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On the Lost Legs of the Snake that Seduced Eve

In art history, there are numerous examples of paintings and sculptures that were inspired by religious texts. Amongst these, many depict a well-known theme from the Garden of Eden: the seduction of Eve. This dramatic biblical scene is described in the third chapter of Genesis, the first book of the Old Testament. The animal that addresses Eve is referred to as serpent, or *serpens* in Latin[1], and is supposed to represent the devil in disguise. In modern languages the word "serpent" is synonymous with "snake". However – and this is noteworthy – the more general meaning of *serpens* is "reptile", derived from the Latin verb *serpere*, meaning "to creep", and thus equivalent to the word "reptile" itself[2]. Naturally, this obscures the true identity of the reptilian animal that is believed to have seduced Eve. The modern meaning of "serpent" has largely determined the way the animal has been depicted in art, as a snake. No matter how beautiful any particular work of art may be, from a biblical perspective such a picture is erroneous, as will be explained below. A well-known, excellent example is "The Garden of Eden with the Fall of Man" (Fig. 1). It was painted around the year 1617 by Peter Paul Rubens (1577–1640), who was responsible for the human figures in it, and Jan Brueghel the Elder (1568–1625), who drafted the flora and fauna. This magnificent piece of art is housed at the Mauritshuis (The Hague, the Netherlands). The painting depicts the moment just prior to the

[1] Hebrew–English Bible. Retrieved from http://www.mechon-mamre.org/p/pt/pt0.htm. B. Fischer, H.J. Frede, J. Gribomont, H.F.D. Sparks, W. Thiele (Eds.): *Biblia sacra iuxta vulgata versionem*. Stuttgart 1984.

[2] S.A. Handford, M. Herberg: *Langenscheidt's Pocket Latin Dictionary. Latin–English, English–Latin*. Maspeth, NY, 1966.

consumption of the forbidden fruit and the fall of man[3]. Apparently Brueghel was familiar with the majority of the animals he painted. For instance, the head and antlers of the male roe deer (*Capreolus capreolus*)[4] are absolutely correct zoologically and therefore immediately recognisable as such. Even the snake, offering apples to Eve, can be identified unambiguously. In fact, it is a grass snake (*Natrix natrix*)[5]. The yellow collar behind the head, the typically green to brown colour of the body, the dark spots, and the typical hue of the ventral scales: all these characteristics are seen in Brueghel's snake. However, *Natrix natrix* is not an arboreal species; probably the painter was not familiar with exotic, more "appropriate" taxa.

There is yet another category of artwork dealing with the Seduction. Here, the serpent is some kind of a mythical diabolic animal with a snake-like body with front limbs. Occasionally, additional wings attached to the back are present. The front limbs may have reptilian claws or may take the form of human arms (Fig. 2). It is no coincidence that in such "cases" female breasts are present and that these serpents have heads with faces mirroring Eve's. The portrayal of the serpent head as a mirror image of Eve's face was common in earlier iconography because women were identified as the source of the original sin[6].

Those works in which the serpent is represented as a tetrapod are even more interesting. Invariably, in these cases, the hind limbs are reptilian in nature, while the front limbs may be either human or reptilian (Figs 3, 4). The serpent in "The Fall and Redemption of Man" by Hugo van der Goes (†1482) has a remarkably lizard- or crocodile-like body, with the exception of the head, which, again, shows Eve's face mirrored (Fig. 4). Without a culturally determined misogynistic iconography, the serpent could have been expected to be pictured as in the example of Figure 5. Only some artists – amongst whom were Hugo van der Goes and Hieronymus Bosch (*c.* 1450–1516) – interpreted the third chapter of Genesis almost correctly, because, after all, the divine wrath evoked by the consumption of the forbidden fruit affected not only Adam and Eve, but also the serpent[7], who was punished and lost its legs. Thus, before handing Eve the

[3] According to Genesis 3:5, concerning the consumption of the forbidden fruit, the serpent says to Eve: "… ye shall be as God, knowing good and evil"; in Latin version we read: "… *eritis sicut dii scientes bonum et malum*". "*Malum*" means "evil" as well as "apple". Hence, the forbidden fruit is always depicted as an apple.

[4] C. Linnaeus: *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis.* Ed. 10, Tomus 1. Stockholm 1758.

[5] Ibidem.

[6] E.M. Dowling, W.G. Scarlett (Eds.): *Encyclopedia of Religious and Spiritual Development*. Thousand Oaks, CA, London, New Delhi 2006, pp. 328, 329.

[7] "And the LORD God said unto the serpent: 'Because thou hast done this, cursed art thou from among all cattle, and from among all beasts of the field; upon thy belly shalt thou go, and dust shalt thou eat all the days of thy life'". Genesis 3:14. In: Hebrew–English Bible. Latin version: "*et ait Dominus Deus ad serpentem quia fecisti hoc maledictus es inter omnia animantia et bestias*

forbidden fruit the serpent must have had limbs. Now this is remarkable, since the first chapter of Genesis states that "… *God made the beast of the earth after its kind, and the cattle after their kind, and everything that creepeth upon the ground after its kind…*"[8]. The change in appearance of the serpent would thus seem to be a biblical contradiction or even a record of evolution.

As matters stand today, the evolution of snakes from tetrapod ancestors (particularly with regard to the loss of legs) is well understood on the basis of data from the fossil record and discoveries in the field of molecular biology. The latter yielded the genetic blueprint and gene expression of the limbless and elongated vertebrate body form (*Bauplan*)[9]. Yet, even in the Ancient Middle East, where the third chapter of Genesis was written around 3,000 BP[10], the view that the limbless snake was "exceptional" as compared to lizards, and monitors in particular, could easily have arisen. Furthermore, similarities amongst all these squamate reptiles (that is, possessing a bifurcated tongue and a skin with scales) could have led to the assumption that snakes once had legs.

For a long time, only fossil snakes similar to extant species had been known[11]. However, at least since the 1859 publication of Charles Darwin's *magnum opus* "On the Origin of Species", it was possible for the concept of a tetrapod snake ancestor to emerge. A notable clue in this respect is the fact that in boas and pythons vestiges of hind limbs appear externally as cloacal spurs, and pelvic remnants are found in the trunk musculature (Fig. 6)[12].

A milestone in our understanding of the evolution of snakes was the identification of the Late Cretaceous (early Cenomanian) squamate *Pachyrhachis problematicus*[13] from the Middle East as a genuine – albeit primitive – snake with a fully developed pelvis and articulating hind limbs in which femur, tibia,

terrae super pectus tuum gradieris et terram comedes cunctis diebus vitae tuae". In: B. Fischer, H.J. Frede, J. Gribomont, H.F.D. Sparks, W. Thiele (Eds.): *Biblia sacra iuxta vulgata versionem*.

[8] Genesis 1:25. In: Hebrew–English Bible.

[9] L.I. Held Jr: *How the Snake Lost Its Legs. Curious Tales from the Frontier of Evo-Devo*. Cambridge, UK, 2014, xii + 285 pp. M.W. Caldwell: "Without a leg to stand on": On the Evolution and Development of Axial Elongation and Limblessness in Tetrapods. *Canadian Journal of Earth Sciences*, vol. 40, no. 4, 2003, pp. 573–588.

[10] G.I. Davies: *Introduction to the Pentateuch*. In: J. Muddiman, J. Barton (Eds.): *The Oxford Bible Commentary. The Pentateuch*. Oxford 2010, pp. 16–52.

[11] For instance, from the 48-million-year-old Eocene deposits of the world-famous Messel Quarry near Darmstadt, Germany. See: G. Gruber, N. Micklich (Eds.): *Messel – Schätze der Urzeit*. Darmstadt 2007.

[12] G.R. Zug, L.J. Vitt, J.P. Caldwell: *Herpetology. An Introductory Biology of Amphibians and Reptiles*. San Diego, San Francisco, New York, Boston, London, Sydney, Tokyo 2001, xiv + 630 pp.

[13] G. Haas: On a Snakelike Reptile from the Lower Cenomanian of Ein Jabrud, near Jerusalem. *Bulletin du Muséum national d'Histoire naturelle de Paris*, 4th ser., no. 1, 1979, pp. 51–64.

and fibula are recognised[14]. In view of the fact that this important fossil was collected from marine sedimentary rocks and that *Pachyrhachis* shared cranial characteristics with extinct marine monitors, the Late Cretaceous mosasaurs, two conflicting scenarios of the origin of snakes persisted for decades: one positing a terrestrial, the other a marine ancestor[15]. The first record of a Cretaceous, unambiguously terrestrial snake with robust hind limbs and a pelvic girdle was published in 2006[16]. However, the year 2015 witnessed an important turning point when a snake with an elongated body and reduced front and back limbs from the Lower Cretaceous (Aptian) Crato Formation of Brazil was described, and appropriately named *Tetrapodophis amplectus*: a four-legged snake, capable of constriction[17]. In the same year, much older fossils comprising vertebrae and skull elements with recurved teeth as in extant snakes were recorded. Interestingly, these finds were made in strata formed in freshwater or swampy settings. They pushed snake evolution about 70 million years backwards in time, into the Jurassic[18]. In other words, based on the fossil record, snake evolution has a terrestrial origin and is associated with body elongation and limb reduction, culminating in total (or near-total, as in boas and pythons) loss of legs.

Why did snake evolution take place? What was the advantage of mutations that led to limblessness and body elongation? It is plausible that selection pressure triggered the ultimate loss of limbs and elongation of the body in (proto-) snakes, because this yielded opportunities for these predators to pursue their prey into a system of burrows[19]. This transition was initiated mainly by mutations in two Hox genes. These genes determine the way an animal is constructed according to a basic body plan[20]. With regard to the loss of limbs in snakes, two important mutated Hox genes are involved. One mutation leads to the formation of ribs on cervical vertebrae, simultaneously preventing the formation of front limbs. The other prevents the inhibition of rib formation in the lumbar region, with consequences for the hind limbs being similar to those for the front limbs[21].

[14] M.W. Caldwell, M.S.Y. Lee: A Snake with Legs from the Marine Cretaceous of the Middle East. *Nature*, vol. 286, 1997, pp. 705–709.

[15] M.S.Y. Lee, M.W. Caldwell: Adriosaurus and the Affinities of Mosasaurs, Dolichosaurs, and Snakes. *Journal of Palaeontology*, vol. 74, no. 5, 2000, pp. 915–937; M.S.Y. Lee: Molecular Evidence and Marine Snake Origins. *Biology Letters*, vol. 1, no. 2, 2005, pp. 227–230.

[16] S. Apesteguía, H. Zaher: A Cretaceous Terrestrial Snake with Robust Hindlimbs and a Sacrum. *Nature*, vol. 440, 2006, pp. 1037–1040.

[17] D.M. Martill, H. Tischlinger, N.R. Longrich: A Four-legged Snake from the Early Cretaceous of Gondwana. *Science*, vol. 349, 2015, pp. 416–419.

[18] M.W. Caldwell, R.L. Nydam, A. Palci, S. Apesteguía: The Oldest Known Snakes from the Middle Jurassic-Lower Cretaceous Provide Insights on Snake Evolution. *Nature Communications*, vol. 6, 2015, doi:10.1038/ncomms6996.

[19] L.I. Held Jr: *How the Snake Lost Its Legs…*

[20] C. Nüsslein-Volhard: *Coming to life. How genes drive development*. Carlsbad, CA, 2006, xiii + 166 pp.

[21] L.I. Held Jr: *How the Snake Lost Its Legs…*

Furthermore, it has been demonstrated that during embryonic development, formation of the vertebral column is four times faster in snakes than in mice, which explains the characteristic body elongation[22].

The conclusion is that the origination of snakes from a tetrapod ancestor is well understood from a developmental-biological point of view, and that this transition is documented fairly well in the fossil record. Indeed, this is a fine example of evolution. What is equally fascinating is the fact that the loss of legs of the serpent attracted the attention of an ancient Middle East civilisation, within which it was considered to be God's punishment.

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Figure 1. "The Garden of Eden with the Fall of Man" by Peter Paul Rubens (1577–1640) and Jan Brueghel the Elder (1568–1625) at the Mauritshuis (The Hague, the Netherlands).
Source: https://en.wikipedia.org/wiki/The_Garden_of_Eden_with_the_Fall_of_Man.

[22] Ibidem.

Figure 2. Adam, Eve and the serpent in a 13th-century sculpture at the entrance to Notre Dame Cathedral in Paris, France. The portrayal of the serpent as a mirror image of Eve was common in earlier iconography because women were seen as the source of the original sin.
Source: https://commons.wikimedia.org/wiki/File:Temptation_Adam_Eva.jpg.

Figure 3. Detail of the left inner wing of the triptych "The Last Judgement" by Hieronymus Bosch (*c.* 1450–1516) (Akademie der bildenden Künste, Vienna, Austria). Adam and Eve are tempted into eating of the fruit of the Tree of Knowledge by a half-human/half-reptilian creature, with its face mirrored on Eve's.
Source: https://commons.wikimedia.org/wiki/File:Bosch_Last_Judgement_Detail.jpg.

Figure 4. Left panel of the diptych "The Fall and Redemption of Man" by Hugo van der Goes (†1482) (Kunsthistorisches Museum, Vienna, Austria). Note, again, the mirror image of Eve's face in the creature.

Source: https://en.wikipedia.org/wiki/Vienna_Diptych#/media/File:Hugo_van_der_Goes_-_The_Fall_of_Man_and_The_Lamentation_-_Google_Art_Project.jpg.

Figure 5. The moment of seduction; a literal interpretation of Genesis, Chapter 3. Pencil drawing by Monique Aarnink (Denekamp, the Netherlands, 2016).

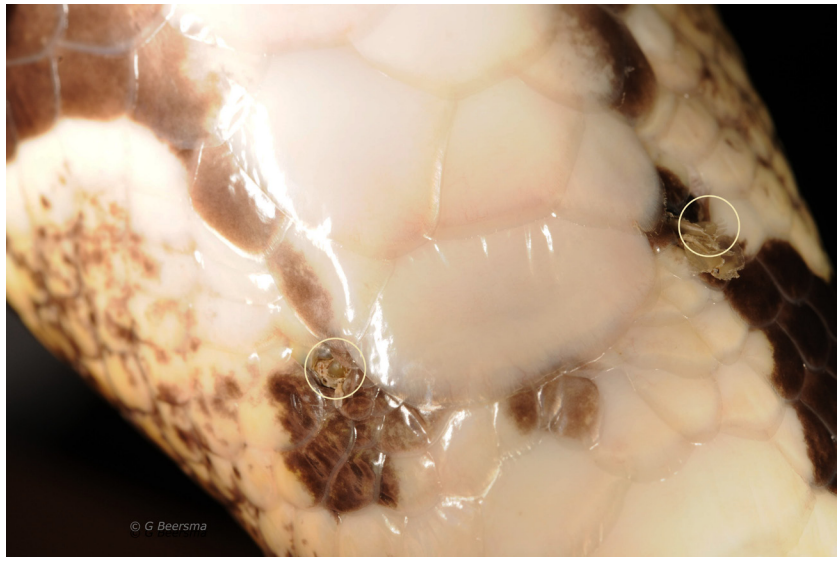

Figure 6. Ventral view of the abdominal-caudal transition of a female individual of *Python regius* (Shaw 1802), held as a pet at Museum Natura Docet Wonderryck Twente (Denekamp, the Netherlands). Cloacal spurs can be seen in the white circles; the length of the right spur in ventral view is 0,5 mm. Photograph by Gerard Beersma (Zwolle, the Netherlands, 2016).

Abstrakt

O utraconych kończynach węża, który kusił Ewę

Istnieje wiele obrazów i rzeźb przedstawiających znany motyw z ogrodu Eden: uwodzenie Ewy. Zwierzę, które kusi Ewę w Księdze Rodzaju, pierwszej księdze Starego Testamentu, jest określane jako wąż. Nowoczesne znaczenie słowa "wąż" w dużej mierze uzależniło sposób przedstawienia tego zwierzęcia w sztuce. Jednak zgodnie z literalną interpretacją Księgi Rodzaju, przed oddaniem Ewie zakazanego owocu wąż musiał mieć kończyny. Wydaje się, że zmiana wyglądu węża jest sprzeczna z zapisem biblijnym, a nawet ewolucyjnym. Na dzień dzisiejszy ewolucja węży od czworonożnych przodków jest dobrze poznana na podstawie danych z zapisu kopalnego i odkryć w dziedzinie biologii molekularnej. Proces ostatecznej utraty kończyn i wydłużenia ciała u (proto-)wężów to świetny przykład ewolucji. Równie fascynującym jest to, że utrata nóg węża przyciągnęła uwagę starożytnej cywilizacji na Bliskim Wschodzie, która uważała, że jest to kara boska.

Słowa klucze:
sztuka, uwodzenie Ewy, Księga Rodzaju (Stary Testament), żmija, wąż, ewolucja, utrata kończyn, wydłużenie ciała

Абстракт

Об потерянных конечностях змея, который соблазнил Еву

Есть много картин и скульптур, которые изображают известную тему из Эдемского сада: соблазнении Евы. Животное, которое обращается к Еве в Книге Бытия, первой книги Ветхого Завета определяется как змея. Современное значение слова «змея» во многом определила то как это животное было изображено в искусстве. Тем не менее, перед тем как передать Еве запретный плод змей должен был иметь конечности, согласно буквальному толкованию Бытия. Изменение внешнего вида змеи, оказывается библейским противоречием и даже фактом эволюции. На сегодняшний день эволюция змей от четвероногих предков хорошо изучена на основе ископаемых и открытий в области молекулярной биологии. Это прекрасный пример развития эволюции, проявившийся в окончательной потере конечностей и удлинения тела у (прото) змей. Не менее увлекательным является тот факт, что потеря ног у змей привлекла внимание уже во времена древней цивилизации Ближнего Востока, когда считалось, что это Божье наказание.

Ключевые слова:
искусство, соблазнение Евы, Книга Бытия, змей, змея, эволюция, потеря конечностей, удлинение тела