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The Brooklyn snake papyrus: why the enigmatic *k3r3* could be a chameleon

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ABSTRACT
The Brooklyn snake papyrus (*c.* 380-343 BC) has intrigued Egyptologists since its publication in 1989. Thirty-seven of the 38 entries in the first half of the text describe individual snakes, as well as outline the physical effects of their bites, which has enabled the scientific identification of many to the species level. However, the identity of the last animal listed in the treatise, the *k3r3*, is debated. The text describes the animal as green with three divisions on its head or back and possessing the ability to change colour, features that have suggested to many scholars that the *k3r3* is a chameleon (Family Chamaeleonidae), but because these lizards are not dangerous to humans, its apparent association with venomous snakes has caused others to doubt this conclusion. Reference in the text to the creature possessing "two legs under it" has added to the confusion. Here I present information that has not been considered previously, which further supports the earlier identification of the *k3r3* as a chameleon and explains why its grouping with snakes may have been considered logical according to the taxonomy used by the ancient Egyptians.

KEY WORDS
Ancient Egypt,
lizards,
folk taxomomies,
animal behaviour.

RÉSUMÉ
Le papyrus du serpent de Brooklyn: pourquoi l'énigmatique k3r3 *pourrait être un caméléon.*
Le papyrus du serpent de Brooklyn (vers 380-343 av. J.-C.) intrigue les égyptologues depuis sa publication en 1989. Trente-sept des 38 entrées de la première moitié du texte décrivent des spécimens de serpents ainsi que les effets physiques de leurs morsures, ce qui a permis l'identification scientifique de beaucoup d'individus au niveau de l'espèce. Cependant, l'identité du dernier animal répertorié dans le traité, le *k3r3*, fait débat. Le texte décrit l'animal comme vert avec trois divisions sur la tête ou le dos et possédant la capacité de changer de couleur, des caractéristiques qui ont suggéré à de nombreux chercheurs que le *k3r3* est un caméléon (Famille des Chamaeleonidae), mais comme ces lézards ne sont pas dangereux pour les humains, son association apparente avec des serpents venimeux a amené certains à douter de cette conclusion. La référence dans le texte à la créature possédant « deux pattes en dessous » a ajouté à la confusion. Ici, je présente des informations qui n'ont pas été prises en compte auparavant, qui soutiennent davantage l'identification antérieure du *k3r3* en tant que caméléon et expliquent pourquoi son regroupement avec les serpents peut avoir été considéré comme logique selon la taxonomie utilisée par les anciens Égyptiens.

MOTS CLÉS
Égypte ancienne,
lézards,
taxonomies populaires,
comportement des
animaux.

Fig. 1. — Common chameleon (*Chamaeleo chamaeleon* (Linnaeus, 1758)). Photo credit: mirecca (https://www.istockphoto.com).

INTRODUCTION

The Brooklyn Papyrus (nos 47.218.48 and 47.218.85) has been the focus of much scientific interest since its first translation and posthumous publication by Serge Sauneron in 1989. The hieratic text, which has been dated to the 30th Dynasty (*c.* 380-343 BC) (Sauneron 1989: xi; Aufrère 2012: 226), is divided into two parts: the first catalogues a variety of snakes and the physical effects of their bites, while the second part recommends practical and magical ways to treat these, as well as the bites and stings of other venomous creatures, such as scorpions. Most scholars thus agree that the papyrus is a physician's manual intended to guide the identification of medically dangerous animals and aid the diagnosis and treatment of afflicted patients.

The first part of the manuscript originally catalogued a total of 38 reptiles; however, the first 13 entries are now missing due to substantial damage to the beginning of the roll. Each snake is first provided with its Egyptian name and its appearance described before the physical effects and toxicity of its bite are reviewed; the deity affiliated with each species is also often noted. When sufficient details are provided in the text, Sauneron (1989) attempted to identify the snakes at species level, and subsequent scholars have further sought to clarify the animals listed – sometimes suggesting alternative species that appear to better fit the morphological and behavioural clues provided by the manual's author (e.g., Leitz 1997; Brix 2010; Aufrère 2012, 2019; Andreozzi 2020; Mahlich 2021). While there is often agreement between scholars regarding the identities of the snakes (see Andreozzi 2020: 135, 136 for a recent summary), the final reptile described in the treatise (no. 38) has been the subject of much speculation. The text may be translated as follows: "As for the *k3r3*, it is [an] entirely green [animal]; its belly is white; it has two legs under it; the back of its head has three divisions, two [turned] forward, the other rearward. If it lands on something, it takes on the colour of that thing. One can save him until the seventh day. It is a manifestation of Anubis. One can exorcise against it with words of appeasement" (Sauneron 1989: 35).

Sauneron (1972; 1989: 35) earlier identified this animal as a chameleon based on its green colouration, ability to take on the colour of its surroundings, and the three divisions on its head, which are known features of these lizards; however, he was unable to account for why chameleons, which pose no danger to humans, have been grouped with the venomous snakes otherwise listed in the papyrus. This puzzling relationship has since caused some scholars to cast doubt on Sauneron's conclusion. Here I present new information about these distinctive lizards that strongly supports the identification of the *k3r3* as a chameleon and offers fresh insights into how the Egyptians chose to categorise the animal world.

CHAMELEONS

Four chameleon taxa (Family Chamaeleonidae) have been identified in Egypt in the present day: the African chameleon (*Chamaeleo africanus* Laurenti, 1768), the Smooth chameleon (*C. laevigatus* Gray, 1863), and two sub-species of the Common chameleon (*C. chamaeleon chamaeleon* Linnaeus, 1758) and *C. chamaeleon musae* Steindachner, 1901) (Fig. 1; Anderson

Fig. 2. — Common chameleon (*Chamaeleo chamaeleon* (Linnaeus, 1758)) tongue protrusion. Photo credit: Mehmetkrckrc (CC BY-SA 4.0). https://commons.wikimedia.org/wiki/File:Hunter_chameleon.jpg, last consultation on 22 November 2022.

1898: 225-232; Smyth Flower 1933: 781-784; Marx 1968: 25; Le Berre 1989: 140-143; Baha El Din 2006: 138-144; Tilbury 2018: 611, *passim*). All four taxa may be green in colour, with various species-specific markings in the form of spots or disrupted dorso-lateral or dorso-ventral lighter bands. Lizards are rarely attested in the ancient Egyptian archaeological record, but recent evidence has revealed that during the New Kingdom period (*c.* 1500-1069 BC) and later, chameleons occasionally featured in tomb paintings, hidden amongst the foliage in marsh scenes (Evans *et al.* 2020; see also Keimer 1936; Brentjes 1975: 320). Some New Kingdom texts (e.g., the *Teachings of Amenemope*) may also possibly allude to chameleons (Federn 1966; Fischer-Elfert 1991: 231, 232).

Chameleons are unique lizards, both anatomically and behaviourally (Tolley & Herrel 2014). Due to the lateral compression of their body, their legs descend directly beneath their body instead of sprawling out to the sides, as usually found in other lizards (Gans 1967: 53). Their hands and feet are also distinctive (Fig. 1), as their digits are fused to form two, opposing pincer-like pads (i.e. they are zygodactylous; Higham & Anderson 2014: 64). As most chameleon species are arboreal, the arrangement of their legs and opposed digits help them to maintain their balance and grip when moving slowly along branches, as does their prehensile tail, which when outstretched or coiled around foliage aids stability. Chameleons are further characterised by distinctive head ornaments. Most exhibit lateral ridges that extend from the nostrils and over the eyes to join the "casque", a helmet-like crest on the crown, and some species display up to three pairs of horns, which can project widely from their forehead and/or snout (Freedman 2014: 877, 878; Anderson & Higham 2014: 40, 41; Tilbury 2018: 61). The chameleons' bizarre appearance is further enhanced by their prominent conical eyes, which can move independently and swivel in different directions simultaneously (Ketter-Katz *et al.* 2020). Although most species are green, yellow or brown, specialised skin cells (chromatophores and iridiphores) allow chameleons to change colour rapidly in response to their mood, temperature fluctuations, social situations or illness (Stuart-Fox 2014: 117-119; Teyssier *et al.* 2015). Their renowned ability to blend in with their surroundings is not only due to colour change but also to their distinctive walk, in which they mimic the movement of surrounding foliage by rocking back and forth gently as they take each slow step. Consequently, their stealthy movement and excellent vision help them to hunt for insects, which they catch by projecting their unusually long tongue to ensnare their prey on its sticky, club-shaped tip (Fig. 2; Freedman 2014: 877; Higham & Anderson 2014: 72-83; Anderson 2016: 1-9).

PREVIOUS INTERPRETATIONS OF THE *K3R3*

Many scholars have accepted Sauneron's (1972) identification of the *k3r3* as a chameleon, based on the features he highlighted (Aufrère 2012; 2013: 110; Andreozzi 2020: 136; Golding 2020: 138; Mahlich 2021: 117, 118; also Cannuyer 1984: 189; Fischer-Elfert 1991: 231, 232; Osing 1998: 123;

Table 1. — Possible reptile candidates for the *k3r3*, based on descriptions of Egyptian species listed in Baha El Din (2006).

Egyptian species	Green colour	Head ornaments	Two legs visible
Chamaelonidae	+	+	+
Agamidae	+/–	+/–	–
Gekkonidae	–	–	–
Scincidae	–	–	+/–
Serpenetes	–	+/–	+/–

von Lieven 2004: 158, n. 6). However, others have challenged this conclusion. Leitz (1997: 143-145) has argued that other lizard species are also green and so the *k3r3*'s colouration is not necessarily evidence of a chameleon. He proposes that the *k3r3* instead describes a gecko or agamid lizard (Leitz 1997: 143-145; Hansen 2003: 290; see also Meeks 2002: 10), as some species in these families are able to alter the colour of their skin in response to changes in the temperature or their emotional state (e.g., in aggressive encounters), or during the breeding season. To support his position, Leitz (1997) notes that Greek authors did not view the chameleon as venomous, but their description of a poisonous "basiliskos" lizard (although see Böhme & Koppetsch 2021: 480, 489) closely resembles the *k3r3*, having three protrusions on its head. He also observes that if the Brooklyn text instead refers to projections on the *k3r3*'s back, rather than on its head (as Sauneron [1989: 35] has translated the text), then the desert agamid, *Agama mutabilis* (now *Trapelus mutabilis* Merrem, 1820), may fit the description, as it appears to have three distinct bulges when viewed from above (although see Mahlich 2021: 117, 118).

Further doubts have also been raised about the *k3r3*'s identity due to the text's reference to it possessing "two feet under it", a physical feature that does not match most snakes or lizard species. Some pythons and boas have a pair of claw-like vestigial hind legs, but these are so minute they are barely visible (Smith & Wright 2018: 3). Similarly, the forelegs of Audouin's skink (*Chalcides sepsoides* Audouin, 1829), which is found in Egypt, are atrophied so that its hindlegs are more visible; however, this species is neither venomous nor green in colour and spends most of its time buried in sand (Baha El Din 2006: 205-207). Most scholars therefore assume that this part of the text is simply a scribal error (e.g., Sauneron 1972: 162; Andreozzi 2020: 136), although given the Egyptians' close observation and awareness of animals, such a fundamental mistake seems unlikely. As Aufrère (2012: 241) notes, "Reste cette erreur – on mentionne deux pattes au lieu de quatre – qui peut surprendre dans un texte qui, dans l'ensemble, paraît donner plus d'éléments justes que d'erreurs" (There remains this error – two legs are mentioned instead of four – which may be surprising in a text which, on the whole, seems to give more correct elements than errors).

Regardless of whether the *k3r3* is a chameleon, agamid, gecko, or skink (Table 1), Leitz (1997) and others (e.g., Fischer-Elfert 1991: 232; Vernus 2005: 320) have questioned why a lizard would occur in a list of poisonous animals, since none of them is dangerous to humans. Its presence is indeed curious, as among the more than 7000 lizard species found worldwide, only five are known to be venomous (i.e. able to inject venom), namely Gila monsters (*Heloderma suspectum* Cope, 1869), Mexican beaded lizards (*H. horridum* Wiegmann, 1829), Chiapan beaded lizards (*H. alvarezi* Bogert & Martin Del Campo, 1956), Guatemalan beaded lizards (*H. charlesbogerti* Campbell & Vannini, 1998) and Rio Fuerte beaded lizards (*H. exasperatum* Bogert & Martin Del Campo, 1956), all of which are restricted to Central and North America (Reiserer *et al.* 2013; Scheinin 2018: 278). Aufrère (2013: 110) suggests that the Egyptians may simply have been confused about the toxicity of chameleons, believing them to be poisonous for unknown reasons and hence wrongly grouped with snakes (for modern attitudes towards reptiles, see Janovcová *et al.* 2019). This is plausible but still leaves unanswered the question of why they might have held such a belief. Could it be that we have misunderstood the characteristics of these animals that were important to the Egyptians and by which they subsequently categorised them?

EGYPTIAN FOLK TAXONOMY

Folk taxonomies – namely, the idiosyncratic ways in which different cultures may choose to categorise the living things in their immediate environment – provide valuable insights into their owners' conceptual worlds (Berlin 1973; for reconstructions of ancient folk taxonomies, see VanPool & VanPool 2009; Guasparri 2022). How plants and animals are grouped together culturally is based on local knowledge about their appearance combined with other defining characteristics, and reflects social agreement regarding which of those characteristics is required for group membership. The Linnean (scientific) taxonomic system also relies on the presence of shared morphological characteristics to determine hierarchical groupings of plants and animals. Folk taxonomies, on the other hand, arise from what a given culture believes is significant about natural phenomena, which may be influenced by a range of social and economic factors (e.g., Forth 2013). Consequently, this allows for connections to be made between different plants or different animals based on features that may not be immediately understood or appreciated by those outside of the cultural group. For example, folk taxonomies may place the members of a single species according to the Linnaean system into two or more groups, based on nuances of particular features – such as fur colour ("over-differentiation"; Berlin 1973: 267-269). Or they may choose to cluster together two or more scientific species into a single group, based on characteristics that are irrelevant according to the Linnean system but which are considered highly significant culturally ("under-differentiation").

A range of evidence confirms that the ancient Egyptians perceived separate groups of plants and animals, although the principles underlying their folk classification system are sometimes difficult for us to discern or understand (for an extensive discussion of available sources of information, see Brémont *et al.* 2020). The systematic application of deter-

minatives in their hieroglyphic script undoubtedly reveals that they recognised categories of objects based on certain shared characteristics (Baum 1988; Goldwasser 1999, 2002, 2009). Similarly, when funerary texts and hymns identify the forms of life that comprise the divine creation of the world, they often divide the animal kingdom into groupings that roughly align with the taxonomic classes we recognise today, namely mammals, birds, reptiles, fish, amphibians, and invertebrates. Such divisions appear to be based on shared aspects of morphology, habitat, and/or form of locomotion (Gerke 2017: 82-86; Evans 2020: 74, 75). For example, Spell 154 of the *Book of the Dead* states: "But every creature likewise that shall die, the whole of them altogether – even all quadrupeds, all fowl, all fish, all snakes, all worms – living or dead, they are yonder, having passed on, after all the worms have finished [their work]" (Allen 1974: 154), and in the Chester Beatty Papyrus IV (rto, 5-7) it is observed that: "… there came into being men, gods, cattle and all goats in their totality, [and] all that flieth and alighteth" (Gardiner 1935: 32). Some administrative titles highlight the salient features that differentiated types of animals (e.g., "Overseer of horned, hoofed, feathered, and scaled"; Gerke 2017: 84), while natural groupings of animals are apparent in onomastica and lists. Indeed, Andreozzi (2020: 134) recently observed that "Lists can […] be considered clusters and they can be used […] to understand and reveal which entities writers considered to belong to which group". In his examination of the Brooklyn Papyrus, he established that the animals described not only fall largely into four species groups, but that they also represent a hierarchy based on their level of toxicity, namely that cobras occur at the start of the list, then so-called "*ḥnp*-snakes", then vipers, and finally relatively harmless colubrid species are presented, including the disputed *kꜣrꜣ* (see also Golding 2020: 206).

In contrast, Andreozzi (2020: 130, 131) also highlights an example in which snakes and lizards appear to have been conflated by the Egyptians. On a wall fragment from the pyramid complex of the Fifth Dynasty king, Djedkare Isesi, the determinative/classifier applied twice to the word *ḥfꜣ.w* (snakes) is a lizard (Gardiner 1935: I1). This may imply that the term could encompass either snakes or lizards interchangeably, depending on the context, possibly based on their comparable forms of serpentine movement (Aufrère 2019: 49). In a similar vein, cultural images that combine the features of many animals into a single composite figure also show how the Egyptians could draw connections between separate species based on particular features they deemed significant. For example, Meeks (2010) has observed that insect-shaped determinatives show substantial variation (e.g., representations of the *ḫpr* beetle) because they are hybrids, incorporating the features of a range of species based on perceived similar functions. Similarly, McDonald (2000) has demonstrated how the enigmatic Seth animal is likely an amalgamation of the dangerous characteristics of aggressive animals, while I have proposed that the Anubis animal (Evans 2008), Egyptian bee glyph (Evans 2018), and so-called "dragonflies" in tomb scenes (Evans & Weinstein 2021) are probably composite figures, blending the features of a range of similar species into one based on either shared morphological or behavioural criteria. The manifestations of deities that combine the features of a number of animals follow the same principle, such that the defensive aggression of hippos, lions, and crocodiles were combined in the figure of the protective goddess, Taweret, while the offensive attributes of the same animals could represent the composite demoness, Ammit. In particular, the depiction of three bats amidst an array of 29 birds in the Middle Kingdom tomb of Baqet III (no. 15) at Beni Hassan (e.g., Kanawati & Evans 2018: pls 70-72) and a similar, recently discovered scene in the nearby tomb of Khety (no. 17) (Kanawati & Evans 2020: pl. 84) seem to indicate that despite their very different morphology, the Egyptian artists at this site perceived birds and bats collectively due to their shared possession of wings and/or their ability to fly.

In each of these last examples, the Egyptian folk taxonomy exhibits under-differentiation – the clustering of independent species based on one or more culturally meaningful, shared characteristics that have outweighed otherwise gross physical differences. Based on this apparent conceptual capability, I propose that the animals listed in the Brooklyn Papyrus may also represent under-differentiation, such that snakes and chameleons have been grouped together by the author based on a distinctive behavioural similarity, which has hitherto not been considered when analysing the *kꜣrꜣ*.

CHAMELEON BEHAVIOUR

When attacking prey or defending themselves, snakes strike their victim by launching their body rapidly towards the threat, biting swiftly, and then retracting (e.g., see Kardong & Bels 1998). Over half of their anterior body may be lifted above the substrate and extended laterally during the strike, which occurs at lightning speed; indeed, the strike of vipers has been described as "the fastest thing in nature", but it has recently been confirmed that the strike speed of some non-venomous snakes is in fact faster (Penning *et al.* 2016). Venomous and non-venomous snakes have been found to strike their targets in *c.* 50-90 milliseconds, which is faster than a human blink (202 milliseconds; Penning *et al.* 2016: 2). Extremely rapid body extension, which may or may not result in subsequent envenomation, is thus a distinctive characteristic of the defensive and/or predatory behaviour of many snake species.

While all lizard species can protrude their tongues, only chameleons use theirs as a projectile to capture prey (Fig. 2; Schwenk 2000: 257). Once a prey item has been detected in the chameleon's visual field, its tongue is first partially expelled and then projected forward at ballistic speed to engage its sticky, club-shaped tip with its victim in *c.* 45 milliseconds or less (Wainwright *et al.* 1991: 116; Anderson 2016; Brau *et al.* 2016). The tongue is then retracted back into its mouth with the prey adhered to the end (Müller & Kranenbarg 2004; Freedman 2014: 877). Remarkably, chameleons are able to elongate and extend their tongue from 1.5 times to more than double the length

of their body (Müller & Kranenbarg 2004: 1; Anderson 2016: 2; Iwasaki *et al.* 2019: 344, 345), enabling them to strike prey from a considerable distance away and thus rendering them highly effective and lethal stealth predators. Despite its speed, the chameleon's hunting technique can be easily understood by observers, especially when heavy prey causes the elongated tongue to dangle briefly while being retracted.

I suggest that the *k3r3* describes chameleons and that they are grouped with snakes in the Brooklyn Papyrus due to the unique action of their projectile tongues, which resembles the snake's rapid predatory or defensive strike. Furthermore, it should be noted that the bulbous tip of the chameleon's tongue is not unlike the distinct heads of some snake species (e.g., vipers). Chameleons can thus effectively be viewed as having a snake in their mouth, which moves with the same rapidity as snakes and can cause the death of the creatures it strikes – although by ingestion rather than envenomation. I propose, therefore, that ballistic strike capability, rather than toxicity, may have been the defining attribute that allowed chameleons to be included alongside snakes in the Brooklyn Papyrus.

CHAMELEON MORPHOLOGY

If it is accepted that the *k3r3* is a chameleon, further clarification of the Brooklyn description is possible. The curious reference to the creature having "two legs under it", which might otherwise cast doubt on its identification as either a snake or a lizard, may be explained by another unusual feature of the chameleon's anatomy. As noted earlier, the animals' digits are fused together to create two paddle-shaped paws on each limb (Fig. 1), which they use to grip branches and foliage as they move (Gans 1967: 53; Peterson 1984: 25; Higham & Anderson 2014: 64, 65). Indeed, this gives the impression that the end of each leg has been split into two opposing parts. This physical feature is entirely unique among lizards and so will undoubtedly have been noticed by Egyptian observers. Furthermore, the chameleons' joints are structured so that they can rotate their hands and feet far more freely and flexibly than terrestrial lizards (Anderson & Higham 2014: 31, 32; Diaz & Trainor 2015: 2, 3). When combined with the equally unusual placement of the chameleons' legs directly beneath their body rather than out to the sides like other small lizards, the special mention of the *k3r3* having "two legs (or paws) under it" is perhaps finally justified.

According to Serge Sauneron's translation of the Brooklyn text, "the back of [the *k3r3*'s] head has three divisions, two [turned] forward, the other rearward". The sentence is problematical, however, and has also been translated as, "There are three subdivisions on its back, two toward the front, one towards the back" (Aufrère 2012: 233). Sauneron (1972: 163-164) argued convincingly that the text describes three ridges located on the chameleon's head: two that extend from the nostrils to the top of the casque (the lateral crests) and a third ridge on top of the head (the parietal crest). However, in line with Aufrère's translation, the "three divisions" may equally describe the lateral and the parietal crests, which are thus "toward the front" of the chameleon's upper body, while the third refers to the "dorsal crest", a ridge that runs the length of the spine to the tail, and is thus "towards the back" (Anderson & Higham 2014: 40, 41). These unique morphological features are found in all chameleons to varying degrees and so it is not possible to propose an individual species based on these, but the reference to "three divisions" nonetheless aligns strongly with an identification of the *k3r3* as a chameleon.

CONCLUSION

Hansen (2003: 291) has pointed out that, "It is wrong to assume that the ancient Egyptians classified animals in the same way we do today, or even considered the same attributes when grouping them". This is undoubtedly true, yet it is nonetheless difficult to fully abandon the unconscious scientific lens through which we perceive and analyse Egyptian evidence, leading us to potentially disregard or dismiss features that do not align with our modern assumptions. For Egyptologists and historians, lizards do not belong with snakes – they are physically distinct – but within folk taxonomies, like that of the Egyptians, such groupings are possible because characteristics other than strict morphological resemblance may take precedence. Determining what features mattered to the ancient Egyptians and hence underpin their animal groupings would seem an impossible task, but we can gain valuable insights by considering all aspects of the species they interacted with – not just the animals' appearance, but their species-specific behaviour as well.

The startling strike capability of snakes and the chameleon's snake-like tongue both elicit fascination in modern observers. It is not unreasonable to accept that the same reaction was experienced by Egyptian observers but who went further to see an affinity between the reptiles based on this shared feature. Some caution is warranted, however. As Gerke (2017: 94, 95) points out, the Egyptians have thus far left us little evidence of their general view of animals, and so the association of a chameleon with snakes in the Brooklyn Papyrus may simply reflect the author's opinion alone, not represent a widely held belief. Nevertheless, as the animals' affiliation was recorded in this manner, it implies an expectation that readers of the manual will have recognised why the chameleon's inclusion was logical. The Brooklyn snake papyrus thus provides yet further confirmation of the Egyptians' acute awareness of the animal kingdom and the ways in which this impacted and enriched their cultural lives.

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