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Wolf-Ekkehard Lönnig

22 September 2023 to 12 December 2023

Hippo Origin

(*Hippopotamus amphibius* Linnaeus 1758)



Photographs W.-E. L. 5 June 2022 Oasis Wildlife Fuerteventura

Accidental DNA Mutations¹ or Ingenious Design?

¹Apart from changes in RNA viruses and the generally known DNA mutations, there are further possible mutations. Cf. for example: Jonathan Wells J (2013) The membrane code: A carrier of essential biological information that is not specified by DNA and is inherited apart from it. In: Marks RJ II, Belhe MJ, Dembski WA, Gordon BL, Sanford JC, eds. Biological Information: New Perspectives. World Scientific (Singapore) pp 474-488. And J. Wells (2014): Membrane patterns carry ontogenetic information that is specified independently of DNA. BIO-Complexity 2:1-28. doi:10.5048/BIO-C.2014.2.

Abstract

My comment on the rhinos², to wit that they do not belong to the most handsome/good-looking or graceful creatures of the animal kingdom, can unquestionably also be applied on the hippos. Moreover, the latter are most certainly also a fascinating group for further research.

So, what do we know about the origin of the hippos?

- 1) The family Hippopotamidae **appears abruptly** in the fossil record – like all the other groups, which I have so far investigated in detail (see please the footnote³).
- 2) As compared to the variation possible within living species like humans and others (see below), the two subfamilies and most of the hippo genera and species, which have been determined solely on the basis of anatomical and morphological criteria, may simply have been special populations of Mendelian recombinants from a genetical point of view (i. e. according to the **genetical species concept**). These recombinants (putative new subfamilies, species and genera) also appear abruptly in the fossil record.
- 3) The present evolutionary derivation of the Hippopotamidae from Anthracotheriidae by most paleontologists has been disproved by the detailed investigations of their fellow researcher Martin Pickford (for instance 2009, 2011, 2022). However, his alternative, the Doliochoeridae as ancestors of the hippos, is equally doubtful.
- 4) **All three families** just mentioned **appear abruptly in the fossil record** and subsequently display **constancy/stasis over large periods of time**⁴. In no case is there any documentation of a continuous evolution of one family from another by “infinitesimally small changes” (Darwin) or by mutations with “slight or even invisible effects on the phenotype” (Mayr). Otherwise, there would be no contradictory evolutionary derivations.
- 5) The popular objection, the incompleteness of the fossil record as the reason for these phenomena in the Hippos has *in principle* been refuted by (among many others) paleontologist Oskar Kuhn stating “that in many animal groups such a rich, even overwhelming amount of fossil material exists (foraminifers, corals, brachiopods, bryozoans, cephalopods, ostracods, trilobites etc.), that **the gaps between the types and subtypes must be viewed as real**”. There is no reason that it would be different in the hippos if we had more fossils. The evolutionary “ghost lineage” will forever continue to consist mostly of “ghosts”.
- 6) Cladistics has not refuted the objection of circular reasoning for the evolutionary hypotheses and derivations (“Decisions as to whether particular character states are homologous, a precondition of their being synapomorphies, have been challenged as involving circular reasoning and subjective judgements”). And now according to *transformed* cladistics “**it is a mistake to believe even that one fossil species or fossil “group” can be demonstrated to have been ancestral to another**” (Nelson).
- 7) The true answer on *Hippo Origin: Accidental DNA Mutations or Ingenious Design* – apart from the abrupt appearance of this (and virtually all other) families in the fossil record – that is to be drawn from their ingenious blueprints involving structures of **irreducible complexity** in probably all groups and generally enormous amounts of **specified complexity** on all biological levels (morphology, anatomy, physiology and genetics) is **intelligent/ingenious design**. – **Georges Cuvier**, usually referred to as the “founding father of paleontology” (and “Cuvier's scientific theories upheld the traditional view of God's creation...”) as well as renowned researchers such as **Louis Agassiz** argued for “**One Supreme Intelligence as the Author of all things**”.

² <http://www.weloennig.de/Rhinoceros.pdf>

³ For example: (2011) http://ad-multimedia.de/evo/long-necked-giraffe_mU.pdf

(2012) <http://www.weloennig.de/Hunderassen.Bilder.Word97.pdf>

(2012) <http://www.weloennig.de/Utricularia2011Buch.pdf>

(2018) <http://www.weloennig.de/ExplosiveOrigins.pdf>

(2019) <http://www.weloennig.de/KutscheraPortner.pdf>

(2019) <http://www.weloennig.de/ElephantEvolution.pdf>

(2021/2022) <http://www.weloennig.de/AngiospermsLivingFossils.pdf> (2020) <http://www.weloennig.de/HumanEvolution.pdf>

(2023) <http://www.weloennig.de/SauropodDinosaur.pdf>

(2023) <http://www.weloennig.de/Rhinoceros.pdf>. The abrupt appearance of new forms has also been validated from a strictly materialistic viewpoint and **is true even for the horse**. See, for example, Stephen Jay Gould & Niles Eldredge (1993): *Punctuated equilibrium comes of age*. (They nevertheless **believe** that *Hyracotherium* was the ancestor of *Equus*) <https://www.nature.com/articles/366223a0> Some citations here: <http://www.weloennig.de/EvolutionHorsesNilsson.pdf>

⁴ See **many more examples** in <https://evolutionnews.org/author/gbechly/>

Just a **Few Key Points**⁵ of the Contents⁶

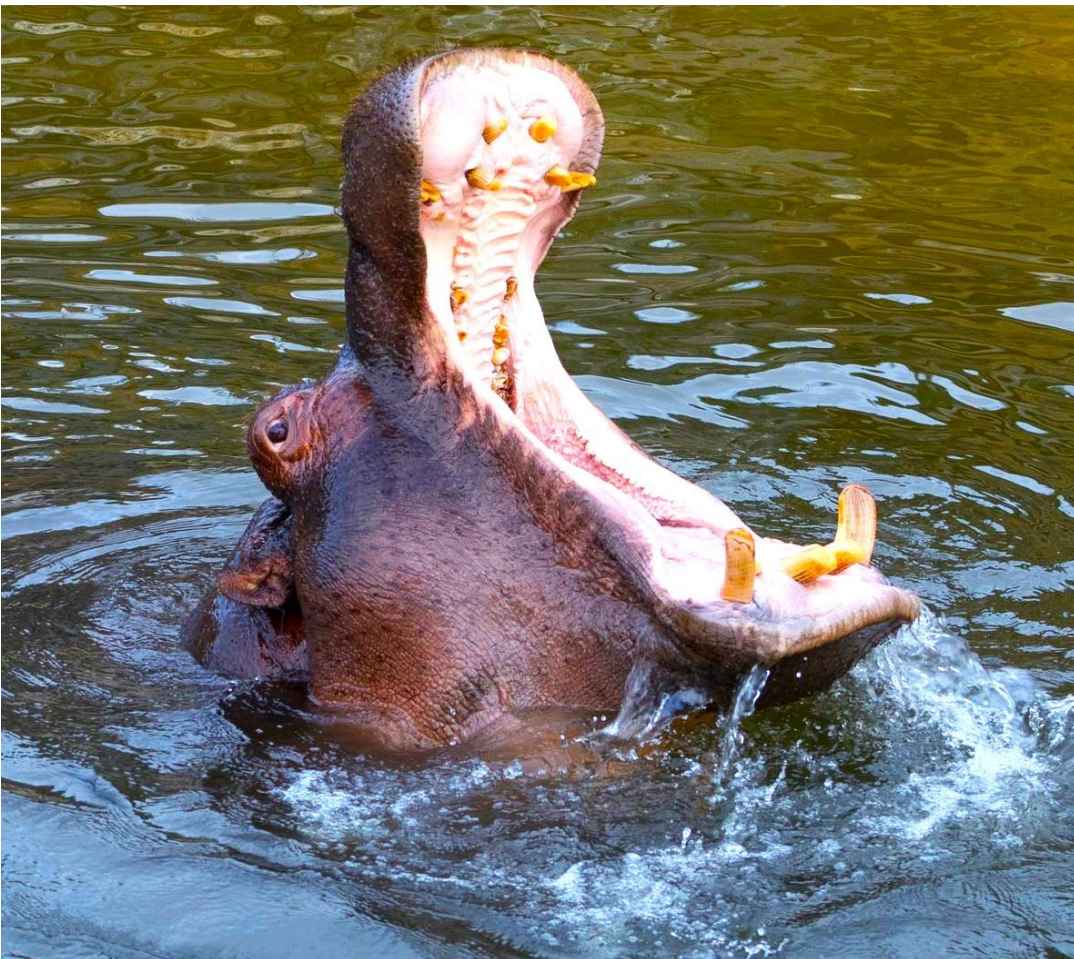
- **Brief Profile of the *Hippopotamus***
- **Genus *Hippopotamus* in the Fossil Record**⁷
- **The Fossil Record of the Entire FAMILY Hippopotamidae**
- **Subfamily Hippopotaminae**
- ***Archaeopotamus harvardi***
- **Genus *Choeropsis***
- ***Interim Note on the Taxonomic Endeavors for the Hippos***
- **The Genetic Species Concept and Haeckel's Twelve Species of Men**
- **Comparison of the Tallest People with the Smallest of the World**
- **Mendelian Recombination and Pygmy Hippos**
- **Subfamily Kenyapotaminae**
- **Hippo Origin: Pickford's Refutation of the Anthracotheriidae-Hypothesis**
- **The True Answer⁸ on Hippo Origin: Ingenious Design**
- **The Oldest Document on the Origin and Life of *Hippopotamus***
- **Supplement**

⁵ Note please that virtually all **highlighting/emphasis in the typeface** by W.-E. L. (except italics for *genera* and *species* names as well as adding a note when the cited authors themselves emphasized certain points). **Why so often?** Well, *since many people do not have the time to study a more extensive work in detail, these highlights can serve as keywords to get a first impression of what is being discussed* in the respective paragraphs.

⁶ Page numbers may change in a future update. Incidentally, citations do not imply consent of the authors quoted with my overall views nor *vice versa*. Moreover, I alone am responsible for any mistakes.

⁷ On some questions concerning absolute dating methods, see <http://www.weloennig.de/HumanEvolution.pdf>, p. 28

⁸ I know, of course, that a strict application of the *Intelligent Design Theory* would modestly prefer to speak not of the "true answer" but only of the "best answer" of the presently competing theories. However, since my *evolutionary friends increasingly use the adjective "true" for their hypothesis* (see, for example, J. Coyne) – I'm using "true" here with the challenge to Neo-Darwinism to refute the basic points of the present article.



Above: "Hippos in Luangwa Valley, Zambia, Southern Africa." Autor: Paul Maritz (2005):

https://commons.wikimedia.org/wiki/File:Hippo_pod_edit.jpg

Below: "Hippopotamus Who Yawns." User: Rodrigo.Argenton

[https://commons.wikimedia.org/wiki/File:Hippopotamus_Who_Yawns_\(223394487\).jpeg](https://commons.wikimedia.org/wiki/File:Hippopotamus_Who_Yawns_(223394487).jpeg)

"When a hippopotamus yawns it does not always mean that the animal is tired. It could also be a sign of aggression."

<https://www.youtube.com/watch?v=Ehpahz-fXXg> (Britannica Education)

Moreover, as I noted several times, hippos also open their mouths wide open when, for example, they expect something to eat thrown to them by a zookeeper.



Hippopotamus amphibius L. Photographs by W.-E. L. 10 October 2023 Zoo Cologne

I would like to especially emphasize the very fitting name coined by Linnaeus 1758: it is really *H. amphibius*.

For the photo above, note please especially the nasal openings/nostrals, which the hippo can close (to be under water und open above)

“The **subdermal glands** are an outstanding feature of the skin...They vary in number per unit surface area with age and size, as well as over different surfaces of the body. These glands empty through ducts clearly visible to the naked eye, sometimes near but more often well away from a hair; they can be cannulated and the secretion collected. On the whole, even in apparently well-nourished animals **there is little subcutaneous fat**. In the population examined it was noticeable that only in a few animals was there a substantial layer.” Before that the authors stated: The weight of a fully grown hippopotamus *in this area* is about **1500 kg** [see below that “males usually weigh **3,200 kg**”]. The expected weight of the **skin** in such an animal is 270 kg., i.e. about 18 percent of the total body weight.”

<https://physoc.onlinelibrary.wiley.com/doi/pdf/10.1113/expphysiol.1964.sp001695>

Brief Profile of the *Hippopotamus*

“Behold now behemoth, Which I made with thee; He eateth grass as an ox...” See Job 40:15-24

Probably the oldest known description of the hippo: [more than 3,500 years old](#). Cf. several translations from the Hebrew text at the end of this article. Sentence above from the King James Version of 1611.

Just a few key points – for much more see please the original articles:

Encyclopaedia Britannica:

“General characteristics: The hippopotamus has a bulky body on stumpy legs, **an enormous head**, a short tail, and four toes on each foot. Each toe has a nail-like hoof. Males are usually 3.5 metres (11.5 feet) long, stand 1.5 metres (5 feet) tall, and **weigh 3,200 kg** (3.5 tons). In terms of physical size, males are the larger sex, weighing roughly 30 percent more than females. The **skin is 5 cm** (2 inches) thick on the flanks but thinner elsewhere and nearly hairless. Colour is grayish brown, with pinkish underparts. **The mouth is half a metre wide and can gape 150° to show the teeth**. The **lower canines** are sharp and **may exceed 30 cm** (12 inches). Hippos are well adapted to aquatic life. **The ears, eyes, and nostrils are located high on the head** so that the rest of the body may remain submerged. **The ears and nostrils can be folded shut to keep out water**. The body is so dense that hippos can walk underwater, where they **can hold their breath for five minutes**. Although often seen basking in the sun, hippos lose water rapidly through the skin and become dehydrated without periodic dips. They must also retreat to the water to keep cool, for they do not sweat. Numerous skin glands release an oily reddish or pinkish “lotion,” which led to the ancient myth that hippos sweat blood; this **pigment actually acts as a sunblock, filtering out ultraviolet radiation**.

... Reproduction and life cycle: In the wild, females (cows) become sexually mature between ages 7 and 15, and males mature slightly earlier, between ages 6 and 13. In captivity, however, members of both sexes may become sexually mature as early as ages 3 and 4. **Dominant bulls more than 20 years old, however, initiate most of the mating**.

“**Pygmy hippopotamus** The rare pygmy hippopotamus (*Hexaprotodon liberiensis*, also known as *Choeropsis liberiensis*), **the other living species of the family Hippopotamidae**, is about the size of a domestic pig. The pygmy hippo is less aquatic than its larger relative, although, when pursued, it hides in water. Less gregarious, it is seen alone or with one or two others in the lowland tropical forests of Liberia, Côte d’Ivoire, Sierra Leone, and Guinea, along streams and in wet forests and swamps. Liberians call it a “water cow.” It eats some grasses and also fresh leaves of trees and bushes, herbs, and fallen fruits. *The International Union for Conservation of Nature has classified the pygmy hippopotamus as endangered since 2006.*”⁹

Encyclopedia.com (Oxford University Press):

“**The common or river hippopotamus** (*Hippopotamus amphibius*) is a huge, even-toed hoofed herbivore that lives in bodies of freshwater in central and southern Africa. A second species, the pygmy hippopotamus (*Hexaprotodon liberiensis*), lives in water bodies in West African rainforests. Both species are included in the family Hippopotamidae.” ... A hippo’s eyes, ears, and nostrils are **all positioned in a single plane that can stay above water when the rest of the animal is submerged**. Both the ears and the nostrils can close, at least partially, when in water. **... A single herd of hippos may include up to 100 animals**. The herd’s location, foraging, and movement are **controlled by a group of mature females**. The females and their young inhabit the center of a herd’s territory, called the crèche. The male’s individual territories, called refuges, are spaced around the crèche. ... The animals breed as the dry season is ending, with the females selecting their mates. **Hippos mate in water**. Gestation lasts about eight months, and the calves are **occasionally born in the water** at the height of the rainy season when the most grass is available. A new calf is about 3 ft (1 m) long and weighs about 60 lb (27 kg) when born. On land, it can stand very quickly. It will be several weeks, however, before the mother and her infant rejoin the group. ... Young females are sexually mature at three to four years old, but usually **do not mate until they are seven or eight years old**. Male hippos are mature at about five years old, but do not successfully challenge the dominant males for the right to mate until they are much older.

The pygmy hippo Pygmy hippos were discovered relatively recently in 1913, when an agent for a German animal collector caught several specimens and sent them back to Europe. **The smaller pygmy hippo is proportioned more like a pig than the common hippo**. **Pygmy hippos reach a height of only about 3 ft (1 m), a length of 5 ft (1.5 m), and weigh only about 500 lb (227 kg)**. The oily black skin has a greenish tinge, with lighter colors, even yellow-green, on its underparts. ... Unlike the common hippo, the pygmy hippo’s eyes do not bulge out and it has only one set of incisors.”¹⁰ (In this encyclopedia the **pygmy hippo** is referred to in different paragraphs as *Hexaprotodon* or *Choeropsis*.)

Wikipedia:

“Hippos have barrel-shaped bodies with short tails and legs, and an hourglass-shaped skull with a long snout.^{[34][8]:3,19} Their skeletal structures are graviportal, adapted to carrying their enormous weight,^{[8]:8} and their dense bones and low centre of gravity allows them to sink and move along the bottom of the water.^[35] Hippopotamuses have small legs (relative to other megafauna) because the water in which they live reduces the weight burden.^[36] The pelvis rests at an angle of 45 degrees. ... Hippos usually trot to move quickly on land **and can gallop at 30 km/h (19 mph) when needed**. They are incapable of jumping but can walk up steep banks.^[34] Despite their rounded appearance, **hippos have little fat**. ... Despite being semiaquatic and having webbed feet, an **adult hippo is not a particularly good swimmer**, nor can it float. It rarely enters deep water; when it does, the animal moves by bouncing off the bottom. **An adult hippo surfaces every four to six minutes, while young need to breathe every two to three minutes**. ... The **hippo’s jaw** is powered by **huge masseter and digastric muscles** which give them large, droopy cheeks. **The jaw hinge allows the animal to open its mouth at almost 180°**. **A folded orbicularis oris muscle allows the hippo to attain an extreme gape without tearing any tissue**. On the lower jaw, the incisors and canines grow continuously, the former reaching 40 cm (1 ft 4 in), while the latter can grow to up to 50 cm (1 ft 8 in). **The lower canines are sharpened through contact with the smaller upper canines**. The canines and incisors are used mainly for combat instead of feeding. **Hippos rely on their flattened, horny lips to grasp and pull grasses which are then ground by the molars**. The hippo is considered to be a pseudoruminant; it has a complex three-chambered stomach, but does not “chew cud”. ... Two **highly acidic pigments** have been identified in the secretions; one red (hipposudoric acid) and one orange (norhipposudoric acid), which inhibit the growth of disease-causing bacteria and their light-absorption profile peaks in the ultraviolet range, creating a sunscreen effect. **Regardless of diet, all hippos secrete these pigments so food does not appear to be their source; rather, they may be synthesised from precursors such as the amino acid tyrosine**. **This natural sunscreen cannot prevent the animal’s skin from cracking if it stays out of water too long**.¹¹

[Different Article.] **Pygmy hippopotamus: The pygmy hippo is reclusive and nocturnal**. The pygmy hippo is herbivorous, feeding on ferns, broad-leaved plants, grasses, and fruits it finds in the forests. A rare nocturnal forest creature, the pygmy hippopotamus is a difficult animal to study in the wild. ... **Several species of small hippopotamids have also become extinct in the Mediterranean** in the late Pleistocene or early Holocene.”¹² (In that article the extant pygmy hippo is listed as *Choeropsis liberiensis*.)

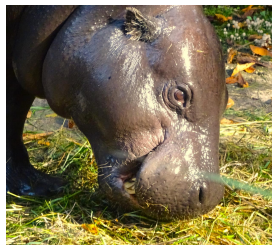
⁹ <https://www.britannica.com/animal/hippopotamus-mammal-species> (retrieved 25 September 2023)

¹⁰ <https://www.encyclopedia.com/plants-and-animals/animals/vertebrate-zoology/hippopotamus> (also retrieved 25 September 2023)

¹¹ <https://en.wikipedia.org/wiki/Hippopotamus> (extraordinarily extensive article) “This page was last edited on 21 September 2023...”

¹² https://en.wikipedia.org/wiki/Pygmy_hippopotamus (retrieved 25 September 2023 as well)

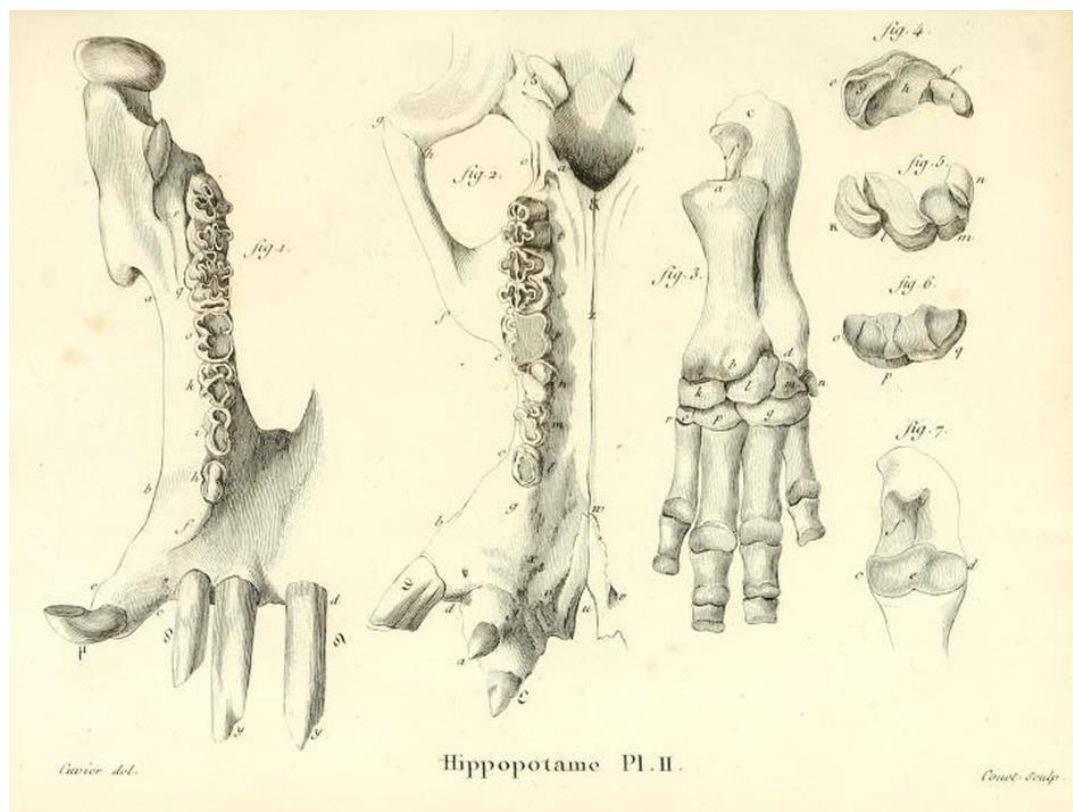
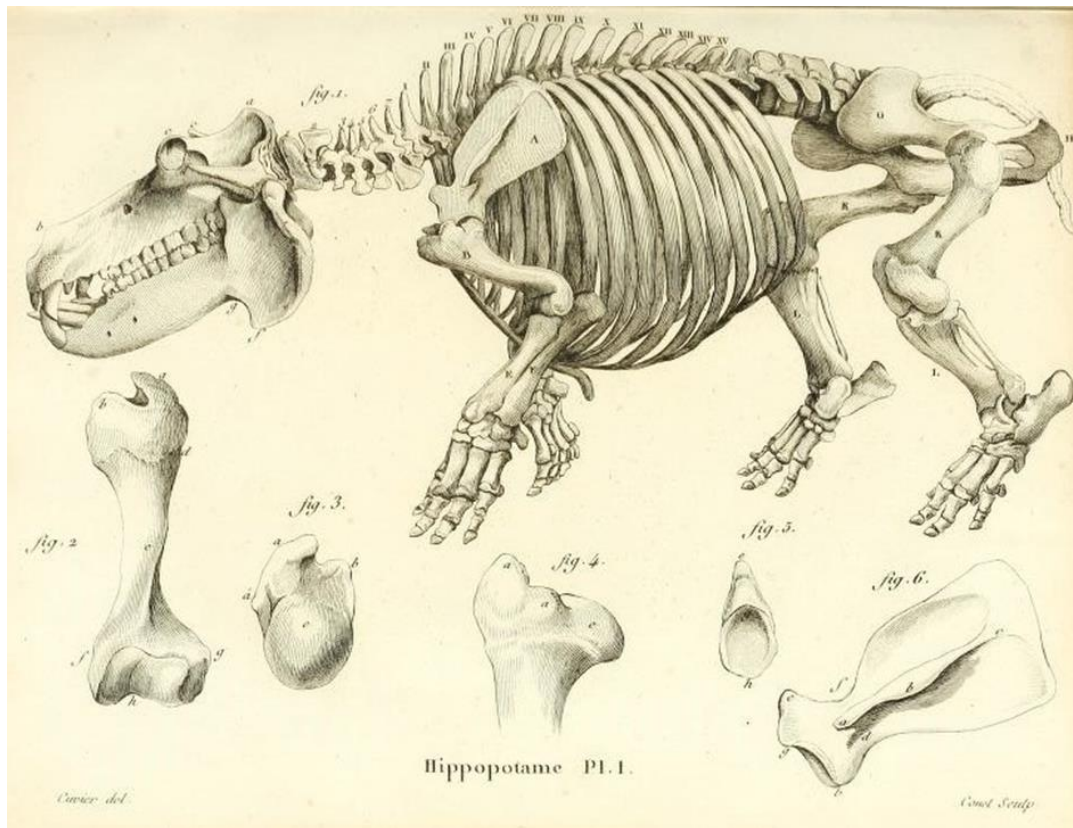
Comparison of *Hippopotamus amphibius* (enlargement of a photo above) with *Hippopotamus liberiensis*¹³ (below) also known as the pygmy hippo *Choeropsis liberiensis* or *Hexaprotodon liberiensis*



To emphasize some key points from the reference books just cited above, now starting with the pygmy hippo: “The smaller pygmy hippo is proportioned more like a pig than the common hippo. Pygmy hippos reach a height of only about 3 ft (**1 m**), a length of 5 ft (**1.5 m**), and weigh only about 500 lb (**227 kg**). ... Unlike the common hippo, the pygmy hippo’s eyes do not bulge out and it has only one set of incisors.”

Hippopotamus amphibius: “General characteristics: The hippopotamus has a bulky body on stumpy legs, an enormous head, a short tail, and four toes on each foot. Each toe has a nail-like hoof. Males are usually **3.5 metres** (11.5 feet) long, stand **1.5 metres** (5 feet) tall, and weigh **3,200 kg (3.5 tons)**. In terms of physical size, males are the larger sex, weighing roughly 30 percent more than females.” Fotos. W.-E.L. Fuerteventura (above) and Duisburg (below).

¹³ For the different names, see please the discussion below.



Above: skeleton of *Hippopotamus major*, now *H. antiquus* (but according to the [genetic species concept](https://www.biodiversitylibrary.org/item/123713#page/142/mode/1up) *Hippopotamus amphibius major* – see below. <https://www.biodiversitylibrary.org/item/123713#page/142/mode/1up>)

More details: <https://www.biodiversitylibrary.org/item/123713#page/143/mode/1up> (Explanations of the details in that book)

Georges Cuvier (1812): *Recherches sur les ossements fossiles de quadrupèdes : où l'on rétablit les caractères de plusieurs espèces d'animaux que les révolutions du globe paroissent avoir détruites* (Research on the fossil bones of quadrupeds: where we restore the characteristics of several species of animals that the revolutions of the globe appear to have destroyed).

Note at <https://www.biodiversitylibrary.org/bibliography/60807>:

“First edition of a work which laid the foundation to vertebrate paleontology.”



Slightly different view of the same large *Hippopotamus* as on the first page. Photograph W.-E. L. 5 June 2022 Oasis Wildlife Fuerteventura

For the Background of this Article, to wit *Gradualism, Punctuated Equilibrium (Punk Eek)* and *Intelligent Design* see please pp. 6-8 in <http://www.weloennig.de/Rhinoceros.pdf> (2023).

Genus *Hippopotamus* in the Fossil Record: Age Range and Collections According to PBDB (2023)¹⁴: Collections: 442 total

“Maximum range based only on fossils: base of the Messinian to the top of the Holocene or 7.24600 to 0.00000 Ma. Minimum age of oldest fossil (stem group age): 5.333 Ma.”

Genus *Hippopotamus*: Base of the Messinian 7. 246 Ma to present.
However, under the family name Hippopotamidae *H. kaisensis* is noted with 23.03 Ma.¹⁵
LIVING FOSSIL.: CONSTANCY/stasis up to more than 7 or ca. 23 Ma
“Total: 442 collections including 496 occurrences”

¹⁴https://paleobiodb.org/classic/basicTaxonInfo?taxon_no=42481

¹⁵https://paleobiodb.org/classic/checkTaxonInfo?taxon_no=42479&is_real_user=1 (Both sources retrieved 26 September 2023.)

Now, our next step is the fossil record of the entire *FAMILY* Hippopotamidae: Total: 588 collections including 695 occurrences

In PBDB the authors first mention the ensuing dates: “Maximum range based only on fossils: base of the Burdigalian to the top of the Holocene *or* 20.44000 to 0.00000 Ma. Minimum age of oldest fossil (stem group age): 15.97 Ma.” However, in their corresponding table¹⁶ they note 6 occurrences for the Early/Lower Miocene (Oldest occurrence 23.03 Ma.):

Hippopotamidae (hippopotamus)
Mammalia - Hippopotamidae

Age range
Maximum range based only on fossils: base of the Burdigalian to the top of the Holocene *or* 20.44000 to 0.00000 Ma
Minimum age of oldest fossil (stem group age): 15.97 Ma

Oldest occurrences		Collections (585 total)	
Time interval	Ma	Country or state	Original ID and collection number
Early/Lower Miocene	23.03 - 15.97	Kenya	Kulutherium kenyensis (77025)
Early/Lower Miocene	23.03 - 11.608	Uganda	Morotochoerus ugandensis (28292 28293)
Middle Miocene			
Miocene - Pliocene	23.03 - 2.588	South Africa	Hippopotamus sp. (22220 22229)
Miocene - Pliocene	23.03 - 2.588	Uganda	Hippopotamus kaisensis, Hexaprotodon imagunculus (22399)
Neogene	23.03 - 2.588	Myanmar	Hippopotamus sp. (215569)
Miocene - Pleistocene	23.03 - 0.0117	Ethiopia	Hexaprotodon sp. (22128)
Burdigalian	20.44 - 15.97	Kenya	Kulutherium kenyensis (77024)
Langhian - Serravallian	15.97 - 11.62	Kenya	Hippopotamidae indet. (22273) Morotochoerus ugandensis (22303) Palaeopotamus temani (74559)
Serravallian	13.82 - 11.62	Kenya	Hippopotamidae indet. (22284) Kenyapotamus coryndoni (22292)
Serravallian	13.82 - 11.62	Kenya (Central Nyanza)	Kenyapotamus temani (21340)
Serravallian - Tortonian	13.82 - 7.246	Ethiopia	Hippopotamidae indet. (22157)
Serravallian - Tortonian	13.82 - 7.246	Tunisia (Gafsa)	Kenyapotamus sp. (35277 35279 35280)
Tortonian	11.62 - 7.246	Kenya	Hippopotaminae indet., Kenyapotamus coryndonae (219711)
Tortonian - Messinian	11.62 - 5.333	Kenya	Hexaprotodon sp., Hexaprotodon harvardi (22243) Hexaprotodon sp., Hexaprotodon lothagamensis, Hexaprotodon harvardi (22241)
Tortonian - Zandean	11.62 - 3.6	Kenya	Hippopotamidae indet., Hexaprotodon harvardi, Hippopotamus sp. A Hippopotamus sp. B (22236)
Tortonian - Zandean	11.62 - 3.6	Ethiopia	Hexaprotodon sp. (22158 22159 22179) Hexaprotodon sp., Hexaprotodon harvardi (22139)
Late/Upper Miocene	11.608 - 5.333	Thailand (Nakhon Ratchasima)	Hexaprotodon sp. (144187)
Late/Upper Miocene	11.608 - 5.333	United Arab Emirates (Abu Dhabi)	Hexaprotodon harvardi (28245)
Late/Upper Miocene - Early/Lower Pliocene	11.608 - 3.6	Uganda	Hippopotamus sp., Hippopotamus kaisensis, Hexaprotodon imagunculus (22345)
Late/Upper Miocene - Early/Lower Pliocene	11.608 - 3.6	Chad	Hexaprotodon harvardi, Hexaprotodon mingoz (24181)

In the following citations mainly from PBDB (2023), *fossilworks* (2023), and, among others, Wikipedia (2023) I have regularly chosen some points relevant for our topic HIPPO ORIGINS

SUBFAMILY HIPPOPOTAMINAE (GRAY 1821) **Total (2023): 544 collections including 636 occurrences** **Genus *Archaeopotamus* (Boisserie 2005) (also known as *Hexaprotodon*)**

“Age range: base of the Messinian to the top of the Early/Lower Pliocene *or* 7.24600 to 3.60000 Ma” “Collections (22 total)”¹⁷

¹⁶ See again: https://paleobiodb.org/classic/checkTaxonInfo?taxon_no=42479&is_real_user=1

¹⁷ For the Fossil Record, see: https://paleobiodb.org/classic/basicTaxonInfo?taxon_no=77329 and https://paleobiodb.org/classic/checkTaxonInfo?taxon_no=77329&is_real_user=1

For the following citation of the Wikipedia article on *Archaeopotamus* I have several queries:

“*Archaeopotamus* is an extinct genus of Hippopotamidae that lived between 7.5 and 2.58 million years ago in Africa and the Middle East. The genus was described in 2005 to encompass species of hippos that were **previously grouped in *Hexaprotodon***. *Archaeopotamus* means “the ancient of the river”. Of all identified hippos, only *Kenyapotamus* is older. *Kenyapotamus*, however, is only known from partial fossils; *Archaeopotamus* is the oldest well-identified hippo.

Many prehistoric hippo fossils are **known primarily through fossils of the lower jaw**. *Archaeopotamus*, like *Hexaprotodon*, has three pairs of incisors. Unlike other *Hexaprotodon*, *Archaeopotamus* has a **highly elongate mandibular symphysis**. The informal name “narrow muzzled hippos” has been suggested for this genus.”¹⁸

“Size: 3 m in length, 140 cm in height, 500 -900 kg of weight ... Although the proportions of *A. harvardi* and *A. lothagamensis* are similar, the former species is significantly smaller. **Femurs of *A. harvardi* are approximately the same size as those of the modern hippopotamus.**”¹⁹

Now my queries are:

Are features as a “highly elongate mandibular symphysis” (and some additional relatively small anatomical differences) enough to rename *Hexaprotodon* as *Archaeopotamus*? Measured with the yardstick of anatomical variation *within* many extant species, Fig 9 of Jean-Renaud Boisserie (2005, p. 13) shows differences which could occur all within one and the same **Mendelian population** (moreover, “...this structure can only be described accurately through a set of continuous variables ... only a few such symphysis characters have been included in the present data matrix...”²⁰ – so, may one not surmise an imperfect fossil record also of this feature?). Moreover, let’s keep in mind that **strong variation not only within a genus but also within a species is quite common in the world of living beings**²¹, even when considering only modifications, being by definition, non-hereditary (just have a look at *Homo sapiens* for hereditary and non-hereditary variations).²²

Moreover, gender (females and males) can display **astounding differences in length of the mandibular symphysis** in humans²³. For Hippos: “**males** are the larger sex, weighing roughly **30 percent** more than females” (see Britannica as quoted above). Is there no variation of the mandibular symphysis *within* the different hippo species and genera – not to speak of males and females?

From a geneticist’s point of view the differences of this feature, as measured from relatively only few fossils (check https://paleobiodb.org/classic/checkTaxonInfo?taxon_no=77333&is_real_user=1) for *A. harvardi* so far) could possibly be due to just the space of modificational and/or DNA variation given *within* several of the (morphological) species and genera of the subfamily Hippopotaminae.

Last not least, fossils have often somewhat been deformed (not seldom even grossly, see for example *Ardipithecus ramidus*²⁴) during and following the process of fossilization, among the factors are differences in soil structure (physicochemical environment) and moreover, earth movements in the millions of years here stipulated for these fossils (hurricanes, typhoons, and cyclones²⁵, fires, floods and earthquakes).

Have all these factors really been carefully considered before suggesting far reaching phylogenetic conclusions like “*Indeed, the symphyseal area serves to effectively discriminate different Hippopotamidae species and, for some, indicates clear evolutionary trends during the Mio-Pliocene* (Weston, 1997, 2000; Boisserie et al., 2003; Boisserie & White, 2004). *Hence, its phylogenetic significance is undoubtedly important*” (Boisserie 2005). Well, one may doubt it.

For *Hexaprotodon harvardi* a maximal time interval from 11.62 – 2.588 (combining different finds) is given by the PBDB. So, this results in a constancy of the species of ca. 9 Ma. Why, then, do the authors only calculate 7.24600 to 3.60000 Ma”, which implies a stasis of “only” some 3.6 Ma? However, concerning “*Archaeopotamus harvardi* Coryndon 1977 (hippopotamus)” *fossilworks.org*²⁶ notes: “Age range of

¹⁸ <https://en.wikipedia.org/wiki/Archaeopotamus>

¹⁹ <https://prehistoric-fauna.com/Archaeopotamus>

²⁰ (2005) <https://academic.oup.com/zoolinnean/article/143/1/1/2726725?login=false>: “Weston (2000) argued that elongate mandibular symphysis (Fig. 11) should be primitive within the family, the hippopotamids showing, in some cases, a trend toward shortening of the symphysis. It seems, however, that this opinion is based on the incidental fact that at the time the Lothagam hippos were the only well-known Miocene hippos and on the presumption that the Hippopotamidae derived probably from an animal having a narrow mandibular symphysis. Several comments are in order: **the immediate forerunner of the Hippopotamidae remains unknown**, and hence the ancestral morphology is likewise unknown (the symphysis of *Kenyapotamus* is not sufficiently preserved to further elucidate this issue);”

²¹ Cf. <http://www.weloennig.de/AesIV3.html> <http://www.weloennig.de/AesIIaEnHu.html>

²² For details see <http://www.weloennig.de/KidneyEvolution.pdf> <http://www.weloennig.de/Artbegriff.html> <http://www.weloennig.de/NaturalSelection.html>

²³ (2021) <https://www.sciencedirect.com/science/article/pii/S1319562X2030468X>

²⁴ C. Lusk 2022: <https://evolutionnews.org/2022/10/the-standard-story-of-human-evolution-a-critical-look/> (“Calling Ardi “new” may have been a poor word choice, for it was discovered in the early 1990s. Why did it take some 15 years to publish the analyses? A 2002 article in *Science* explains **the bones were “soft,” “crushed,” “squished,” and “chalky.”** Later reports similarly acknowledged that “portions of Ardi’s skeleton were found **crushed nearly to smithereens** and needed extensive digital reconstruction,” including **the pelvis, which “looked like an Irish stew.”**)

²⁵ <https://travel.state.gov/content/travel/en/international-travel/emergencies/what-can-you-do-crisis-abroad/tropical-storm-season.html>

²⁶ http://www.fossilworks.org/cgi-bin/bridge.pl?a=taxonInfo&taxon_no=77333

11.608 to 3.6 Ma”. For “†*Archaeopotamus lothagamensis* Weston 2000 (hippopotamus)” an “Age range: 11.608 to 7.246 Ma” is given by the same source²⁷.

Species: *Archaeopotamus harvardi*
(*Hexaprotodon harvardi*) “Collections (22 total)”
CONSTANCY/stasis up to 8 or 9 Ma



Above: Reconstruction of *Archaeopotamus harvardi* (or *Hexaprotodon harvardi*) according to fandom.com/ru/wiki²⁸ *Archaeopotamus*: “Size: 3 m in length, 140 cm in height, 500 -900 kg of weight. Typical representative: †*Archaeopotamus harvardi* (Coryndon 1977)”²⁹
 Below: Thus, it seems to be larger than our present/extant pygmy hippo *Choeropsis liberiensis* (or *Hexaprotodon liberiensis*/*Hippopotamus liberiensis*) but definitely smaller than *H. amphibius*. Photo of pygmy hippo below W.-E.L.: 7 Oct. 2023.



Let’s compare *Archaeopotamus* with the large *Hippopotamus amphibius*: “Males are usually 3.5 metres (11.5 feet) long, stand 1.5 metres (5 feet) tall, and weigh 3,200 kg (3.5 tons). In terms of physical size, males are the larger sex, weighing roughly 30 percent more than females.”

So, there are still many open questions surrounding that genus, from its name to variability of its mandibular symphysis, gender differences, the extent of deformations during and after the process of fossilization, up to the differences given

²⁷ http://www.fossilworks.org/cgi-bin/bridge.pl?a=taxonInfo&taxon_no=77331 (All sources retrieved 28 September 2023).

²⁸ <https://extinct-animals.fandom.com/ru/wiki/%D0%90%D1%80%D1%85%D0%B5%D0%BE%D0%BF%D0%BE%D1%82%D0%B0%D0%BC> (Retrieved 29 September 2023.) Wiki picture by WillemSvdMerwe. There are several additional attempts to reconstruct the animal – all are of course imperfect.

²⁹ <https://prehistoric-fauna.com/Archaeopotamus>

for its age range. Now let's have a closer look at the pygmy hippo *Choeropsis* (or *Hexaprotodon*). As for *age ranges most of the rest of genera* (except the next one and also for subfamily Kenyapotaminae), see Fig. by Boisserie below.

**Genus *Choeropsis* with one species *Ch. liberiensis*
(or *Hexaprotodon liberiensis* / *Hippopotamus liberiensis*)**

(2023) “Maximum range based only on fossils: Holocene or 0.01170 to 0.00000 Ma.
Minimum age of oldest fossil (stem group age): 0.0 Ma.”³⁰



Again: our present/extant pygmy hippo *Choeropsis liberiensis* (or *Hexaprotodon liberiensis*/*Hippopotamus liberiensis*) Photos W.-E.L.: 7 Oct. 2023. Zoo Duisburg

³⁰ https://paleobiodb.org/classic/checkTaxonInfo?taxon_no=77326&is_real_user=1



Photo already shown above, but now strongly enlarged: Side view of head of extant pygmy hippo *Choeropsis liberiensis* (or *Hexaprotodon liberiensis*/*Hippopotamus liberiensis*) Photo W.-E.L.: 7 Oct. 2023. Zoo Duisburg

Concerning Age Range: Well, my first question would be: Why is there hardly any fossil record of this genus *Choeropsis*, the pigmy hippopotamus, whereas we have a rather rich record of almost all the other genera, including small hippos?³¹ Could perhaps some of the other pygmy finds, which were given entirely different genus names, be just imperfectly determined fossil remnants of *Choeropsis* (which in according to the **genetic species concept** would still much more appropriately addressed at least as *Hippopotamus liberiensis* – see below).

“The taxonomy of the genus of the pygmy hippopotamus has changed as understanding of the animal has developed. Samuel G. Morton initially classified the animal as *Hippopotamus minor*, but later determined it was **distinct enough** to warrant its own genus, and labeled it *Choeropsis*. In 1977, Shirley C. Coryndon proposed that the pygmy hippopotamus was **closely related to *Hexaprotodon***, a genus that consisted of prehistoric hippos mostly native to Asia.”

Question: “*distinct enough*” reminds me of a word by H. K. Airy Shaw: “***Taxonomy is very much a matter of personal opinion.***” What are the objective

³¹ “During the Mio-Pliocene, Hippopotamidae diversified and became very abundant in African ecosystems. ***Their remains are among the most frequent mammals found in various palaeontological sites*** (Coryndon, 1971; Gèze, 1985; Harris, Brown & Leakey, 1988; Pavlakis, 1990; Harris, 1991; Faure, 1994; Leakey et al., 1996; Harrison, 1997; Alemseged, 1998; Brunet et al., 1998; Vignaud et al., 2002). The apparent success of these mammals may be linked to their unusual semiaquatic way of life.” Jean-Renaud Boisserie (2005): <https://academic.oup.com/zoolinnean/article/143/1/1/2726725?login=false>

criteria for “*distinct enough*”? Could this be just another case (of so many others) of “**oversplitting**” in taxonomy? See, for example a comment by Stephen J. Gould quoted on p. 15 of <http://www.weloennig.de/ElephantEvolution.pdf> – a comment that can equally well applied to the “production” of new genera (*cf.* long footnote below).

So, it may be not “the understanding of the animal” that has further developed to create and justify the new names – from *Hippopotamus minor* (Desmarest 1822 for the Cyprus pygmy hippo and Morton 1844³² with the same name for the Liberian fossils) to *Hippopotamus liberiensis* (Morton 1849) to *Choeropsis liberiensis* (Leidy 1853: *Choeropsis*, meaning “resembling a pig” – which in my view it does so only superficially) to *Hexaprotodon liberiensis* (Coryndon 1977) back to *Choeropsis liberiensis* (Boisserie 2005), – but taxonomic misunderstandings overly stressing relatively small morphological and anatomical differences³³ by taxonomists often motivated by the endeavor to label as many species and genera as possible in order to add their names behind the new finds³⁴ – for the higher the category the more important the fossils are *as well as their discoverers* (entirely ignoring the often enormous extent of variability detected in contemporary life forms by biologists in general and geneticists in particular *within* species and genera)³⁵.

³² Morton had evidently overlooked that the name *Hippopotamus minor* had already been given to another dwarf hippo: “The Cyprus dwarf hippopotamus or Cypriot pygmy hippopotamus (*Hippopotamus minor* or *Phanourios* [!] *minor*) is an extinct species of hippopotamus that inhabited the island of Cyprus from the Pleistocene until the early Holocene. The 200-kilogram (440 lb) **Cyprus dwarf hippo was roughly the same size as the extant pygmy hippopotamus.**” https://en.wikipedia.org/wiki/Cyprus_dwarf_hippopotamus (retrievd 12 October 2023)

³³ <https://www.biodiversitylibrary.org/page/35780321#page/241/mode/1up>

Samuel George Morton (1849, p. 234) who kept the genus name *Hippopotamus* but described the pygmy hippo of Liberia as a new species: “...it is to be remarked, that **the orbit is replaced much nearer a central point than in the *H. amphibius***, as will be more particularly evident in the reduced vertical view. Pl. 34. Fig. 5.” Jean-Renaud Boisserie has given a meticulous overview on the history of hippo taxonomy <https://academic.oup.com/zoolinnean/article/143/1/1/2726725?login=false> (2005):

“Historically, three genera have been employed for fossil and extant hippo species. The genus *Hippopotamus* (abbreviated *Hip.*) was created for the only known hippo during the 18th century: the extant common hippo *Hip. amphibius*, which is distinguished by **four incisors** (tetraprotodont). Subsequently, *Hexaprotodon* was proposed as a **subgenus** (Falconer & Cautley, 1836) for Siwalik (India/Pakistan) Mio-Pliocene hippos having **six incisors**. **Owen (1845) elevated *Hexaprotodon* to genus rank**. Finally, in regard to its peculiar morphology, Leidy (1853) attributed the genus name *Choeropsis* to the extant diprotodont Liberian hippo, initially described by Morton (1844) as *Hip. liberiensis*.

These genera have been intensely discussed in subsequent literature. The discrimination of *Hexaprotodon* (Asian hippos) and *Hippopotamus* (Afro-European hippos) **on the basis of incisor number was shown to be inadequate** (Lydekker, 1884). Nevertheless, Colbert (1935) recognized the distinctness of *Hexaprotodon* in many cranial features, notably **on the basis of bone contacts and their shapes in the lachrymal area**. In a major work on hippos, Hooijer (1950) recognized that the Asian hippos form a distinct lineage, but preferred to use only the name *Hippopotamus* for the following reason (Hooijer, 1950: 33): ‘I prefer not to split the genus *Hippopotamus* because this would leave us a certain number of as yet unsatisfactorily identifiable forms from Europe and Africa which certainly do not belong to *Hippopotamus*.s. with *Hip. amphibius* as the genotype and for which the creation of new generic names then would be inevitable’. However, studying the East African fossil hippos, Coryndon (1967, 1977, 1978) decided to place most of the fossil African and Asian hippos in the genus *Hexaprotodon*, **defined mainly on the absence of contact between the lachrymal and the nasal bones**. **This position was strongly contested by Stuenes** (1989), who revealed that the Madagascan hippos (*Hip. madagascariensis* and *Hip. lemerlei*), once thought closely related, exhibit, respectively, ***Hexaprotodon* and *Hippopotamus* features, as well as important intraspecific variation in the lachrymal area**. With some minor reservations, Stuenes (1989) agreed with Pickford (1983) **in including all fossil hippos in *Hippopotamus***. Most recent authors (Harris, 1991; Harrison, 1997; Weston, 1997, 2000, 2003; Gentry, 1999; van der Made, 1999; see also Fig. 1) admit that *Hexaprotodon* (sensu Coryndon, 1977) is based on plesiomorphic features and is likely paraphyletic, but have maintained the distinct use of *Hippopotamus* and *Hexaprotodon* awaiting a revision of hippo phylogeny.” [Incidentally, according to Leidy, Morton seems to have been the first who coined the name *Choeropsis*.]

See also Gabriella L. Flacke and Jan Decker (2019): <https://academic.oup.com/mspecies/article/51/982/100/5661028?login=false>

Headline of their detailed article: *Choeropsis liberiensis* (Artiodactyla: Hippopotamidae) “...[Leidy] proposed ***Choeropsis***, from the Greek for “**pig-like**” and *liberiensis* to describe geographic origin (Leidy 1853). ***Early anatomists and zoologists disputed whether the pygmy hippo should be assigned to a separate genus from *Hippopotamus**** (Flower 1887; Chapman 1894; Renshaw 1904), but ***majority opinion*** [W.-E.L.: that’s a scientific argument!] eventually supported the distinction. *Choeropsis* was used until Coryndon (1977) placed the pygmy hippo in the genus ***Hexaprotodon***, meaning “**six front teeth**.” Both names appear interchangeably in the scientific literature, but only *Choeropsis* is correct.” (*Mammalian Species* 51, Issue 982, 6 December 2019, Pages 100–118).

W.-E.L. Well, that are fine illustrations that “Taxonomy is [in fact] very much a matter of personal opinion.” And additional contradictory hypotheses are going to be created by evolutionary speculations on the basis of cladistics (see perhaps in this context also <http://www.weloennig.de/Feduccia2020.pdf> pp. 7 and 8). Applying the method of many taxonomists to our **domestic dog, an entirely new family with dozens of new genera and hundreds of new species could be “created”**. <http://www.weloennig.de/Hunderassen.Bilder.Word97.pdf>

³⁴ Reminded me for some such examples of a word by William Shakespeare: “Though this be madness, yet there is some method in it.”

<https://www.allgreatquotes.com/hamlet-quotes-121/>

³⁵ *Cf.* <http://www.weloennig.de/Artbegriff.html>

Moreover, there is another important point involved in that often infinitely new name-coining process for closely related forms in taxonomy, forms that are not seldom represented only by some fossil fragments: The ‘creation’ of new species and genera (which — measured with the scale of variation within present-day species and genera — in reality all belong to one and the same Mendelian population (all forms potentially being fertile with all others))³⁶ also implies and/or is deliberately/purposefully meant to emphatically demonstrate the presupposed enormous evolutionary power of the “great designers, mutation and selection” (Nobel Laureate K. Lorenz³⁷).

Interim Note on the Taxonomic Endeavors for the Hippos³⁸

First, according to the *morphological species concept*, the following different two **subfamilies** and 10 **genera** of the family Hippopotamidae have been proposed and used during the last >200 years of paleontological research (symbols used by the authors of PBDB: † for extinct, no symbol: extant):

Fm. Hippopotamidae Gray 1821

Subfm. **Hippopotaminae** Gray 1821

- G. †*Archaeopotamus* Boisserie 2005
- G. *Choeropsis* Leidy 1853 [pygmy hippo]
- G. †*Chororatherium* Boisserie et al. 2003
- G. †*Hexaprotodon* Falconer and Cautley 1836 [pygmy hippo]
- G. *Hippopotamus* Linnaeus 1758 [hippo]
- G. †*Phanourios* Boekschoten and Sondaar 1972
- G. †*Saotherium* Boisserie 2005

Subfm. †**Kenyapotaminae** Pickford 1983

- G. †*Kenyapotamus* Pickford 1983
- G. †*Kulutherium* Pickford 2007

Second, the following different *species names* have been suggested species within each genus:

Fm. Hippopotamidae Gray 1821

Subfm. **Hippopotaminae** Gray 1821

- G. †*Archaeopotamus* Boisserie 2005
 - †*Archaeopotamus harvardi* Coryndon 1977
 - †*Archaeopotamus lothagamensis* Weston 2000
- G. *Choeropsis* Leidy 1853 [pygmy hippo]
 - Choeropsis liberiensis* Morton 1844
- G. †*Chororatherium* Boisserie et al. 2003
 - †*Chororatherium roobii* Boisserie et al. 2003
- G. †*Hexaprotodon* Falconer and Cautley 1836 [pygmy hippo]
 - †*Hexaprotodon aethiopicus* Coryndon and Coppens 1975
 - †*Hexaprotodon bruneti* Boisserie and White 2004
 - †*Hexaprotodon corydoni* Geze 1985
 - †*Hexaprotodon crusafonti* Aguire 1963
 - †*Hexaprotodon dissimilis* Falconer and Cautley 1836
 - †*Hexaprotodon dulu* Boisserie 2004
 - †*Hexaprotodon garyam* Boisserie et al. 2005
 - †*Hexaprotodon imaguncula* Hopwood 1926
 - †*Hexaprotodon iravticus* Falconer and Cautley 1847
 - †*Hexaprotodon mingoz* Boisserie et al. 2003
 - †*Hexaprotodon namadicus* Falconer and Cautley 1847
 - †*Hexaprotodon palaeindicus* Falconer and Cautley 1847
 - †*Hexaprotodon pantanellii* Joleaud 1920
 - †*Hexaprotodon primaevus* Crusafont et al. 1964
 - †*Hexaprotodon sahabiensis* Gaziry 1987
 - †*Hexaprotodon shungurensis* Geze 1985

³⁶ Cf. again <http://www.weloennig.de/Artbegriff.html> (Book: 622 pp.)

³⁷ “Die großen Konstrukteure des Artenwandels, Mutation und Selektion...“ K. Lorenz: Über die Wahrheit der Abstammungslehre pp. 13-31. 1975, quotation p. 21. In: Hoimar von Ditfurth: Evolution. Ein Querschnitt durch die Forschung. Hoffmann und Campe. Hamburg. See also: <http://klha.at/> (Last Update 2014) http://search.freefind.com/find.html?si=55616344&pid=r&n=0&_charset_=UTF-8&bcd=%C3%B7&query=%C3%9Cber+die+Wahrheit+der+Abstammungslehre&x=5&y=11 (1964)

³⁸ For the genera according to https://paleobiodb.org/classic/checkTaxonInfo?taxon_no=42479&is_real_user=1 and for the species https://paleobiodb.org/classic/checkTaxonInfo?taxon_no=42479&is_real_user=1

- †*Hexaprotodon siculus* Hooijer 1946
 †*Hexaprotodon sivalensis* Falconer and Cautley 1836
 †*Hippopotamus (Hexaprotodon) hipponensis* Gaudry 1867
- G. ***Hippopotamus*** Linnaeus 1758 [hippo]
 †*Hexaprotodon protamphibius turkanensis* Geze 1985
 Subg. †*Hippopotamus (Tetraprotodon)* Falconer and Cautley 1836
 †*Hippopotamus aethiopicus* Coryndon and Coppens 1975
 †*Hippopotamus afarensis* Geze 1985
Hippopotamus amphibius Linnaeus 1758 [hippo]
 Invalid names: *Hippopotamus incognitus* Faure 1984 [synonym]
 †*Hippopotamus antiquus* Desmarest 1822
 Invalid names: *Hippopotamus tiberinus* Mazza 1991 [synonym]
 †*Hippopotamus behemoth* Faure 1986
 †*Hippopotamus coryndonae* Geze 1985
 †*Hippopotamus creutzburgi* Boekschoten and Sondaar 1966
 †*Hippopotamus gorgops* Dietrich 1928
 †*Hippopotamus kaisensis* Hopwood 1926
 †*Hippopotamus karumensis* Coryndon 1977
 †*Hippopotamus laloumena* Faure and Guerin 1990
 †*Hippopotamus lemerlei* Milne Edwards 1868
 Invalid names: *Hippopotamus leptorhynchus* Grandidier and Filhol 1894 [synonym]
 †*Hippopotamus madagascariensis* Guldberg 1883
 †*Hippopotamus major* Cuvier 1824
 †*Hippopotamus meltensis* Major 1902
 †*Hippopotamus minor* Desmarest 1822
 †*Hippopotamus protamphibius* Arambourg 1944
 †*Hippopotamus sirensis* Pomel 1896
 Invalid names: *Hippopotamus amphibius standini* Monnier and Lambertson 1922 [nomen nudum], *Trilobophorus* Geze 1985 [synonym]
- G. †***Phanourios*** Boekschoten and Sondaar 1972
 G. †***Saotherium*** Boissarie 2005
 †*Saotherium mingoz* Boissarie 2005
 Subfm. †***Kenyapotaminae*** Pickford 1983
 G. †*Kenyapotamus* Pickford 1983
 †*Kenyapotamus coryndonae* Pickford 1983
 †*Kenyapotamus ternani* Pickford 1983
 Invalid names: *Palaeopotamus* Pickford 2007 [synonym]
- G. †***Kulutherium*** Pickford 2007
 †*Kulutherium kenyensis* Pickford 2007
- G. †***Morotochoerus*** Pickford 1998
 †*Morotochoerus ugandensis* Pickford 1998
 Invalid names: Hippopotamina Gray 1825 [empty]

The impression left on readers by so many new species and genera and additionally two subfamilies of the hippos is (at least for those who are not specialists) that of an extensive anatomical and morphological evolution of the *Hippopotamus* family with unclear limits, so that a phylogenetic transition to other families should not be a major difficulty. It is as almost as if each newly discovered fossil fragment had been given its own genus or species name.

Now, it would be a major task to critically and painstakingly analyze (by examinations, investigations and exact measurements as objectively as possible) the entire hippo fossil record in the corresponding museums in many countries around the world *considering all the queries which I have enumerated above* for the series of spinning/rotating genus names given to the extant pygmy hippo *Hippopotamus/Choeropsis/Hexaprotodon* (all belonging to the species *liberiensis*). I would like to remind my readers of the comment by S. J. Gould on **oversplitting**³⁹ and apply that verdict also on the production of new genera in many cases.

³⁹ <http://www.weloennig.de/ElephantEvolution.pdf>, p. 15: In contrast to Gould's following first sentence of such a "past taxonomic practice", I would like to emphasize that it is, in fact, still commonplace today. Nevertheless, I fully agree with the rest of Gould's statement as quoted below. Another key point is that the "genus has traditionally been regarded as the lowest unit of rough comparability in paleontological data". Gould states (2002, pp. 792/793 and 2007, pp. 72/7383): "I don't doubt, of course, that past taxonomic practice, *often favoring the erection of a species name for every morphological variant* (even for odd individuals rather than populations), has greatly inflated the roster of legitimate names in many cases, particularly for fossil groups last monographed several generations ago.

Employing the *genetic species concept*⁴⁰, I would suggest the **tertiary nomenclature** – for the time being for practical reasons, to easily identify the authors and their fossil descriptions (of course, usually without the specious name “*amphibius*” – their species would now be just subspecies [ssp.] or varieties [var.]).

Applying this proposal to our *Hippopotamus amphibius* L. it would read as follows:

G. *Hippopotamus* Linnaeus 1758 [hippo]

†*Hippopotamus amphibius* ssp. *turkanensis*

(Geze 1985 called it *Hexaprotodon protamphibius turkanensis*)

†*Hippopotamus amphibius* ssp. *pentlandi* (Meyer 1832) (to be added)

†*Hippopotamus amphibius* ssp. *aethiopicus* (Coryndon and Coppens 1975)

†*Hippopotamus amphibius* ssp. *afarensis* (Geze 1985)

Hippopotamus amphibius [ssp. *amphibius*] Linnaeus 1758 [hippo]

†*Hippopotamus amphibius* ssp. *antiquus* (Desmarest 1822)

†*Hippopotamus amphibius* ssp. *behemoth* (Faure 1986)

†*Hippopotamus amphibius* ssp. *coryndonae* (Geze 1985)

†*Hippopotamus amphibius* ssp. *creutzburgi* (Boekschoten and Sondaar 1966)

†*Hippopotamus amphibius* ssp. *gorgops* (Dietrich 1928)

†*Hippopotamus amphibius* ssp. *kaisensis* (Hopwood 1926)

†*Hippopotamus amphibius* ssp. *karunensis* (Coryndon 1977)

†*Hippopotamus amphibius* ssp. *laloumena* (Faure and Guerin 1990)

†*Hippopotamus amphibius* ssp. *lernerlei* (Milne Edwards 1868)

†*Hippopotamus amphibius* ssp. *madagascariensis* (Guldberg 1883)

†*Hippopotamus amphibius* ssp. *major* (Cuvier 1824)

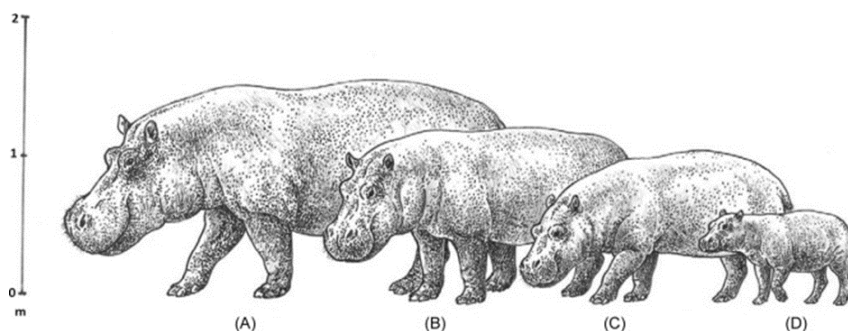
†*Hippopotamus amphibius* ssp. *meltensis* (Major 1902)

†*Hippopotamus amphibius* ssp. *minor* (Desmarest 1822)

†*Hippopotamus amphibius* ssp. “*protamphibius*” (according to Arambourg 1944)

†*Hippopotamus amphibius* ssp. *sirensis* (Pomel 1896)

Although the ensuing artistic reconstruction of the *H. minor* appears to be somewhat too small, nevertheless the species name now “†*Hippopotamus amphibius minor*” would immediately show the reader the immediate relationship of this and other pygmy forms with the extant large *Hippopotamus amphibius* from which they all most likely descended.



Artistic reconstruction of the dwarf insular hippopotamuses *Hippopotamus pentlandi* (Sicily and Malta) (B), *Hippopotamus creutzburgi* (Crete) (C) and *Hippopotamus minor* (Cyprus) (D) compared with the extant *Hippopotamus amphibius* (A).

<https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/hippopotamus> Fig. 8. Drawing by S. Maugeri.

Of course, genetic examinations of these forms are hardly possible anymore (but perhaps by DNA sequences from some well-preserved fossils?) – not to speak of

(Our literature even recognizes the half-facetious term “monographic bursts” for *peaks of diversity thus artificially created*. But this problem of past oversplitting cannot be construed as either uniquely or even especially paleontological, for neontological systematics then followed the same practices as well.) The *grossly uneven, and often greatly oversplit, construction of species-level taxonomy* in paleontology has acted as a strong impediment for the entire research program of the prominent school of “taxon-counting” (Raup, 1975, 1985). For this reason, **the genus has traditionally been regarded as the lowest unit of rough comparability in paleontological data** (see Newell, 1949). Sepkoski (1982) therefore compiled his two great compendia – the basis for so much research in the history of life’s fluctuating diversity – at the family, and then at the genus, level (*but explicitly not at the species level in recognition of frequent oversplitting and extreme imbalance in practice of research among specialists on various groups*.) Example: The great Haeckel, the leading biologist who established Darwinian evolutionary theory in the German speaking countries, justified his system of Human species (*twelve species in four genera* of contemporary human beings), among other things, by pointing out: “that our progressive knowledge of animal forms always leads to an ever-increasing division of the groups. Related species united by Linné in one genus, by Cuvier in a family, now form an extensive order with several families and many genera” (1911, p. 754). Fact is that today all informed biologists – I don’t know of any exceptions so far – agree that “all humans who are living at present belong to one species: *their matings have fertile offspring*” (Vogel and Motulsky) or Eldredge and Tattersall: “Today we are but a single species, *Homo sapiens*, and some [8] billion of us have encircled the globe. We are eurytopic: our adaptations are broad and general. Our cultures, diverse as they are, serve to fit us to the physical exigencies of the wide variety of environments in which we live. **But we are a single species.**” “The billions of human beings living today all belong to one species: *Homo sapiens*” (Smithsonian Inst. 2018). So, at least in that case – almost a rare exception – oversplitting has been corrected.

⁴⁰ See <http://www.weloennig.de/AesIV3.html> and the following chapters, especially <http://www.weloennig.de/AesIV3.Fr.html>

hybridizations. Hence, what can we do? Well, "...an old paleontological in joke proclaims that mammalian evolution is a tale told by teeth mating to produce slightly altered descendant teeth."⁴¹

So, *how can we apply the genetic species concept to the fossil hippos* when we cannot employ the usual genetic tools of the trade as described in detail in most modern textbooks of genetics as well as all those important additional aspects discussed in <http://www.weloennig.de/AesIV3.html> to <http://www.weloennig.de/AesIV3.Fr.html>?⁴²

Moreover, there is the question how to deal with the *two subfamilies and 10 genera* of the family Hippopotamidae that have been proposed by taxonomists working with the morphological species concept during the last >200 years of fossil research?

Above I have mentioned the existence of forms (different species and genera – see extensive documentation in <http://www.weloennig.de/Artbegriff.html>), which – measured with the scale of variation *within* present-day species and genera – in reality all belong to one and the same Mendelian population (all forms potentially being fertile with all others) and in <http://www.weloennig.de/AesIIME.html> I have examined as a prime example our species *Homo sapiens*.

Now, here are the “zwölf Menschenarten” (“the twelve species of men”) divided into “four genera” that Prof. Ernst Haeckel once ‘identified’⁴³:

SYSTEM OF THE TWELVE SPECIES OF MEN, DIVIDED INTO FOUR GENERA.

Four Genera.	Hair on Head.	Form of Skull.	Colour of Skin.	Twelve Species.
I. Lophocomus Tufted and woolly-haired Man (<i>Homo papuoides</i>)	Woolly tufts of hair, with long elliptical cross-section, black	With slanting teeth, long-headed (dolichocephalous and prognathous)	Tone yellowish-brown	1. <i>Lophocomus Hottentottus</i> South Africa
			Tone brownish-black	
II. Eriocomus Fleecy-haired Man (<i>Homo negroides</i>)	A woolly fleece of hair, with elliptical cross-section, black	With slanting teeth, long-headed (dolichocephalous and prognathous)	Tone black or blackish-brown	3. <i>Eriocomus Cafer</i> South Africa
			Tone black or blackish-brown	
III. Euthycomus Straight-haired Man (<i>Homo mongoloides</i>)	Stiff, straight circular cross-section, black	Mostly short-headed (brachycephalous); many with medium heads (mesocephalous)	Tone brown	5. <i>Euthycomus Malayus</i> Sundanese Polynesians
			Tone yellow	
			Tone yellow	7. <i>Euthycomus Arcticus</i> Hyperboræ
			Tone copper-red or reddish-brown	
IV. Euplocamus Curly-haired Man (<i>Homo eranoioides</i>)	Curly or waved, with roundish cross-section, of very various colour	With slanting teeth, long-headed (dolichocephalous and prognathous)	Tone black or black-brown	9. <i>Euplocamus Australis</i> Australia
			Tone reddish-brown	
			Tone reddish-brown	11. <i>Euplocamus Naba</i> North-eastern Africa
			Tone light (reddish-white or brownish)	

Even in the view of our modern systematists and taxonomists, these “species and genera of men” are just all nonsense – nobody accepts them today, nobody works with them anymore. Recall please that “all humans who are living at present

⁴¹ Gould S J (1989, p. 60): Wonderful Life. Norton Paperback 1990; reissued 2007.

⁴² Although written a few decades ago, these aspects are all the more relevant today because nowadays – despite being key points to understand species definitions – they are largely neglected.

⁴³ Cf. also the detailed footnote a few pages earlier. Concerning Haeckel’s *Natürliche Schöpfungsgeschichte* (1868): “Until 1909, eleven editions had appeared, as well as 25 translations into other languages. https://en.wikipedia.org/wiki/Ernst_Haeckel (Retrieved 18 Oct. 2023). By Outlook Verlag 2022 of 1924 Edition.

belong to *one species*: their matings have fertile offspring”, or, to emphasize this important point again:

“Today we are but a single species, *Homo sapiens*, and some [8] billion of us have encircled the globe. We are eurytopic: our adaptations are broad and general. Our cultures, diverse as they are, serve to fit us to the physical exigencies of the wide variety of environments in which we live. **But we are a single species.**” “The billions of human beings living today all belong to one species: *Homo sapiens*” (Smithsonian Inst. 2018/2020).”

But how many genera and species of the present human family would many paleontologists propose if they had to base their investigations on only the bones (including entire skeletons) of the different varieties of men and women? What would they suggest? Let us take for example a comparison of the Pygmies⁴⁴ with the Sudanese Dinka Tribe. First some data on the Pygmies:

“Pygmy, in anthropology, member of any human group *whose adult males grow to less than 59 inches (150 cm) in average height*. A member of a slightly taller group is termed pygmoid. The best-known Pygmy groups and those to whom the term is most commonly applied are the Pygmies of tropical Africa; elsewhere in Africa some of the San (Bushmen) of the Kalahari are of Pygmy size. **There are also Pygmy groups, commonly known as Negritos, in Asia.**”⁴⁵

Or, take another encyclopedia now including comments on classic authors on the topic:

“As regards stature, the smallest are the African Negrilloes, their *average height being 1.38 m.* (4.2 ft.).”

“Various writers have localized pygmies in different portions of the earth's surface. **Pliny** makes mention of dwarfed races in both Asia and Africa. Reference is made to the **Catizi dwarfs in Thrace**, and to a **similar race dwelling in Caria**. **Ctesias**, a century after Herodotus, wrote of a race of **pygmies in the heart of India**, describing them as black and ugly, and only two *pygmai* in height. The Chinese author, **Chao Fu-Kua**, in the beginning of the 13th century, described a tribe of **black pygmies dwelling in the Philippine Islands**; in the depth of the valleys there lived, he said, a tribe of men called Hai-tan, small in size, with round, yellow eyes, curly hair, and with the teeth showing through their lips. These were no doubt the ancestors of the present **Aetas**. **Relics of a pygmy race are supposed to exist now in Sicily and Sardinia**, *i.e.* along the high road between Pleistocene Africa and Europe.

Near Schaffhausen, **Dr [J.] Kollman**⁴⁶ found **skeletal remains of small human beings**, which have been regarded by some authorities as belonging to the European pygmies of the Neolithic period. Some anthropologists of authority, indeed - in spite of the absence of definite data in support of such a view - believe that a dwarf negroid race at one time existed in northern Europe, and may have given rise to the traditional tales of elves, goblins, gnomes and fairies.

At the present time the existing pygmy races may be subdivided into two main groups or sub-races: (a) the African pygmies (Negrilloes), (b) the Asiatic pygmies (Negratoes).⁴⁷

Moreover, under the subheading “Archaic humans”⁴⁸ Wikipedia informs us that:

“The extinct archaic *human species* *Homo luzonensis* has been classified as a pygmy group. The remains used to identify *Homo luzonensis* were discovered in Luzon, the Philippines, in 2007, and **were designated as a species in 2019**. *Homo floresiensis*, another archaic human from the island of Flores in Indonesia, stood around 1.1 m (3 ft 7 in) tall.”⁴⁹

⁴⁴ “The term pygmy, as used to refer to diminutive people, derives from Greek πῦγματος pygmaios via Latin Pygmaei (sing. Pygmaeus), derived from πῦγμα – meaning a short forearm cubit, or a measure of length corresponding to the distance from the wrist to the elbow or knuckles. (See also Greek πῆχυς pēkhys.) In Greek mythology the word describes a tribe of dwarfs, first described by Homer, the ancient Greek poet, and reputed to live in India and south of modern-day Ethiopia. https://en.wikipedia.org/wiki/Pygmy_peoples (Informative article on many aspects of the topic) (Retrieved 19 October 2023)

⁴⁵ <https://www.britannica.com/topic/Pygmy> “General Characters of the Pygmy Races”

⁴⁶ <https://www.jstor.org/stable/2842391>

⁴⁷ <https://theodora.com/encyclopedia/p2/pygmy.html> (“Classic Encyclopedia”) (Also retrieved 19 October 2023)

⁴⁸ https://en.wikipedia.org/wiki/Pygmy_peoples

⁴⁹ Cf. <https://www.contestedbones.org/copy-of-about-book> (*Homo luzonensis*: “The bones recovered included: 7 post canine teeth of the upper jaw, 2 finger bones, 2 foot bones, and the shaft of a thigh bone. Détroit et al., published their findings in *Nature* in April 2018. The researchers reported: “These specimens display a combination of primitive and derived morphological features that is different from the combination of features found in other species in the genus *Homo* (including *Homo floresiensis* and *Homo sapiens*) and warrants their attribution to a new species, which we name *Homo luzonensis*.” [1] **The researchers acknowledge the overall human morphology of the bones and appropriately attribute them to members of the human genus, *Homo***. However, typical of taxonomic “splitters” these researchers focus on relatively minor morphological differences when compared to the corresponding bones of *Homo sapiens* and *Homo floresiensis* (a small-bodied human from Flores, nicknamed “Hobbit”). The Flores Hobbit is a controversial *species that has been argued to be true *Homo sapiens* by members of the discovery team*. The authors of Contested Bones agree with the dissenter’s interpretation.”) Concerning *H. floresiensis* see more by **Christopher Rupe and John Sanford** (2019): **Contested Bones**. FMS Publications (*Homo floresiensis* CHAPTER 5: “Is “Hobbit” a New Species?”) Quoting Paleoanthropologist Lee Berger, University of the Witwatersrand as follows: “Flores LB1 [Hobbit] may represent a congenitally abnormal individual drawn from a small bodied population of *H. sapiens*...results from founder effects, genetic isolation and a high inbreeding coefficient.” The authors have presented an in-depth discussion of that view. See also <https://idthefuture.com/1216/> see also <https://evolutionnews.org/2023/10/not-enough-evidence-casey-luskin-on-recent-homo-naledi-claims/> <https://uncommondescent.com/intelligent-design/the-claim-that-flores-man-is-a-separate-human-species-is-being-revived-again/> Compare also <https://evolutionnews.org/2019/04/new-fossil-human-species-thwarts-core-darwinian-predictions/> and <http://www.weloennig.de/HumanEvolution.pdf>, pp. 24 and 55 especially on *Homo luzonensis*.

Now let's briefly compare just the height of probably the tallest people with the smallest of the world:



Left: Drew Binsky⁵⁰ (height 5 feet 7 inches⁵¹/170cm) with some people of the Dinka Tribe (“So, I came to South Sudan. And I feel like I just entered Manhattan because I’m surrounded by skyscrapers, these guys are like 7 feet [213cm] tall.”)

Right: “2 months later” Drew Binsky with pygmies (“They’re like my little brothers”)⁵²

And let's additionally consider just the faces and somewhat of the head shapes of many further human populations from around the globe:



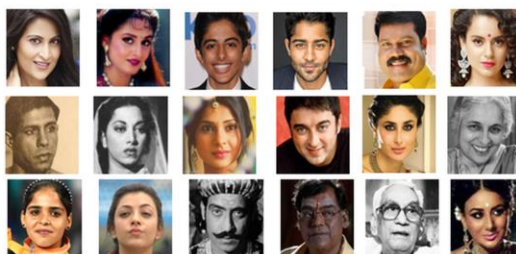
(a) African-American subjects



(b) Asian subjects



(c) Caucasian subjects



(d) Indian subjects

By Adrian Sergiu Darabant et al. (2021): “The gathering of a large-scale “in the wild” face dataset (FaceARG) annotated with race and ethnicity information. To our knowledge, we gathered the largest available face database (of more than 175,000 images) annotated with race, age, gender and accessories information.”⁵³

⁵⁰ https://en.wikipedia.org/wiki/Drew_Binsky (Retrieved 23 October 2023).

⁵¹ <https://www.facebook.com/drewbinsky/videos/hes-the-worlds-tallest-man/423478179387768/> (Height 251 cm. Also retrieved 23 October 2023).

⁵² World's Tallest & Smallest People (are neighbors!): <https://www.youtube.com/watch?app=desktop&v=-BgsV-Xgmo>

Darabant, A.S.; Borza, D.; Danescu, R. Recognizing Human Races through Machine Learning—A Multi-Network, Multi-Features Study. Mathematics 2021, 9, 195. <https://doi.org/10.3390/math9020195> Recognizing Human Races through Machine Learning—A Multi-Network, Multi-Features Study. ⁵³ <https://www.mdpi.com/2227-7390/9/2/195>

So, how many genera and species of men and women of the present human family would paleontologists propose according to the *morphological species concept*, if they had to base their investigations on only human bones from around the globe with the taxonomic yardstick of our Hippopotamidae examples shown above?

Let's return for the moment to the Pygmies (average height of, for example, the African Negrilloes (1.38 m) as compared with the Dinka Tribe (ca. 2.28 m): Would the different Pygmy groups just hinted at above (African, Asiatic and Oceanic Pygmies, all with some features distinguishing them from each other) not get at least different species names (as has already been practiced for some "Archaic Humans") and possibly the entire group even be categorized as a *different genus* or even *different subfamily* in comparison with, for example, some Sudanese tribes? (Recall please the photos shown by Drew Binsky above or a bit more cautious "In the case of some Sudanese tribes, **males** can have an **average height** of **1.9 m** (6 ft, 4in) (!), while **women** of **1.8 m** (6 ft)⁵⁴", not to speak of several of the *individually* tallest people of the world (see for example the following photos).



Left: "Robert Wadlow, the tallest verified human, with his average-size father": Date: Before 1937⁵⁵
 Right: "When the world's tallest man and shortest woman met in Egypt"⁵⁶

Of course, the taxonomic splitters of paleontology would, wherever possible, concentrate on *populations* with (best) identical or (at least) very similar bone features (although in many cases just some fossil fragments have already been given new species and genera names as in the hippo family and unnumbered other examples).

Richard Goldschmidt⁵⁷ has so far illustrated this in an unsurpassed way as follows (see additional points at <http://www.weloennig.de/AesIV2.A.3.Ka.html>):

"At this point of our discussion there ought to be mentioned a rather informative example which is rarely discussed in the light of our problem; namely, the *subspecific differentiation of the human race*. Though it is possible that different species of the genus *Homo* have existed and have disappeared again, **nobody can fairly claim that present mankind belongs to more than one species**. Let us suppose that a giant collector from Mars (W.-E.L.: Spätestens seit den genauen Messdaten amerikanischer Satelliten zur Frage nach Leben auf dem Mars hätte man den 'collector' wahrscheinlich ferner im All angesiedelt. Das Beispiel ist jedenfalls sehr instruktiv) visited the earth, made a collection of human beings, and returned to work them up in his Martian museum. He would most certainly come to the conclusion, in *applying usual taxonomic standards, that he had found a new family*, Hominidae, and

⁵⁴ <https://news.softpedia.com/news/The-Tallest-People-in-the-World-61130.shtml>

⁵⁵ https://en.wikipedia.org/wiki/List_of_tallest_people https://commons.wikimedia.org/wiki/File:Robert_Wadlow_postcard.jpg (2022).

⁵⁶ <https://kids.guinnessworldrecords.com/news/2022/4/when-the-worlds-tallest-man-and-shortest-woman-met-in-egypt-698038> See also

<https://www.youtube.com/watch?v=CK9cxeH8Wmg> <https://www.buzzfeednews.com/article/elliethall/the-worlds-tallest-man-and-shortest-woman-hung-out-at-the>

⁵⁷ https://en.wikipedia.org/wiki/Richard_Goldschmidt (see also Theissen, G (2006). "The proper place of hopeful monsters in evolutionary biology". *Theory Bioscience* **124**: 349–369.

within this a number of very distinct genera, like the white, the black, the brown, the yellow man. Within these genera he would distinguish species or ecospecies, replacing each other geographically. For example, he would identify in the black genus the species Bantu, Bushman, Hottentot, Pygmy, Australian (Kursiv vom Verfasser.). Within some species with a rather large geographical range he would find geographical races; e.g., the different tribes of Negroes across the center of the African continent. If the collection were large enough he would meet with isolated subspecies, with very different insular forms, with subspecies down to small hordes, with differential specific traits. (Regarding the latter point, not generally known, I think, I might mention a personal observation among the **semisavage head-hunting tribes of Formosa** (1927a). I noticed that in two different small tribes of this Malaylike group the men within the tribe *resembled each other to such an extent in certain features of the face that they might have been picked out of a crowd as brothers. The genetical basis, homozygosity by inbreeding, is obvious.*)“

Emphasizing the relevance of his illustration for innumerable other taxonomic studies, he draws the logical conclusion applying the taxonomist’s method for humans to the animal kingdom in general, Goldschmidt continues as follows:

“In short, his description would closely compare with innumerable other taxonomical studies, and it would also be perfectly correct, as far as information goes. But the next collector might have better chances to observe his specimens and he would find difficulties. He might reach the same conclusion as have recent students of insular faunas (Galapagos finches, Hawaiian drepanids) (see below), that from a taxonomic point of view all the forms might also be assigned to a single species, *though the morphological and ecological differences between Negrito and Swede, Papuan and Eskimo, Hottentot and Chinese are quantitatively just as large as are those between different so-called genera; e.g., of gall wasps*. The next Martian visitor might be a geneticist who would notice that all these forms, if given a chance, interbreed and produce fertile offspring. He would notice that this also applies to cases in which differences in the structure of the genitals exist (the Hottentot-Boer hybrids), and he would state with perfect confidence **that only a single species, with many sub- and subspecies**, exists. Now, there can be no doubt that many of the isolated human subspecies or end-members of a series are as different from each other as are extreme subspecies in animals. There is no doubt that some subspecies, like those in animals, have been isolated for a very long time. There is no doubt that the time available for subspecific differentiation has been about the same as that which is assumed for the cases in animals and plants. There may also be detected at some points the presence, due to migration, of two races which are interfertile but which do not produce hybrids on account of psychological isolation. Such an occurrence would be a special feature without any evolutionary significance. *We conclude, then, that if the subspecies is an incipient species, this must also be the case for the major human races*. I wonder whether anybody would be willing to accept such a conclusion!”⁵⁸

The alternative to Goldschmidt’s exposition would be to return (in principle at least) to Haeckel’s ‘Twelve species of men divided in four genera’, which has now been universally rejected by virtually all informed scientists around the globe.

Now, let’s turn back to the family Hippopotamidae: How to further apply Goldschmidt’s inferences (being in principal agreement with the *genetic species concept*) on the different hippo genera and species cited above? Namely:

Fm. Hippopotamidae Gray 1821
 Subfm. **Hippopotaminae** Gray 1821
 G. †*Archaeopotamus* Boissierie 2005
 G. *Choeropsis* Leidy 1853 [pygmy hippo]
 G. †*Chororatherium* Boissierie et al. 2003
 G. †*Hexaprotodon* Falconer and Cautley 1836 [pygmy hippo]
 G. *Hippopotamus* Linnaeus 1758 [hippo]
 G. †*Phanourios* Boekschoten and Sondaar 1972
 G. †*Saotherium* Boissierie 2005
 Subfm. †**Kenyapotaminae** Pickford 1983
 G. †*Kenyapotamus* Pickford 1983
 G. †*Kulutherium* Pickford 2007

Concerning *Archaeopotamus* we have already heard that the “the genus was described in 2005 to encompass species of hippos that were previously grouped in *Hexaprotodon*” and that “unlike other *Hexaprotodon*, *Archaeopotamus* has a highly elongate mandibular symphysis”.

In my queries from a geneticist’s point of view I have argued that (apart from the fact that most of the fossil material is rather fragmentary) that several parameters have not been adequately considered to reclassify the respective

⁵⁸ Richard Goldschmidt (1940, pp. 121-123): *The Material Basis of Evolution*. Yale University Press, New Haven. See perhaps also: https://www.azquotes.com/author/23446-Richard_Goldschmidt

species known so far (i. e. *A. harvardi* and *A. lothagamensis*) from *Hexaprotodon* to *Archaeopotamus* (modifications, gender, Mendelian populations, differences due to DNA variation within species and genera regarding the length of the mandibular symphysis, environmental factors – see the details above). So, according to the **genetic species concept**, the genus *Archaeopotamus* could simply be a subspecies (or a variety) of *Hexaprotodon* with its species (now) *H. harvardi* and *H. lothagamensis* for the time being.

As for the genus *Choeropsis*, our pygmy *Hippopotamus*, it appears to be just a diminutive form of *Hippopotamus amphibius* (and, as shown above, there were several other dwarf forms of the hippos and it may also be noted that there are many more miniature varieties within other species in the animal and plant kingdoms in general). As a hippo subspecies it could be classified by the name *Hippopotamus amphibius* ssp. *liberiensis*.

Now let's first skip the next genus *Chororatherium* and focus our attention directly on *Hexaprotodon*. In which characteristics is *Hexaprotodon* different from *Hippopotamus amphibius*?

First some general points: “*Hexaprotodon* m [von hexa- [ἕξ- (hexa-☆) → grc „sechs-“], griech. prōtos = erster, odōn = Zahn], (Falconer und Cautley 1836).”⁵⁹

Taxonomy

“The name *Hexaprotodon* was often applied to the pygmy hippopotamus before its reclassification into the genus *Choeropsis*. The genus has been historically applied to numerous fossil hippopotamus species spanning Asia, Africa and Europe. ... The uncontroversial, core Asian members of the genus most closely related to the type species *H. sivalensis* first appeared around 6 million years ago, during the latest Miocene and were widespread throughout South and Southeast Asia, with the oldest records coming from the Siwalik Hills. **The African species *Hexaprotodon bruneti* from the Early Pleistocene of Ethiopia may be closely related to the Asian *Hexaprotodon* species**, and thus belong in the genus in its more narrow sense. If so, it likely originates from a migration from Asia.

Description

The Asian species of *Hexaprotodon*, like the living hippopotamus (*Hippopotamus amphibius*), but unlike the pygmy hippopotamus are thought to have had **a semiaquatic ecology, with their skull shape greatly resembling that of *H. amphibius*, with elevated orbits that allowed them to see above water while submerged. This lifestyle likely evolved independently in both *Hexaprotodon* and the genus *Hippopotamus*. In comparison to *Hippopotamus*, the mandibular symphysis is much more robust, the canine processes do not extend laterally outwards, and the molar teeth are lower crowned.** The more slender and less massive postcranial skeleton compared to *H. amphibius* also suggests that *Hexaprotodon* was less adapted to walking in mud.[6] **Dental microwear suggests a grazing diet for Asian *Hexaprotodon* species, similar to *H. amphibius*.**⁶⁰

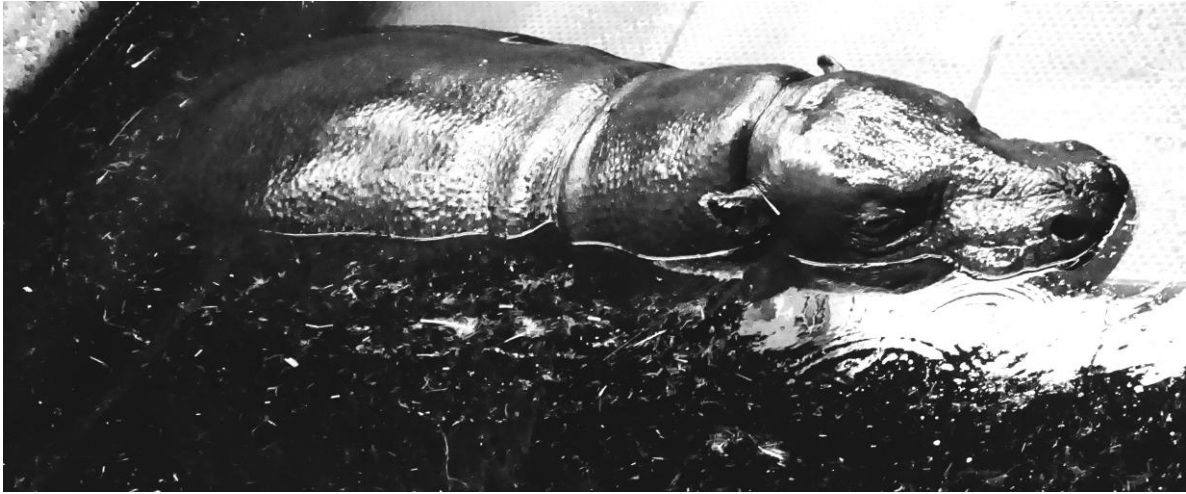
“...unlike the pygmy hippopotamus”: Well, the Pygmy hippo is also semi-aquatic (Google please “pygmy hippopotamus semi-aquatic” and you’ll find a series of references; see also Boisserie 2005, p. 16). So, *Hippopotamus amphibius*, *Hippopotamus liberiensis* and the species of *Hexaprotodon* are all semi-aquatic. *Hexaprotodon* with its “elevated orbits that allowed them to see above water while submerged” is in this key structure even more similar to *H. amphibius* than to *H. liberiensis* – although the latter can also see above water while (at least largely) submerged⁶¹:

⁵⁹ <https://www.spektrum.de/lexikon/biologie/hexaprotodon/31791> (“...ausgestorbene Gattung der Flusspferde afrikanischen Ursprungs mit primitiveren Schädel- und Gebissmerkmalen als beim rezenten *Hippopotamus amphibius*; **je 6 (Name!) Incisivi in Ober- und Unterkiefer**“ [W.-E. L.: **Warum sollten 6 Incisivi „primitiv“ sein?** Zum umstrittenen Gebrauch des Begriffs „primitiv“ siehe pp. 269 bis 283, 286 bis 288/289 und weiter bis 292 bis 294: <http://www.weloennig.de/Hunderassen.Bilder.Word97.pdf>. Jetzt weiter der Spektrum-Artikel:] „Die ältesten europäischen Formen waren wahrscheinlich ebenfalls hexaprotodont, **es gab aber auch tetraprotodont Arten**; Zugehörigkeit der europäischen Formen zu *Hexaprotodon* umstritten. Verbreitung: Obermiozän bis Holozän, Afrika; Obermiozän bis Jungpleistozän, Asien; Obermiozän bis Unterpliozän, Europa.“

English: (“...extinct genus of hippopotamus of African origin with more primitive cranial and dentition features than in the recent *Hippopotamus amphibius*; 6 (name!) incisivi each in upper and lower jaw” [W.-E. L.: **Why should 6 incisivi be “primitive”?** On the controversial use of the term “primitive”, see pp. 269 to 283, 286 to 288/289 and on to 292 to 294: <http://www.weloennig.de/Hunderassen.Bilder.Word97.pdf>. Now back to the Spektrum article:] “The oldest European forms were probably also hexaprotodont, **but there were also tetraprotodont species**; affiliation of European forms to *Hexaprotodon* disputed. Distribution: Upper Miocene to Holocene, Africa; Upper Miocene to Late Pleistocene, Asia; Upper Miocene to Lower Pliocene, Europe.”

⁶⁰ <https://en.wikipedia.org/wiki/Hexaprotodon> (retrieved 27 October 2023)

⁶¹ Nicely illustrated by a text from Zoo Krefeld (written in the first person/I-form): “**During the day I prefer to lie in the water, usually you can only see my eyes and ears flashing out of the water.**” <https://www.facebook.com/zookrefeld/photos/hallo-ich-bin-katka-und-ich-wohne-nun-seit-einem-jahr-im-dick%C3%A4therhaus-des-krefeld/1695156663929666/> (Retrieved 1 November 2023). This is also what I have noted for a female *H. liberiensis* in Zoo Duisburg.



Above: Extant pygmy hippo *Choeropsis liberiensis* (or *Hexaprotodon liberiensis*/*Hippopotamus liberiensis*.)
 It seems to stand with its hind legs on the ground of its swimming pool.
 Middle: Female pygmy hippo half standing in its pool. Note please that its orbits are also slightly elevated.
 Below: Face of male pygmy hippo. All photos W.-E. L.: 7 Oct. 2023 Zoo Duisburg.

In this context it is certainly illuminating to recall the enormous size and weight differences between the large *Hippopotamus amphibius* and the pigmy hippo, *Hippopotamus liberiensis*⁶²: In case of the large one “Males are usually 3.5 metres (11.5 feet) long, stand 1.5 metres (5 feet) tall, and **weigh 3,200 kg**”, *H. liberiensis* “Pygmy hippos reach a height of only about 3 ft (1 m), a length of 5 ft (1.5 m [and somewhat more]), and weigh only about 500 lb (**227 kg** [up to ca. 270kg])” – probably with some morphological effects also on skull form (*cf.* humans shown above: tallest man and shortest woman).

The enormous size and weight differences could be due mainly to the effects of just a few Mendelian genes.

		P: AA bb CC DD				x				aa BB cc dd					
		F ₁ : Aa Bb Cc Dd													
F ₂ : GAMETEN	ABCD	ABcD	AbcD	ABcD	AbcD	AbcD	AbcD	aBCD	aBcD	aBcD	aBCD	abCD	abCD	abCD	abcd
ABCD	AABBCCDD														AaBbCcDd
ABcD		AABbCCDd													AaBbCcDd
AbcD			AABbCCDd												AaBbCcDd
ABcD				AABbCCDd											AaBbCcDd
AbcD					AAbbccDD										AaBbCcDd
aBCD						AAbbccDD									AaBbCcDd
aBcD							AAbbccDD								AaBbCcDd
aBCD								AaBbCcDd							AaBbCcDd
aBcD									AaBbCcDd						AaBbCcDd
abCD										AaBbCcDd					AaBbCcDd
abCD											AaBbCcDd				AaBbCcDd
abcd															AaBbCcDd

2^4	=	16
2^{10}	=	1.024
2^{20}	=	1.048.576
2^{30}	=	1.073.741.824

Task: Replace the upper and lower case letters chosen in <http://www.weloennig.de/pic/QuadratGr.jpeg> for the parents (P) by upper case letters on the left with only **AA BB CC DD** (four functional dominant alleles) for *Hippopotamus amphibius* and on the right all with the lower case letters **aa bb cc dd** (four loss-of-function alleles) for the smallest hippo *Hippopotamus minor* (once on Cyprus) and the recombination square shows us a series of different hippo sizes from the present large one to the smallest hippos, assuming that each loss-of-function implies a clear step in the reduction of size and weight – all belonging to the same Mendelian population – and thus to one and the same species.

Interestingly, according to Makvandi-Nejad et al (2012): “**Four loci explain 83% of size variation in the horse**”⁶³. Important factors are inbreeding and selection comparable to what has been happening on many islands around the globe (*cf.* <http://www.weloennig.de/NeoB.Ana2.html> also explaining the rather fast extinction of so many island species).

See also Takasuga (2016): “A recent progress on stature genetics has revealed simple genetic architecture in livestock animals in contrast to that in humans. **PLAG1** and/or **NCAPG-LCORN**, **both of which are known as a locus for adult human height**, have been detected for association with body weight/height **in cattle and horses**, and for selective sweep in **dogs and pigs**.”⁶⁴

Adaptation due to losses of gene functions is a widespread phenomenon in living organisms: *Cf.* Examples have discussed by me, W.-E. L., in a long series

⁶² So far still assuming that they are two species like horse and donkey (*cf.* <http://www.weloennig.de/AesIV3.Fr.html>) and not subspecies or just variants.

⁶³ Shokouh Makvandi-Nejad et al. (2012): Four loci explain 83% of size variation in the horse: <https://pubmed.ncbi.nlm.nih.gov/22808074/> “In support of this, here we show with genome-wide association scans (GWAS) that **genetic variation at just four loci can explain the great majority of horse size variation**. Unlike humans, which are naturally reproducing and possess many genetic variants with weak effects on size, we show that horses, like other domestic mammals, carry just a small number of size loci with alleles of large effect. Furthermore, three of our horse size loci contain the **LCORN**, **HMG2** and **ZFAT** genes that have previously been found to control human height. The **LCORN/NCAPG** locus is also implicated in cattle growth and **HMG2** is associated with dog size.

⁶⁴ Akiko Takasuga (2016): **PLAG1** and **NCAPG-LCORN** in livestock: <https://pubmed.ncbi.nlm.nih.gov/26260584/> The author continues: “The findings indicate a significant impact of these loci on mammalian growth or body size and usefulness of the natural variants for selective breeding. However, association with an unfavorable trait, such as late puberty or risk for a neuropathic disease, was also reported for the respective loci, indicating an importance to discriminate between causality and association.” See also: Iris J M Boegheim et al. (2017): <https://pubmed.ncbi.nlm.nih.gov/28697878/> and <https://pubmed.ncbi.nlm.nih.gov/19455035/>

In humans the situation is generally more complex: “Recent large meta-analyses of genome-wide association studies for height have yielded **47 loci robustly associated with height variation**. ...some of these height loci include genes that have been previously implicated by **Mendelian genetics in tall or short stature syndromes**”; <https://pubmed.ncbi.nlm.nih.gov/19455035/> However: according to <https://www.science.org/content/article/landmark-study-resolves-major-mystery-how-genes-govern-human-height>: “Nearly 10,000 common gene variants influence how tall a person becomes.” But what about Goldschmidt’s nearly homozygous “semisavage head-hunting tribes of Formosa” where “within the tribe resembled each other to such an extent in certain features of the face that they might have been picked out of a crowd as brothers.” (But even with 10.000 variants all humans belong to the same species *Homo sapiens*.)

of articles and books from 1971 onwards until the present so far (2023), almost all of which can be downloaded from my homepage⁶⁵. See also Michael J. Behe (2019): *Darwin Devolves: The New Science About DNA That Challenges Evolution* (HarperOne; 352 pp.) and additional examples by the same author, at present up to 2023⁶⁶, including the yeast *Saccharomyces cerevisiae*, the cetacean (whales and dolphins) lineage and the mammoth.

Now, to the next point of the description cited above: "...This lifestyle likely **evolved independently** in both *Hexaprotodon* and the genus *Hippopotamus*."

According to the **genetic species concept** the sentence could read as follows (yet without my consent of the contents of the statement): "...This lifestyle likely **evolved independently** in both (a) the series of species or subspecies of *Hippopotamus* called *Hexaprotodon* according to the **morphological species concept** – and (b) all the other species and subspecies of the genus *Hippopotamus* that have already been enumerated above."

Applying the genetic species concept (with the yardstick of the stark variation found within the **one species *Homo sapiens***), it immediately becomes clear that the postulate of an independently evolved lifestyle ("likely evolved independently") in such closely related groups of species and subspecies is unreasonable if not absurd. For, what does this lifestyle imply if not the entire Bauplan/blueprint/construction plan of *Hippopotamus amphibius* albeit with some *relatively* minor anatomical and now especially ethological deviations from the basic hippo type?

Concerning the extreme improbability of the origin of complex convergences due to selection of accidental/haphazard/random DNA mutations, see the links in the footnote below⁶⁷.

I have already mentioned that – as a key feature – *Hippopotamus amphibius* is characterised by **four incisors** (tetraprotodont) and *Hexaprotodon* by **six incisors**⁶⁸ and that Owen (1845) elevated Falconer and Cautley's subgenus *Hexaprotodon* (1836) to genus rank. So, **four vs. six incisors** – would this difference not be sufficient to separate these populations into two genera, even from a genetic point of view? However, recall please the commentary by Boisseries as cited above:

"These genera [*Hippopotamus* and *Hexaprotodon*] have been intensely discussed in subsequent literature. The discrimination of *Hexaprotodon* (Asian hippos) and *Hippopotamus* (Afro-European hippos) **on the basis of incisor number was shown to be inadequate** (Lydekker, 1884). Nevertheless, Colbert (1935) recognized the distinctness of *Hexaprotodon* in many cranial features, **notably on the basis of bone contacts and their shapes in the lachrymal area**."

⁶⁵ <http://www.weloennig.de/internetlibrary.html>

⁶⁶ <https://evolutionnews.org/author/mbehe/>

⁶⁷ http://www.unser-auge.de/evolution/philcoxia-minensis_konvergenzerscheinungen_karnivore-pflanzen.htm, <http://www.weloennig.de/SauropodDinosaur.pdf>, http://www.weloennig.de/Gesetz_Rekurrente_Variation.html, <http://www.weloennig.de/Hunderassen.Bilder.Word97.pdf>, <http://www.weloennig.de/Utricularia2011Buch.pdf> <https://www.youtube.com/watch?v=NEyFUB7vtJw> <http://www.weloennig.de/AuIn.html>, <https://evolutionnews.org/2020/02/aquatic-bladderworts-michael-behes-irreducibly-complex-mousetrap-in-nature/>

⁶⁸ Incidentally Zoo Krefeld tries to explain the presence of such tooth in hippos as follows (also written in the first person/I-form): "Warum wir als Veggies so imposante Eckzähne haben? Tja, wir verstehen eben keinen Spaß, **wenn wir angegriffen werden, verteidigen wir uns wirkungsvoll mit den Zähnen**." English: "Why do we as veggies have such impressive canines? Well, we just can't take a joke. **When we are attacked, we defend ourselves effectively with our teeth**." <https://www.facebook.com/zookrefeld/photos/hallo-ich-bin-katka-und-ich-wohne-nun-seit-einem-jahr-im-dickh%C3%A4uterhaus-des-krefel/1695156663929666/> (Retrieved 1 November 2023).

“...on the basis of bone contacts”? And “...their shapes in the in the lachrymal area”? Well, “This position was strongly contested by Stuenes (1989), who revealed that the Madagascan hippos (*Hip. madagascariensis* and *Hip. lemerlei*), once thought closely related, exhibit, respectively, *Hexaprotodon* and *Hippopotamus* features, as well as **important intraspecific variation in the lachrymal area.**” And, most revealing: “With some minor reservations, Stuenes (1989) agreed with Pickford (1983) **in including all fossil hippos in *Hippopotamus*.**”⁶⁹

As for the extant hippos – the large and the small one – we can hope that future careful comparisons will shed light on the exact differences and their functions on the DNA level between *Hippopotamus amphibius* and *H. liberiensis*.

(Article continued 7 November 2023) Now, let’s have a brief look on the rest of the Hippopotamidae genera mentioned at PBDB, namely:

- G. †*Chororatherium* Boissarie et al. 2003
- G. †*Phanourios* Boekschoten and Sondaar 1972
- G. †*Saotherium* Boissarie 2005
- Subfm. †**Kenyapotaminae** Pickford 1983
- G. †*Kenyapotamus* Pickford 1983
- G. †*Kulutherium* Pickford 2007

Just a glimpse of *Chororatherium* Boissarie et al. (2017) from their paper *Basal hippopotamines from the upper Miocene of Chorora, Ethiopia*:

“**Although fragmentary**, these remains represent a new, mid-sized hippopotamid species dated to ca. 8 Ma, as well as a somewhat younger, larger form. A cladistic analysis of a large array of cetartiodactyls indicates that the Chorora taxa were basal to the latest Miocene hippopotamines. The new species displays a mosaic of dental characters that support the attribution of the new species to a new genus within Hippopotaminae.”⁷⁰

Well, concerning far reaching conclusions I would suggest **to wait for more complete remains**. Martino et al. (2023) emphasize that “The first and archaic Hippopotaminae include **the poorly known genus *Chororatherium***, for now represented by a single described species, *C. roobi* from Chorora, Ethiopia (ca. 8 Ma) (Boissarie et al. Citation2017b).⁷¹ And this is Weston’s comment (2017) in an interview with *Scientific American*; “...the findings from the teeth might be overturned if researchers discover other remains, says Eleanor Weston, an independent mammalian palaeontologist in the United Kingdom. **A jawbone or skull “might completely change the story”**, she says.”⁷²). So, let’s hope that more complete material will be found for a more exact analysis and that such additional findings will adequately interpreted – not exclusively according to the morphological species concept.

⁶⁹ See Boissaries above.

⁷⁰ Jean-Renaud Boissarie, Gen Suwa, Berhane Asfaw, Fabrice Lihoreau, Raymond L. Bernor, Shigehiro Katoh & Yonas Beyene:

<https://www.tandfonline.com/doi/abs/10.1080/02724634.2017.1297718>

⁷¹<https://www.tandfonline.com/doi/full/10.1080/08912963.2023.2194912>

⁷² *Scientific American* <https://www.scientificamerican.com/article/teeth-tell-tale-of-hippo-s-quick-spread-across-africa/> “The fossils are mostly teeth, but those are distinctive enough to recognize new species, Boissarie says. The star of the show is *Chororatherium roobii*, a new species named in part after a local word for hippopotamus. The animal lived roughly 8 million years ago and probably spent much of its time in the water. It weighed perhaps half as much as the 1,400-kilogram common hippo. ... But the findings from the teeth might be overturned if researchers discover other remains, says Eleanor Weston, an independent mammalian palaeontologist in the United Kingdom. A jawbone or skull “might completely change the story”, she says.”

Concerning taxonomy, I would like to ask again: What could be the exact yardstick to support the attribution/allocation of the new species to a new genus within the subfamily Hippopotaminae?

Also, recall, please, the problems of cladistic analyses shown in the reference <http://www.weloennig.de/Feduccia2020.pdf> now pp. 5, 6 – 9, 16, 28/29.

Moreover, "...a mosaic of dental characters" could be due to Mendelian recombination (generally many genes are involved in teeth formation; cf. <http://www.weloennig.de/Hunderassen.Bilder.Word97.pdf> p. 229: "**More than 300 genes have so far been associated with tooth development**"⁷³). Judging from the morphological and anatomical differences *within* species, according to the **genetic species concept** this new morphological genus and species *Chorotherium roobii* could just be a recombinant belonging to the genus *Hippopotamus* (see the crossing square or combination square above).

As for the genus *Phanourios* Boekschoten and Sondaar 1972, it is another name for *Hippopotamus minor* (Cyprus) (see, please, above).⁷⁴ Interestingly *Phanourios* "was synonymized subjectively with *Hippopotamus* by Coryndon (1977)."⁷⁵ Perhaps this was *genetically* more objectively synonymized than generally thought of today (*Hippopotamus* subspecies or recombinants by inbreeding and adaptations due to losses of gene functions).

Now some thoughts on *Saotherium*: "*Saotherium* was a **small hippopotamid similar to the pygmy hippopotamus in size and morphology**. The elongated shape of its brain case and the relatively large orbits suggest a possible evolutionary relationship with the latter."⁷⁶ "*Saotherium* was named by Boisserie (2005). It is not extant. It was assigned to Hippopotamidae by Boisserie (2005); and to Hippopotaminae by Boisserie et al. (2005), Weston and Boisserie (2010) and Boisserie et al. (2011)."⁷⁷

Boisserie (2005, p. 15):

"...the parsimony analysis relates these Pliocene hippopotamids to the extant Liberian hippo. However, the long list of convergences accumulated by the latter taxon, its apomorphies and autapomorphies (see below) and the absence of the peculiar cranial structure of *Saotherium* obviously differentiate these animals. In fact, these taxa mainly share character states that are **plesiomorphic or convergent** with other taxa in the analysis, with the exception of the **enlarged orbit size** (character 8, state 1, see Fig. 3 and the above results). *However, given the available data, it is difficult to define the most probable primitive state of this feature and hence its probable evolutionary trend.* Therefore, this relationship must be carefully envisaged, but not completely ignored."⁷⁸

The "convergences accumulated by the latter taxon [*Hippopotamus liberiensis* also known as *Choeropsis liberiensis* and *Hexaprotodon liberiensis*], its apomorphies and autapomorphies" **genetically** do not exclude it from the genus *Hippopotamus* (see the detailed discussion above). Applying the yardstick for convergences,

⁷³ See also: <https://academic.oup.com/icb/article/63/1/162/5881634?login=false> (2023): "Applying the definition of GRN modules presented here, we suggest that, in mammals, cusp formation involves **reiteration of the core and sub-modules**, with the core module being responsible for the formation of each cusp at earlier developmental stages and the **sub-modules being responsible for determining the shape of cusps at later developmental stages**. Modification of the submodules over evolutionary time would explain differences in cusp shape among species (Figs. 2 and 4).

⁷⁴ See perhaps also <https://www.sciencedirect.com/science/article/abs/pii/S1616504716301215> and <https://www.sciencedirect.com/science/article/abs/pii/S0031018218310733> "During the Pleistocene, Cyprus was inhabited by *Phanourios minor*, the smallest Mediterranean dwarf hippopotamus known, featuring a body mass of approximately 130 kg (Lomolino et al., 2013)." However, one may raise several questions whether the arguments of several authors for a more terrestrial lifestyle are really correct. Some interesting points also in <https://www.sciencedirect.com/science/article/abs/pii/S0031018218310733> The evolutionary interpretation of the anatomy Hippopotamidae from the Mediterranean islands could be due mostly to losses of a few gene functions and Mendelian recombinations. On evolution on islands in general cf. <http://www.weloennig.de/NeoB.Ana2.html>

⁷⁵ https://paleobiodb.org/classic/displayReference?reference_no=42941 See also https://paleobiodb.org/classic/basicTaxonInfo?taxon_no=77324

⁷⁶ <https://en.wikipedia.org/wiki/Saotherium> .

⁷⁷ https://paleobiodb.org/classic/checkTaxonInfo?taxon_no=77324&is_real_user=1 (Retrieved 7 November 2023)

⁷⁸ <https://academic.oup.com/zoolinnean/article/143/1/1/2726725>

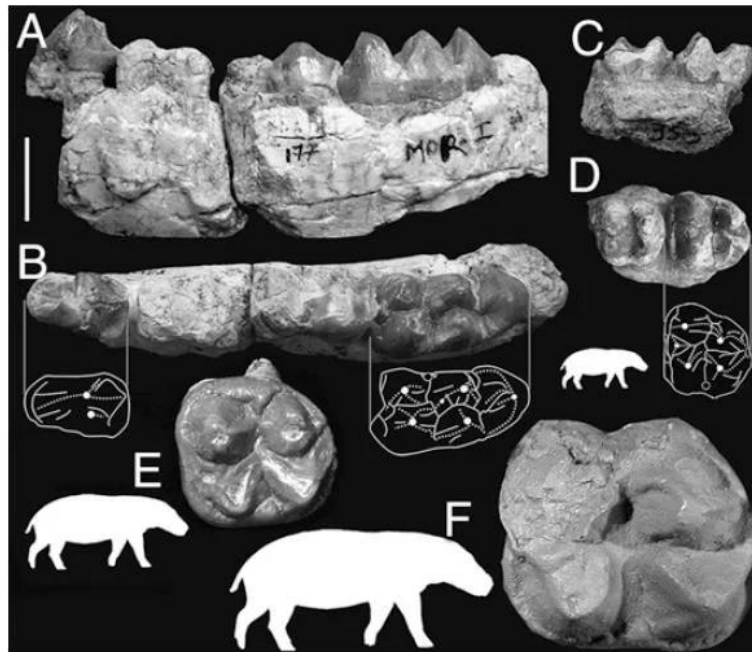
M. Pickford⁸¹ himself thinks that “Hippopotamidae evolved from Old World Tayassuidae early in the middle Miocene or in the lower Miocene.”

“The discovery of *Kenyapotamus coryndoni* and *K. ternani*, two new taxa of Hippopotamidae, permits a reassessment of the origins of the family. *Hitherto considered to have been derived from an anthracothere stock, it now seems more likely that Hippopotamidae evolved from Old World Tayassuidae early in the middle Miocene or in the lower Miocene.* The new genus is known by two species, a small one at Fort Ternan and Maboko, a slightly larger one at Ngeringerowa and Nakali. The palaeoenvironments of large amphibious mammals of Eastern Africa are examined. It is noted that Anthracotheres which were common in lower Miocene deposits of Kenya became extinct locally by the time that the earliest hippopotamids came on the scene. A straightforward niche exchange may be visualised whereby hippopotamids either replaced anthracotheres in the East African large mammal amphibious niche, or evolved in response to the vacation of this niche by anthracotheres.”⁸²

Problem is, among others, that the very existence of “Old World Tayassuidae” has become doubtful during the last years.⁸³ See, however, Pickford 2022 as cited below.

As for the last genus of the series mentioned above, *Kulutherium* Pickford 2007, let’s make a long story short with a citation from the *National Geographic*:

“The analysis of Orliac and colleagues focused on two enigmatic African species **known from partial jaws** – the 20.6 million year old *Morotochoerus ugandensis* and the ~16 million year old *Kulutherium kenyensis*. **Consensus about what these animals actually were has been hard to achieve.** *Morotochoerus* was initially described as an anthracothere before being identified as an African peccary, **while *Kulutherium* was lumped in with anthracotheres after being proposed as a hippo.** Both animals are clearly relevant to the relationships of early hippos, anthracotheres, and perhaps Old World peccaries, but until now they had not been studied in enough detail to place them in their proper evolutionary context.”⁸⁴



“The fossil remains of *Morotochoerus* (A, B, C, D), *Kenyapotamus* (E), and *Kulutherium* (F), with silhouettes to show comparative size (*Kulutherium* would have been about the size of a modern-day hippo, and *Kenyapotamus* the size of a pygmy hippo). From Orliac et al., 2010.”⁸⁵

⁸¹ https://en.wikipedia.org/wiki/Martin_Pickford (Retrieved 8 November 2023)

⁸² <https://www.sciencedirect.com/science/article/abs/pii/S0016699583800199?via%3Dihub>

⁸³ Another evolutionary hypothesis states this: “Although some taxa from the Old World like the European Miocene *Taucanamo* have been suggested to be members of Tayassuidae, their **assignment to the group is equivocal**, with a 2017 phylogenetic analysis recovering *Taucanamo* outside the clade containing suids and peccaries. The oldest unambiguous fossils of peccaries are from the Early Miocene of North America, with the North American Eocene-Oligocene genus *Perchoerus*, also often considered an early peccary, recovered outside the clade containing peccaries and suids.” <https://en.wikipedia.org/wiki/Peccary> (Also retrieved 7 November 2023)

⁸⁴ <https://www.nationalgeographic.com/science/article/of-fossil-ghosts-and-hippos-past>. Moreover, according to https://paleobiodb.org/classic/checkTaxonInfo?taxon_no=113475&is_real_user=1 “It was assigned to Anthracotheriidae by Pickford (2007) and Holroyd et al. (2010); and to Kenyapotaminae by Orliac et al. (2010) and Boisserie et al. (2011).”

And on the basis of just one tooth (2015): “The present specimen provides additional evidence that a hippopotamus-sized, large hippopotamid was already living during the early Miocene. If it proves to be *Kulutherium*, it provides additional evidence that *Kulutherium* should be assigned to the Kenyapotaminae.” <https://bioone.org/journals/Paleontological-Research/volume-19/issue-4/2015PR015/A-Lower-Molar-of-a-Primitive-Large-Hippopotamus-from-the/10.2517/2015PR015.short>

⁸⁵ Of Fossil Ghosts and Hippos Past: <https://www.nationalgeographic.com/science/article/of-fossil-ghosts-and-hippos-past>. (Italics of the names of the genera added). And the original PNAS paper by Orliac et al. here <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2900691/>

Interim remark: The introductory sentence is certainly correct stating: “*To call hippos “charming” may seem a bit of a stretch, but they are most certainly among the classic charismatic megafauna of the African continent.*”⁸⁶

As for the subfamily Kenyapotaminae: Examining the fragmentary fossil record of this subfamily so far, one may ask whether this classification is perhaps not somewhat too early.

Now let’s transfer the taxonomic yardstick determining species and genera⁸⁷ in the hippo family by comparing it to **tooth variation in humans**.

So, first, what do we know about tooth variation in humans? And how many human genera and species could be created applying the hippo taxonomic yardstick?

“**Human tooth shape varies greatly among individuals and populations.** Examples of common dental features include the **groove patterns in crowns, the relative size of cusps, the number of roots,** and the **presence or absence of wisdom teeth.** *These dental traits are heritable, with certain traits commonly observed within families. Some of them occur at different frequencies across populations in a way that is similar to the inheritance and variation of DNA.*”

Hannes Rathmann has this to say on the causes of human tooth variation in an interview with the *British Dental Journal* (2020, p. 665-666):

“Most human dental traits **probably arose by chance as a result of genetic drift.** That is an evolutionary process that is considered to be **neutral,** having no particular advantages or disadvantages for individuals or the population.”

The interviewer then continued: “By contrast, it has also been proposed that some traits evolved in a non-neutral manner as a result of natural selection and adaptation, perhaps in response to chewing behaviour or environmental factors” and cited the co-author of the research and article, Hugo Reyes-Centeno as follows:

“Teeth that evolve neutrally are useful for inferring genetic relationships and can be highly informative for reconstructing the human past’. In order to disentangle the neutral and non-neutral evolutionary mechanisms, the researchers compared the variation in dental traits to the variation in neutrally evolving **DNA across various populations around the world.**

The researchers developed an algorithm that could compare DNA data against commonly used dental traits and all the possible combinations of these traits. **They performed extensive calculations and looked at more than 130 million possible combinations of dental traits.** This enabled them to identify a set of highly informative trait combinations that preserve neutral genetic signals best - making them the most useful for reconstructing genetic relationships.⁸⁸

For their Fig. 1 in *PNAS* discussing and showing human tooth variation for “**27 dental morphological traits** considered in the ASUDAS⁸⁹ for reconstructing neutral genetic variation across worldwide modern human populations” see, please, the original article <https://www.pnas.org/doi/10.1073/pnas.1914330117>: Hannes Rathmann and Hugo Reyes-Centeno (2020): Testing the utility of dental morphological trait combinations for inferring human neutral genetic variation. *Proceedings of the National Academy of Sciences* **117**: 10769-10777.

Now, how many human species and genera could be created by the “**134,217,700 possible combinations of dental traits**? I’ll leave the answer to the reader.”⁹⁰ Cf. Haeckel vs. Gould and Goldschmidt and me as cited above.

⁸⁶ The article continues: “In the wake of the end-Pleistocene ecological catastrophe – during which waves of extinction denuded the planet of many strange, large-bodied mammals from woolly mammoths to wombats the size of small cars between 20,000 and 10,000 years ago – Africa remained a refuge for some of the last-remaining vestiges of prehistoric megamammal diversity, preserving an oddball assemblage of lineages which had proliferated in the not too distant past.”

⁸⁷ Or perhaps even a subfamily?

⁸⁸ <https://www.nature.com/articles/s41415-020-1605-8>

⁸⁹ Arizona State University Dental Anthropology System (ASUDAS)

⁹⁰ For dental variation in man, see also: <https://www.biorxiv.org/content/10.1101/2023.05.23.541877v1.full>

This is What the Fossil Record Tells Us on the Origin of Hippos: Abrupt Appearances and Constancy/Stasis of the Major Taxa

Apart from the inference that from the viewpoint of the **genetic species concept** (applying the yardstick of the stark variation in humans and other well-known extant species) most of the exclusively **morphologically determined genera** mentioned for the hippos above are most probably nothing more than different subspecies or in some cases species (like horse and donkey⁹¹) of the hippo family – the basic question remains: what does the fossil record tell us about the very origin of the family Hippopotamidae?

“Hippos (that is, hippopotamids) are included within a more inclusive clade – Hippopotamoidea – that includes a set of Eocene and Oligocene taxa collected termed anthracotheres or anthracotheriids (Lihoreau et al. 2015). There’s a lot that could be said about these animals. Indeed, *there’s a long-standing controversy as goes whether they really do include the ancestors of hippos or not* (Pickford 2008) - ...Anthracotheres take the history of the hippo lineage way back into the Paleogene.”⁹²

Martin Pickford comments this question in his paper on “*The myth of the hippo-like anthracothere: The eternal problem of homology and convergence*” as follows (2009, p. 31):

“The notion that anthracotheres had hippo-like body proportions, locomotion and lifestyles has been in the literature for so long, and has been repeated so many times, that it has taken on the aura of unquestionable truth. However, right from the beginning of studies into hippo-anthracothere relationships over a century and a half ago, *observations were made that revealed the existence of fundamental differences in dental, cranial and postcranial anatomy in the two groups*. ...It is concluded that they played no part in it, whereas palaeochoerids could well represent the **ghost lineage** that has evaded scientists for more than a century.”⁹³

And in another article, now of 2011, he added:

“*Because of this huge gap in the fossil record*, some researchers have proposed that anthracotheres (specifically the bothriodontines) represent the missing lineage that links whales and hippos (Boisserie et al., 2005a, Boisserie et al. 2005b or that the genera *Kulutherium* and *Morotochoerus* are primitive hippopotamids which extend the fossil record of the family back to the **early Miocene** of East Africa (Orliac et al., 2010). The former hypothesis has not found general acceptance, mainly because *anthracothere skeletal and dental morphology is widely divergent from that of hippos on the one hand* (Pickford, 2008) *and that of whales on the other, but also because the group* (*Libycosaurus - Merycopotamus*) proposed to fill the morphological gap between whales and hippos **occurs appreciably later in time than the earliest known hippos**. The latter hypothesis, by the same authors as the former, is not supported by fossils from Moroto, Uganda, described herein.”⁹⁴

And again in 2022 with a discussion of additional anatomical differences:

“In the literature on anthracotheres and hippopotamids there has been a strange ambivalence about the relationships between these two groups of mammals, *with many authors inferring that they are closely related, yet at the same time remarking that they differed from each other in many morphological features of the skeleton and dentition as well as in their overall body plan* (e.g., the length of neck, Lydekker, 1876) (Pickford, 2008b).”⁹⁵

In this 2022 paper on *The axial skeleton of Brachyodus onoideus (Mammalia, Anthracotheriidae): taxonomic and functional implications* Martin Pickford has given us an excellent summary of the profound differences between anthracotheres and

⁹¹ For the details, see perhaps again <http://www.weloennig.de/AesIV3.Fr.html>

⁹² Darren Naish (November 28, 2015): <https://blogs.scientificamerican.com/tetrapod-zoology/a-quick-history-of-hippopotamuses/>

⁹³ https://www.researchgate.net/publication/277155693_The_myth_of_the_hippo-like_anthracothere_The_eternal_problem_of_homology_and_convergence *Revista Espanola de Paleontologia* 23: 31-90.

⁹⁴ Pickford, M. (2011): *Morotochoerus* from Uganda (17.5 Ma) and *Kenyapotamus* from Kenya (13-11 Ma): Implications for hippopotamid origins. *Estudios Geológicos* 67:523-540

⁹⁵ Pickford, M. (2022): The axial skeleton of *Brachyodus onoideus* (Mammalia, Anthracotheriidae): taxonomic and functional implications. *Spanish Journal of Palaeontology* 37: 35-52.

hippos, which is so well written that I am going to cite a larger passage of his analyses **being of key relevance for the hippo origin question** (Pickford 2022, p. 36):

“A major difference between the cervical vertebrae of anthracotheres and hippopotamids is that, in **anthracotheres**, the bones are generally in compression relative to one another, the head being at the upper end of a **long, upwardly sloping neck** with the weight of the head pushing the vertebrae together, whereas in **hippopotamuses**, the cervical vertebrae are generally held at a low angle slightly above horizontal, with the **weight of the head tending to pull the vertebrae away from the thorax and from each other** when on land (when in the water, the head is partly bouyed up like the rest of the body, so the force of gravity on the limbs and vertebrae is reduced). As a consequence of the extensive or compressive forces acting on the vertebrae, **the system of sinews, muscles, intervertebral discs and other soft tissues of the neck, differs in the two groups**. For example, the hypaphyseal process in the cervical vertebrae of hippos (and other mammals with low-slung heads such as suids and carnivores) is V- or Y-shaped, whereas in anthracotheres (and other mammals with heads held high) it is a simple undivided process (Pickford, 2015).

The presence of a moderately elongated neck in the Namibian specimen of ‘*Brachyodus*’ *aequatorialis*, implying an above-the-shoulder posture of the head, prompted Pickford (2015) to question the oft-repeated hypotheses that anthracotheres possessed body plans similar to those of hippopotamuses (Geais, 1934; Orliac et al., 2013) and by inference that they had similar ecological requirements such as amphibiosis.

The presence of a **medium length neck in *Brachyodus*** casts doubt on the notion that **hippopotamuses**, which have **extremely short necks**, descended from anthracotheres (Lihoreau & Boissarie, 2004; Boissarie et al., 2005a, 2005b, 2006). Pickford (2008) concluded that *Brachyodus* was morphofunctionally closer to ruminants (in particular traguloids) in its dentition, skeleton, overall body plan and cursorial locomotor repertoire, than to hippopotamids which, in these complexes, are closer to some families of Old World «peccaries» (at the time called Palaeochoeridae, but now known as doliochoeroids, **not to be confused with *New World Peccaries, which are rather different from them***, Pickford, 2017). The vertebral column of *Brachyodus* supports this inference, the morphology of the atlanto-axial articulation being derived with respect to those of «suiformes» but not as derived as those of ruminants, being in some ways intermediate between the two extremes. In hippopotamids the atlanto-axial articulation is plesiomorphic, **an observation that essentially refutes the notion that hippos descended from anthracotheres, because, if so, then one would have to invoke a reversal from a derived morphological state to a plesiomorphic condition of this articulation**.

The **sacrum** of *Brachyodus*, like the cervical vertebrae, **differs fundamentally in morphology from those of hippopotamuses**. The anthracothere sacrum narrows distally and has short transverse processes, as in many large-bodied terrestrial cursorial ungulates, whereas in *Hippopotamus* and *Choeropsis*, all the sacral vertebrae posterior to the first one are subequal in breadth, with some individuals having a 5th sacral vertebra in which the transverse processes are slightly broader than those on the second and third ones. **The tail vertebrae are correspondingly large in hippos, with prominent, robust, elongated transverse processes**.

In hippopotamuses, the short but **fleshy tails** are endowed with **strong musculature which actively and rapidly swish the tail from side to side during defecation, acting somewhat like a dung-spreader** (both in the water and on land) (Skinner & Smithers, 1990; Klingel, 2013; Robinson, 2013). In these animals, the coccygeal vertebrae have elongated transverse processes to support the muscle mass. The caudally narrowing sacrum of *Brachyodus onoideus*, in contrast, indicates that the **coccygeal vertebrae** would have been narrow with **reduced or absent transverse processes**, as in *Anthracotherium* (Kowalevsky, 1874) and thus would probably have been similar in general morphology to those of large ruminants and equids, and if so, **then its tail would have been more gracile and not as muscular as those of hippopotamuses**.”

Taken together, all these profound, in fact, far-reaching anatomical and morphological differences between the families Hippopotamidae and Anthracotheriidae (down to the smallest, persnickety detail) surpass anything in variation, which we have found so far *within* species, genera and virtually all families⁹⁶ in other life forms in the wild. So, Pickford has shown us convincing reasons in rejecting the assertion that the “putative stem-group to Hippopotamidae is generally thought to be the family Anthracotheriidae”⁹⁷ (Boissarie 2005, p. 1). Or, in the words of Orliac et al (2010, p.11871):

“Recent phylogenetic analyses suggested that the Kenyapotaminae are the sister taxon of the Hippopotaminae and that the Hippopotamidae are monophyletic as well as deeply nested within the extinct, paraphyletic Anthracotheriidae. However, **a morphological gap remains between these earliest known hippopotamids and their hypothesized anthracotheriid stem group**.”

⁹⁶ See some points on the validity of taxonomic unit “family” in <http://www.weloennig.de/AngiospermsLivingFossils.pdf> (2022, p. 25)

⁹⁷ This result also implies that **the usual reconstructions** of Anthracotheriidae as shown, for example in <https://de.wikipedia.org/wiki/Anthracotheriidae>, **have to be revised**.

Yes, the family Hippopotamidae is probably monophyletic, but “deeply nested within the extinct, paraphyletic Anthracotheriidae” proves nothing (*cf.* the references to the doubtful method of cladistics for evolutionary inferences).

Despite mentioning a different opinion, the Anthracotheriidae are still emphasized to be the possible ancestors of the hippos in a recent Wikipedia article (last edited on 3 November 2023) as follows:

“Some skeletal characters of anthracotheres suggest they are related to hippos. The nature of the sediments in which they are fossilized implies they were amphibious, which supports the view, based on anatomical evidence, that **they were ancestors of the hippopotamuses**. In many respects, especially the anatomy of the lower jaw, *Anthracotherium*, as with other members of the family, **is allied to the hippopotamus, of which it is probably an ancestral form**. *However, one study suggests that instead of anthracotheres, another pig-like group of artiodactyls, the palaeochoerids, are the true stem group of Hippopotamidae.*”⁹⁸

Now, what about the hypothesis that the Palaeochoeridae “now known as doliochoeroids, not to be confused with New World Peccaries, which are rather different from them, Pickford, 2017)” are “the true stem group” of the hippos?

After pointing out that “if one is to derive hippopotamuses from anthracotheres, then one would need to invoke **a reversal from a derived pattern towards a primitive condition** of the atlanto-axial articulation”, Pickford cautiously formulates (2022, p, 50):

“*It is perhaps more likely* that hippopotamuses descended from an ancestral group that possessed a peg-like dens of the axis and a bunodont dentition, **rather than an alternative scenario featuring evolutionary reversals in the dentition and axial skeleton which would be the case if one attempts to derive them from anthracotheres**. Among the bunodont artiodactyls with a peg-like dens with a cone-in-cone atlanto-axial articulation, the **Doliochoeridae** and Siderochoeridae are the closest to hippopotamuses (Pickford, 2017).”

The PBDB gives us the ensuing information on the subfamily Doliochoerinae⁹⁹ (but so far “no matching results for Doliochoeridae”¹⁰⁰):

“Doliochoerinae was named by Simpson (1945). It is not extant. It was synonymized subjectively with Palaeochoerinae by van der Made (1997). It was assigned to Tayassuidae by McKenna and Bell (1997) and Pickford and Morales (1998).”

“Age range: base of the Early/Lower Oligocene to the top of the Zanclean or 33.90000 to 3.60000 Ma” – so a **CONSTANCY/stasis of more than 33 Ma**. “Collections (8 total)”.

PBDB on Anthracotheriidae: Just the “Age range: base of the Duchesnean to the top of the Messinian or 40.40000 to 5.33300 Ma. Collections (320 total)¹⁰¹). Thus, a **CONSTANCY/stasis of more than 35 Ma**.¹⁰²

Concerning the “parent taxon: **Hippopotamoidea** according to L. Scherler et al. 2019” Pickford points out (2022, p. 50) that “the concept of Hippopotamoidea as employed by Gomes-Rodrigues et al. (2021) to embrace anthracotheres and hippopotamids *within the same superfamily, needs to be tested* by adding characters from the postcranial skeleton (especially the axial skeleton) and taxa (especially the Doliochoeridae and Siderochoeridae) to their character matrix which included 221 characters gleaned from 70 taxa.”

⁹⁸ <https://en.wikipedia.org/wiki/Anthracotheriidae> (Retrieved 12 November 2023)

⁹⁹ https://paleobiodb.org/classic/checkTaxonInfo?taxon_no=97097&is_real_user=1

¹⁰⁰ Retrieved 12 November 2023

¹⁰¹ Total: **324 collections including 425 occurrences** according to https://paleobiodb.org/classic/basicTaxonInfo?taxon_no=42443

¹⁰² As for **many more examples of abrupt appearances and constancy/stasis**, see please paleontologist Günter Bechly from 2016 to the present 2023 (and most probably also further on): <https://evolutionnews.org/author/gbechly/>

As for that “long-standing controversy”, which of the two groups, Anthracotheriidae or Doliochoeridae (Doliochoerinae) include the ancestors of hippos – the *honest answer from a purely naturalistic/evolutionary point of view* is that **nobody really knows!**

If argued that the reason for this situation would be the imperfection of the fossil record, I would answer with two statements of the paleontologist Oskar Kuhn – statements, which have time and again been corroborated during the last more than 50 years:

"The prejudice that the phylogenetic history of life could only be an accumulation of the smallest variational steps and that a more complete knowledge of the paleontological documents would prove [the assumed] gradual evolution, is deeply rooted and widely accepted. But the paleontological facts have long spoken against this prejudice! Especially German paleontologists such as Beurlen, Dacqué and Schindewolf have emphatically pointed out **that in many animal groups such a rich, even overwhelming amount of fossil material exists** (foraminifers, corals, brachiopods, bryozoans, cephalopods, ostracods, *trilobites etc.*), *that the gaps between the types and subtypes must be viewed as real*".¹⁰³

So even if we had a much more perfect fossil record of the hippos, most probably we would still have the same situation: Abrupt appearance of new forms being constant over enormous periods of time – as has been shown in detail, for example, for the *Origin and Evolution of the Rhinos* (Family Rhinocerotidae)¹⁰⁴, the elephants: *Elephant Evolution: What Do We Really Know?*¹⁰⁵, and the giraffes¹⁰⁶.

And as for the usually evolutionary practice – including cladistics with its special methods¹⁰⁷ – being applied worldwide to draw phylogenetic inferences:

"The similarity of forms was explained by evolution, and evolution in turn was proven by the various grades of similarities. It was hardly noticed that here **one has fallen victim to circular reasoning; the very point that one set out to prove, namely that similarity was based on evolution, was simply assumed, and then the different degrees in the gradation of the (typical) similarities, were used as evidence for the truth of the idea of evolution.** Albert Fleischmann has repeatedly pointed out the lack of logic in the above thought process. The same idea, according to him, was used interchangeably as assertion and as evidence. However, **similarity can also be the result of a plan,** and ...morphologists such as Louis Agassiz, one of the greatest morphologists that ever lived, attributed the similarity of forms of organisms to a creation plan, not to evolution."

According to the American Museum of Natural History (2015, retrieved 13 November 2023): “Much has changed in evolutionary biology since Darwin sketched out this tree three years before publishing *The Descent of Man* in 1871. Debates have waxed and waned on how best to group organisms, and on what basis. The most commonly used system today is cladistics, which uses *shared derived traits to discover how close – or distant – the relationship is between groups of organisms.* ... And yet,

¹⁰³ See, for example, Lönig: http://ad-multimedia.de/evo/long-necked-giraffe_mU.pdf

¹⁰⁴ <http://www.weloennig.de/Rhinoceros.pdf>

¹⁰⁵ <http://www.weloennig.de/ElephantEvolution.pdf>

¹⁰⁶ Again http://ad-multimedia.de/evo/long-necked-giraffe_mU.pdf

¹⁰⁷ Although it is regularly stated that “the cladistic method does not identify fossil species as actual ancestors of a clade”, the method presupposes the overall theory of evolution based on similarities and differences. And as we have seen above for the hippos, *de facto*, there is constant talk of possible ancestral relationships and the implicit search for real evolutionary ancestors. “Disregarding all autapomorphies and the abrupt appearance of new life forms in the fossil record, morphological sequences are often simply transformed into evolutionary successions, concatenations and progressions of ancestors and descendants” (<http://www.weloennig.de/ElephantEvolution.pdf>)

“Cladistics, either generally or in specific applications, has been criticized from its beginnings. Decisions as to whether particular character states are **homologous**, a precondition of their being synapomorphies, have been challenged as **involving circular reasoning and subjective judgements**.[33] Of course, the potential unreliability of evidence is a problem for any systematic method, or for that matter, for any empirical scientific endeavor at all.[34][35] Transformed cladistics arose in the late 1970s [36] in an attempt to resolve some of these problems by removing a priori assumptions about phylogeny from cladistic analysis, but it has remained unpopular.[37] <https://en.wikipedia.org/wiki/Cladistics> (Retrieved 13 November 2023).

It is transformed cladistics, which transcends the questions of phylogenetics: Recall please from the **Elephant article**: “As evolutionary biologist Gareth J. Nelson has formulated in his renowned paper of 1969 (and further elaborated 2005 and 2014) ... [that] “*It is a mistake to believe even that one fossil species or fossil “group” can be demonstrated to have been ancestral to another.* The ancestor-descendant relationship may only be assumed to have existed in the absence of evidence indicating otherwise.” (P. 23) “The history of comparative biology teaches us that the search for ancestors is doomed to ultimate failure; thus, with respect to its principal objective, this search is an exercise in futility. Increased knowledge of suggested “ancestors” usually shows them to be **too specialized** to have been direct ancestors of anything else.” And on Nelson’s Presentation to the American Museum of Natural History, also in same year, David Williams and Malte Ebach commented in 2010, p. 613: “Nelson’s talk caused an outrage. Previously, fossil taxa that were similar to younger species were labeled as ancestors and a lineage was proposed based on the rates of similarity and the arrow of time dictated by the rock record. Biologists or “neontologists” were dismissed as possessing neither the faculty nor the data to find evolutionary relationships. Paleontology was thought to be superior, and, as a consequence, many fossils were thought to be real ancestors.” See more in the article already mentioned above with references: <http://www.weloennig.de/ElephantEvolution.pdf> (pp. 22-27)

the key to building trees of life still lies in the foundation Darwin laid for the fact of evolution itself: “descent with modification by means of natural selection.”¹⁰⁸

So where are we now with the tree of life according “the foundation Darwin laid for the fact of evolution itself” and the application of cladistics?

The following summary *Of Fossil Ghosts and Hippos Past* written **from a strict evolutionary viewpoint** in *National Geographic* of Oct. 2010, is still largely relevant today:

“Molecular studies have time and again confirmed that **hippos are most closely related to whales** among living mammals – a finding which fostered the rearrangement of the artiodactyl (even-toed, hoofed mammal) family tree to include whales – *but the fossils which would take us back to the last common ancestor of these two groups have been elusive*. The earliest definitive whales, such as the semi-aquatic *Pakicetus*, date back to about 53 million years ago, but the earliest hippos go back only 16 million years (with hippos of modern aspect only originating about 7.5 million years ago). **Given that the two lineages must have diverged before the appearance of the first whales, there is a gap of about 40 million years between the earliest hippos and their last common ancestor with whales.**

The fossil gap between hippos and early whales could be filled in by figuring out what creatures the earliest hippos originated from. These missing creatures – predicted to exist but not yet identified – belong to what paleontologists call a “**ghost lineage**.” True hippos may have originated very recently, but through discerning their closest relatives in the fossil record and working backwards paleontologists would be able to trace their lineage back to the point **where the hippo and whale-lines split**. Making these determinations has been no easy task. Based upon anatomical studies, *different experts have associated early hippos more closely with Old World peccaries (palaeochoerids) or alternatively with a group of hippo-like creatures called anthracotheres.*”¹⁰⁹

And the *Wikipedia* article (last edited 5 November 2023) explains “*The most recent theory of the origins of Hippopotamidae*” (again on several unproven evolutionary presuppositions simply taken for granted) as follows:

“The *most recent theory of the origins of Hippopotamidae suggests hippos and whales shared a common semiaquatic ancestor* that branched off from other artiodactyls **around 60 million years ago**. This **hypothesised ancestral group likely split into two branches again around 54 million years ago**.

One branch would evolve into cetaceans, possibly beginning **about 52 million years ago**, with the protowhale *Pakicetus*¹¹⁰ and other early whale ancestors collectively known as Archaeoceti. **This group eventually underwent aquatic adaptation into the completely aquatic cetaceans**. The other branch became the *anthracotheres, a large family of four-legged beasts, the earliest of which in the late Eocene would have resembled skinny hippos with comparatively smaller, narrower heads*¹¹¹. All branches of the anthracotheres, except that which evolved into Hippopotamidae, became extinct during the Pliocene, leaving no descendants.

A **rough evolutionary lineage** of the hippo can thus be traced from Eocene and Oligocene species: *from Anthracotherium and Elomeryx to the Miocene species Merycopotamus and Libycosaurus and finally the very latest anthracotheres in the Pliocene*. These groups lived across Eurasia and Africa. The discovery of *Epirigenys* in East Africa, which was likely a descent of Asian anthracotheres and a sister taxon to Hippopotamidae, suggests that **hippo ancestors entered Africa from Asia around 35 million years ago**. **An early hippopotamid is the genus Kenyapotamus**, which lived in Africa from 15 to 9 million years ago. Hippopotamid species would spread across Africa and Eurasia, including the modern pygmy hippo. **From 7.5 to 1.8 million years ago, a possible ancestor to the modern hippo, Archaeopotamus**¹¹², lived in Africa and the Middle East. *The oldest remains of H. amphibius are known from Africa, and date to the Early Pleistocene, approximately 2 million years ago.*”

Nevertheless, the evolutionary “ghost lineage” still consists mostly of “ghosts” – no documentation of a continuous evolution by “infinitesimally small changes” etc. (Darwin)¹¹³ in sight – otherwise there would be no contradictory evolutionary derivations.

Now let’s turn from these *hippo origin* explanations by natural selection of accidental/haphazard/random DNA mutations always implicit in all these evolutionary reconstructions¹¹⁴ and speculations including several doubtful new genera (see discussion above) to what I will call the basically true answer on the origin of our hippos.

¹⁰⁸ <https://www.amnh.org/explore/news-blogs/news-posts/darwin-s-evolutionary-trees>

¹⁰⁹ <https://www.nationalgeographic.com/science/article/of-fossil-ghosts-and-hippos-past>

¹¹⁰ See, however, <https://evolutionnews.org/2022/09/fossil-friday-walking-whales-and-why-all-critiques-of-the-waiting-time-problem-fail/>

<https://evolutionnews.org/2021/12/to-shave-a-cow-sternberg-on-whale-evolution/>

¹¹¹ See Martin Pickford cited on the real differences between anthracotheres and hippos below.

¹¹² Cf. my queries concerning *Archaeopotamus* above.

¹¹³ According to today’s dominant theory of evolution – Neo-Darwinism, also called “the synthetic theory of evolution” and “modern synthesis” – all life forms have evolved gradually from earlier life forms by natural selection of an almost endless array of mutations with “slight or even invisible effects on the phenotype” (in the words of Mayr, one of the architects of the modern synthesis) or *phenotypically* exactly as in Darwin’s formulations of his theory between 1859 and 1882 by “...innumerable slight variations”, “extremely slight variations” and “infinitesimally small inherited variations” <http://www.weloenig.de/Rhinoceros.pdf>

¹¹⁴ Some of the geographical data appear to be correct.

The True Answer on Hippo Origin: Accidental DNA Mutations¹¹⁵ or Ingenious Design?

“The earliest true Hippopotamus appears in the Kenya fossil record **rather abruptly** at about 7 m.y. ago.” (Martin Pickford)

The answer of the founder of scientific paleontology and comparative anatomy, Georges Cuvier, as well as renowned Louis Agassiz (see below) as well as many other qualified researchers was/is – in modern terminology – *ingenious intelligent design*.

Neither the Anthracotheriidae nor Doliochoeridae (Doliochoerinae) include “the ancestors” of Hippopotamidae. According the Cuvier and Agassiz, the basic types or, in my words, the “primary species” (“primäre Arten”)¹¹⁶ of all three families were directed created – this is, after about 200 years of intensive biological research, all the more the best and most reliable scientific conclusion to be drawn from the *abrupt appearances* of these (and other) families in the fossil record as well as their *ingenious blueprints on all biological levels*: Morphology, anatomy, physiology and genetics.

Georges *Cuvier*, often referred to as the “founding father of paleontology” and the researcher who “was instrumental in establishing the fields of comparative anatomy and paleontology through his work in comparing living animals with fossils”¹¹⁷, convinced most of the audience of the intelligent origin of life through a series of biological facts and powerful arguments in the debate with Étienne Geoffroy *Saint-Hilaire* (1830) whose philosophy “is seen as early support of evolution theory”. So, Cuvier is “generally considered the winner¹¹⁸ of the debate”¹¹⁹.

¹¹⁵ To repeat: Apart from changes in RNA viruses and the generally known DNA mutations, there are further possible mutations. Cf. for example: Jonathan Wells J (2013) The membrane code: A carrier of essential biological information that is not specified by DNA and is inherited apart from it. In: Marks RJ II, Behe MJ, Dembski WA, Gordon BL, Sanford JC, eds. Biological Information: New Perspectives. World Scientific (Singapore) pp 474-488. And J. Wells (2014): Membrane patterns carry ontogenetic information that is specified independently of DNA. BIO-Complexity 2:1–28. doi:10.5048/BIO-C.2014.2.

¹¹⁶ <http://www.weloennig.de/Artbegriff.html>

¹¹⁷ https://en.wikipedia.org/wiki/Georges_Cuvier (Retrieved 13 November 2023)

¹¹⁸ I myself would prefer to say that the biological and paleontological facts combined with true/sincere/accurate arguments were the winners the debate: Systematic abrupt appearances and constancy/stasis of new life forms implying (in modern terms) irreducible complexity in probably all cases and generally enormous amounts of specified complexity. See also Cuvier vs. Lamarck: <https://journals.plos.org/plosbiology/article?id=10.1371/journal.pbio.2005558>. As to variation within species, genera and families see again the detailed discussion in: <http://www.weloennig.de/Artbegriff.html>. Incidentally, I would apply this preference just mentioned also to my own discussions with D. Sperlich (<http://www.weloennig.de/Tuebingen1991.MP3>), R. W. Kaplan (<http://www.weloennig.de/NeoIn.html>) and later U. Kutschera (z. B. <http://www.weloennig.de/KutscheraPortner.pdf>).

¹¹⁹ https://en.wikipedia.org/wiki/Cuvier%E2%80%93Geoffroy_debate (Also retrieved 13 November 2023). My view on this article is - although it contains much valuable information - that the debater’s basic differences of opinion (in present language Intelligent Design and Creation (Cuvier) vs. Evolution (Geoffroy) could be much more emphasized. For example: T. Appel 1987, p. 133: “**To both Geoffroy and Lamarck (and to Blainville and many other nineteenth-century naturalists), the notion of God intervening at various times in the uniform operation of nature was thoroughly abhorrent**”... “*Evolution, in effect, was required by Geoffroy's world view*, even though he lacked the factual data to demonstrate it. ... P. 141: “It seemed patently absurd to Geoffroy that Cuvier could number the cranial pieces of fishes from one to thirty-three, find homologies in the higher vertebrates for twenty-five pieces, and insist that the remainder of the bones were created *ad hoc* just for fishes” ... P. 146: “Geoffroy asserted that while it was proper in the past for zoologists to concentrate on the differences of animals, the object of zoology today had become “**the knowledge of the philosophical resemblances of beings.**”” P. 51: “In *Le regne animal* he [Cuvier] asserted, “The pretended scale of beings is only an erroneous application of partial observations to the totality of **creation** . . . and this application has, in my opinion, harmed to a degree that can scarcely be imagined the progress of natural history in our day.” Not only did the chain of being seem to nullify the work of taxonomists, it also conflicted with Cuvier’s teleological functionalism. Animals might vary in insignificant properties, he contended, but **once a major organ was modified, all the organs must be modified so that the animal maintained its integrity**. It would be impossible to pass from one combination of organs to another by insensible gradations, because the intermediaries would simply not be able to function as animals. This same argument of the **nonviability of intermediate forms was used by Cuvier to combat evolution**. Cuvier publicly rejected evolution well before Lamarck announced his theory in 1800. In his first paleontological paper, delivered in 1796, he explicitly denied the possibility that the anatomical differences between the Indian and African elephants might be owing to climate. To believe otherwise, he argued, would be tantamount to proposing that “all quadrupeds could derive from a single species; that the differences they manifest are only successive degenerations. In a word, **this would reduce all natural history to nothing, since its object would consist only of variable forms and fugitive types.**” P. 58: “To say that religious motives affected his scientific doctrines is not equivalent to saying that he blindly rejected evolution on the basis of religious faith. Insofar as the evidence allowed, **Cuvier's scientific theories upheld the traditional view of God's creation and providential concern for His creatures, the recent creation of man and the biblical Flood.**” P. 184: “**A theory of evolution was almost a necessary corollary of Geoffroy's general views on God, nature, and natural law, for the alternative was the entirely unacceptable proposition that God had intervened from time to time to create new animals.**”

W.-E.L.: Although not free from unproven evolutionary presuppositions and the evolutionary world view in general (defending Geoffroy’s views often implicitly or subtly being derogatory of Cuvier’s arguments and achievements), still the most erudite book I have seen so far on this debate is that just quoted of Toby Appel (1987): *The Cuvier-Geoffroy Debate: French Biology in the Decades before Darwin*. New York, New York: Oxford University Press. Text: <https://epdf.tips/the-cuvier-geoffroy-debate-french-biology-in-the-decades-before-darwin.html>

Louis Agassiz, “Swiss-born American biologist and geologist who is recognized as a scholar of Earth's natural history” and he was, among many other activities (see geological and biological tributes¹²⁰), the founder of Museum of Comparative Zoology (formally the Agassiz Museum of Comparative Zoology) with collections of about 21 million specimens, being located on the grounds of Harvard University in Cambridge, Massachusetts.¹²¹

From the doubtful perspective of the ruling evolutionary theory, Neo-Darwinism, one can often read comments like these:

“**Despite** his intensive studies of the anatomy and systematics of recent and fossil fish, through which he was familiar with the graded morphological similarities and possible lines of development, *Agassiz remained a supporter of the catastrophism founded by Georges Cuvier until his death and as such a staunch opponent of the theory of evolution developed by Charles Darwin*. He argued that the usual circumstances used by Darwin for his theory, such as variability and hereditary changes in species, climate change, geological upheavals and even ice ages, **could only ever lead to the extinction of species, but never to the emergence of new species.**”¹²²

Instead of “despite”, Cuvier and Agassiz would most probably say “because of”.

Now, let’s speak Agassiz himself – if only briefly here – from his *Essay on Classification* composing¹²³ the following profound and convincing lines of thought (1859; 1962, pp. 20/21):

„Nothing is more striking throughout the animal and vegetable kingdoms than the **unity of plan in structure of the most diversified types**. From pole to pole, in every longitude, mammalia, birds, reptiles, and fishes exhibit one and the **same plan of structure, involving abstract conceptions of the highest order**, far transcending the broadest generalizations of man, for it is only after the most laborious investigations man has arrived at an imperfect understanding of this plan. *Other plans, equally wonderful, may be traced in Articulata, in Molluscs, in Radiata, and in the various types of plants. And yet the logical connection, these beautiful harmonies, this infinite diversity in unity are represented by some as the result of forces exhibiting no trace of intelligence, no power of thinking, no faculty of combination, no knowledge of time and space*. If there is anything which places man above all the other beings in nature, it is precisely the circumstance that he possesses those **noble attributes without which, in their most exalted excellence and perfection, not one of these general traits of relationship so characteristic of the great traits of the animal and vegetable kingdoms can be understood or even perceived. How, then could these relations have been devised without similar powers?** If all these relations are almost beyond the reach of the mental powers of man, and if man himself is part and parcel of the whole system, how could this system have been called into existence if there does not exist **One Supreme Intelligence as the Author of all things?**”

For the systematic scientific justification of the intelligent design theory, see please the following articles and the many links listed there:

<http://www.weloennig.de/Rhinoceros.pdf> (2022/2023, pp. 8, 47 – 51, 54)

<http://www.weloennig.de/HumanEvolution.pdf> (2019, pp. 46 – 47)

<http://www.weloennig.de/PlantGalls.xyz.pdf> (2020, pp. 4, 14, 50 – 55)

As already pointed out in the latter article: Concerning the systematic refutation of objections and criticisms (raised mostly by scientific materialists/ naturalists (both not seldom extraordinarily polemical) yet also by some other intellectuals against the

¹²⁰ https://en.wikipedia.org/wiki/Louis_Agassiz (w.-e.l.: Agassiz would have rejected polygenism if he had taken Genesis, Mat 19:4 and Acts 17:26 seriously).

¹²¹ https://en.wikipedia.org/wiki/Museum_of_Comparative_Zoology

¹²² https://de.wikipedia.org/wiki/Louis_Agassiz (original German text: “Trotz seiner intensiven Studien der Anatomie und Systematik an rezenten und fossilen Fischen, durch die er mit den abgestuften morphologischen Ähnlichkeiten und möglichen Entwicklungslinien vertraut war, blieb Agassiz bis zu seinem Tod ein Anhänger des von Georges Cuvier begründeten Katastrophismus und als solcher ein entschiedener Gegner der Evolutionstheorie, die von Charles Darwin entwickelt wurde. Er argumentierte, dass die gewöhnlichen Umstände, die von Darwin für seine Theorie herangezogen wurden, wie Variabilität und erbliche Veränderung der Arten, Klimawechsel, geologische Umbrüche und selbst Eiszeiten, immer nur zum Aussterben von Arten führen könnten, aber niemals zur Entstehung neuer Arten.” (Retrieved 14 November 2023)

¹²³ Apart from discussing many other illuminating and thought-provoking facts and arguments.

theory of intelligent design, *cf.* **check please rigorously the books and articles** by Douglas Axe, Günter Bechly, Michael J. Behe, David Berlinski, Tom Bethell, William A. Dembski, Michael Denton, Marcos Eberlin, Phillip E. Johnson, Matti Leisola, Wolf-Ekkehard Lönnig, Casey Luskin, Stephen C. Meyer, J. P. Moreland et al. (eds.), Walter James ReMine, Paul Nelson, John C. Sanford, Siegfried Scherer, Granville Sewell, David W. Swift, James Tour, Jonathan Wells, and many others.

The Oldest Document on the Origin and Life of the Hippopotamus was Written About 3500 Years Ago¹²⁴: Job 40 : 6 and 15 - 24

Continued from the “Brief Profile of the Hippopotamus” above (“Behold now behemoth, Which I made with thee; He eateth grass as an ox...” See Job 40:15-24. Probably the oldest known description of the hippo: more than 3,500 years old.” Sentence above from the King James Version of 1611.)

“Viewing the original **1611 KJV** with **archaic English spelling**” (1611)

Verses 1 and 2:

Moreouer the Lord answered Iob, and said,

Shall hee that contendeth with the Almightye, instruct him? he that reprocueth God, let him answer it.

Verse 6:

Then answered the Lord vnto Iob out of the whirlwinde, and said:

Verses 15 to 24:

Beholde now Behemoth [Hippopotamus]¹²⁵ which I made with thee, hee eateth grasse as an oxe.

Loe now, his strength is in his loynes, and his force is in the nauell of his belly.

Hee moueth his taile like a Cedar: the sinewes of his stones are wrapt together.

His bones are as strong pieces of brasse: his bones are like barres of iron.

Hee is the chiefe of the wayes of God: he that made him, can make his sword to approach vnto him.

Surely the mountaines bring him foorth foode: where all the beasts of the field play.

He lieth vnder the shady trees in the couert of the reede, and fennes.

The shady trees couer him with their shaddow: the willowes of the brooke compasse him about.

Behold, he drinketh vp a riuer, and hasteth not: he trusteth that he can draw vp Iordan into his mouth.

He taketh it with his eyes: his nose pearceth through snares.¹²⁶

¹²⁴ Although having been in error many times and often been corrected by new findings of archeology, there is still a strong tendency of critics of the Bible to date most of its books as late as possible. Job is no exception. “Scholars generally agree that it was written between the 7th and 4th centuries BCE” (Wikipedia 17 November 2023), strange agreement on very imprecise/inaccurate/inexact dates. However, there are powerful facts and arguments that the book was written much earlier, namely by Moses around 1500 years BCE, using even more ancient sources and texts – although this could be a chapter of its own, the following quotation will provide some important points: “Job is written in a form of Hebrew that is even older than the ancient Hebrew that makes up most of the Old Testament. In fact, the language used in Job is not even usually referred to as ancient Hebrew. Instead, it is called “*Paleo-Hebrew*.” The book also contains Syriac and Arabic expressions which point to a period of time between 1900 and 1700 B.C. when the Shemitic tribes had not yet separated into speaking separate Syriac, Hebrew and Arabic dialects. Instead, they still shared a common language.” ... “The age of the book of Job can also be found in what is noticeably missing from the book. There are no mentions of the covenant, the Law of Moses or the priesthood. There are not even any mentions of the Israelite people or the Promised Land. Instead, Job offers sacrifices himself for his sons without the use of a priesthood, temple or consecrated altar. His wealth is measured by the size of his herds and the amount of “qesiytah,” unique silver coins, he possesses. **Both herds and silver were used as ancient systems of money between 1900 and 1700 B.C.** The names of Job’s sons were also uncommon in later time periods but *were common before and during the time of the patriarchs.*” <https://www.beliefnet.com/faiths/christianity/what-is-the-oldest-book-in-the-bible.aspx> (As for citations, see above: *Just a Few Key Points of the Contents*: the footnote for *Contents*.)

¹²⁵ “...a number of Bible translations (AT, La, Ro, NW, JB, RS) use the word “hippopotamus” in the main text or in footnotes to identify the creature referred to by God.” More here: <https://wol.jw.org/en/wol/d/r1/lp-e/1200000619> And ro ro ro Tierwelt, Das Urania Tierreich in 18 Bänden bemerkt in Säugetiere 3 (p. 377): ...die Bibel [bekundet] die frühgeschichtliche Existenz des Flusspferdes in Klein- und Vorderasien, **besonders Palästina, unter dem Namen „Behemot“**. Diese Erwähnung wird durch **archäologische Belege und Knochenfunde bestätigt**.“ Und Grzimeks Tierleben. dtv. Säugetiere 4 (p. 107): „Noch im Altertum war das Flusspferd über weite Teile Afrikas verbreitet und lebte **auch in einigen Gebieten Palästinas**.“

¹²⁶ https://www.kingjamesbibleonline.org/1611_Job-Chapter-40

Now **some modern translations** of the Hebrew Text:

New World Translation of the Holy Scriptures (2013)

Chapter 40

Verses 1 to 2:

Jehovah¹²⁷ continued to answer Job:

Should a faultfinder contend with the Almighty? Let the one who wants to reprove God answer.

Verse 6:

Then Jehovah answered Job out of the windstorm:

Verses 15 – 24:

Here, now, is Be·he'moth [the Hippopotamus]¹²⁸,
which I made as I made you.

It eats grass like a bull.

Look at the strength in its hips

And the power in the muscles of its belly!

It stiffens its tail like a cedar¹²⁹;

The sinews of its thighs are woven together.

Its bones are tubes of copper;

Its limbs are like wrought-iron rods.

It ranks first among the works of God;

Only its Maker can approach it with his sword.

For the mountains produce food for it,

Where all the wild animals play.

It lies down under the lotus trees¹³⁰,

In the shelter of the reeds of the marsh.

The lotus trees cast their shadow on it,

And the poplars of the valley surround it.

If the river is turbulent, it does not panic.

It is confident, although the Jordan rushes against its mouth.

Can anyone capture it while it is watching,

Or pierce its nose with a hook?¹³¹

New International Version (2011)

Chapter 40:

Verses 1 and 2:

The LORD said to Job:

"Will the one who contends with the Almighty correct him?

Let him who accuses God answer him!"

Verse 6:

Then the Lord spoke to Job out of the storm:

Verses 15 – 24:

¹²⁷ As for the pronunciation of God's name, see, for example: Gérard Gertoux (2002): The Name of God Y.eH.oW.aH Which is pronounced as it is Written I_Eh_oU_Ah University Press Of America. Lanham, Maryland. https://www.amazon.com/Y-eh-ow-ah-Which-Pronounced-Written-I_Eh_Ou_Ah/dp/0761822046
See also the interviews with Hebrew scholars in the film by Fritz Poppenberg (2015): Der Name Gottes. Sprachen: Deutsch, English, Español. Untertitel: französisch, spanisch, italienisch, polnisch, russisch, tschechisch, portugiesisch, türkisch, dänisch. <https://www.dreilindenfilm.de/produkt/der-name-gottes/>

¹²⁸ See footnote previous page.

¹²⁹ "In hippopotamuses, the short but **fleshy tails are endowed with strong musculature** which actively and rapidly swish the tail from side to side during defecation, acting somewhat like a dung spreader (both in the water and on land) (Skinner & Smithers, 1990; Klingel, 2013; Robinson, 2013). **In these animals, the coccygeal vertebrae have elongated transverse processes to support the muscle mass.**" See long citation of Pickford above in the main text.

¹³⁰ "In the Bible, the Book of Job also has two lines (40:21–22), with the Hebrew word עֲלִים (tse'elim),[5] which appears nowhere else in the Bible. A recent translation into English has been "lotus trees" since the publication of the Revised Version of the King James Bible of 1881. However, it is otherwise rendered simply as "shady trees." https://en.wikipedia.org/wiki/Lotus_tree (Retrieved 23 November 2023)

¹³¹ <https://www.jw.org/en/library/bible/study-bible/books/job/40/>

Look at Behemoth,
 which I made along with you
 and which feeds on grass like an ox.
 What strength it has in its loins,
 what power in the muscles of its belly!
 Its tail sways like a cedar;
 the sinews of its thighs are close-knit.
 Its bones are tubes of bronze,
 its limbs like rods of iron.
 It ranks first among the works of God,
 yet its Maker can approach it with his sword.
 The hills bring it their produce,
 and all the wild animals play nearby.
 Under the lotus plants it lies,
 hidden among the reeds in the marsh.
 The lotuses conceal it in their shadow;
 the poplars by the stream surround it.
 A raging river does not alarm it;
 it is secure, though the Jordan should surge against its mouth.
 Can anyone capture it by the eyes,
 or trap it and pierce its nose?¹³²

Then New Living Translation (2015):

Chapter 40:

Verses 1 and 2:

Then the Lord said to Job,
 “Do you still want to argue with the Almighty?
 You are God’s critic, but do you have the answers?”

Verse 6:

Then the Lord answered Job from the whirlwind:

Verses 15 – 24:

“Take a look at Behemoth,
 which I made, just as I made you.
 It eats grass like an ox.
 See its powerful loins
 and the muscles of its belly.
 Its tail is as strong as a cedar.
 The sinews of its thighs are knit tightly together.
 Its bones are tubes of bronze.
 Its limbs are bars of iron.
 It is a prime example of God’s handiwork,
 and only its Creator can threaten it.
 The mountains offer it their best food,
 where all the wild animals play.
 It lies under the lotus plants,
 hidden by the reeds in the marsh.
 The lotus plants give it shade
 among the willows beside the stream.
 It is not disturbed by the raging river,
 not concerned when the swelling Jordan rushes around it.
 No one can catch it off guard
 or put a ring in its nose and lead it away.¹³³

¹³² <https://www.biblegateway.com/passage/?search=Job%2040&version=NIV> or http://web.mit.edu/jywang/www/cef/Bible/NIV/NIV_Bible/JOB+40.html

¹³³ <https://www.biblegateway.com/passage/?search=Job%2040&version=NLT>

Revised Standard Version (1952)

Chapter 40: Verses 1 and 2:

And the Lord said to Job:

“Shall a faultfinder contend with the Almighty?

He who argues with God, let him answer it.”

Verse 6:

Then the Lord answered Job out of the whirlwind:

Verses 15 – 24:

Behold, Be'hemoth,[a]

which I made as I made you;

he eats grass like an ox.

Behold, his strength in his loins,
and his power in the muscles of his belly.

He makes his tail stiff like a cedar;
the sinews of his thighs are knit together.

His bones are tubes of bronze,
his limbs like bars of iron.

“He is the first of the works[b] of God;
let him who made him bring near his sword!

For the mountains yield food for him

where all the wild beasts play.

Under the lotus plants he lies,
in the covert of the reeds and in the marsh.

For his shade the lotus trees cover him;
the willows of the brook surround him.

Behold, if the river is turbulent he is not frightened;
he is confident though Jordan rushes against his mouth.

Can one take him with hooks,[c]
or pierce his nose with a snare?¹³⁴

Footnotes:

Job 40:15 Or the **Hippopotamus**, Job 40:19 Heb ways, Job 40:24 Cn: Heb in his eye

And an *Interlinear Translation Hebrew German* by Rita Maria Steurer (1967/77, 1984 by Deutsche Bibelgesellschaft, Stuttgart. Copyright 1999 by Hänssler Verlag, Holzgerlingen, Germany. Job 40: Verses 1 and 2, 6 and 15 – 24 (Pp. 506 – 509).

To be read from right to left.

וַיֹּאמֶר׃ wayyoʾmar. :sprach-(er)-und	אֶת־אִיּוֹב ʾet-ʾiyoʾb-ʾet Ijob***	יְהוָה y-hwəh JHWH	1 וַיַּעַן wayyaʿan entgegnete-(es=)er-Und	40
מוֹכִיחַ moʾkiʾah Rügender-(Ein)	יֹסֵר yissoʾr ?Tadler-(der)-(wird)	שְׂדָי šadday Schaddai	עִם -ʿim mit	2 הָרֹב hʾrob Streiten-(ein)-Etw
אִיּוֹב ʾiyoʾb Ijob	3 וַיַּעַן wayyaʿan entgegnete-(es=)er-Und	יַעֲנֶנּוּ׃ yaʿnennəh. ?(es=)sie-(be)antworten-(soll=)wird-(er)	אֱלֹהִים ʾeloʾah Eloah	

וַיֹּאמֶר׃ wayyoʾmar. :sprach-(er)-und	סַעֲרָה[סַעֲרָה] [sʾʿrəh]sʾʿrəh Sturmwind-(dem)	מִמֶּנּוּ [min]min (aus=)von	אֶת־אִיּוֹב ʾet-ʾiyoʾb-ʾet Ijob***	יְהוָה y-hwəh JHWH	6 וַיַּעַן -wayyaʿan entgegnete-(es=)er-Und
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¹³⁴ <https://www.biblegateway.com/passage/?search=Job%2040%3A15-24&version=RSV>

Verses 15 – 24

508		Ijob		40,15-21	
אֲשֶׁר־ -šer welches	בַּהֲמוֹת b ^h hemo ^w t ,(Flusspferd-das=)Behemot	נָא no ^ʔ (nur=)doch	15 הִנֵּה־ -hinne ^h Sieh	יְמִינֶךָ: y ^m mi ⁿ ek ^h . !Rechte-deine	
יֹאכַל: yo ^ʔ kel. frisst-(es=)er	כַּבָּקָר kabbqqr Vieh-das-wie	חֲצִיר ħ ^ʕ šir Gras	עִמָּךְ ‘immok :(dich-wie=)dir-mit	עָשִׂיתִי ‘ ^ʕ šiti ^y (schuf=)gemacht-ich	
וְאָנוּ w ^ʔ ono ^w Kraft-seine-und	בְּמַתְנֵיוֹ b ^ʔ mot ^ʔ no ^w Lenden-(zwei)-seinen-in	כֹּחַ koħ ^w Stärke-seine	נָא no ^ʔ (nur=)doch	16 הִנֵּה־ -hinne ^h Sieh	
כַּמוֹ- -k ^ʔ mo ^w wie	זַנְבוֹ z ^ʔ nbo ^w Schwanz-sein(en)	17 יַחַפֵּן yah ^ʔ poš strafft-(Es=)Er	בְּטֶנוֹ: bi ^ʔ no ^w . !Leib(es)-sein(es)	בְּשָׂרָיו biš ^ʔ ri ^y Muskeln-(den)-in	
יִשְׂרָגוּ: y ^ʔ so ^ʕ gu ^w . ,verflochten-sind-(sie)	פַּחְדּוֹ [פַּחְדּוֹ] [pah ^ʔ do ^w]pah ^ʔ do ^w Schenkel-seine(r)	גִּידֵי gi ^ʔ de ^y Sehnen-(die)	אָרְזִי ‘ ^ʔ rez ;Zeder-(eine)		
גְּרָמֵיו g ^ʔ ra ^ʔ mo ^w Glieder-seine	נְחוּשָׁה n ^ʔ ħu ^w š ^ʕ ^h ,Erz	אֲפִיקֵי ‘ ^ʔ pi ^ʔ qe ^y (aus)-Röhren-(wie-sind)	18 עֲצָמוֹ ‘ ^ʔ šo ^ʔ mo ^w Knochen-Seine		
דַּרְכָּי־ -dar ^ʔ ke ^y Wege-(der)	רֵאשִׁית re ^ʔ šit Erstling-(der)	19 הוּא hu ^w (war)-(Es=)Er	בְּרֹזֶל: bar ^ʔ zel. .Eisen-(aus)	כַּמְטִיל kim ^ʔ til Stange-(eine)-wie	
יָגֵשׁ yaggeš herbeibringe-(es=)er-(dass)	הָעֹשֹׂה ħo ^ʔ šo ^w ,(es=)ihn-war-machend(e)-der	אֵל ‘ ^ʔ el ,(Gottes=)El			
הַרִימ ħori ^ʔ m Berge-(der)	בּוֹל bu ^w l Erzeugnis-(das)	20 כִּי־ -ki ^y ,(Wahrlich=)Denn	חַרְבוֹ: ħar ^ʔ bo ^w . .Schwert-sein		
חַיַּת ħayat (Wild=)Tier	וְכֹל־ -w ^ʔ kol alles-und	לּוֹ lo ^w ,ihm-zu	יִשְׂאוּ־ -yiš ^ʔ u ^w bringen-(soll-man=)werden-sie		
21 תַּחַת -taħat Unter	שָׁם: š ^ʔ m. .dort	יִשְׂחַקּוּ־ -y ^ʔ š ^ʔ ħ ^ʔ qu ^w (spielt=)sich-erlustigen-(sie)	הַשָּׂדֶה ħaššode ^h Feldes-(freien)-des		

ובצה: u ^w biššəḥ.	קנה qone ^h	בסתור b ^s eter	ישכב yiš ^o kob	צאלים še ^o li ^m
.Sumpf-und	Schilfrohr-(von)	Versteck-im	,lagert-(es=)er	Lotusbüschen

צללו šil ^o lo ^w	צאלים še ^o li ^m	22 יסכחו y ^s sukkuhu ^w
,Schatten-sein-(als)	Lotusbüsche	(es=)ihn-bedecken-(Es=)Er

יעשק ya ^{ca} šoq	23 הן hen	ערבי-נחל: noḥal- ^c ar ^o be ^y .	יסבחו y ^s subbu ^w hu ^w
andringt-(gewaltig)-(er)	Wenn	.Fluss-pappeln-(die)	(es=)ihn-umgeben-(es=)sie

כי- -ki ^y	יבטח yib ^t ah	יחפוז yah ^o po ^w z	לא lo ^o	נהר nohor
dass	,vertraut-(es=)er	,bestürzt-wird-(es=)er	nicht	,Strom-(der)

פיהו: pi ^h hu ^w .	אל- -el	ירדן yar ^o den	יניח yngi ^h ah
.(Beute)-(Maul=)Mund-sein(en)	(in=)zu	Jordan-(der)	hervortreibt-(er)

במוקשים b ^o mo ^w q ^o šim	יקחנו yiqqo ^h ennu ^w	24 בעיניו b ^e e ^o ni ^w
Fanghaken-(mit=)in	,(es=)ihn-(griffe=)packt-(w)er	Augen-seine(n)-(An=)In

אף: af ^o .	ינקב- -yin ^o qob
?Nase-(die)	durchbohrt(e)-(w)er

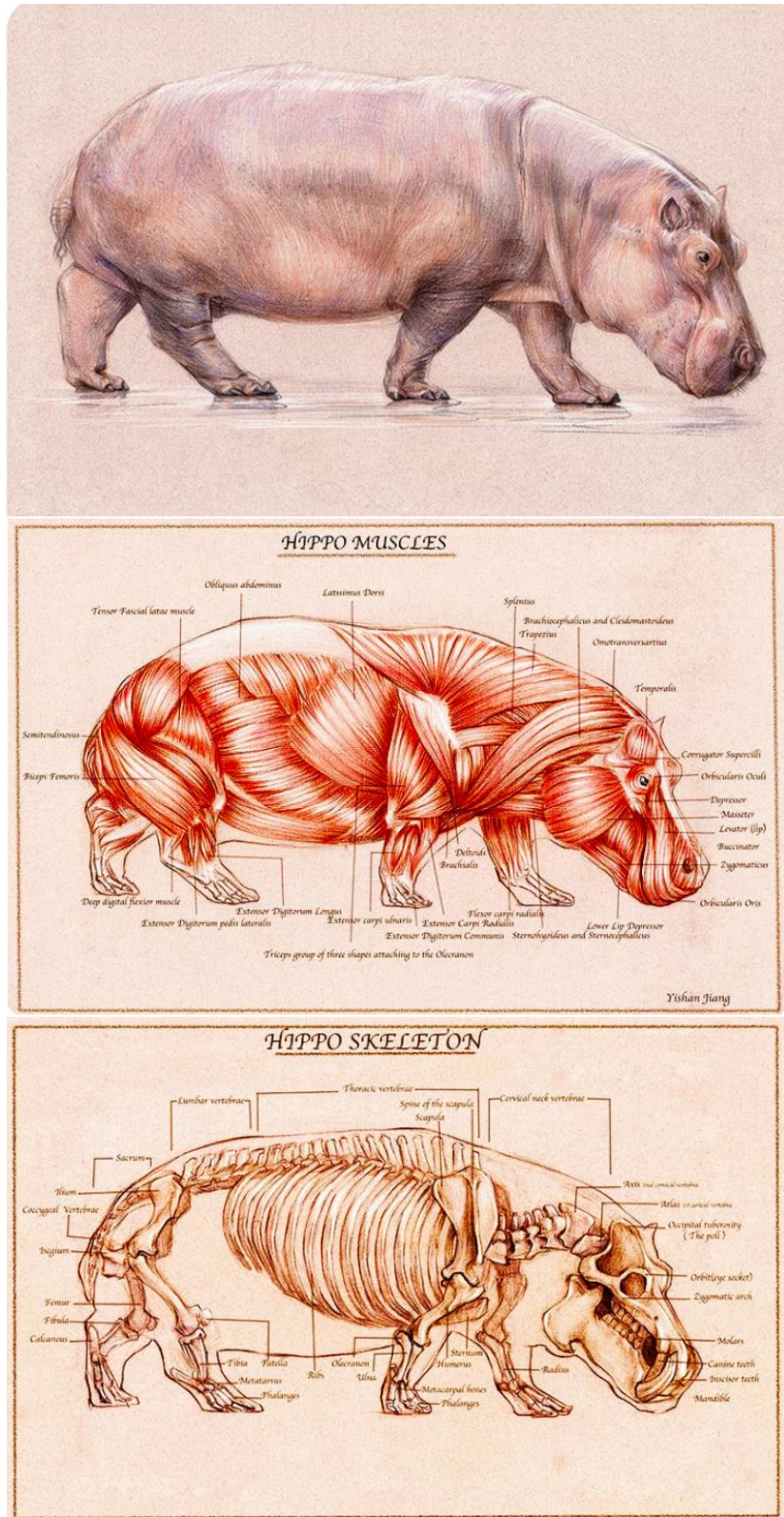
And an English version here: <https://biblehub.com/interlinear/job/40.htm>

(15) “It eats grass like a bull.”



“Hippopotamus (*Hippopotamus amphibius*) in Chobe National Park, Botswana” Author Bernard Gagnon (2017)
https://commons.wikimedia.org/wiki/File:Hippopotamus_in_Chobe_National_Park_02.jpg (Retrieved 8 December 2023)

(16) “Look at the strength in its hips / And the power in the muscles of its belly!” (17) “It stiffens its tail like a cedar¹³⁵; / The sinews of its thighs are woven together.” (18) “Its bones are tubes of copper; / Its limbs are like wrought-iron rods.”



Hippo drawing by YishanJiang on DeviantArt
<https://www.pinterest.de/pin/166070304995800515/>
 (Retrieved 8 December 2023)

¹³⁵ See please again footnote above for the text of The New World Translation.

(20) “For the mountains produce food for it,
Where all the wild animals play.”

See: <https://depositphotos.com/de/photo/animal-community-be-different-24773895.html>

And a series of further photographs of *hippos together with many additional animals* here: <https://zoorope.hu/en-mixed-exhibit-hippopotamidae/> (Both links retrieved 8 December 2023)

The identification of Behemoth with the *Hippopotamus*¹³⁶ as presented above does *not exclude*, of course, an allegorical/metaphorical interpretation of that animal – nor of most (or all?) of the other animals (young lions, raven, mountain goats, deer, wild donkey, zebra (?), wild bull, ostrich, stork, horse, locust, falcon, eagle), and plants (“every green plant”, grass, cedar, lotus trees, reeds, poplars) mentioned in the 2 chapters before. However, that would go beyond the scope of the present article.

Supplement

I hesitated some time before I decided to reproduce the following text on Cuvier *vs.* Lamarck by Herbert Wendt from his book *In Search of Adam* here. Wendt (1914 – 1979) was an evolutionary biologist¹³⁷ who correspondingly wrote this book from his strictly anti-creationary and anti-catastrophist¹³⁸ viewpoint. “His international bestseller was *In Search for Adam*¹³⁹ and his reference works *Grzimek's Animal Life* and Kindler's *Encyclopaedia of Man* are of lasting scientific importance.” “He [also] acted as editor-in-chief and author of many contributions to the publication of the encyclopaedia *Grzimek's Animal Life*, which bears his stylistic signature in large parts through revision.”

Cuvier is portrayed here as such a ruthless protagonist of his views, so that in the end one can only feel sorry for Lamarck. As far as I could find out, no corrections were made of this section of the narrative in the following improved editions of the book¹⁴⁰.

Nevertheless, this vivid description may show something of the **tense atmosphere**¹⁴¹ in which the debate not only between Cuvier and Lamarck but also between Cuvier and St. Hilaire and further of Cuvier's opponents took place, even from Wendt's Darwinian perspective.

Now, Herbert Wendt's text on *Die Verurteilung des Jean Baptiste Lamarck* (The Judgement on Jean Baptiste Lamarck):¹⁴²

“On the day on which his fate was to be decided he was lecturing on the cave salamander. He was fond of referring to this classical example. The creature lived in the caves of the Illyrian alps and had according to the

¹³⁶ When, on 7 October 2023 in the late afternoon, I went on carefully studying the pigmy hippo in the Duisburg Zoo/Germany, a group of visitors appeared, talked about it in a language I did not understand, but one of them clearly and unmistakably said “Behemoth”. When I kindly tried to ask them where they are from and why “Behemoth”, they were unfortunately unresponsive. I can only surmise that they were Jewish visitors.

¹³⁷ [https://de.wikipedia.org/wiki/Herbert_Wendt_\(Schriftsteller\)](https://de.wikipedia.org/wiki/Herbert_Wendt_(Schriftsteller))

¹³⁸ However, after enormous polemics during the last some 130 years against it from around 1830 to 1980, catastrophism is nowadays seriously discussed in science: See for example: <https://en.wikipedia.org/wiki/Catastrophism> (Retrieved 30 November 2023)

¹³⁹ “It was **translated into around twenty languages** and was the second German book to be honoured as “Book of the Month” in the USA after the war in August 1956. *In search of Adam* **achieved high print runs** and was **published again and again in improved editions over the next decades**.” The English edition also in 1973 by Greenwood Press 1973.

¹⁴⁰ „Wendt describes the personalities and quarrels of the early fossil hunters in convincing detail, in particular the disputes between Cuvier and Lamarck and Marsh and Cope.” <https://www.kirkusreviews.com/book-reviews/a/herbert-wendt-6/before-the-deluge/>

“In Search of Adam by Herbert Wendt is a comprehensive exploration of mankind's pursuit to uncover the truth about their earliest ancestors. The book delves into the history of human evolution and the various scientific discoveries that have contributed to our understanding of the origins of humanity. From the discovery of the first hominid fossil to the latest genetic research, Wendt takes readers on a fascinating journey through time to uncover the truth about our earliest ancestors. The book also examines the cultural and social implications of our evolving understanding of human origins, including the impact on religion, philosophy, and society as a whole. With its engaging narrative and in-depth analysis, In Search of Adam is a must-read for anyone interested in the history of human evolution and the quest for knowledge about our origins. This scarce antiquarian book is a facsimile reprint of the old original and may contain some imperfections such as library marks and notations. Because we believe this work is culturally important, we have made it available as part of our commitment for protecting, preserving, and promoting the world's literature in affordable, high quality, modern editions, that are true to their original work.”

<https://www.goodreads.com/book/show/11041852-in-search-of-adam>

¹⁴¹ As I have experienced myself in several public discussions.

¹⁴² https://archive.org/details/insearchofadamst00wend_0/page/38/mode/2up?q=Cuvier 1956, pp. 163 – 165/166.

environment theory, lost its sight because it had no need of vision in the darkness of the caves. But if it were kept for any length of time in an illuminated aquarium its sight returned. As Lamarck was explaining how his salamander grew genuine little eyes under the influence of light a stir of excitement passed through the hall. But this reaction was not caused by the miracle of the salamanders. It was because someone had suddenly entered the lecture room and sat down on one of the rear benches. The students turned round. Some of them clapped. Cornélie Lamarck looked up. She turned as white as a sheet. For the newcomer was Cuvier himself.

Cuvier listened for some time to the story of the salamanders. Then he stood up. He called out in a rude and tactless way that was unlike him, "If that is so, Monsieur Lamarck, one can only conclude that you, too, have made no use of your eyesight, and have consequently lost it!" Not a sound came from the hall. Lamarck had nothing to say, for he possessed very little presence of mind. He fiddled nervously with his collar. "If you used your eyes a little more," Cuvier went on ironically, "you would get a better idea of nature, instead of indulging in obscure fancies. Then perhaps you might get your sight back, eh?"

Several of the students laughed. Cornélie laid her head on the desk and began to cry quietly. "I beg you, Cuvier," said Lamarck in faint voice, "let us not make this a personal matter!"

Cuvier snapped back, "You didn't make any personal attacks on me in your philosophy of zoology, did you?"

"Not that I am aware of," Lamarck mumbled. A further wave of excitement ran through the hall. Some of the hostile students cracked jokes. They suggested that Lamarck ought to be asked how it was that he had not bequeathed his blindness to his numerous offspring. Seizing her father's arm, Cornélie tried to pull him out of the hall, away from this agonizing scene. He resisted her, and glared in the direction of Cuvier. Then he said in a defiant tone that sounded above the uproar, "I stand by everything I have written and taught. And I must now ask you, Cuvier, to leave the room!"

"Are you afraid?" Cuvier inquired. "If you are not, kindly answer one question, will you? Do you still maintain your assertion that fossilized forms of life are the predecessors of present-day species?"

"Certainly," replied Lamarck.

"You dare to tell me that to my face?" Cuvier banged the desk with his fist. "You know perfectly well that I have proved the contrary!"

"I don't believe in your doctrine of catastrophes," retorted Lamarck imperturbably. But no sound of agreement reached him. "Your demonstrations, Cuvier," he went on, "do not constitute proof, as far as I am concerned."

"That is an insult!" Cuvier thundered back. "I formally challenge you to produce your counterevidence or publicly retract your theory!"

Lamarck shook his head. "My theory cannot be proved any more than yours can," he said. "Not yet. Posterity will decide between us."

"Then you are no scientist, but a dreamer!" Cuvier glanced round the room. Most of the listeners were gazing at him excitedly. "I can prove anything I teach," he said. "I propose that the audience adjourn to my own lecture room. Find out for yourselves, gentlemen, which theory is correct, mine or that of this pitiful creature!"

The students followed Cuvier out of the room. However painful the incident might have been, even those of them who supported Lamarck did not want to miss the promised entertainment. Only Lamarck and Cornélie remained behind.

Cuvier's lecture hall was furnished with blackboards upon which sketches of antediluvian monsters had been drawn. Cuvier discussed them. He chose one, *Palaetherium magnum*, which looked like a mixture of rhinoceros, tapir and horse. He asked his listeners whether they thought it conceivable that any living creature could be derived from such a monster. No one did think so. "The type," said Cuvier, "is immutable. Paleotherium never was and never became anything but a Paleotherium. For nature is no subject to caprice, but to order, not to the play of chance, but to correlation."

He pointed to a stone slab lying on the table before him. "I should like now to try to reconstruct for you, from a single bone, an animal that I have never yet seen," he told the students, who were breathless with excitement. "If I succeed, you will be so good as to accept it as a proof that I understand fossils better than Monsieur Lamarck!" Only a tiny fragment of bone protruded from the slab. Everything else lay hidden in the stone. "I have never come across such a fossil before," he went on. "But I believe that from the small bone visible I can deduce the invisible from inside the stone. And I don't only believe it, gentlemen, I am sure of it; for I know that nature works in accordance with fixed, unalterable plans. This animal is an opossum dating from the early Tertiary period."

The students were torn between faith and skepticism. No one could yet identify the typical pouch bones and the typical opossum teeth. Perhaps Lamarck was right, after all, and some quite different animal might come out of the stone, stamped in some special way with the character of its environment. Cuvier chiseled away chip after chip from the slab. Nerve-recking minutes and quarters of an hour passed. Everyone was staring, spellbound, at the stone. At last, just as one of the students uttered a low cry of astonishment, with a jovial laugh Cuvier held up the pouch bones to the light. The fossil was in fact an early Tertiary opossum, as he had foretold.

The victorious expert was carried triumphantly through the Jardin. No one any longer doubted the truth of his teaching. Lamarck's utopian visions faded before the realities which Cuvier conjured out of stone and identified with calm certainty. It did not occur to anyone that this sort of reconstruction, though it might well prove the law of correlation, did not prove the theory of catastrophes. The fascination exercised by the magical art of this zoologist was so great, that even Saint-Hilaire, who had always opposed Cuvier, set aside his scruples and worked in close collaboration with him for some time. In any case, Geoffroy Saint-Hilaire had never really felt confident about the environment theory in the emphatic form given it by Lamarck.

The latter's lecture hall thenceforward remained empty. In deep distress the little man from Picardy waited day after day in vain for his pupils to return. He was shunned like a leper. Soon after the collision with Cuvier he had to resign his professorship on account of total blindness. He lived almost another twenty years, in miserable circumstances, giving occasional private lessons in natural science for low fees and preparing frivolous students who had been idling through their school year for their final examinations. It is amazing that he nevertheless retained enough energy to dictate from memory to his loyal daughter Cornélie and her sister the eleven volumes of his natural history of invertebrates. Even completion of this work did not suffice to rescue him from poverty. It was ignored until the age of Darwin. Finally, about 1890, the zoologist Alfred Giard gave Lamarckism currency in France.

Toward the end of his life Lamarck had one more piece of good fortune. The first French socialists appeared and proclaimed that nature and mankind could be altered by a change in the constitution of society. Lamarck's idea that animate beings are created by their environment suited their political program. They visited him in his tenement and did their best to obtain some support from him in natural science for their social theories, but Lamarck had grown too old and weak to throw himself once more into the struggle. He courteously declined the invitation of the eager party theorists of the school of Count Saint-Simon and Francois Marie Charles Fourier to impart enlightenment."

And another report on Cuvier¹⁴³:

"Later on, when Cuvier had reached the height of his fame, an incident occurred that caused even amateur naturalists to extol his correlation law. Some students plotted to play a trick on him. One of them dressed up as the Devil, stuck horns on his head, put on shoes shaped like a cloven hoof, and broke into Cuvier's house by night in this garb, while his companions crowded round the window and stared in.

Cuvier was lying fast asleep when suddenly a great voice roared in his ear: "Wake up, thou man of catastrophes! I am the Devil!" Cuvier at once opened his eyes, lit a candle, and observed the monster with interest. "I am the Devil!" cried the disguised intruder once more. "I have come to devour you!"

Devour me?" Cuvier shook his head. "I doubt whether you can. You've got horns and hoofs. According to the Law of Correlation you only eat plants." He turned on his other side and went to sleep again. And the students outside the window, instead of laughing, gave him an enthusiastic ovation."

As for the "First edition of a work which laid the foundation to vertebrate paleontology" see please (again):

Georges Cuvier (1812): *Recherches sur les ossements fossiles de quadrupèdes: où l'on rétablit les caractères de plusieurs espèces d'animaux que les révolutions du globe paroissent avoir détruites* (Research on the fossil bones of quadrupeds: where we restore the characteristics of several species of animals that the revolutions of the globe appear to have destroyed)¹⁴⁴. On the *Hippopotamus*:

<https://www.biodiversitylibrary.org/item/123713#page/140/mode/1up>
or, more correctly, from page/111/to 174:

<https://www.biodiversitylibrary.org/item/123713#page/111/mode/1up>
<https://www.biodiversitylibrary.org/item/123713#page/174/mode/1up>¹⁴⁵

Back to Internet Library

¹⁴³ Here now from Wendt, p. 149, i.e. before the long text of the book as quoted above.

¹⁴⁴ There seems to be also an English translation of Cuvier's book *Recherches sur les ossements fossiles ...* in 1813 and as well as of later editions: See details by Jean Chandler Smith (1993): Georges Cuvier. An Annotated Bibliography of His Published Works. Smithsonian Institution Press. Washington and London. 251 pp. (See pp. 150/151) Foreword by Stephen Jay Gould, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (pp. vii - xi).

¹⁴⁵ All retrieved 30 November 2023.