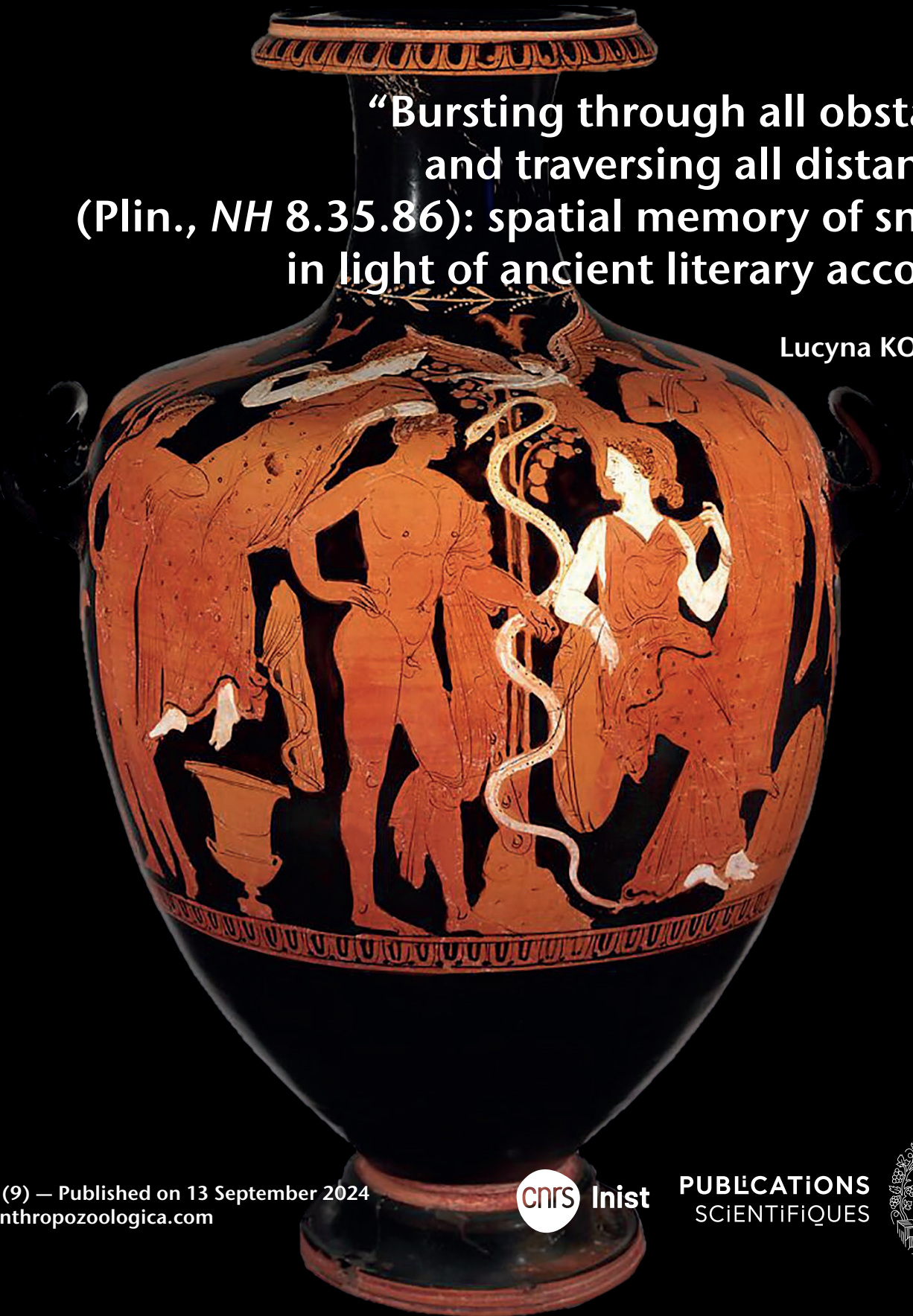


“Bursting through all obstacles
and traversing all distances”
(Plin., *NH* 8.35.86): spatial memory of snakes
in light of ancient literary accounts

Lucyna KOSTUCH



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“Bursting through all obstacles and traversing all distances” (Plin., NH 8.35.86): spatial memory of snakes in light of ancient literary accounts

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ABSTRACT

Until recently, scientists believed snakes to have little spatial ability. However, new behavioural experiments have proven that snakes display a capacity for spatial learning, and therefore possess spatial memory. Beginning with Homer, the snake appears throughout antiquity in all possible literary genres. The considerable amount of the extant ancient literary source material leads to the following research question: Did the Greeks and Romans attribute the snake with a fully-functional spatial memory based on their observations of the animal’s behaviour? The answer is positive. It was believed in antiquity that the snake had a well-developed spatial memory. According to the ancient authors, vision was the basic sense that allowed the snake to travel efficiently and to remember its path. The ancients had many occasions (in public and private spaces) to learn about the behaviour of the reptile. The ancient authors describing the behaviour of the snake most often relied on knowledge collected through numerous incidents of contact with the animal. Although the extant accounts are comprised mostly of anecdotes and sometimes myths, a critical analysis of these accounts indicates that the ancient authors were interested in the abilities of the snake that have only just started to gain recognition in modern science.

KEY WORDS
Ancient Greeks and
Romans,
snakes and humans,
snake senses,
snake behaviour.

RÉSUMÉ

« *Il triomphe des obstacles, il traverse les espaces* » (Plin., NH 8.35.86): *la mémoire spatiale des serpents au regard des témoignages littéraires anciens.*

Jusqu’à récemment, les scientifiques pensaient que les serpents étaient des animaux dotés de capacités spatiales limitées. Cependant, de nouvelles expériences comportementales montrent que les serpents font preuve d’apprentissage spatial et sont donc dotés d’une mémoire spatiale. Depuis Homère, le serpent apparaît dans tous les genres littéraires au cours de l’histoire ancienne. Le fait que nous disposions de sources anciennes substantielles nous amène à formuler la question de recherche suivante: Les Grecs et les Romains, sur la base de l’observation du comportement du serpent, ont-ils reconnu à cet animal le fait d’être doté d’une mémoire spatiale développée? La réponse est affirmative. Dans l’Antiquité, on attribuait au serpent une mémoire spatiale très développée. Selon les écrivains anciens, la vue était le premier sens qui permettait au serpent de se déplacer efficacement et de se souvenir de son chemin. Dans l’Antiquité, les gens avaient de nombreuses occasions (dans les espaces publics et privés) de s’informer sur le comportement des reptiles. Les auteurs anciens qui décrivent le comportement du serpent s’appuient le plus souvent sur des connaissances accumulées lors de nombreux contacts avec l’animal. Bien que les témoignages qui nous sont parvenus soient principalement anecdotiques et parfois même mythologiques, une analyse critique permet de reconnaître que dans l’Antiquité, on prêtait attention aux capacités du serpent, alors que la science moderne ne fait que commencer à les apprécier.

MOTS CLÉS
Grecs et Romains des
temps anciens,
serpents et humains,
sens des serpents,
comportement des
serpents.

INTRODUCTION

In 2021, De Meester and Baeckens wrote: “Only very recently, the field of animal cognition experienced a true ‘reptilian renaissance’, in which the myth of the blunt, slow reptilian has finally been rebuked.” The researchers believe that “Reptiles exhibit fast and flexible learning, long-term memory, spontaneous problem-solving abilities, quantity discrimination, and even social learning” (De Meester & Baeckens 2021: 1058, 1059). The subject literature indicates that among reptiles, snakes are the least frequent subject of research on animal spatial cognition. As Burghardt explains, “their perceptual world and effector operating space are [...] alien to ours” (Burghardt 2002: 116). Nevertheless, in studies on the spatial memory of snakes, it has been observed that these reptiles have to solve numerous problems to survive in their natural habitat. Snakes need spatial orientation to use their feeding ground effectively, find a sexual partner and recall the path to their shelter, particularly the hibernaculum. Behavioural experiments have proven that snakes display the ability for spatial learning, and therefore possess spatial memory (Holtzman 1998; Holtzman *et al.* 1999; Stone *et al.* 2000).

As Kitchell Jr. concludes, “Few animals appear in Greek and Latin literature and art as frequently as snakes” (Kitchell 2014: 173, *s.v.* *Snake*; cf. Lewis & Llewellyn-Jones 2018: 578). Greece, as well as Italy, was inhabited by over twenty snake species (Greek: *drakōn*, *ophis*; Latin: *anguis*, *serpens*, *coluber*, *colubra*), and it should be added that the Greeks and Romans were fascinated by the numerous snakes living in the Ancient East (Kitchell 2014: 173; Lewis & Llewellyn-Jones 2018: 578).

Beginning with Homer, the snake appears throughout antiquity in all possible literary genres. The considerable amount of the extant ancient literary source material leads to the following research question: Did the Greeks and Romans attribute the snake with a fully-functional spatial memory based on their observations of the animal’s behaviour? Of course, the ancient authors did not have at their disposal the tools available to modern zoology, ethology and animal behavioural psychology. The formal study of spatial memory in animals began in the 1930s (Thinus-Blanc 1996: 1-22). However, the lack of modern scientific methods did not prevent the ancients from formulating the questions: How do snakes find their way? (Do snakes return to the same place? Do snakes remember where they have been before? Do snakes travel long distances?) Ancient “zoological” observations (both in the field and in captivity) represent “the first attempt at fundamental research” (Bodson 1983: 3; cf. Newmyer 2005, 2008). The root meaning of observation was watching and attentive waiting (Aristotle’s term *tērēsis*). Pliny used the term *observatio* to describe the practice of noting and recording (Park 2011: 15-20). The ancient sources certainly contain numerous observations from first-hand knowledge. Liliane Bodson emphasizes the potential role of “practitioners of some expertise working or getting into

close contact with nature and animals” (Bodson 2014: 569). Undoubtedly, ancient snake-hunters, snake-charmers and drug-preparers had such first-hand knowledge about spatial abilities of snakes.

Despite the extensive source material, reconstructing ancient observations, notions and beliefs about the snake is difficult for a few reasons. The main problem is the underrepresentation of zoological works and uneven progress in the knowledge about animals. Today, apart from the works by Aristotle (384-322 BC), it would be difficult to distinguish strictly zoological works in the ancient literature. Little is known about the “zoological” inquiry before Aristotle (Lennox 2018: 215, 216). In the case of many ancient works about animals, including the works of Theophrastus (*c.* 372-*c.* 286 BC), Aristotle’s successor, only their titles or fragments have survived (e.g., *On Creatures that Bite and Sting*; Sharples 1995: 32-48). The term “natural history” is the broader term, meaning an inquiry or investigation into nature (Greek *physis*, Latin *natura*; French 1994: 4). Snakes are discussed in some detail in the natural histories of Pliny the Elder (23-79 AD), Plutarch (*c.* 50-*c.* 120 AD) and Aelian (*c.* 165-*c.* 230 AD). These authors based their works more on knowledge compiled from texts than on direct observation of animals (however, on personal observation, see, for example: Ael., *NA* 2.11; 5.26; 5.47; 11.40). They drew on Aristotle, Theophrastus and other early sources. Reports about the behaviour of local animals have been a part of ancient historiography since its beginnings. Ancient historians like Herodotus (485-425 BC), Diodorus Siculus (first century BC) and Livy (59 BC-17 AD) serve as valuable sources of anecdotes about snakes. Similarly, Pausanias (*c.* 115-*c.* 180 AD) drew his information about snakes from local sources (the author relied significantly on the assistance of *exēgētai*). However, it should be remembered that the depiction of the snake may be a faithful reflection of the natural reality regardless of the literary genre or period. The behaviour of the animals depicted in philosophical and religious texts, poetry, drama etc. “is not purely metaphorical but its roots in the lived experience of the ancient world” (Lewis & Llewellyn-Jones 2018: 3; cf. Kitchell 2015). Nicander (a poet and scholar active in the second century BC) took his inspiration from prose works of Apollodorus of Alexandria (third century BC, his major work was *On Poisonous Animals*). It should be emphasized that the ancient authors drew from each other’s works, as well as from works that have not survived to our times and from distant oral traditions, which makes it difficult to recreate the chronological order in which various observations and beliefs spread throughout the Mediterranean Basin. Moreover, the Greek and Roman writers describing the behaviour of the snake most often relied on common knowledge collected through numerous incidents of contact with the animal. But it is worth highlighting that there is a great deal of common knowledge concerning animals among the ancients (Kitchell 2017: 183, 188, 200). Pellegrin (1986: 47) defined it as: “the spontaneous zoology of the man in the street”.

Identifying the snakes described by the Greeks and Romans in accordance with modern taxonomy constitutes another difficult challenge (Bodson 1981, 2012; Sancassano 1996; Stothers 2004; Trinquier 2008; Ogden 2013a: 3-5; 2013b: 2; Kitchell 2014: 61, *s.v. Draco*; 2015: 135, 136; Böhme & Koppetsch 2021). Therefore, it is difficult to recreate the behavioural characteristics of the individual species based on ancient accounts, all the more so because the Greeks and Romans tended to generalise in the case of snakes. The Greek authors used the word *drakōn* in the same ways that they used *ophis*. *Serpens*, *anguis* and *draco* are distinguished by Servius (*ad Virg. Aen.*, 2.204, transl. Hagen & Thilo 2011). But Servius himself admits that his distinction is not always observed (in fact, Servius' distinction is inadequate; see Kitchell 2014: 174, *s.v. Snake*). Rodríguez Pérez (2021: 9) notes that: "The term *drakōn* is seldom used in historical works of the period and only rarely do ancient naturalists choose it". However, *drakontes* (often regarded as monstrous beasts) were conceived on the model of real snakes (Trinquier 2008).

This study is comprised of five main parts. The Greek and Roman beliefs are discussed together, according to different subjects. In the first part of the article, the question about whether the ancients believed that animals had memory is answered. The second part of the article outlines the beliefs of the Greeks and Romans in relation to the role of the snake's senses in how it collects and memorises information. Finally, the ancient source material concerning the spatial orientation of snakes is discussed in the last three parts.

ABBREVIATIONS

AA	Galen, <i>De anatomicis administrationibus</i>
<i>ad Virg. Aen.</i>	Servius, <i>ad Virgili Aeneidam</i>
<i>Aen.</i>	Virgil, <i>Aeneid</i>
<i>Ant.</i>	Plutarch, <i>Antonius</i>
<i>Char.</i>	Theophrastus, <i>Characteres</i>
<i>De abst.</i>	Porphyry, <i>De abstinentia</i>
<i>De archit.</i>	Vitruvius, <i>De architectura</i>
<i>De comp. med.</i>	Scribonius Largus, <i>De compositione medicamentorum</i>
<i>De Is. et Os.</i>	Plutarch, <i>De Iside et Osiride</i>
<i>De loc. aff.</i>	Galen, <i>De locis affectis</i>
<i>De mat. med.</i>	Dioscorides, <i>De materia medica</i>
<i>De soll. anim.</i>	Plutarch, <i>De sollertia animalium</i>
<i>Div.</i>	Cicero, <i>De divinatione</i>
<i>Eth. Nic.</i>	Aristotle, <i>Ethica Nicomachea</i>
HA	Aristotle, <i>Historia Animalium</i>
IA	Aristotle, <i>De inessu animalium</i>
Il.	Homer, <i>Iliad</i>
LSJ	Liddell, Scott & Jones, <i>Greek-English Lexicon</i>
Mem.	Aristotle, <i>De memoria et reminiscencia</i>
Met.	Ovid, <i>Metamorphoses</i>
Metaph.	Aristotle, <i>Metaphysica</i>
Mir.	Antigonus of Carystus, <i>Rerum mirabilium collectio</i>
Mir.	Ps.-Aristotle, <i>De mirabilibus auscultationibus</i>
Mor.	Plutarch, <i>Moralia</i>
NA	Aelian, <i>De natura animalium</i>
NH	Pliny, <i>Naturalis historia</i>
PA	Aristotle, <i>De partibus animalium</i>
Ph.	Aristotle, <i>Physica</i>
Philops.	Lucian, <i>Philopseudes</i>
Phlb.	Plato, <i>Philebus</i>
Quaest. Rom.	Plutarch, <i>Quaestiones Romanae</i>
TGr.	Plutarch, <i>Tiberius Gracchus</i>
Ther.	Nicander, <i>Theriaca</i>
Tusc.	Cicero, <i>Tusculanae disputationes</i>

SPATIAL MEMORY, MNĒMĒ, MEMORIA: MEMORY OF ANIMALS

Researchers recognise several types of animal memory. According to *Encyclopedia of Animal Behavior*, "Spatial memory is used to return to rewarding locations (home, foraging sites, and so on) [...] Visual landmarks, distances, and directions often form the basis for this kind of memory [...] To reliably navigate to important sites, many species appear to learn about places in their environment, and how to reach these locations" (Pritchard 2019: 320, *s.v. Spatial Memory*). The contents of spatial memory depend on the scale of the space which is being learned (navigation between familiar sites; navigation over large scales: Pritchard 2019: 322). Of course, there is no such definition in ancient sources. But the particular elements of this definition were undoubtedly familiar to the ancients.

The topic of memory in animals was considered by the ancient authors to be difficult to research, mostly because the memory mechanism remained a mystery, even in the case of humans. Pliny believed that the human memory centre was located deep in the ear, but this belief was not grounded in old traditions, because neither Aristotle nor Cicero was able to locate precisely where memories are stored in the body. Galen knows that memories are somehow stored in the brain (Plin., *NH* 11.103.251; Arist., *Mem.* 453a14-15; Cic., *Tusc.* 1.59-60; Gal., *De Loc. aff.* 3.9, 8.174-175; Kühn 1824). Chiara Thumiger states that even though the subject drew keen interest from a medical context, the ancient literature lacks theoretical discussions, apart from the work by Aristotle (*De memoria et reminiscencia*), or attempts at explaining the basic functioning of memory (Thumiger 2017: 406-411).

There are no extant works dedicated exclusively to the functioning of memory (Greek: *mnēmē*, Latin: *memoria*) in animals. Even Theophrastus, a prolific author of works on animals, has not been attributed with a monograph discussing this subject. According to Diogenes Laërtius, the first works concerning (human and animal) memory were written by Aristotle and Xenocrates (Diog. Laert., 4.12, 5.26). In his extant work *De memoria et reminiscencia* (*On Memory and Recollection*), Aristotle claimed that some animals possessed memory. The philosopher specified that he meant the animals that perceived time (Arist., *Mem.* 449b28-30, 450a15-22). In *Historia animalium*, Aristotle wrote that many animals have memory and the ability to learn (Arist., *HA* 488b25-27). In another place of this work, the philosopher observed a connection between the intelligence and memory of animals and their engagement in social life (Arist., *HA* 589a1-4). The opening passage to the *Metaphysics* also clearly attributes to some animals memory (Arist., *Metaph.* 980a27-980b28). Finally, in *Ethica Nicomachea*, he stated that animals possess memories of particular things (Arist., *Eth. Nic.* 1147b11-12). Aristotle never gives examples of animals without memory. Which animals perceive time? Can snakes perceive time? Aristotle defines time as the number of motion in respect of before and after (Arist., *Ph.* 219b1-2). Johansen speculates that "Aristotle's claim that there are animals that do not have memory will apply only to stationary animals" (Johansen

2012: 217). According to the three-fold division of land animals, according to which “some [animals] walk, some creep, some wriggle”, snakes belong to the second category (Arist., *HA* 487b20, transl. Peck 1965-1970; Arist., *IA* 708a9-20; Pellegrin 1986: 22, 149; cf. Kullmann 2014: 192-194). Sponges, sea-anemones, oysters, sea cucumbers are animals that Aristotle classifies as stationary (see Rapp 2020: 32). In a work by Plato we read that a human without memory would be like “a mollusc or some other shell-fish like the oyster” (Plat., *Phlb.* 21CD, transl. Fowler & Lamb 1925; see Bell & Naas 2015: 255: Plato’s *Animals Index*, s.v. *Oyster*). Aristotle also says that animals without memory leave their offspring. The philosopher mentions that many birds leave their young (Arist., *HA* 563b9-11), “so it is natural [...] to think that his point applies to some birds” (Johansen 2012: 217).

For centuries after Aristotle lived, a discussion took place with the participation of Seneca, Pliny, Plutarch and Porphyry about whether animals are capable of perceptual recognition or possess genuine memory (see Sorabji 1993: 50-54). Various authors debated on whether memory is a product of *physis* (nature) or the product of *technē* (craft knowledge). One such author was Aelian. In *De natura animalium*, he praised the natural memory of animals (see Smith 2019).

In their musings on memory, the views of the ancient authors change with respect to individual animal species. Some species were found to have excellent memory of route, distinguishing them from other species, such as the dog (*Canis lupus familiaris* Linnaeus, 1758) about which Pliny wrote: “they [dogs] remember the way to places however distant” (Plin., *NH* 8.61.146, transl. Rackham *et al.* 1938-1962; cf. Solin., 15.11, transl. Mommsen 1895). Apart from the dog, many other animals possessing such memory are mentioned in *Naturalis historia*, including the elephant (*Elephas maximus* Linnaeus, 1758) (if an elephant meets a man lost in the desert he is merciful and points out the way: 8.5.9) and the pig (*Sus domesticus* Erxleben, 1777) (pigs are able to find their way home: 8.77.208). In the context of memory of route, Plutarch mentioned the fish *anthias* (barbier, *Anthias anthias* (Linnaeus, 1758): Thompson D’Arcy 1947: 14-16, s.v. *anthias*). The author speculates that “there are indications of places free from monsters, which the fish comes to know and frequents, being an intelligent creature with a good memory” (Plut., *De soll. anim.* 32; *Mor.* 981DE). Aelian emphasised the memory of migrating cranes and supplied the appropriate description: “in mid-autumn they leave [Thrace] for Egypt, Libya and Ethiopia, appearing to know the map of the earth” (Ael., *NA* 3.13, transl. Scholfield 1958-1959).

Conversely, Pliny stated that the lizard completely lacks memory: “Lizards do not hatch their eggs, but forget where they laid them, as this animal has no memory” (Plin., *NH* 10.85.187, transl. Rackham *et al.* 1938-1962). Snakes resemble lizards more than they do other reptiles. But the snake disturbed the ancient researchers of nature because it defied classification. Aristotle did not distinguish reptiles as a separate taxonomic unit (Pellegrin 1986: 12); therefore, he could not compare the abilities of the snake to those of other animals

genetically related to it. The philosopher sometimes compared snakes to lizards, and other times to fish. Balme observed that “Both the snakes and the sea-anemones and sponges are left under no generic heading” (Balme 1987: 84; cf. snakes and crocodiles: Arist., *HA* 505b31; Kullmann 1998: 170, 171). Nowhere in the sources is it stated that snakes have no memory.

THE FOUNDATIONS OF SPATIAL MEMORY: VISION AND OTHER SENSES OF THE SNAKE

In antiquity, it was believed that the snake mostly interprets the natural environment by relying on visual cues. Of course, knowledge about the complexity of the visual system of the snake was beyond the reach of ancient researchers, even though they performed dissections, and even did so frequently (Galen wrote that he often dissected animals that crawl, like snakes: Gal., *AA* 6.1, 2.537, transl. Kühn 1821; see Von Staden 2013: 137). According to modern research, “Vision is likely a principal sensory channel for snakes, and most snakes have large, well-developed eyes” (Schraft & Clark 2019: 77) and “They heavily rely on visual cues when evaluating the environment [...] and have been suggested to possess dichromatic vision” (Huang *et al.* 2022: 2). Some snake species, in addition to the visible spectrum, are able to detect infrared radiation (Schraft & Clark 2019: 77-82), and it should be added that most snakes have a wide field of view (Lillywhite 2014: 167). Of course, snakes also use chemical cues and vibrations transferred through the ground, as well as communicating through touch. The importance of these forms of interaction with the environment increases when natural obstacles obstruct the vision of these animals (Ford & Burghardt 1993).

In addition to venom, it was the snake’s eyes that drew the most attention from the Greeks and Romans. The crucial importance attributed to vision is substantiated by the belief that young snakes (*opheis*) were able to regenerate gouged eyes, as was mentioned by Aristotle, and later by the Hellenistic paradoxographer Antigonos of Carystus and Pliny (Arist., *HA* 508b5-7; Antig., *Mir.* 72; *serpentium catulis*: Plin., *NH* 11.55.152). Aristotle himself was sceptical. He wrote: “Some say that serpents have the same faculty as swallow-chicks: that if anyone pricks their eyes out they grow again” (Arist., *HA* 508b5-7). Although Pliny was sceptical about magic, he added that wearing the right eye of a snake (*serpentis oculum*) as an amulet can cure lacrimation as long as the snake is set free (Plin., *NH* 29.38.131), implying that the eye would grow back. The importance of the snake’s vision was also emphasised by the belief that medicine produced from the body parts of a snake could treat eye diseases in humans (Magnus 1998: 207). Admittedly, Aristotle and Nicander mentioned blind snakes (*Typhlopidae*), the species of which is difficult to identify today (Arist., *HA* 567b25, 604b26; Nic., *Ther.* 492; Spatafora 2007: 142); but in general, the ancient snakes had keen eyesight. Aelian, who wrote about snakes extensively in *De natura animalium*, repeated many times that the snake has the keenest sight of all animals.

Unfortunately, we have no evidence that Aelian observed snakes directly. The fact that Aelian does not reference any authority suggests the belief that snakes (*drakontes*) had extraordinary vision was a common one (Ael., *NA* 6.63, 8.11, 10.48, 15.21). Only Pliny disagreed, stating that nature “has bestowed on this accursed creature dim eyes, and those not in the forehead for it to look straight in front of it, but in the temples – and consequently it is more quickly excited by hearing than by sight” (Plin., *NH* 8.35.87, transl. Rackham *et al.* 1938-1962). Such a statement raises questions because earlier, the author of *Naturalis historia* claimed the snake (*serpens*) can recognise specific people in a crowd (Plin., *NH* 8.35.86). Pliny does not explain how the snake can recognise its prey without keen sight. There is no explicit evidence that Pliny studied the snake by means of direct observation.

Perhaps Pliny (or his source) was influenced by the popular belief in antiquity that the snake’s sight becomes periodically weakened when it sheds its skin, a notion that Pliny himself mentioned a few times. Pliny explained that snakes improve their dulled vision by rubbing their eyes against fennel (*Foeniculum vulgare* Mill., 1768). The medicinal agent is, supposedly, the fennel juice. Pliny emphasised that the snake (*anguis, serpens*) is very fond of this plant (Plin., *NH* 8.41.99, 19.56.173, 20.95.254). Before *Naturalis historia*, this belief was also found in a work by Nicander. In *Theriaca*, juicy fennel is said to restore the snake’s sharp, shining sight; although contrary to Pliny, Nicander claimed that the reptile consumes the plant (Nic., *Ther.* 31-34, 35: *ophis*, 390-392). The snake’s temporary worsening of vision, almost always accompanied by the application of fennel as the remedy, was also mentioned by other ancient authors. Aelian explained that the snake rubs its eyes against the edges of fennel, letting the warmth of the plant restore its dulled vision. The author added that the reason why the snake’s sight is worse in spring is that the animal spends the winter in a dark hole (Ael., *NA* 9.16; e.g., Plut., *De soll. anim.* 20; *Mor.* 974b). It is difficult to say when the belief that the snake had to consume or rub against fennel began. Nicander is the first source to mention the snake and the plant (Gaillard-Seux 2015). The author nowhere claims to have done any direct observation of snakes. Aristotle wrote earlier that when the snake (*ophis*) starts shedding, the skin peels off its eyes first, which is why people unfamiliar with the subject may think that the animal’s sight is deteriorating temporarily (Arist., *HA* 600b27-30). Just as today: “the snake keeper may notice that the otherwise clear, penetrating eyes of the snake have a milky appearance” (Grzimek 1972: 349; in fact, it is the outer dermis that occludes the snake’s vision). As we can see, beliefs about the snake’s temporary problems with sight existed as early as in the fourth century BC, and Aristotle’s explanations were ignored by later authors. In reality, snakes are not interested in plants because they are hypercarnivores. They may swallow a plant only by accident, together with their living prey (Lillywhite 2014: 68, 69). In antiquity, the snake was mistakenly classified as omnivorous (Arist., *HA* 594a4-7;

cf. Ael., *NA* 6.18; Luccioni 2012; Schnieders 2019: 458). The reason for the persistence of the false beliefs about the snake and fennel may have been the fact that fennel (Greek: *marathon*, Latin: *feniculum*) was a very common plant in the ancient world, ever since the beginnings of civilisation. Perhaps the Greeks and Romans saw the snake hunting among fennel plants and misinterpreted its behaviour. Fennel was used not only in ancient cuisine (Dalby 2003: 142, *s.v.* Fennel), but importantly, also in medicine; for example in ophthalmology, because the plant was believed to improve human sight (e.g., Diosc., *De mat. med.* 3.70; Plin., *NH* 29.38.119; Scribonius Largus, *De comp. med.* 38). Pliny claimed that it was snakes (*serpentes*) that made fennel a famous medicine (Plin., *NH* 20.95.254).

According to the evidence, the snake described in ancient accounts relied mostly on its vision. However, if we follow the trail of Pliny’s dissenting opinion that the snake’s main sensory channel was hearing, we come across a statement in Aelian’s work that the snake (*drakōn*) not only has the sharpest sight, but also the most acute hearing in the animal world (Ael., *NA* 6.63, 10.48, 15.21). Nicander wrote earlier that the cobra (*aspis*) recovers from a sleep-induced stupor when it hears a sudden noise or it sees something shining (Nic., *Ther.* 164-166). In reality, even though snakes possess an internal hearing organ, it only allows them to hear a limited range of sounds. The ancients likely attributed keen hearing to the snake because they did not realise that the reptile uses other sensory aids; specifically, the tongue, which is used to obtain chemical information from the environment, and the skeletal system, which is sensitive to vibrations (see Lillywhite 2014: 167-173). However, Aristotle and Pliny, among others, assert that the snake has apertures for smelling and dislikes the odour of certain plants (Arist., *HA* 612a29; *PA* 659b1-3; Plin., *NH* 11.59.158, 12.56.126, 22.24.50, 25.55.101).

THE PATH TO AND FROM THE SHELTER: THE SNAKE IN ITS OWN SPACE

According to modern research, even though the snake is not a territorial creature, it stays within its home range. The animal has to travel to and from its shelter multiple times while avoiding predators, as well as to migrate to summer habitats and find its hibernaculum (Holtzman 1998; Schraft & Clark 2019: 77). Terrestrial snakes migrate short distances (< 20 km) between seasonal habitats (Southwood & Avens 2009: 1, 2).

The snake’s shelter appears even in the oldest ancient literature, where it is referred to as *cheia* (Hom., *Il.* 22.93.95; *cheia* – hole, esp. of serpents: *LSJ s.v. cheia*). Homer describes the animal in its natural habitat: the snake (*drakōn*) lies curled near its mountain shelter (Hom., *Il.* 22.93-95). We also know of other terms from later literature used to denote the snake’s shelter; first and foremost, the term *phōleos* (den, lair: *LSJ s.v. phōleos*). The difference between the terms *cheia* and *phōleos* is not clear; however, it seems that *phōleos* referred to the snake’s winter domicile, where the animal hibernates

(Spatafora 2007: 100, 113, 118; Overduin 2014: 216). Huge snakes lived in caves (*antra*). At the fantastic extreme the term *drakontes* was applied to snakes of supernatural size (Fig. 1).

It was observed in antiquity that the snake moved sluggishly and uncertainly when leaving its shelter in spring. In the literary accounts, the purpose of the snake's first trip after the winter hibernation was the abovementioned fennel, which restored the snake's sharpness of vision. Another question concerns the animal's method of searching for this beneficial plant. Although we do not find the answer to this question in the extant accounts, it should be noted that the ancient authors did not mention any problems that the snake may have had with reaching the plant. The snake did not wander aimlessly or make mistakes, but moved straight toward the fennel, most likely by remembering the previous year's trip. The ancient authors agreed that snakes regularly shed their skins every spring. Aelian, for example, wrote: "When a snake sloughs its old skin (it does so at the beginning of spring) [...] after hibernating through the winter in some dark hole [...]" (Ael., *NA* 9.16; cf. Nic., *Ther.* 32; Plin., *NH* 8.41.99). Thus, snakes take the same route every year. Nicander, Pliny and Aelian demonstrated that snakes have ability to accumulate experiences. Moreover, in *Theriaca* (390-392), snakes regain strength from the sun. It is known that fennel grows best in full sun. Vitruvius wrote that during the winter solstices and wintry times, snakes stay motionless, and only start moving more vigorously when the heat removes the moisture from their bodies (Vitr., *De archit.* 6.1.9). According to Aristotle, memory depends on physiological conditions, such as moistness and dryness of the body (Arist., *Mem.* 450b1-8). Good memory resulted from the optimal balance between heat and moisture. Presumably, snakes recovered their memories during "therapy".

The snake's return to the shelter was observed just as attentively. "Like most animals, snakes must rely on spatial abilities to [...] shelter effectively in their habitats" (Stone *et al.* 2000: 575). Spatial memory allows snakes to remember the location of their dens. Laboratory reptiles are trained to find an escape hole in an arena (Grace 2018: 272, 273). In ancient times, snakes were masters of escape in their natural environment. The only source of information about a snake's problems with returning to its shelter concerns extreme weather conditions. Pausanias wrote about the snakes (*opheis*) inhabiting Mount Sepia in Arcadia, which were surprised by the snow and died far away from their shelters. However, even in this situation, some of the animals manage to hide, although they were still killed by the cold (Paus., 8.16.2). Pausanias climbed Mount Sepia to see the tomb of local hero called Aepytyus. It was on Mount Sepia that Aepytyus met his death from the bite of a snake (*seps*). Pausanias does not claim to have actually seen these snakes. He relates that, "These snakes are still to be found, the Arcadians say, on the mountain [...]" (Paus., 8.16.2, transl. Jones 1918-1935). According to other literary sources (belonging to various genres), the ancient snake had the ability to travel extremely quickly towards its shelter (e.g., Paus., 1.37.7; Ael., *NA* 2.26; Luc., *Philops.* 11). The most complete depiction of the snake remembering its way

to a hole can be found in a work by Diodorus Siculus who, based on a work by Agatharchides, presented a herpetological expedition to Ethiopia from the times of Ptolemy II. Diodorus wrote that hunters decided to hunt an enormous snake (*ophis*) to present to the king, counting on a reward. The *Bibliotheca historica* states: "Then, when they had reconnoitred its hole and observed the time when it went forth to feed and returned again, so soon as it had set out to prey upon the other animals, as was its custom, they stopped the opening of its old hole with large stones and earth, and digging an underground cavity near its lair they set the woven net in it [...]" (Diod. Sic., 3.37.2, transl. Oldfather *et al.* 1933-1967). The snake was not fooled and persistently looked for the entrance to its hole in the correct place, and it only crawled into the trap when scared by the hunters' direct attack (Diod. Sic., 3.36.4-3.37.8 = Agatharchides Fr. 80a, transl. Burstein 1989). Liliane Bodson claims that Diodorus' tale, however embellished, is believable from the perspective of natural history and is based on authentic reports by the members of the expedition. The meticulous description preserved in Diodorus' work (morphology, eating habits, ecology, distribution, defensive behaviours, etc.) allows the snake to be identified as a *Python sebae* (Gmelin, 1789) (Bodson 1980; Bodson 2003; but see doubts: Ogden 2013b: 2).

Of course, the ancient literature also contains depictions of snakes captured by birds of prey, as well as being killed by wild quadrupeds or by travelling people. Vergil uses snake imagery in his description of Sergestus' crippled ship. The poet described snakes (*serpentes*) that did not return to their shelter because of humans: "Just as often, when caught on the highway, a serpent which a brazen wheel has crossed aslant, or with blow of a heavy stone a wayfarer has crushed and left half-dead, vainly tries to escape" (Verg., *Aen.* 5.273-276, transl. Fairclough & Goold 1999). The ship can only wriggle along like a crippled snake. Sergestus' ship finally reaches shore (i.e. "the snake's den"). External danger aside, according to the extant accounts, the Greeks and Romans considered the snake to travel very efficiently within its habitat.

SNAKES IN THE HUMAN SPACE

Ancient descriptions of animal behaviour focused on the animals' relations with humans much more than on inter- and intraspecies relations. The snake was believed to seek contact with humans, and was the protagonist of numerous tales in which it showed spatial orientation when leaving its usual space. In antiquity, it was believed that snakes liked to leave their "permanent territory" and could multiply so much that they would take up the entire land, making the life of humans difficult, as was the case with Thessaly (Ps.-Arist., *Mir.* 832a14-23, transl. Bekker 1831; Plin., *NH* 10.31.62; Plut., *De Is. et Os.* 74, *Mor.* 380F; plagues of snakes, see Kitchell 1994: 13-15). Herodotus wrote about snakes (*opheis*) from Arabia that would have occupied the entire Earth had they not encountered obstacles to their reproduction (Hdt., 3.108-109). Porphyry rightly states that a snake (*serpens*) will attack

a human only when stepped on. This opinion, however, was not commonly accepted. As a matter of fact, the philosopher himself wrote in a different place of his work that humans and snakes are hostile towards each other (Porph., *De abst.* 1.14). In fact, snakes are secretive animals and most species will avoid humans at all cost.

Ancient accounts in which a snake finds the way to reach a specific human reveal the animal's excellent orientation skills and spatial memory. The source of these accounts was the false belief that the snake was interested in humans. Plutarch invokes the story of a snake from Aetolia that grew so attached to a woman that it crawled to her each night. When the woman moved to a different town, the snake found her after three or four days of roaming the area, looking for her: "The serpent (*drakōn*) did not come to her for three or four nights; but all the time, we may suppose, it was going about in search of her and missing its goal. At last, when it had somehow found her with difficulty, it embraced her [...]" (Plut., *De soll. anim.* 18, *Mor.* 972E, transl. Cherniss & Hembold 1957). Thus, in Plutarch's view, snakes are able to learn and perform spatial tasks. Aelian told a similar story, about a snake (*drakōn*) in Judea (in the days of King Herod) that for a month came to a place where it met a certain woman: "So she escaped from him and remained away for a month, supposing that the serpent in consequence of his darling's absence would forget her. But loneliness augmented his misery, and every day and night he used to haunt the place" (Ael., *NA* 6.17, transl. Scholfield 1958-1959). Another tale concerns a snake in Arcadia. Pliny and Aelian claimed that this snake (*draco*, *drakōn*) still remembered, many years later, the way to the place which he associated with a boy he had befriended. In order to reach this place, the snake had to travel through an area populated by many wild animals. Pliny drew on the authority of Democritus to invoke this tale (probably Bolus of Mendes, also known as Democritus, active in Alexandria around 200 BC) (Plin., *NH* 8.22.61; Ael., *NA* 6.63). Of course, many anecdotes about cross-species love relationships appear in ancient literature. Humans are paired with a dog, a horse (*Equus caballus* Linnaeus, 1758), a dolphin, a ram (*Ovis aries* Linnaeus, 1758), a goose, a goat (*Capra hircus* Linnaeus, 1758), a jackdaw *Coloeus monedula* (Linnaeus, 1758), a peacock, an elephant and a seal (e.g., Plin., *NH* 9.8.25-28; Plut., *De soll. anim.* 18; Ael., *NA* 1.6, 2.6, 4.56, 6.15, 6.44, 12.37; Aul. Gell., 6.8; see Konstan 2013; Smith 2013). Apart from snakes, only dolphins show spatial memory. According to Pliny and Aulus Gellius, in the reign of Augustus, a dolphin carried a boy back and forth to school from Baiae to Puteoli for several years. Pliny cites Maecenas, Fabianus and Flavius Alfius as authorities (Plin., *NH* 9.8.25). Aulus Gellius quotes the words of the grammarian Apion: "Apion declares that of all this he himself and many others were eye-witnesses" (Aul. Gell., 6.8; Rolfe 1927).

There are also extant anecdotes about snakes allegedly pestering specific people. Pliny claimed that snakes move in pairs, and when one of them is killed by a human, the other chases the human in revenge "bursting through all



FIG. 1. — The Python's cave (*antron*). Leto escapes from Python with Apollo and Artemis in her arms. Lost Apulian red-figure neck amphora, earlier IV BC, drawing by J. H. W. Tischbein after Ogden (2013a: 39, fig. 3).

obstacles and traversing all distances" (*perrumpit omnes difficultates, permeat spatia omnia*). If the killer does not manage to escape immediately or there is no river on the way, the snake (*serpens*) will catch up with the killer, identify them in a crowd and attack (Plin., *NH* 8.35.86; Rackham *et al.* 1938-1962). The snake pursues the man just like a hound pursues its prey.

Snakes rarely have navigational problems in ancient literature. Aristotle probably thought that wine causes disorientation and navigational problems in snakes: "The snakes are also immoderate in regard to wine, and so people hunt even vipers by setting out wine in pieces of pottery in the dry-stone walls: they are caught while drunk" (Arist., *HA* 594a10-13, transl. Balme 1991). The Libyan Psylli and the Italian Marsi possessed "magical powers" to inflict sleep on snakes. It was demonstrated in the streets of Italian towns. In Aelian, a man described as *pharmakotribēs* ("drug-preparer") rears snakes to show them off at fairs (Ael., *NA* 9.62). The Marsi could, with their incantations, draw snakes forth from their holes and stop them in their tracks. As Tibullus wrote: "incantation checks the curse of the angry snake" (Tibullus, 1.8.20, transl. Juster & Maltby 2012; see Ogden 2013b: 213).

In some ancient depictions, the snake performs the role of a "guide" that "leads" people to a designated place, often far away from its own shelter (see Trumpf 1958). This type of tale was created based on the belief that the snake, as a chthonian animal, is perfectly acquainted with the terrain. Among the towns' "founders" were birds (ravens, pigeons, eagles, crows), mammals (for example, wolves [*Canis lupus* Linnaeus, 1758]) and insects (bees). Thus, snakes show the same spatial ability as mobile and active animals (Schmid 1947; Bowie 1993: 154-156). Pausanias wrote that the inhabitants of Epidaurus in Argolis took a holy snake (*drakōn*) with them, when travelling to the sanctuary of Asclepius on Kos on state business. When the snake escaped from the ship and disappeared underground near the sea, the people decided to settle down in the place "indicated" by the snake. This is how a group of people "led" by a snake founded the city Epidaurus Limeria in Laconia (Paus., 3.23.7). Pausanias

also invoked a legend about the founding of Mantinea in Arcadia, according to which the settlement was founded in a place “indicated” by a snake (*drakōn*). In *Graeciae descriptio*, we read that the river flowing through the city is called Ophis (“Snake”) in honour of the snake. The author expressed his regret that no information survived about the species that the “founder” snake belonged to, but he speculated that it was a *drakōn*, which most likely meant a member of the Colubridae family (Paus., 8.8.4-5; Trinquier 2008: 222; Kitchell 2014: 61, *s.v. Draco*). Pausanias’ account allows us to conclude that the author treated the information about the abilities of the snake with full seriousness. The author records information given to him by local guides or informers (“They also say” in Epidaurus Limera; “the breed of snakes is not recorded” in Mantinea). Thus, Pausanias does not reject local Epidaurian and Mantinean traditions. While chronologically speaking, the tale of the founding of Epidaurus Limera (as well as Mantinea) most likely comes from a later period (Pretzler 2005: 26; Riethmüller 2005, vol. 1: 209, 232, 380; vol. 2: 119-122; Ogden 2013b: 313), there is no reason to doubt that some settlements were founded in places “indicated” by a snake, even though the animal was unaware of its role.

THE DISAPPEARING SNAKE: THE ANCIENT “LABYRINTH TEST”

The ancients did not conduct any planned experiments to test the ability of the snake to traverse an area designated by a human, which is the basic method in the modern behavioural research involving this reptile (Grace 2018: 272, 273). Even so, observations were recorded at the time about the snake’s ability to locate its destination. Surprisingly, ancient snakes were eager to expose themselves. In fact, snakes are cryptic creatures and it is important for them to be able to hide away.

On many occasions, the ancient authors described snakes that crawled into private homes and temple buildings, which means spaces that were traps for the reptile. Because a snake spotted in such places caused religious fear in people, the animal was not killed or removed immediately. In describing a superstitious person, Theophrastus wrote that: “If he sees a snake (*ophis*) in his house, he invokes Sabasios if it is a cheek snake, but if it is holy one he immediately founds a hero shrine on the spot” (Theophr., *Char.* 16.4, transl. Rusten & Cunningham 2003). Because the author does not say what a superstitious person usually did with the snake, it may be assumed that the reptile left the building on its own accord. Theophrastus’ “superstitious man” walked the streets of Athens in the late fourth century BC. Divination was considered a religious matter by the Romans. In the first century BC, Cicero asked: “And why a conference about snakes rather than about lizards or mice?” (Cic., *Div.* 2.62, transl. Falconer 1923). Cicero believed the fact that the animal was seen less often than lizards and mice to be the reason why the unexpected visit of a snake would cause anxiety. The reptile was observed in sacred areas, such as in sanctuaries, near altars and in other sites of rituals, in-

cluding the homes of the Greeks and Romans (the snake represents the spirit or *genius* of the owner of the house or of the place) (Fig. 2).

The reactions to the sight of the snake in these sacred grounds must have been intense, considering that Cicero chose to explain in *De divinatione* that there was nothing extraordinary about snakes crawling out from beneath the altar and into a house to gather around the hearth. In such situations, inquisitive people asked soothsayers whether the presence of the snake should be treated as a sign, or they may have kept the snake at home and brought the soothsayers to see it (Cic., *Div.* 2.62). *De divinatione* and other sources mention a consul (*cos* 177 and 163 BC) who found two snakes (*anguēs*) in his house. Tiberius Sempronius Gracchus followed the advice of a soothsayer who he summoned and released one of the snakes (Cic., *Div.* 1.36, 2.62; cf. Plut., *TGr.* 1.2-3; Val. Max., 4.6.1; Plin., *NH* 7.36.122). We can only wonder what Plutarch meant when he wrote that Tiberius Gracchus allowed the female snake (*drakōn*) to leave (if he let the male snake go, his wife was to die in a short time). Did the consul dare to catch the snake with his hands and carry it outside, or did he wait for the animal to find a way out on its own? (Plut., *TGr.* 1.2-3). Cicero relied on the account provided by Gaius Gracchus (the son of Tiberius Gracchus). Similarly, with respect to snakes crawling into temples, the authors only mention that they were sighted. Snakes play a prominent role in the history of Roman prodigies. Livy reported the snake omen at Satricum in 206 BC (the second Punic war): “No less frightening for the people of Satricum were two snakes (*anguēs*) slithering into the temple of Jupiter” (Livy., 28.11.2, transl. Yardley in Foster *et al.* 1919-1959). Livy also reported that a few people saw a snake (*anguis*) in the Temple of Fortuna in 169 BC (Livy., 43.13.4). Did these people wait for the snakes to leave the building on their own? Due to the religious context, that may have often been the case.

The source accounts mention not only the snake’s effectiveness in traversing obstacles, but also the animal suddenly disappearing from human sight. This phenomenon is best illustrated by a tale about the journey of a snake from the Temple of Asclepius in Epidaurus to Rome, which was described by many ancient authors. After a three-day alleged trip through the districts of its town, the snake crawled onto a ship sailing to Italy. On its way, the animal visited the temple of its patron in Antium. Afterwards, when the ship reached Rome, the animal escaped the ship and disappeared on the coast of the island on the Tiber. This way, in 293/292 BC, the snake gave rise to the Temple of Asclepius and to Roman medicine (e.g., Livy., 10.47.6-7; per. 11; Ovid, *Met.* 15.626-744; Val. Max., 1.8.2; Plin., *NH* 29.22.72; Plut., *Quaest. Rom.* 94; *Mor.* 286; Steger & Ursin 2021: 242-244). Ovid describes the journey at length in his poetic *Metamorphoses*. The snake (*serpens*) glides down the temple steps. Next, the reptile makes his way through the city of Epidaurus and down to the harbour (Ovid, *Met.* 15.685-695). The most detailed historical source is Valerius Maximus. The author compiled his collection of historical anecdotes during the

reign of Tiberius (14-37 AD): “For the snake (*anguis*) [...] began to glide through the most populous parts of the city, mild of eye and drawing gently along. For three days he was watched amid the religious wonderment of all, showing no uncertain eagerness for the more illustrious dwelling that he sought, and so made his way to the Rome trireme” (Val. Max., 1.8.2, transl. Shackleton Bailey 2000). Thus, Epidaurus was the snake’s home range. The reptile was allegedly seen by the Roman delegation, the priests of Epidaurus, the citizens of Epidaurus, the Roman sailors and the crowds on the Tiber banks. This snake is supposed to be *Zamenis longissimus* (Laurenti, 1768) or *Elaphe quatuorlineata* (Bonnaterre, 1790), Aesculapian snake, Europe’s largest non-venomous snake, growing up to two meters (Kitchell 2014: 147, 148, s.v. *Pareias*; Lewis & Llewellyn-Jones 2018: 588). Moreover, ancient writers from Livy to Plutarch had no doubts about this curious habit of the snake, which has no basis in reality. Of course, for them it was Asclepius who entered Rome in his zoomorphic guise. The existence and activity of the Roman Temple of Asclepius is considered as a historical fact. Regardless of doubts about whether the snake really crossed the sea on a ship to find another home (e.g., Orlin 2002: 99, 106, 107; Ogden 2013b: 311, 312, 358, 359), the tale indicates that the snake was considered in antiquity to be able to clear obstacles effectively and reach its destination.

A snake quickly disappearing from human sight is a popular motif in the Greek and Roman accounts. Huge snakes disappear through the temple doors, are suddenly lost from sight inside a room or on board a ship, and vanish from the battlefield. An interesting case of a disappearing snake is recounted in the biography of Antony by Plutarch. In describing Cleopatra’s suicide, the author observed that the snake (*aspis*, cobra, *Naja haje*? Kitchell 2014: 33, s.v. *Cobra*) that bit the queen was not spotted in the chamber; however, tracks of its movement were discovered outside, and there were windows in the room. Plutarch assumed, therefore, that the animal had quickly left the chamber on its own through the window (Plut., *Ant.* 86.3; cf. Ael., *NA* 9.61). All such tales of disappearing snakes, which were interpreted as supernatural phenomena, may have originated from the snake’s supposed ability to rapidly find its way among obstacles.

CONCLUSIONS

As Tadić recently concludes, snakes “constantly suffer from “taxonomic chauvinism” [...] or, simply speaking, plain disparagement” (Tadić 2023: 96). It was different in ancient times. The belief that an encounter with the snake was supernatural and never accidental motivated observations of the reptile’s behaviour and the attempts to read its intentions. The ancients had many occasions to learn about the behaviour of the reptile and to draw conclusions about the potential of its memory, based on their observations. Greek and Roman accounts presented the snake as an animal that had achieved great reproductive success and spread throughout the world. There were only some places that were free, or almost free of snakes, but it was due to the intervention of the gods and heroes.



FIG. 2. — Bacchus and Vesuvius. A huge snake is slithering in front of an altar. Pompeii, from the Lararium of the House of the Centenary, 55-79 AD, Naples. National Archaeological Museum, inv. 112286, after Kuivalainen (2021: 117, C17).

According to the ancient authors, vision is the basic sense that allows the snake to travel and to remember its way. One of the writers asserts that the snake has the keenest sight of all animals. As presented in ancient accounts, the snake moves skilfully around its usual space and retains its spatial orientation over long distances. The ancient snake did not have problems with reaching its destination. The ancient writers described the ability of snakes to remember the location of sites they had previously visited. Snakes can learn and remember a large amount of spatial information. Their memory capabilities are closely parallel to those observed in birds and mammals. In short, a well-developed spatial memory was attributed to the snake by the Greeks and Romans.

Of course, the ancient sources contain an element of exaggeration and biological inaccuracies (ancient snakes show almost the same spatial ability as dogs!). Unlike in ancient texts, real snakes are secretive in their habits and would rather hide than expose themselves. It should be remembered that snakes are among the most difficult animals to observe in their natural habitat. In 2012, LaDage and his colleagues concluded: “spatial memory ability in squamate reptiles has been seen as possible, at best, or non-existent, at worst” (LaDage *et al.* 2012: 939). Thus, the ancients eagerly investigated the abilities of the snake that modern science has just started to recognise. For this reason, the ancient evidence cannot be dismissed entirely.

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