who uses it to stress Cyrus’ innate leadership qualities:

“Listen to me,” he said, “O king! For king I take you to be by right of nature; even as the king of the hive among the bees, whom all the bees obey and take for their leader of their own free will; where he stays they stay also, not one of them departs, and where he goes, not one of them fails to follow; so deep a desire is in them to be ruled by him. Even thus, I believe, do our men feel towards you. Do you remember the day you

² Brock (2013), p. 159.

³ The fact that Aeschylus uses this simile specifically for the Persian army and king might reflect Persian notions of the natural superiority of the monarch. On this, see Brock (2013), p. 160 and n. 133.

left us to go home to Persia? Was there one of us, young or old, who did not follow you until Astyages turned us back⁴?

(*Cyropaedia* 5.1.24-25, trans. H. G. Dakyns)

Xenophon uses this simile again to refer to a Greek leader:

When the people came to discover that their hero was not dead, they crowded round his house this side and that, like a swarm of bees clinging to their leader.

(*Hellenica* 3.2.28, trans. H. G. Dakyns)

And once again in the *Oeconomicus* where, however, the king-bee has become a queen-bee, the soldiers have become maidservants and the hive stands for a well-run household presided over by a good wife:

"And what sort of works are these?" she asked; "what has the queen-bee to do that she seems so like myself, or I like her in what I have to do?"

"Why," I answered, "she too stays in the hive and suffers not the other bees to idle. Those whose duty it is to work outside she sends forth to their labours; and all that each of them brings in, she notes and receives and stores against the day of need; but when the season for use has come, she distributes a just share to each. Again, it is she who presides over the fabric of choicely-woven cells within. She looks to it that warp and woof are wrought with speed and beauty. Under her guardian eye the brood of young is nursed and reared; but when the days of rearing are past and the young bees are ripe for work, she sends them out as colonists with one of the seed royal to be their lead-

er [...]Think you, my wife, it is through some such traits of forethought seen in their mistress-leader that the hearts of bees are won, and they are so loyally affectioned towards her that, if ever she abandon her hive, not one of them will dream of being left behind; but one and all must follow her."

(*Oeconomicus* 7.32-38, trans. H. G. Dakyns)

A comparison of the three passages of Xenophon shows that the writer is not interested in whether the bees have a male king or a female queen or whether the bees themselves are male or female. He is simply employing a literary convention already sanctioned by Homer, Hesiod and Aeschylus, adapting it according to the needs of each specific work. This view is supported by the fact that in the passage of the *Oeconomicus* following the one just cited the wife answers:

It would much astonish me (said she) did not these [king]'s works (τα του ηγεμόνος έργα), you speak of, point to you rather than myself. Methinks mine would be a pretty guardianship and distribution of things indoors without your provident care to see that the importations from without were duly made.

(*Oeconomicus* 7.39, trans. H. G. Dakyns)

In the same work Xenophon also uses the drone-simile first attested in Hesiod, but not to refer to people but to weeds that live at the expense of plants in a field and should be pulled out:

'What if weeds are springing up, choking the corn and robbing it of its food, much as useless drones rob bees of the food they have laid in store by their industry?'

'The weeds must be cut, of course, just as the drones must be removed from the hive.'

(*Oeconomicus* 17.14)

Plato (428/427 or 424/423 – 348/347 BC), a contemporary of Xenophon whose philosophical writings are also noted for their literary value, uses the same literary conventions when, in the *Republic*, he mentions leaders who are nurtured by the state like king-bees in the hive:

For we will say to them that it is natural that men of similar quality who spring up in

4 For the persistence of this *topos* cf. Shakespeare *Titus Andronicus* act 5, Scene 1:

Brave slip, sprung from the great Andronicus,
Whose name was once our terror, now our comfort:
Whose high exploits and honourable deeds
Ungrateful Rome requites with foul contempt,
Be bold in us: we'll follow where thou lead'st,
Like stinging bees in hottest summer's day
Led by their master to the flowered fields...

other cities should not share in the labours there. For they grow up spontaneously from no volition of the government in the several states, and it is justice that the self-grown, indebted to none for its breeding, should not be zealous either to pay to anyone the price of its nurture. But you we have engendered for yourselves and the rest of the city to be, as it were, king-bees and leaders in the hive. You have received a better and more complete education than the others, and you are more capable of sharing both ways of life.

(*Republic* 520b-c, trans. Paul Shorey)

And, in the *Statesman*:

But, as the case now stands, since, as we claim, no king is produced in our states who is, like the ruler of the bees in their hives, by birth pre-eminently fitted from the beginning in body and mind, we are obliged, as it seems, to follow in the track of the perfect and true form of government by coming together and making written laws.

(*Statesman* 301d-e, trans. Harold N. Fowler)

In the *Republic*, dangerous or useless members of society are compared to drones who should be excised from the polity, like drones from a hive:

May we not say that this is the drone in the house who is like the drone in the honeycomb, and that the one is the plague of the city as the other is of the hive? [...] And God has made the flying drones, Adeimantus, all without stings, whereas of the walking drones he has made some without stings but others have dreadful stings; of the stingless class are those who in their old age end as paupers; of the stingers come all the criminal class, as they are termed. [...] These two classes are the plagues of every city in which they are generated, being what phlegm and bile are to the body. And the good physician and lawgiver of the State ought, like the wise bee-master, to keep them at a distance and prevent, if possible, their ever coming in; and if they have anyhow found a way in, then he should have them and their cells cut out as speedily as possible.

(*Republic* 552c-564c, trans. Benjamin Jowett)

In these passages, Plato's references to king-bees and useless drones may reflect beliefs current in his time but also adherence to the time-honoured literary conventions mentioned above.

The scientific tradition: Aristotle on the generation of bees

Aristotle (384-322 BC), Plato's pupil and founder of the fact-based scientific method (Lesky 1966, p. 547) had written works intended for a wider public (the so-called "exoteric" or "published" works), of which only the titles survive (cf. Lesky 1966, p. 552ff.). These works had literary merit enough for Cicero to praise the "golden river" of their author's language. The works that have been transmitted to us, however, are based on his teaching at the Peripatos, were composed over a long period of time as new evidence became available and were not considered stylistically accomplished and therefore were only appreciated by a narrow circle of specialists (Norden 1983, p.1). Moreover, these works belonged in a scientific, not a literary tradition. According to Peck (1943, p. xvi) "[Aristotle's] work was a continuation and an expansion of what had been begun by previous scientific workers. Those to whom he most frequently refers by name are three: Anaxagoras, Empedocles, and Democritus, besides several references to theories which can be traced in the Hippocratic treatises". It comes as no surprise, then, that in his discussion of bees we find no elements of literary conventions, but only theories based on evidence collected "on the field" and culled mainly from beekeepers.

Aristotle's most extended references to bees are found in his *Histories of Animals (HA)* and *Generation of Animals (GA)*. In the former, where he mainly describes the behaviour of bees, he repeatedly refers to beekeepers, an indication that they were his main source of information. Some such instances are:

... when the beekeeper started killing them, other bees came out to attack him... (*HA* 623b15); beekeepers call this "dusting" (*HA* 623b30); when beekeepers remove the combs they leave food for the bees (*HA* 626a1); beekeepers chase away the frogs (*HA* 626a10); beekeepers chase wasps (*HA* 627b5); this warns beekeepers that a storm is coming (*HA* 627b5); when beekeepers realise this, they spray the beehive with sweet wine; some beekeepers recognise

their own bees when they are at pasture because they have sprinkled them with flour (HA 627b15).

Aristotle's systematic collection of evidence from beekeepers led him to several correct conclusions about the behaviour of bees. For instance, he accurately describes cell size, bee castes, the division of labour in the hive, the construction and use of the combs, the collection of propolis and pollen, wax moths, the existence of pillaging bees, swarming and its preparation, beekeepers' harvesting techniques, wintering, bee diseases and their cures, bees driving away and killing drones in difficult circumstances, enemies of the bees, the behaviour of the bees near and far from the hive, the unwillingness to collect leftover honey, the transportation of dead bees outside the hive, the ability of bees to use their sting to defend themselves against large animals (HA 623b-627b). Most importantly, he was the first to describe flower constancy as well as the dance of the bees, although he was unaware of its function⁵ (HA 624b).

Naturally, since the means of observation at the disposal of Aristotle and the beekeepers who were his sources were limited, he also reached many erroneous conclusions. He mentions, e.g., that bees do not inhale air (HA 487a); that they collect honey instead of producing it (HA 553b, 554a, GA 759a – although HA 623b seems to suggest that they do produce it); that there are unproductive hives "with bad leaders and many drones" (HA 625a), that in windy weather bees carry a small stone as ballast (HA 625a); that when bees harvest thyme they add water before sealing the comb (HA 627a); that a hive may have two or more kings (HA 554b); that bees live six to seven years (HA 553b).

His gravest error, however, is thought by many to be his inability (or unwillingness) to realise that the queen bee is actually female⁶. It is true that in GA and HA Aristotle refers to the leaders of the bees as kings ("*basileis*" or "*hegemones*"). A closer look at what he actually wrote, however, shows that he does not believe that they are male either. Moreover, his failure to recognise queen bees as female does not stem

⁵ The function of the bee-dance as a means of communication was elucidated in the 1940s by Max von Frisch, a discovery that earned him the Nobel Prize in 1973.

⁶ For a detailed discussion and a convincing refutation of these accusations see Mayhew (2004), pp. 19-27.

from bias but from his refusal to accept anything not corroborated by observation.

Aristotle mentions the generation of bees in HA553a17ff. where he says that not everyone agrees on how bees reproduce: some say that they do not copulate but collect their young (γόνον) from flowers; others say that they only collect the young of the drones, whereas bees are born from the kings (whom some call "mothers" because they give birth; cf. 553b17 where he again reports that kingless hives perish because, according to some, kings contribute to the generation of bees), because drones can be born even without the presence of the king, whereas bees cannot; and others say that they copulate, and that bees are female and drones male.

The main discussion of the generation of bees, however, is found in GA759a-760b. Here, Aristotle begins by admitting that "the generation of bees is a great puzzle" and announcing his conclusion that bees are possibly generated, like some fishes, without copulation, a conclusion, as he says, based on "the *phainomena*" («ἐκ τῶν φαινομένων», 759a11). He goes on to analyse these *phainomena*, while at the same time discussing other current theories and rejecting them as impossible. He thus rejects the notion that bees do not give birth but collect their offspring from flowers, on the grounds that (a) if this offspring grew spontaneously on the flowers it would grow into bees regardless of whether the bees took it to their hives or not, which is not the case; and (b) if bees collected offspring generated by some other animal, it would grow into the generating animal and not into a bee. He thus reaches the conclusion that bees generate their offspring themselves.

He then addresses the question of how this offspring is generated and by which of the three subkinds into which he has classified the bees, i.e. the worker bees, the kings and the drones⁸. The possibilities are: (a) each kind generates its own kind, or (b) one kind generates all the others. Here Aristotle, in "a remarkable piece of analysis"⁹ arrives at the correct solution, guided by the evidence culled from 7 Rendered as "what appears to be the case" by Barnes (1984), as "appearances" by Peck (1943).

⁸ In HA 623b8-14 Aristotle classifies insects that build combs in nine genera; six gregarious: the bee, the king of the bees, the drone who lives among the bees, the wasp, the anthrine and the tenthedon; and three solitary: the small siren, the large siren and the bombylius who is the largest of them all. On this subdivision of bees see Mayhew (2004) p. 20 n.4.

⁹ Peck (1943), p. ix.

beekeepers. This evidence amounts to the following: (a) drones are born even if there are no drones in the hive; (b) worker bees are not born if there are no “kings” in the hive; from this he deduces that bees give birth to drones and that kings give birth to kings and worker bees. The question whether this is done with or without copulation and if with copulation then between which of the subkinds is more problematic, because there the evidence is lacking. His beekeeper sources have never observed copulation between any of the subkinds (GA 759b23 “none of them has ever been seen in the act of copulation” trans. A.L. Peck). He therefore concludes that bees and “king-bees” generate without copulation, “something parallel to what we find occurs with certain fishes” (GA759b28, trans. A.L. Peck)¹⁰. As to the gender of these generating animals, their morphological characteristics lead him to conclude that they are neither male nor female, or that they are both: “although, as far as generating is concerned, they are female, yet they contain in themselves the male as well as the female [factor], just as plants do” (GA 759b29-31, trans. A.L. Peck). On the other hand, he knows that copulation has often been observed among the insects most closely related to the bees, i.e. the wasps. Thus, he has no difficulty accepting that the leaders of the wasps generate by copulation. This, however, does not lead him to the conclusion that they are female either.

In HA 628a17 we read “the leader, the so-called mother-wasp” (Balme’s translation of “ο ηγεμών η καλούμενη μήτρα”, where the Greek word for “leader”, or “king”, is masculine, and the same word that Aristotle uses for the leaders of the bees). In the subsequent discussion he uses the terms “kings” and “mother-wasps” interchangeably for the leaders of the wasps. In GA 761a6-8 he says that the “so-called mother-wasps” generate by copulating with each other, and that this copulation has often been observed. And a few lines above (GA 761a3-5), he states that the only difference between the generation of bees and that of similar animals such as hornets or wasps is that bees generate without copulation. And, in his only departure from observation-based argument, he ascribes this difference to the fact that hornets and wasps “contain no divine ingredient as 10 Jan Swammerdam, who “was the first to describe the egg-laying function of the queen, and the anatomical differences between queen, worker and male larvae and nymphs” did not realise that queens copulate and, like Aristotle, concluded that bees do not copulate, and that “the male Bees eject their sperm in the same manner as Fishes, who only shed it upon the spawn” (<http://www.janswammerdam.org/bees.html>).

the tribe of bees does” (GA 761a5-6, trans. A.L. Peck). That Aristotle did not consider the matter closed but expected his theory to be refuted or confirmed by further evidence is made clear in the much-quoted passage in GA760b30f: “But the facts have not yet been sufficiently ascertained; and if at any future time they are ascertained, then credence must be given to the direct evidence of the senses rather than to theories—and to theories too provided that the results which they show agree with what is observed.” (trans. A.L. Peck).

Science and literature after Aristotle

It is no surprise that Aristotle’s counter-intuitive conclusion that queen-bees (and queen-wasps) were neither male nor female did not influence everyday knowledge. If beekeepers had observed (as Aristotle notes) that queen-bees gave birth, they would naturally have assumed that they were female, and this practical knowledge eventually affected common linguistic usage. This is attested in two passages from Arrian (c. AD 86/89 – after 146/160) and one from *Joseph and Aseneth*¹¹, a pseudepigraphical biblical story expanding a reference in the Book of Genesis and variously dated between the 1st century BC and the 5th century AD.

And Megasthenes says that this oyster is taken with nets; that it is a native of the sea, many oysters being together, like bees; and that the pearl oysters have a king or queen, as bees do. Should anyone by chance capture the king, he can easily surround the rest of the oysters;

Arrian *Historia Indica* 8.2 (trans. E. Iliff Robson)

For who are you? are you the bull of the herd, or the queen of the bees? Show me the tokens of your supremacy, such as they have from nature. But if you are a drone claiming the sovereignty over the bees, do you not suppose that your fellow citizens will put you down as the bees do the drones?

Arrian *Epicteti Dissertationes* 3.22.99 (trans. T.W. Higginson)

And all the bees flew in circles round Aseneth, from her feet right up to her head; and yet more bees as big as queens, settled

¹¹ We are indebted to Harissis et al. (2012) for this reference.

on Aseneth's lips.

Joseph and Aseneth 16.14 (trans. D. Cook)

In approximately the same period, however, Dio Chrysostom (c. 40 – c. 115 AD) has the philosopher Diogenes advising Alexander that a true king need not display emblems of his office in order to be obeyed by his subjects; the example he uses to illustrate this is the king of the bees (βασιλεύς), who is obeyed by his subjects although he is the only bee that has no sting.

Thus spoke Diogenes, counting it as nothing that he might be chastised, yet quite convinced that nothing would happen. For he knew that Alexander was a slave of glory and would never make a bad move where it was at stake. So he went on to tell the king that he did not even possess the badge of royalty. And Alexander said in amazement, «Did you not just declare that the king needs no badges?» «No indeed,» he replied; «I grant that he has no need of outward badges such as tiaras and purple raiment — such things are of no use — but the badge which nature gives is absolutely indispensable.» «And what badge is that?» said Alexander. «It is the badge of the bees,» he replied, «that the king wears. Have you not heard that there is a king among the bees, made so by nature, who does not hold office by virtue of what you people who trace your descent from Heracles call inheritance?» «What is this badge?» inquired Alexander. «Have you not heard farmers say,» asked the other, «that this is the only bee that has no sting, since he requires no weapon against anyone? For no other bee will challenge his right to be king or fight him when he has this badge. I have an idea, however, that you not only go about fully armed but even sleep that way. Do you not know,» he continued, «that it is a sign of fear in a man for him to carry arms? And no man who is afraid would ever have a chance to become king any more than a slave would.» At these words Alexander came near hurling his spear. Dio Chrysostom *Oration* 4.60-64 (trans. J.W. Cohoon).

Writing a century after Arrian and Dio, Aelian (c. 172 – c. 235 AD), a Roman who wrote in Greek and cites Greek authors, again mentions the kings of the bees, in contexts similar to those of Arrian's and Dio's:

The Pearl-oysters of India [...] are obtained in

the following manner. [...] the Pearl-oysters swim in shoals and have leaders (ηγεμόνας) just as bees in their hives have "kings" as they are called (ὡς ἐν τοῖς σμήγεσιν αἱ μέλιτται τοὺς καλουμένους βασιλέας). And I have heard that the "leader" too is conspicuous by his colour and his size.

Aelian, *De natura animalium* 15.8 (trans. A.F. Schofield)

Here, Aelian is certainly relying, if not directly on Arrian or Megasthenes¹², on a source drawing on either or both of these authors; however, unlike Arrian, he makes no mention of a queen of the bees, but of a king.

In another passage Aelian, like Dio, speaks of the fact that king bees have no sting.

According to one story the King Bees are stingless; according to another they are born with stings of great strength and trenchant sharpness; and yet they never use them against a man nor against bees; the stings are a pretence, an empty scare, for it would be wrong for one who rules and directs such numbers to do an injury.

Aelian, *De natura animalium* 1.60 (trans. A.F. Schofield)

In a passage immediately preceding this one, Aelian had praised the bees as master builders, whose abilities surpass even those of the great Persian Kings:

Historians celebrate these constructions, but the dwellings of Bees, which are far cleverer and exhibit a greater skill, of these they take not the slightest notice. And yet, while those monarchs wrought what they wrought through the affliction of multitudes, there never was any creature more gracious than the Bee, just as there is none cleverer. The first thing that they construct are the chambers of their kings (τῶν βασιλέων), and they are spacious above all the rest.

Aelian, *De natura animalium* 1.59 (trans. A.F. Schofield)

The architectural abilities of the bees are also praised by the 4th century AD mathematician Pappus

12 Cf. Lesky (1966), p. 853: "[Aelian] hardly had recourse to the ancient authors but limited himself mainly to collections".

of Alexandria (c. 290–c. 350). In the opening paragraph of the fifth book of his *Synagoge* (Collection), he introduces his discussion of the isoperimetric problem by praising the orderly manner in which bees store honey in the hexagonal cells that they construct. The passage is beautifully written and interesting for many reasons, not least because Pappus mentions a female queen of the bees (ἡ ἡγεμὼν).

Though God has given to men, most excellent Megethion, the best and most perfect understanding of wisdom and mathematics, He has allotted a partial share to some of the unreasoning creatures as well. To men, as being endowed with reason, He granted that they should do everything in the light of reason and demonstration, but to the other unreasoning creatures He gave only this gift, that each of them should, in accordance with a certain natural forethought, obtain so much as is needful for supporting life. This instinct may be observed to exist in many other species of creatures, but it is specially marked among bees. Their good order and their obedience to the queens who rule in their commonwealths are truly admirable, but much more admirable still is their emulation, their cleanliness in the gathering of honey, and the forethought and domestic care they give to its protection. Believing themselves, no doubt, to be entrusted with the task of bringing from the gods to the more cultured part of mankind a share of ambrosia in this form, they do not think it proper to pour it carelessly into earth or wood or any other unseemly and irregular material, but, collecting the fairest parts of the sweetest flowers growing on the earth, from them they prepare for the reception of the honey the vessels called honeycombs, [with cells] all equal, similar and adjacent, and hexagonal in form.

Pappus of Alexandria, *Synagoge* 304.1-308.8 (trans. Ivor Thomas)

We have, then, four writers of the first few centuries AD two of whom write of a queen of the bees and two of a king. Which of them reflect contemporary knowledge about bees? We believe that the answer lies in the difference in purpose and style of their works.

Arrian's work *Epicteti Dissertationes* claims to

be an exact transcription of Epictetus' teaching, setting down his everyday speech without literary embellishment¹³. In the passage from the *Historia Indica* Arrian recounts the facts of pearl-gathering as reported by the 4th century BC diplomat and ethnographer Megasthenes; his aim is to give information on an exotic practice, not to make a literary, philosophical or moral point.

Joseph and Aseneth is a simple narrative written in the biblical Koine, with no literary pretensions whatsoever. We may thus safely conclude that these three passages reflect current practical knowledge and that, at least from the 1st century AD, the queen-bee was commonly regarded as female.

On the other hand, Dio's oration is a speech on kingship delivered before the Roman emperor Trajan and describing the qualities of a monarch. It would hardly be fitting to present the leader of the bees as female in this context.

Aelian's work on the characteristics of animals is a moral work exhibiting "[t]he stoicizing trend towards demonstrating the wisdom of nature" (Lesky 1966 p. 853); the aim is not to impart factual knowledge about animals but to draw a moral relevant to humans. The author, therefore, is interested in drawing the closest possible parallels between human and animal societies, so his bees have kings rather than queens because this is the case among humans.

Pappus, finally, does not aim at giving his readers information about bees, but at proving a mathematical point; and, in order to make his mathematical text more appealing, he includes a passage on the wisdom of bees, characteristic of the same "stoicizing trend" that motivated Aelian. In his case however, possibly under the influence of Xenophon, he envisages the beehive like an orderly household, with the bees preparing a divine food presided over by a capable and respected mistress. Here, therefore, the reference to the queen of the bees should not be attributed to actual knowledge but to stylistic concerns.

To our realism-trained eyes, this may seem fanciful or at least inconsistent¹⁴. At the time when

13 Cf. Lesky (1966), p. 847: "In the surviving books Epictetus' colloquial style has been preserved. They represent a valuable tradition, but not a literary achievement of Arrian's".

14 An outstanding example of realist writing about bees is Tolstoy's passage in *War and Peace* where Moscow, abandoned by its inhabitants, is compared to a queenless hive.

these authors were writing, however, it seems that there was no demand that literature conform to the pronouncements of science. Science and literature were seen as two distinct realms with different concerns and purposes. And this differentiation became explicit precisely at the time when science began to flourish as a discipline separate from literature, philosophy and religion.

Aristotle's evidence-based method "started the development which leads to the science of Alexandria" (Lesky 1966, p. 547). Indeed, the Hellenistic age saw a flourishing of scientific research in fields such as geography, astronomy, mathematics, medicine, philology etc. Major cities hosted important libraries and research centres presided over by scholars who often doubled as poets. These scholar-poets often inserted scientific information in their poetical works. This, however, did not mean that their aim was to impart only accurate scientific information at the expense of notions that had been proven wrong or discredited by systematic observation and research. For instance, Apollonius Rhodius in *Argonautica* 4.1522-1525 describes the symptoms of a lethal snakebite in wording which "fits the medical account of Philumenus" (Overduin 2009, p. 79). This description, however, is preceded by an account of the generation of the snake that administered the bite: it was one of the brood of serpents produced by the blood dripping from the severed head of the Gorgon as Perseus was flying over Libya (*Argonautica* 4.1512-1517). Even if Apollonius had consulted a medical treatise in order to give an accurate description of the symptoms of a fatal snakebite, he certainly did not expect his readers to assume that the explanation of the snake's generation was anything but mythological. In his epic, scientific and mythological knowledge coexist because his objective is not to impart accurate scientific knowledge but to please his readers while displaying his erudition in a variety of fields.

Tolstoy, an avid beekeeper, goes on to describe such a hive in minute detail that any beekeeper will recognize from experience. On the other hand, even in film, a medium with much closer ties to realism, an *auteur's* poetic vision may develop without too much concern for reality. In his film *The Beekeeper*, for instance, Theo Angelopoulos uses beekeeping as a metaphor for his alienated hero's itinerant life. The metaphor, though, goes only skin-deep and Marcello Mastroianni, manifestly uneasy around bees, makes an implausible beekeeper. Compare this film to Victor Nunez's *Ulee's Gold*, where Peter Fonda depicts a beekeeper whose profession truly informs his character and his management of challenging situations. Perhaps one reason why Peter Fonda's performance is so convincing is that his father, Henry Fonda, actually kept bees and produced honey.

The idea that scientific and literary writing do not serve the same purpose was a Hellenistic notion put forward by Eratosthenes, whose view that the poet's aim is not to instruct but to entertain is preserved by Strabo (*Geography* 1.1.10). Strabo may quote Eratosthenes in order to refute him, but the idea emerges again in Galen (*De usu partium* 3.1): Galen, as a physician, explains that two different species cannot mate and produce offspring, but he concedes that Pindar, as a poet, whose "poetic Muse [...] would agitate and enchant and enrapture her hearers, but not teach them"¹⁵, can sing of Ixion who mated with horses and became the ancestor of the Centaurs. And Seneca (*Ep.* 86.15f.) says that Virgil wrote his *Georgics* not to teach farmers but to delight his readers and goes on to give an example of a simple observation of his own that proves Virgil wrong¹⁶.

That this notion on the entertaining function of poetry originated in Hellenistic times is interesting because this was also the era that saw the flowering of didactic poetry, a genre purporting to convey scientific or practical knowledge in hexameter form and tracing its origins back to Hesiod's *Theogony* and *Works and Days*. However, even these didactic epics do not necessarily live up to their proclaimed goal. Instead, many didactic poets seem to use scientific terminology in order to enhance their status as poets, without caring about the accuracy of the information they are imparting. A case in point is Nicander of Colophon, whose *Theriaca* and *Alexipharmaca* claim to offer antidotes to snake-bites and poisons respectively. Modern commentators have remarked that the medical value of Nicander's

15 Strabo and Galen quoted in Curtius (1990), p. 478, n. 2. Curtius also mentions Oppian (*Halieutica* 3.1-8 and Philostratus *Lives of the Sophists* 480, who write that they aim "to provide pleasure and relaxation to the emperor".

16 "Vergil sought, however, not what was nearest to the truth, but what was most appropriate, and aimed, not to teach the farmer, but to please the reader. For example, omitting all other errors of his, I will quote the passage in which it was incumbent upon me to-day to detect a fault:

*In spring sow beans then, too, O clover plant,
Thou'rt welcomed by the crumbling furrows; and
The millet calls for yearly care.*

You may judge by the following incident whether those plants should be set out at the same time, or whether both should be sowed in the spring. It is June at the present writing, and we are well on towards July; and I have seen on this very day farmers harvesting beans and sowing millet." (Trans. Richard Mott Gummere). This passage of Seneca's is mentioned by Dalzell (1996), p. 28 who remarks: "There is a general pattern to these stories: a didactic poet is not expected to be master of his discipline. The demands of the poem take precedence over the accuracy of the text".

poems is practically nonexistent, but he was imitated by Virgil and Lucan and appreciated by poets as late as Milton¹⁷.

Virgil and beyond

We already mentioned Virgil as a poet who, according to Seneca, gives priority to the pleasure of his readers rather than the accuracy of his information. This is also evident in the references he makes to bees in the *Aeneid* and especially in the *Georgics*.

In *Aeneid* 6.706-709 the influence from the Homeric passage cited above is obvious, although here the reference is not to an army but to the souls who bide their time in the Elysian fields, waiting for their regeneration:

Innumerable tribes and peoples hovered round it:

just as, in the meadows, on a cloudless summer's day,

the bees settle on the multifarious flowers, and stream

round the bright lilies, and all the fields hum with their buzzing¹⁸.

Virgil *Aeneid* 6.706-709, transl. A.S. Kline

In *Aeneid* 1.423-436 the Carthaginians building and organizing their city are

17 "And in case we should imagine that the poet makes up for the 'repulsiveness' of his style by the authority of his exposition, Gow writes, 'Whereas the uninitiated reader may learn a good deal of astronomy from Aratus, the victim of snake-bites or poison who turned to Nicander for first aid would be in a sorry plight'. Nicander's stock, however, was not always so low. Virgil and Lucan paid him the compliment of imitation, Plutarch wrote a commentary on him, and Milton thought him valuable reading for schoolboys. Nicander's success, such as it was, seems to have been principally as a writer." Dalzell (1996), p. 29. See also Overduin 2009, 2010a and 2010b, e.g. "Nicander's poem is no longer a scientific treatise. It has become a vehicle for the poet's interest in manipulating the material at hand; it has become his interpretation of contemporary didactic poetry. This does not mean that the poet deliberately makes false claims or intentionally alters scientific observations, as indeed much of the information presented is found elsewhere as well. It *does* mean, however, that ultimately Nicander has little interest in science itself." (Overduin 2010b, p. 5f).

18 Cf. "as bees | In spring-time when the sun with Taurus rides, | Pour forth their populous youth about the hive | In clusters; they among fresh dews and flowers | Fly to and fro . . . So thick the airy crowd swarm'd." Milton *Par. Lost* i. 768 ff.

compared to toiling bees:

The eager Tyrians are busy, some building walls,

and raising the citadel, rolling up stones by hand,

some choosing the site for a house, and marking a furrow:

they make magistrates and laws, and a sacred senate:

here some are digging a harbour: others lay down

the deep foundations of a theatre, and carve huge columns

from the cliff, tall adornments for the future stage.

Just as bees in early summer carry out their tasks

among the flowery fields, in the sun, when they lead out

the adolescent young of their race, or cram the cells

with liquid honey, and swell them with sweet nectar,

or receive the incoming burdens, or forming lines

drive the lazy herd of drones from their hives:

the work glows, and the fragrant honey's sweet with thyme.

Verg. *Aeneid* 1.423-436 (trans. A.S. Kline)

This marvellous and influential example of the *topos* of the bees as an organized and well-run community is a reworking of a passage in *Georgics* 4.158-169 describing the division of labour among bees:

For some supervise the gathering of food, and work

in the fields to an agreed rule: some, walled in their homes,

lay the first foundations of the comb, with drops of gum

taken from narcissi, and sticky glue from
tree-bark,
then hang the clinging wax: others lead the
mature young,
their nation's hope, others pack purest
honey together,
and swell the cells with liquid nectar:
there are those whose lot is to guard the
gates,
and in turn they watch out for rain and
clouds in the sky,
or accept the incoming loads, or, forming
ranks,
they keep the idle crowd of drones away
from the hive.
The work glows, and the fragrant honey is
sweet with thyme.
(trans. A.S. Kline)

Virgil's main source for the behaviour and habits of bees is Varro (116 – 27 BC)¹⁹. However, he diverges from him when he mentions the generation of the bees. Varro (*De re rustica* 3.16.4) says that “bees are born, some from bees, some from the rotten carcase of an ox”. Virgil, on the other hand, claims that bees collect their young from plants, a view, as we have seen above, discussed and discarded by Aristotle.

And you'll wonder at this habit that pleases
the bees,
that they don't indulge in sexual union, or
lazily relax
their bodies in love, or produce young in
labour,
but collect their children in their mouths
themselves from leaves,
and sweet herbs, provide a new leader and
tiny citizens themselves,
and remake their palaces and waxen
kingdoms.

Virgil, *Georgics* 4.197-202 (trans. A.S. Kline)

¹⁹ On Varro's *De Re Rustica* as “not so much a handbook of husbandry, as a treatise on morals and an exercise in rhetoric and logical argumentation—and, possibly, a pedantic display of Varro's encyclopaedic knowledge” see Lewis (2013) p. 636ff, with references.

Virgil, however, is not interested in the biology of the bees but in showing them as an ideal, divinely ordained community (cf. *Georgic* 4.149f: “Come now and I'll impart the qualities Jupiter himself gave bees”). Their freedom from love and sex allows them selflessly to engage in productive communal work. Modern commentators have noted that the theme of the poem is “the regeneration of a war-ridden Italy under the new leadership of Octavius Caesar” (Leach 1977, p. 3)²⁰.

The image of the beehive as an organised community with division of labour is found again in the Archbishop of Canterbury's description of the life of bees in Shakespeare's *Henry V*:

Therefore doth heaven divide
The state of man in divers functions,
Setting endeavour in continual motion;
To which is fixed, as an aim or butt,
Obedience: for so work the honey-bees,
Creatures that by a rule in nature teach
The act of order to a peopled kingdom.
They have a king and officers of sorts;
Where some, like magistrates, correct at
home,
Others, like merchants, venture trade
abroad,

²⁰ This notion of regeneration, of life conquering death and destruction, is also served by the two instances of bugonia in the 4th *Georgic*. On the function of these two passages within the overall structure of the poem, cf. the detailed analysis by Brooks Otis (Otis 1995, pp. 187ff.). Bugonia, the generation of bees from the carcasses of bulls or oxen, is a prime example of a literary *topos* gone wild in the hands of Hellenistic and later writers (for an detailed discussion of bugonia see Harissis, 2009). It is not attested in Greek sources before that time, and Aristotle ignores it in his extensive discussion of the reproduction of bees. It is possible that the belief spread to the Greek world from the Orient in Hellenistic times (Crane 2000, p. 581) and from there to the Romans. Invested with Virgil's authority, it found its way into Medieval and early modern writings. However, Columella (4-c.70AD), who often cites Virgil as an authority, sensibly dismisses this method on practical grounds: “Now Democritus, Mago and likewise Virgil have recorded that bees can be generated [...] from a slain bullock. Mago indeed also asserts that the same thing may be done from the bellies of oxen, but I consider it superfluous to deal in more detail with this method, since I am in agreement with Celsus, who very wisely says that there is never such mortality among these creatures, that it is necessary to procure them by this means. (*De re rustica*, 9.14.6, trans. Harrison Boyd Ash; for “Democritus” we should read “pseudo-Democritus”). Indeed, no true farmer could entertain the notion of sacrificing an animal as precious as an ox in order to obtain some bees that he could easily get for free at swarming time.

Others, like soldiers, armed in their stings,
 Make boot upon the summer's velvet buds,
 Which pillage they with merry march bring home
 To the tent-royal of their emperor;
 Who, busied in his majesty, surveys
 The singing masons building roofs of gold,
 The civil citizens kneading up the honey,
 The poor mechanic porters crowding in
 Their heavy burdens at his narrow gate,
 The sad-eyed justice, with his surly hum,
 Delivering o'er to executors pale
 The lazy yawning drone.

Shakespeare *Henry V* 1.2 183-204

Betts (1968, 152ff.) persuasively argues that this passage is indebted to *Georgic* 4 but also comments on the use Shakespeare makes of it, adapting it to the dramatic context and the character of the Archbishop. Shakespeare uses the bee simile²¹ deploying all the characteristics familiar from classical Greek literature to Virgil, his most likely model: the bees have a king; they are male, or at least they perform masculine tasks and their society is characterised by division of labour; the bees harvesting from flowers are compared to pillaging soldiers; and, last but not least, drones are lazy and must be cast out of the hive.

Thus we see Shakespeare, like Virgil before him, following the lead of a time-honoured literary tradition and adapting its devices to his own artistic ends. Meanwhile, practical knowledge of bees was advancing unheeded by writers of poetry and drama. A few years after Shakespeare wrote *Henry V* (c. 1599), the beekeeper Charles Butler published his *Feminine Monarchie* (1609), where he claims that worker bees are female and have a female queen, "this being an Amazonian or feminine kingdome", where "the males [...] beare no sway at all". Butler is also aware of the usefulness of the drones, as was Pliny, to whom he constantly refers (as he does to Aristotle and Virgil).

Pliny, writing in the first century AD, says of the drones:

And not only in their labours do the drones give them their assistance, but in the propagation of their species as well, the very multitude of them contributing greatly to the warmth of the hive. At all events, it

²¹ Cf. Betts (1968, p. 153): "the bee-comparison had been a literary commonplace even by the Elizabethan age".

is a well-known fact, that the greater the multitude of the drones, the more numerous is sure to be the progeny of the swarm.

Pliny *Natural History* 11.11 (trans. John Bostock)

Butler, who has a reference to this passage of Pliny, is also aware of the fact that drones are male bees²² and that, apart from their procreative role, they had other uses in the hive:

These Cephens or Drones, when they are fledged, doe not only serve for generation [...] but also doe helpe the females much by reason of their great heat, in hatching their broods. And for these causes they are alwaies in breeding-time mingled with them throughout the hive.

Charles Butler *The Feminine Monarchie* chapter 4.21

Yet the idea of the useless drone who lives at the expense of others has persisted not only in Shakespeare but even in our own time; although we are now fully aware of the drones' role in the hive, we persist in using their name to designate lazy, parasitic individuals, as if our knowledge of bees still relied on Hesiod.

²² Although he believed that they mated with the worker-bees, not the queen.

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