EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

WORDS BONES GENES TOOLS
Tracking Linguistic, Cultural, and Biological Trajectories of the Human Past

DFG

Modern Human Origins

Hugo Reyes-Centeno, Yonatan Sahle, Christian Bentz

19 Nov 2018, Lecture 5

For today's lecture:

- **Hominin taxonomy**
  How do we classify human fossils?
- **Modern human fossils**
  When and where do we find anatomically modern fossils?
- **Populations and demes**
  Are population models better than species models?
- **Models of anthropogeny**
  What model of modern human origins is best supported with the current evidence?

Hominin taxonomy

How do we classify human fossils?

Classification and taxonomy

- Classifying the natural world
- Linnean hierarchical classification
- Numerical taxonomy
- Cladistics
- Phylogenetics

Classification and taxonomy

- **Classifying the natural world**

- Classification based on perceived organismal complexity

- Tied to metaphysical understanding of existence

Classification and taxonomy

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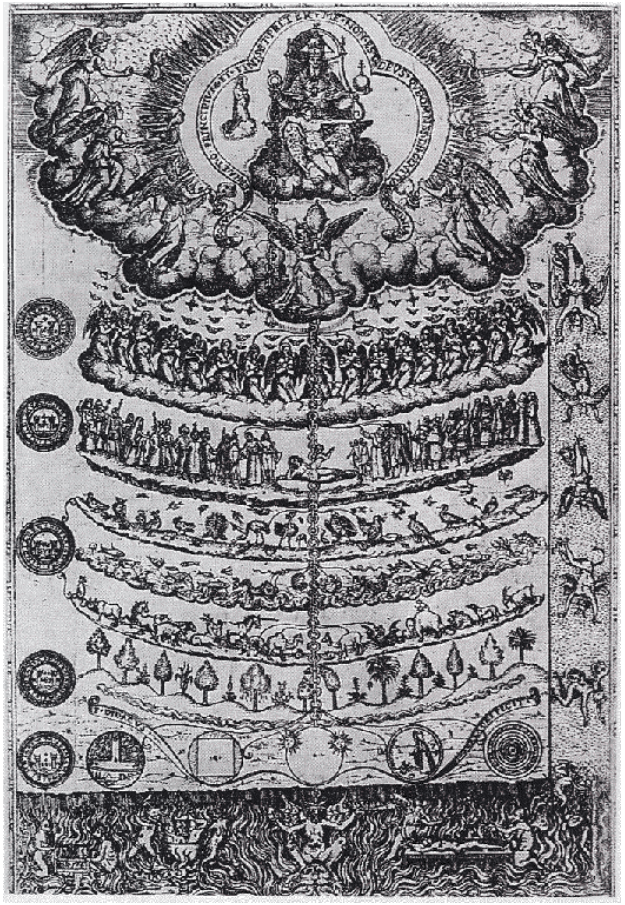
Aristotle‘s Great Chain of Being, Plato‘s Academy, 4th Century Greece



Valades, Didacus. 1579. *Rhetorica Christiana.*

Classification and taxonomy

- **Classifying the natural world**
- Classification based on perceived organismal complexity
- Tied to metaphysical understanding of existence

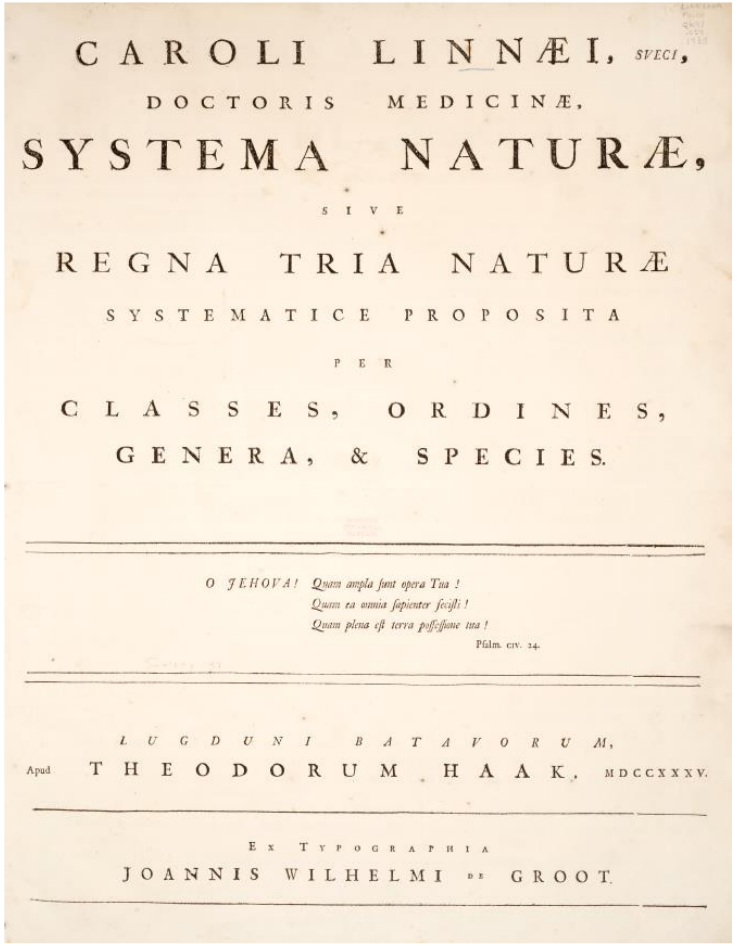
Khaldun's *Introduction to Universal History*, 14th Century Islam, Tunisia

"..the world of creation…started out from the minerals and progressed, in an ingenious, gradual manner, to plants and animals. …the last stage of each group is fully prepared to become the first stage of the newest group. The animal world then widens, its species become numerous, and, in a gradual process of creation, it finally leads to man, who is able to think and reflect. "

Khaldun, Ibn, 14th Century, *The Muqaddimah* (مقدمة)

Classification and taxonomy

- Classifying the natural world
- **Linnean hierarchical classification**
- Numerical taxonomy
- Cladistics
- Phylogenetics



CAROLI LINNÆI, SVECI,
DOCTORIS MEDICINÆ,
SYSTEMA NATURÆ,
SIVE
REGNA TRIA NATURÆ
SYSTEMATICE PROPOSITA
PER
CLASSES, ORDINES,
GENERA, & SPECIES.

O JEHOVA! Quam ampla sunt opera Tua!
Quam ea omnia sapienter fecisti!
Quam plena est terra possessione tua!
Psalm. civ. 24.

LUGDUNI BATAVORUM,
Apud THEODORUM HAAK, MDCCXXXV.

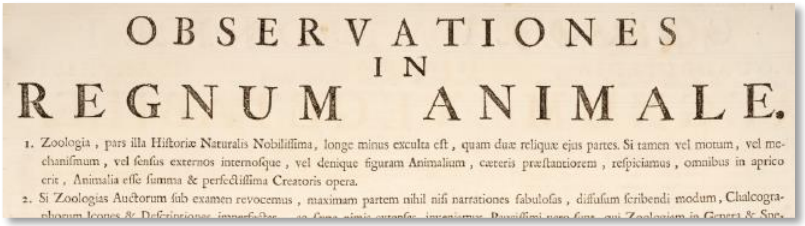
Ex Typographia
JOANNIS WILHELMI DE GROOT.

Classification and taxonomy

- ❑ Classifying the natural world
- ❑ **Linnean hierarchical classification**
  - Classification based on observations and physical affinities
  - Development of binomial nomenclature
  - Establishment of International Commission on Zoological Nomenclature (ICZN) in 1895


OBSERVATIONES
IN
REGNUM VEGETABILE.

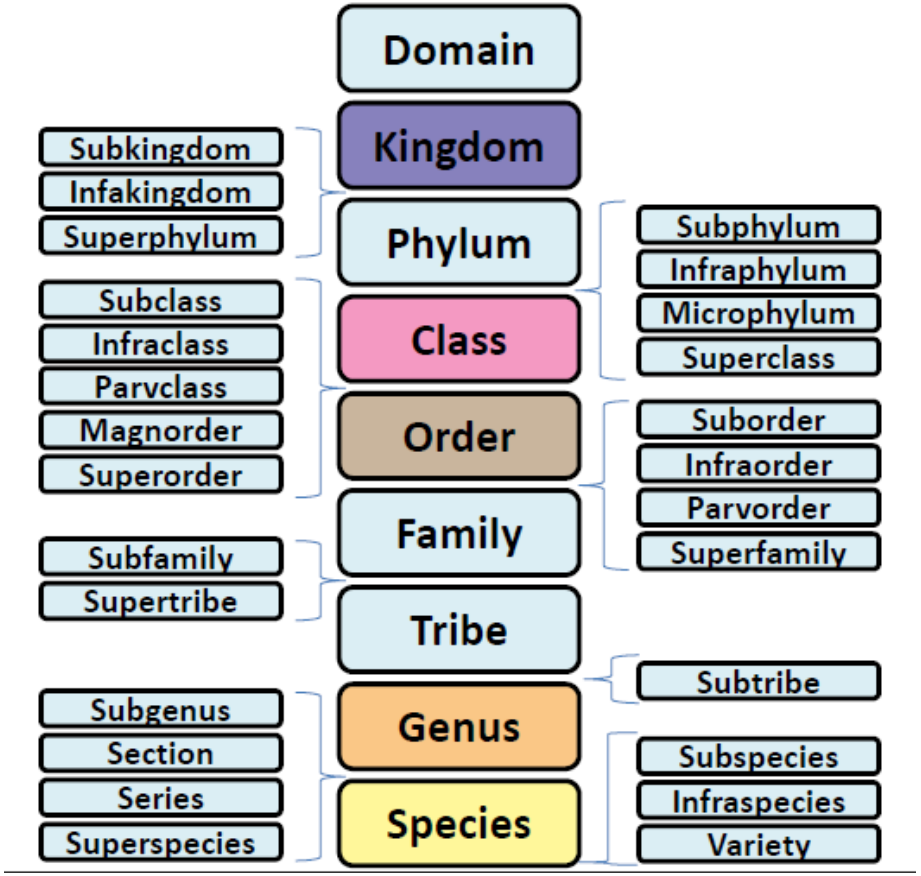
1. Omnem Plantam Fructificatione gaudere, docet in majoribus nuda autopsia; in minoribus, Filicibus nempe, Muscis, Algis & Fungis oculus armatus, ut testantur Clariss. Michelii, aliorumque observationes; nec ullam unquam Plantarum speciem Fructificatione carere posse, patet consideranti analogiam, ulum, finem, structuram, creationem harum. Reliquæ autem Plantarum partes in multis deficiunt, ut Radix, Caulis, Folia, Fulcra; & tamen Vegetabilia sunt; uti Viscus, Lemna, Cuscuta, Tulipa.
2. Fundamentum Botanices consistit in Plantarum Divisione & Denominatione Systematica, Generica, & Specifica


OBSERVATIONES
IN
REGNUM ANIMALE.

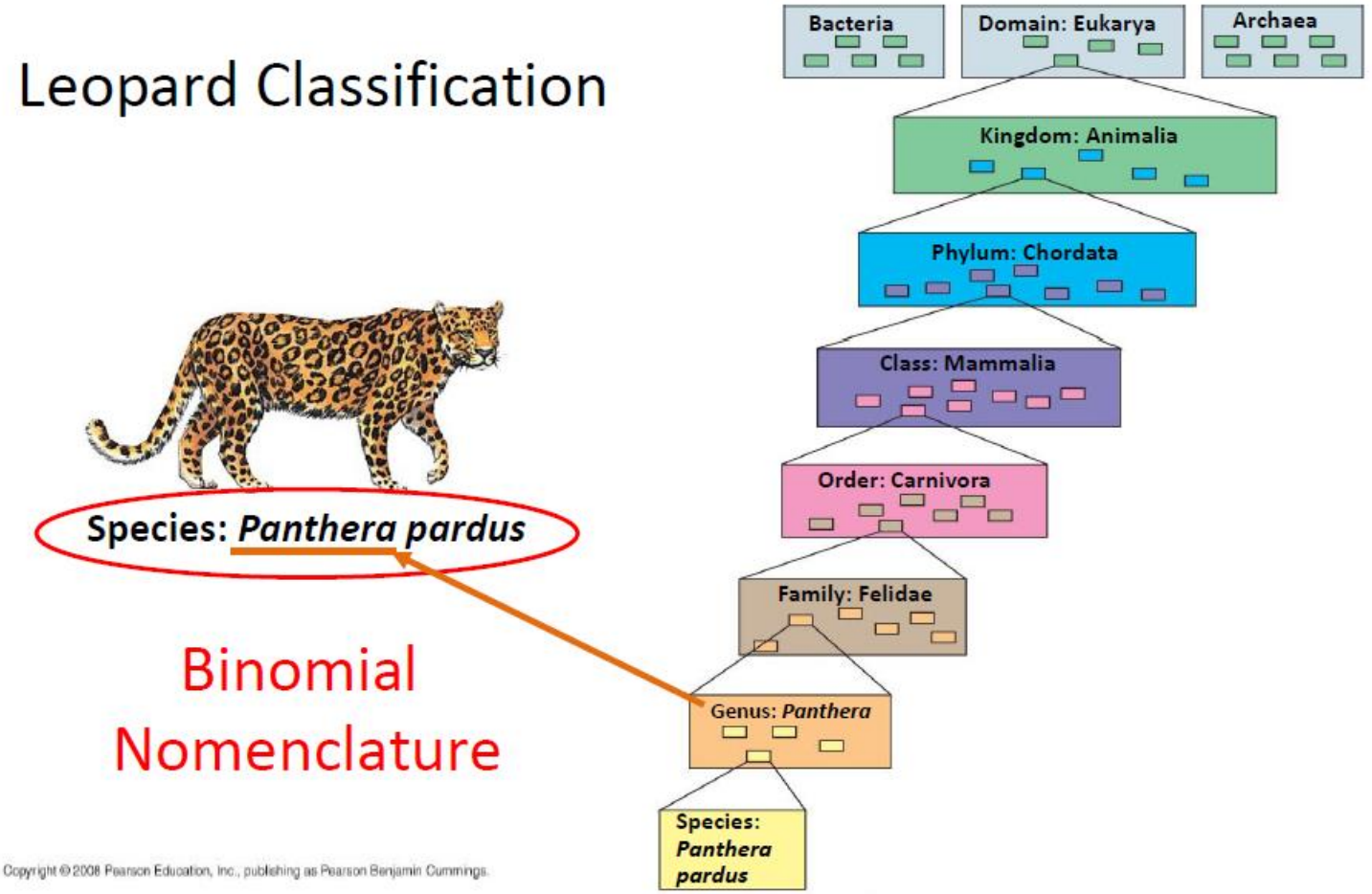
1. Zoologia, pars illa Historiæ Naturalis Nobilissima, longe minus exculta est, quam duæ reliquæ ejus partes. Si tamen vel motum, vel mechanismum, vel sensus externos internosque, vel denique figuram Animalium, cæteris præstantiorem, respiciamus, omnibus in aprico erit, Animalia esse summa & perfectissima Creatoris opera.
2. Si Zoologias Auctorum sub examen revocemus, maximam partem nihil nisi narrationes fabulosas, diffusum scribendi modum, Chalcographorum Icones & Descriptiones imperfectas

Classification and taxonomy

- ❑ **Classifying the natural world**
- ❑ **Linnean hierarchical classification**
- Classification based on observations and physical affinities
- Development of binomial nomenclature
- Establishment of International Commission on Zoological Nomenclature (ICZN) in 1895
- Sub-categories increasingly used



Classification and taxonomy



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  - Sub-categories increasingly used
  - Type specimens

***Papilio agamemnon* Linnaeus, 1758**

Scalebar = 1 cm

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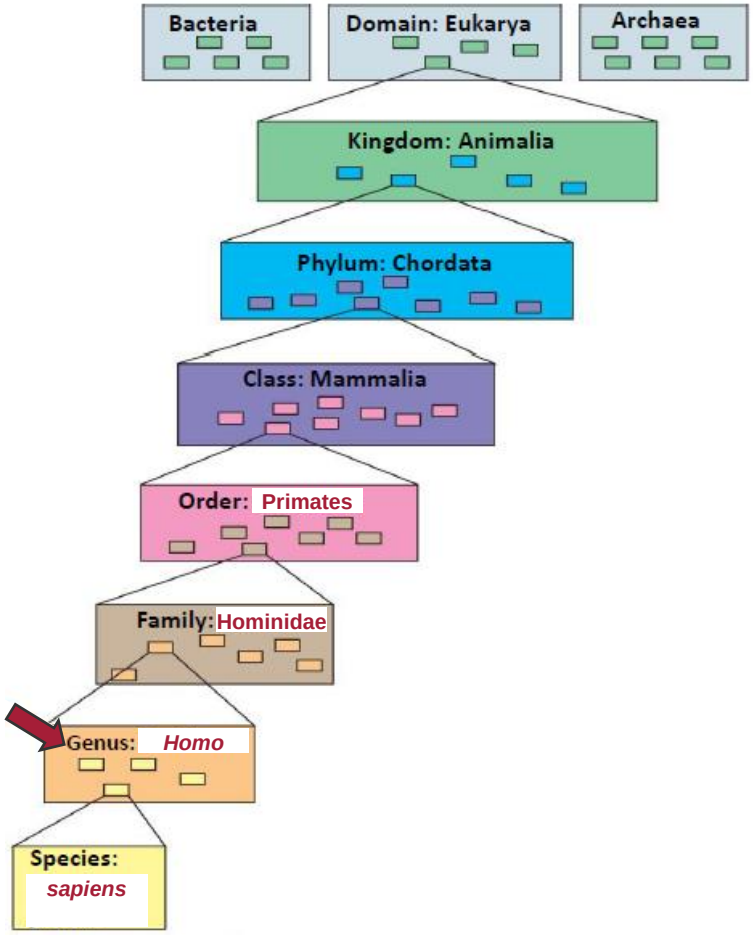

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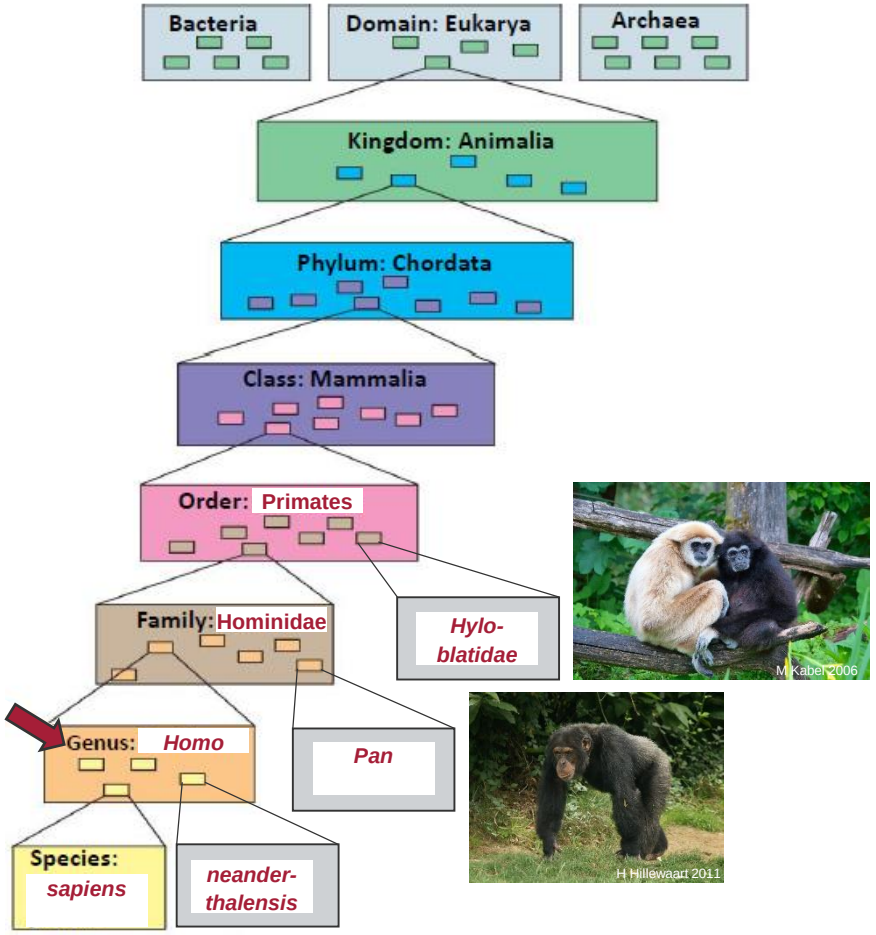

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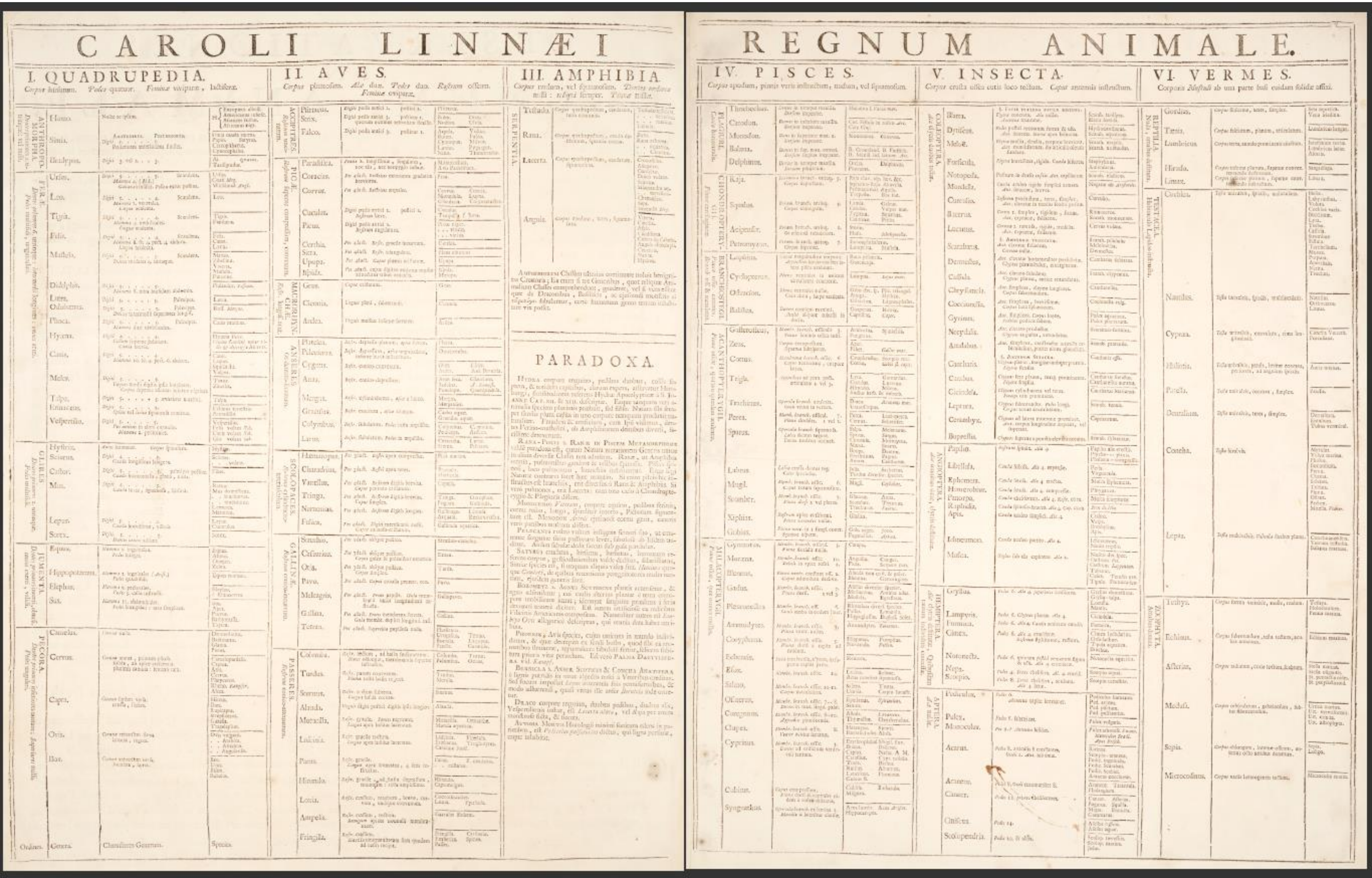


CAROLI LINNÆI REGNUM ANIMALE.

I. QUADRUPEDIA. Corpus hirsutum. Pedes quatuor. Feminæ viviparæ, lactiferæ.

ANTHROPOMORPHA: Homo. Simia. Bradypus.

FERÆ: Ursus. Leo. Tigris. Felis. Mustela. Didelphis. Lutra. Odobenus. Phoca. Hyæna. Canis. Meles. Talpa. Erinaceus. Vespertilio.

GLIRES: Hystrix. Sciurus. Castor. Mus. Lepus. Sorex.

JUMENTA: Equus. Hippopotamus. Elephas. Sus.

PECORA: Camelus. Cervus. Capra. Ovis. Bos.

Ordines. Genera. Characteres Generum. Species.

II. AVES. Corpus plumosum. Alæ duæ. Pedes duo. Rostrum osseum. Feminæ oviparæ.

ACCIPITRES: Psittacus. Strix. Falco.

PICÆ: Paradisæa. Coracias. Corvus. Cuculus. Picus. Certhia. Sitta. Upupa. Ispida.

MACROR[H]YNCHÆ: Grus. Ciconia. Ardea.

ANSERES: Platea. Pelecanus. Cygnus. Anas. Mergus. Graculus. Colymbus. Larus.

SCOLOPACES: Hæmatopus. Charadrius. Vanellus. Tringa. Numenius. Fulica.

GALLINÆ: Struthio. Casoarius. Otis. Pavo. Meleagris. Gallina. Tetrao.

PASSERES: Columba. Turdus. Sturnus. Alauda. Motacilla. Luscinia. Parus. Hirundo. Loxia. Ampelis. Fringilla.

III. AMPHIBIA. Corpus nudum, vel squamosum. Dentes molares nulli: reliqui semper. Pinnæ nullæ.

SERPENTIA: Testudo. Rana. Lacerta. Anguis.

PARADOXA

IV. PISCES. Corpus apodum, pinnis veris instructum, nudum, vel squamosum.

PLAGIURI: Thrichechus. Catodon. Monodon. Balæna. Delphinus.

CHONDROPTERYGII: Raja. Squalus. Acipenser. Petromyzon.

BRANCHIOSTEGI: Lophius. Cyclopterus. Ostracion. Balistes.

ACANTHOPTERYGII: Gasterosteus. Zeus. Cottus. Trigla. Trachinus. Perca. Sparus. Labrus. Mugil. Scomber. Xiphias. Gobius.

MALACOPTERYGII: Gymnotus. Muræna. Blennius. Gadus. Pleuronectes. Ammodytes. Coryphæna. Echeneis. Esox. Salmo. Osmerus. Coregonus. Clupea. Cyprinus. Cobitis. Syngnathus.

V. INSECTA. Corpus crusta ossea cutis loco tectum. Caput antennis instructum.

COLEOPTERA: Blatta. Dytiscus. Meloë. Forficula. Notopeda. Mordella. Curculio. Buprestis. Locusta. Scarabæus. Dermestes. Cassida. Chrysomela. Coccinella. Gyrinus. Necydalis. Attelabus. Cantharis. Carabus. Cicindela. Leptura. Cerambyx. Buprestis.

ANGIOPTERA: Papilio. Libellula. Ephemera. Hemerobius. Panorpa. Raphidia. Apis. Ichneumon. Musca.

HEMIPTERA: Gryllus. Lampyris. Fumaria. Cimex. Notonecta. Nepa. Scorpio.

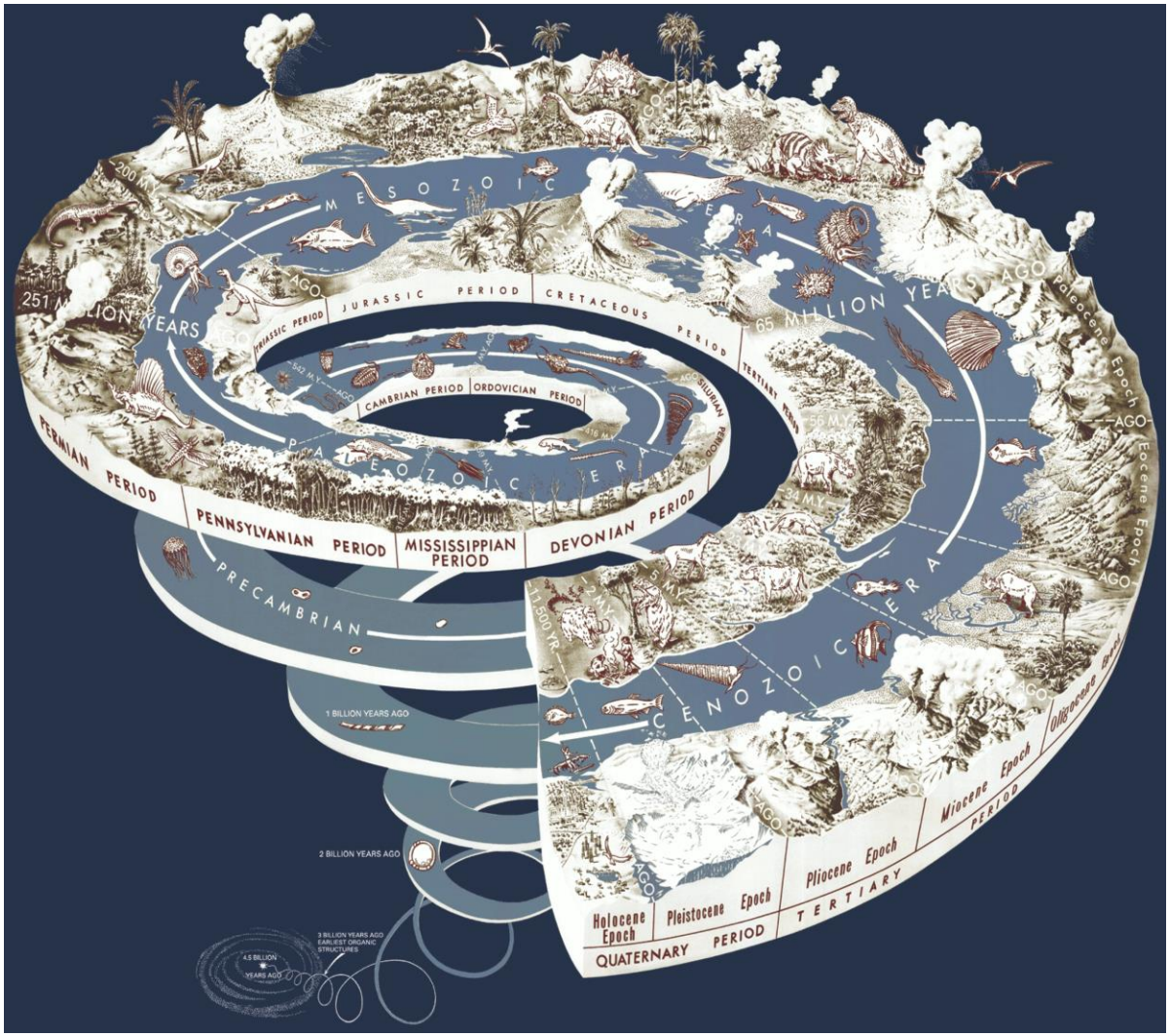
APTERA: Pediculus. Pulex. Monoculus. Acarus. Aranea. Cancer. Oniscus. Scolopendria.

VI. VERMES. Corporis musculi ab una parte basi cuidam solidæ affixi.

REPTILIA: Gordius. Tænia. Lumbricus. Hirudo. Limax.

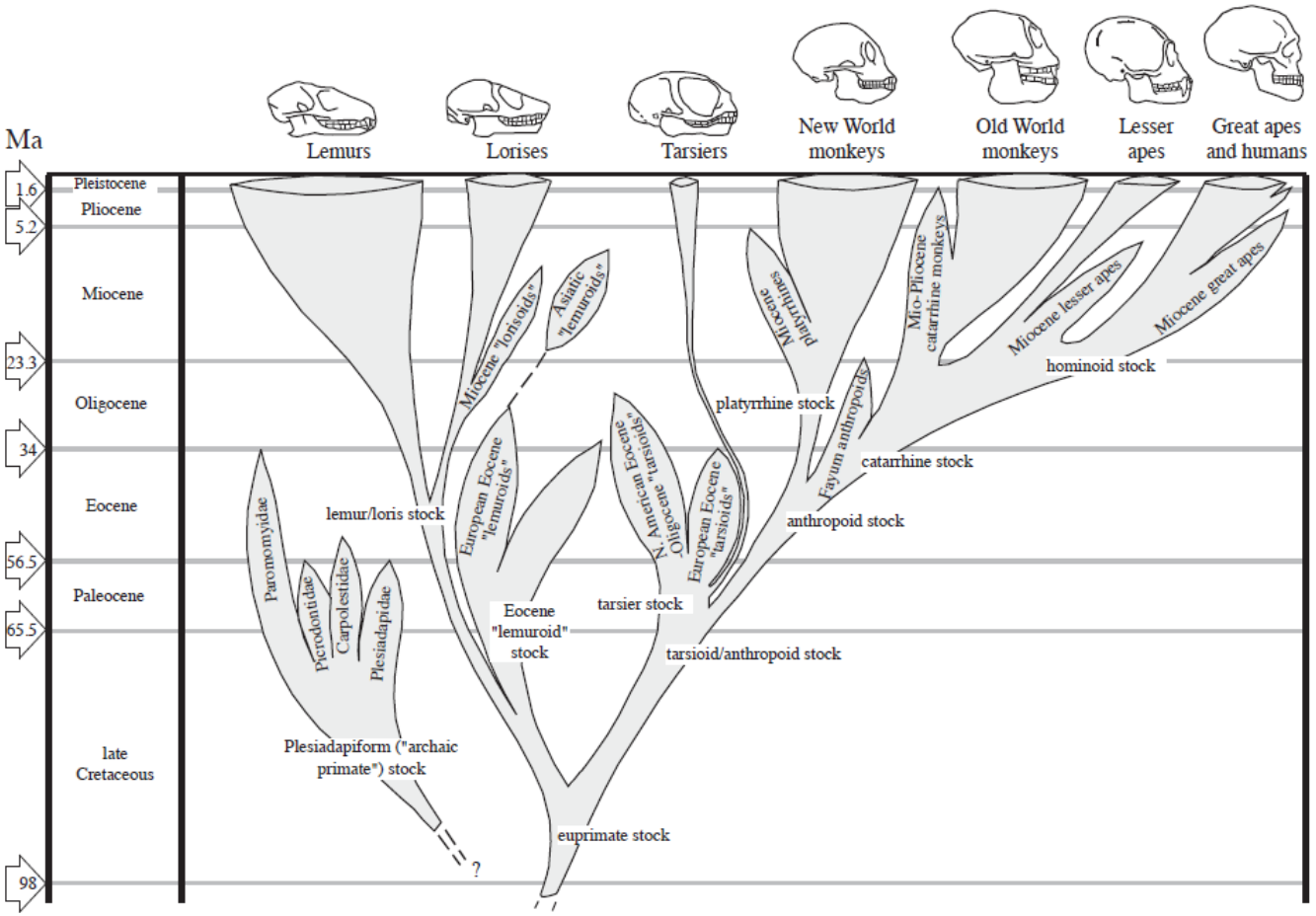
TESTACEA: Cochlea. Nautilus. Cypræa. Haliotis. Patella. Dentalium. Concha. Lepas.

ZOOPHYTA: Tethys. Echinus. Asterias. Medusa. Sepia. Microcosmus.

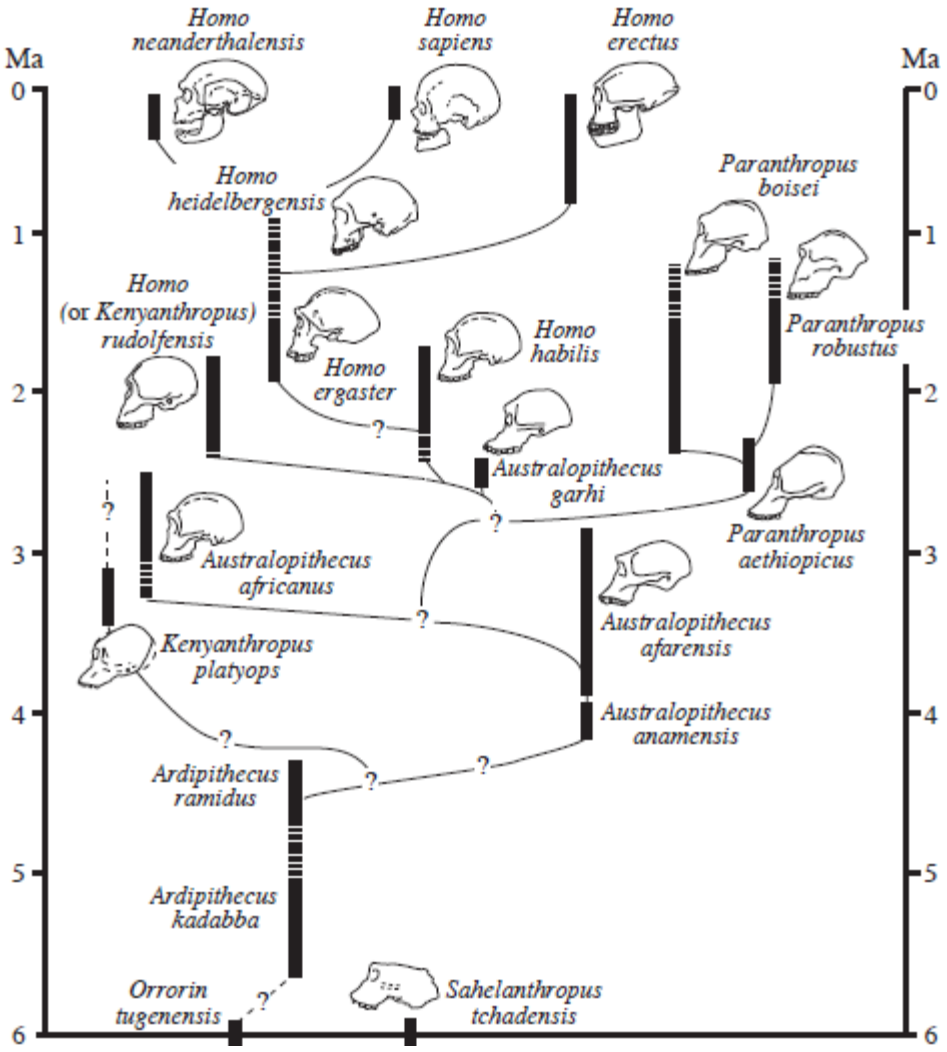


- Primates
- Hominoids
- Hominids
- Modern humans

Credit: U.S. Geological Survey


Ma
Lemurs
Lorises
Tarsiers
New World monkeys
Old World monkeys
Lesser apes
Great apes and humans
1.6
5.2
23.3
34
56.5
65.5
98
Pleistocene
Pliocene
Miocene
Oligocene
Eocene
Paleocene
late Cretaceous
Miocene "lorisoids"
Asiatic "lemuroids"
Miocene platyrrhines
Mio-Pliocene catarrhine monkeys
Miocene lesser apes
Miocene great apes
hominoid stock
platyrrhine stock
Fayum anthropoids
catarrhine stock
anthropoid stock
European Eocene "lemuroids"
N. American Eocene "tarsioids"
Oligocene "tarsioids"
European Eocene "tarsioids"
lemur/loris stock
Paromomyidae
Picrodontidae
Carpolestidae
Plesiadapidae
Eocene "lemuroid" stock
tarsier stock
tarsioid/anthropoid stock
Plesiadapiform ("archaic primate") stock
?
euprimate stock

Klein 2009


Ma
0
1
2
3
4
5
6
Homo neanderthalensis
Homo sapiens
Homo erectus
Homo heidelbergensis
Paranthropus boisei
Homo (or Kenyanthropus) rudolfensis
Homo habilis
Paranthropus robustus
Homo ergaster
Australopithecus garhi
Paranthropus aethiopicus
Australopithecus africanus
Australopithecus afarensis
Kenyanthropus platyops
Australopithecus anamensis
Ardipithecus ramidus
Ardipithecus kadabba
Orrorin tugenensis
Sahelanthropus tchadensis

Klein 2009

Classification and taxonomy

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  - Sub-categories increasingly used
  - Type specimens

articles

New hominin genus from eastern Africa shows diverse middle Pliocene lineages

Meave G. Leakey*, Fred Spoor†, Frank H. Brown‡, Patrick N. Gathogo‡, Christopher Kiarie*, Louise N. Leakey* & Ian McDougall§

* Division of Palaeontology, National Museums of Kenya, P.O. Box 40658, Nairobi, Kenya
† Department of Anatomy & Developmental Biology, University College London, WC1E 6JJ, UK
‡ Department of Geology & Geophysics, University of Utah, Salt Lake City, Utah 84112, USA
§ Research School of Earth Sciences, The Australian National University, Canberra ACT 0200, Australia

Most interpretations of early hominin phylogeny recognize a single early to middle Pliocene ancestral lineage, best represented by *Australopithecus afarensis*, which gave rise to a radiation of taxa in the late Pliocene. Here we report on new fossils discovered west of Lake Turkana, Kenya, which differ markedly from those of contemporary *A. afarensis*, indicating that hominin taxonomic diversity extended back, well into the middle Pliocene. A 3.5 Myr-old cranium, showing a unique combination of derived facial and primitive neurocranial features, is assigned to a new genus of hominin. These findings point to an early diet-driven adaptive radiation, provide new insight on the association of hominin craniodental features, and have implications for our understanding of Plio–Pleistocene hominin phylogeny.

The eastern African hominin record between 4 and 3 Myr is represented exclusively by a single species, *A. afarensis*, and its possible ancestor, *Australopithecus anamensis*, which are commonly thought to belong to the lineage ancestral to all later hominins[1,2]. This apparent lack of diversity in the middle Pliocene contrasts markedly with the increasingly bushy phylogeny evident in the later hominin fossil record. To study further the time interval between 4 and 3 Myr, fieldwork in 1998 and 1999 focused on sites of this age at Lomekwi in the Nachukui Formation, west of Lake Turkana. New hominin discoveries from Lomekwi, as well as two mandibles and isolated molars recovered previously[3] (Table 1), indicate that multiple species existed between 3.5 and 3.0 Myr. The new finds include a well-preserved temporal bone, two partial maxillae, isolated teeth, and most importantly a largely complete, although distorted, cranium. We assign the latter specimen to a new hominin genus on the basis of its unique combination of primitive and derived features.

Description of *Kenyanthropus platyops*

Order Primates LINNAEUS 1758
Suborder Anthropoidea MIVART 1864
Superfamily Hominoidea GRAY 1825
Kenyanthropus gen. nov.

Etymology. In recognition of Kenya's contribution to the understanding of human evolution through the many specimens recovered from its fossil sites.

Generic diagnosis. A hominin genus characterized by the following morphology: transverse facial contour flat at a level just below the nasal bones; tall malar region; zygomaticoalveolar crest low and curved; anterior surface of the maxillary zygomatic process positioned over premolars and more vertically orientated than the nasal aperture and nasoalveolar clivus; nasoalveolar clivus long and both transversely and sagittally flat, without marked juga; moderate subnasal prognathism; incisor alveoli parallel with, and only just anterior to, the bicanine line; nasal cavity entrance stepped; palate roof thin and flexed inferiorly anterior to the incisive foramen; upper incisor (I^1 and I^2) roots near equal in size; upper premolars (P^3, P^4) mostly three-rooted; upper first and second molars (M^1 and M^2) small with thick enamel; tympanic element mediolaterally long and lacking a petrous crest; external acoustic porus small. *Kenyanthropus* can be distinguished from *Ardipithecus ramidus* by its buccolingually narrow M^3, thick molar enamel, and a temporal bone with a more cylindrical articular eminence and deeper mandibular fossa. It differs from *A. anamensis*, *A. afarensis*, *A. africanus* and *A. garhi* in the derived morphology of the lower face, particularly the moderate subnasal prognathism, sagittally and transversely flat nasoalveolar clivus, anteriorly positioned maxillary zygomatic process, similarly sized I^1 and I^2 roots, and small M^1 and M^2 crowns. From *A. afarensis* it also differs by a transversely flat midface, a small, external acoustic porus, and the absence of an occipital/marginal venous sinus system, and from *A. africanus* by a tall malar region, a low and curved zygomaticoalveolar crest, a narrow nasal aperture, the absence of anterior facial pillars, a tubular, long and crestless tympanic element, and a small, external acoustic porus. *Kenyanthropus* lacks the suite of derived dental and cranial features found in *Paranthropus aethiopicus*, *P. boisei* and *P. robustus* (Table 2), and the derived cranial features of species indisputably assigned to *Homo* (For example, *H. erectus s.l.* and *H. sapiens*, but not *H. rudolfensis* and *H. habilis*)[4].

Type species *Kenyanthropus platyops* sp. nov.

Etymology. From the Greek *platus*, meaning flat, and *opsis*, meaning face; thus referring to the characteristically flat face of this species.

Specific diagnosis. Same as for genus.

Types. The holotype is KNM-WT 40000 (Fig. 1a–d), a largely complete cranium found by J. Erus in August 1999. The paratype is KNM-WT 38350 (Fig. 1e), a partial left maxilla found by B. Onyango in August 1998. The repository is the National Museums of Kenya, Nairobi.

Localities. Lomekwi localities are situated in the Lomekwi and Topernawi river drainages in Turkana district, northern Kenya (Fig. 2). The type locality LO-6N is at 03° 54.03′ north latitude, 035° 44.40′ east longitude.

Horizon. The type specimen is from the Kataboi Member, 8 m below the Tulu Bor Tuff and 12 m above the Lokochot Tuff, giving an estimated age of 3.5 Myr. The paratype is from the lower Lomekwi Member, 17 m above the Tulu Bor Tuff, with an estimated age of 3.3 Myr.

Cranial description and comparisons

The overall size of the KNM-WT 40000 cranium falls within the range of *A. afarensis* and *A. africanus*. It is preserved in two main parts, the neurocranium with the superior and lateral orbital margins, but lacking most of the cranial base; and the face, lacking

Classification and taxonomy

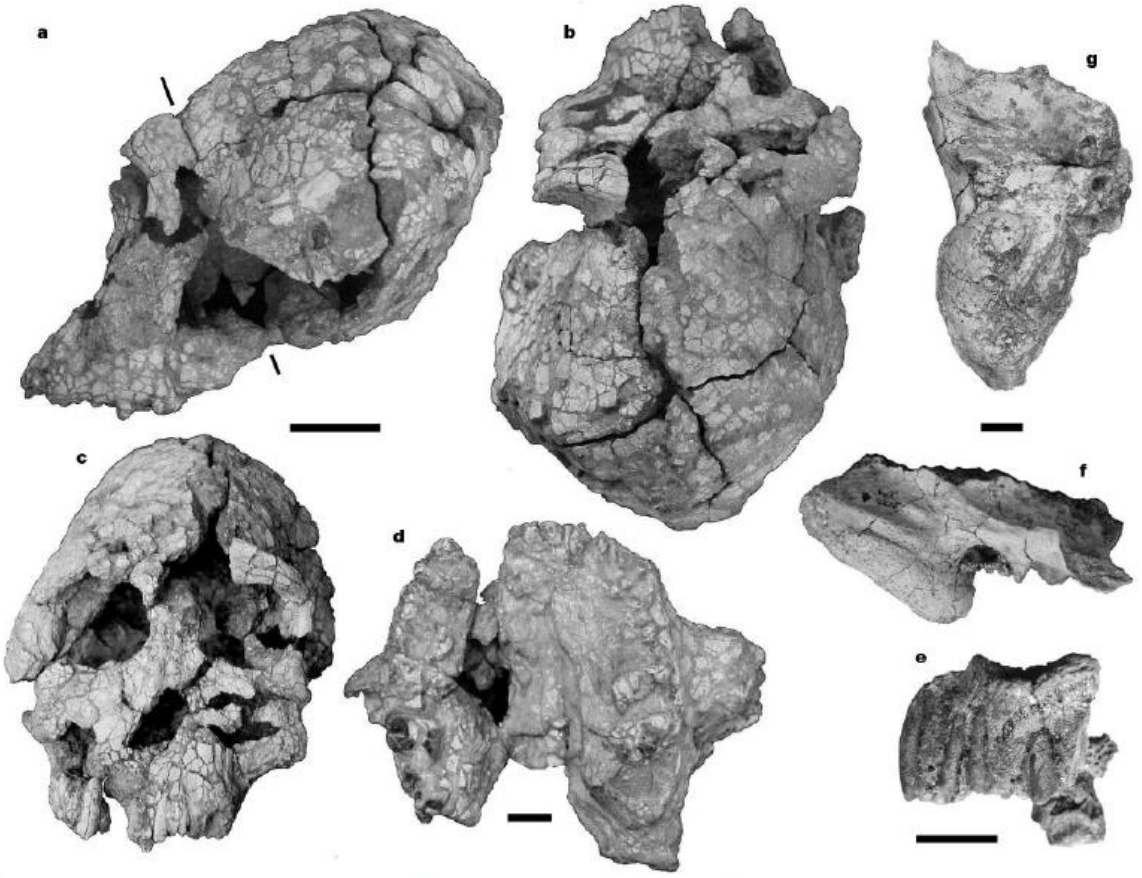

Figure 1 Holotype KNM-WT 40000 **a**, left lateral view (markers indicate the plane separating the distorted neurocranium and the well-preserved face). **b**, Superior view. **c**, Anterior view. **d**, Occlusal view of palate. Paratype KNM-WT 38350. **e**, Lateral view. KNM-WT 40001. **f**, Lateral view. **g**, Inferior view. Scale bars: **a–c**, 3 cm; **d–g**, 1 cm.

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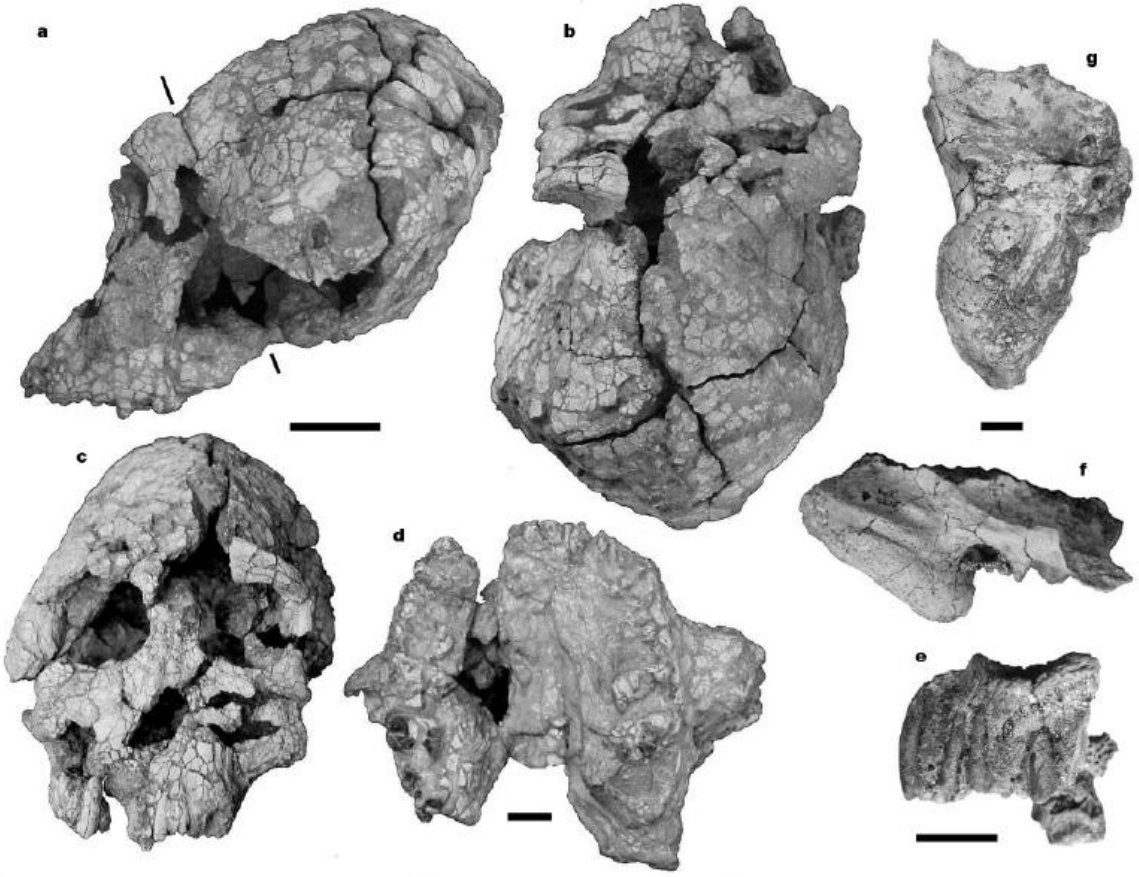
Leakey et al. 2001

Classification and taxonomy



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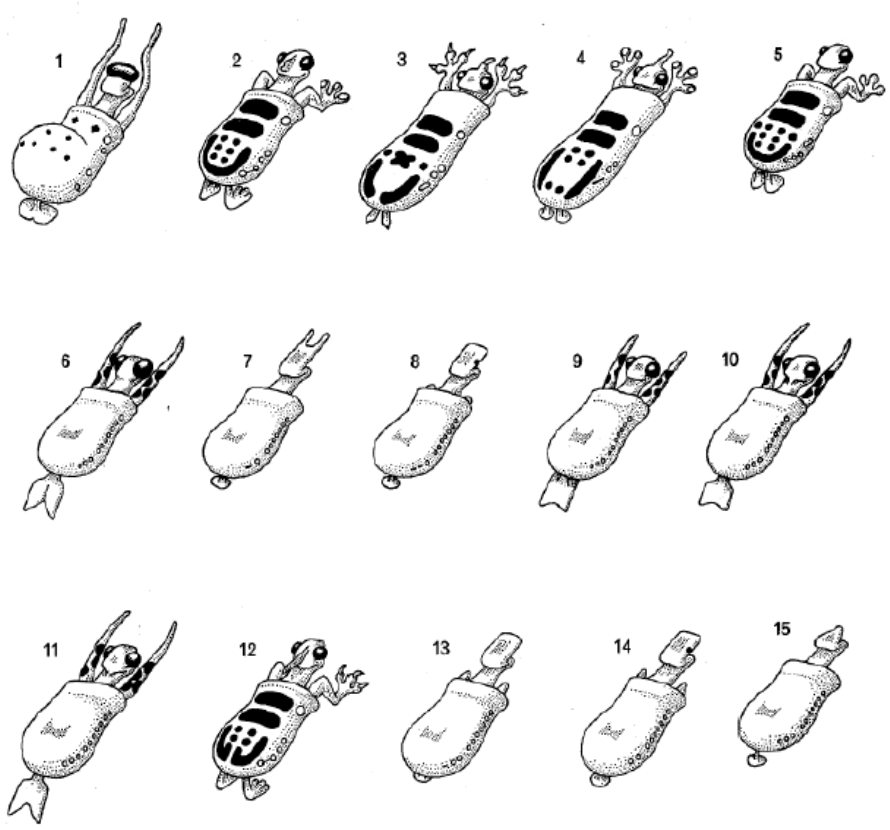
Classification and taxonomy

- Classifying the natural world
- Linnean hierarchical classification
- **Numerical taxonomy**
- **Cladistics**
- **Phylogenetics**

Classification and taxonomy

- ❑ Classifying the natural world
- ❑ Linnean hierarchical classification
- ❑ **Numerical taxonomy**

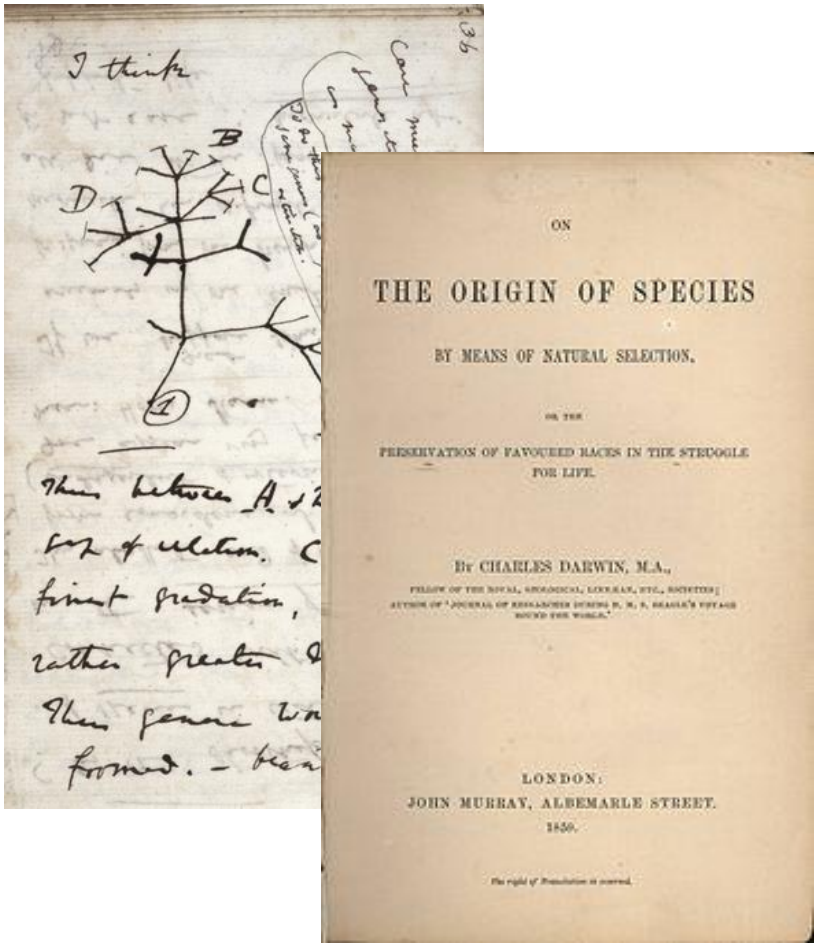
- A quantitiative comparative method: a multivariate approach to assess operational taxonomic units (OTUs)
- In general, quantifying more characters is better since there is often correlation between characters



Classification and taxonomy

- Classifying the natural world
- Linnean hierarchical classification
- Numerical taxonomy
- **Cladistics**

  - Explicitly accounts for evolutionary history: affinities are based on lines of descent (and modification)



Classification and taxonomy

- ❑ Classifying the natural world
- ❑ Linnean hierarchical classification
- ❑ Numerical taxonomy
- ❑ **Cladistics**

- Explicitly accounts for evolutionary history: affinities are based on lines of descent
- Characters should *only* reflect evolutionary history and not common function

Classification and taxonomy

- ❑ Classifying the natural world
- ❑ Linnean hierarchical classification
- ❑ Numerical taxonomy
- ❑ Cladistics
- ❑ **Phylogenetics**

- Explicitly accounts for evolutionary history: affinities are based on lines of descent
- All traits considered should be heritable
- Phylogenetic methods rely on specific evolutionary models (e.g. rate of change)

Classification and taxonomy

Modern human fossils

When and where do we see anatomically modern fossils?

Classification and taxonomy

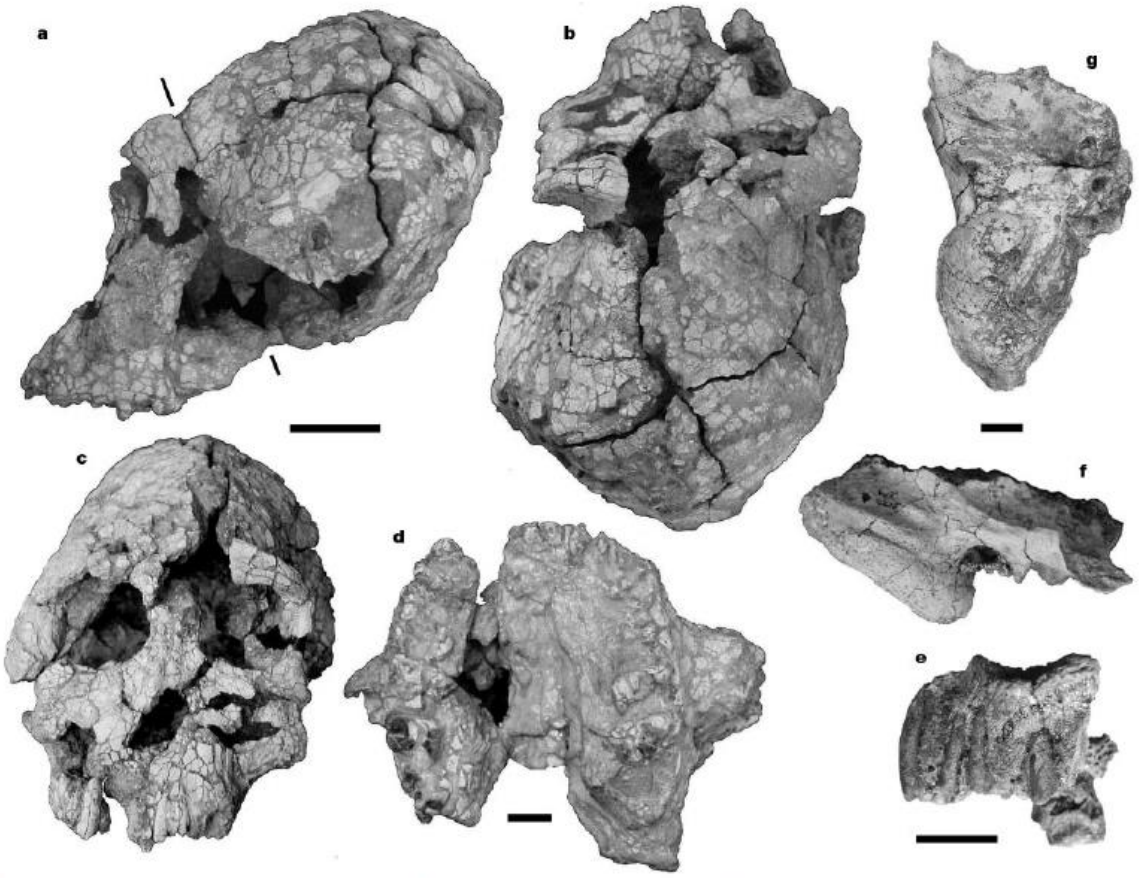


Figure 1 Holotype KNM-WT 40000 **a**, left lateral view (markers indicate the plane separating the distorted neurocranium and the well-preserved face). **b**, Superior view. **c**, Anterior view. **d**, Occlusal view of palate. Paratype KNM-WT 38350. **e**, Lateral view. KNM-WT 40001. **f**, Lateral view. **g**, Inferior view. Scale bars: **a–c**, 3 cm; **d–g**, 1 cm.

What (or who) is the modern human holotype?

20 MAMMALIA PRIMATES. Homo.

I. PRIMATES.

Dentes Primores ſuperiores IV, paralleli.
Mammæ Pectorales II.

1. HOMO noſce Te ipſum (*)

Sapiens. 1. H. diurnus; *varians cultura, loco.*
Ferus. tetrapus, mutus, hirſutus.
Juvenis Urſinus lithuanus. 1661.
Juvenis Lupinus heſſenſis 1344.
Juvenis Ovinus hibernus. Tulp. obſ. IV. 9
Juvenis Hannoveranus.
Pueri 2 Pyrenaici. 1719.
Johannes Leodicenſis.

Americanus. α. rufus, cholericus, rectus.
Pilis nigris, rectis, craſſis; *Naribus* patulis; *Facie* ephelitica, *Mento* ſubimberbi.
Pertinax, hilaris, liber.
Pingit ſe lineis dædaleis rubris.
Regitur Conſvetudine.

β al-

(*) NOSSE SE IPSUM gradus eſt primus ſapientiæ, dictumque *Solonis*, quondam ſcriptum litteris aureis ſupra *Dianæ* Templum. *Muſ. ADOLPH. FRID. Præfat.*

Phyſiologice: Te contextum Nervis, intertextum Fibris, Machina tenella, ſed adoleſcente in perfectiſſimam, facultatibus inſtructam fere omnibus pluribusque, quam reliqua cuncta. *Nudum in nuda humo, natali die, abjecit natura ad vagitus ſtatim & ploratum, manibus pedibusque devinciendum Animal cæteris imperaturum; cui ſcire nihil ſine doctrina: non fari, non ingredi, non veſci, non aliud natura ſponte. Plin. Vides itaque qualem vitam nobis rerum natura promiſit, quæ primum naſcentium omen fletum eſſe voluit. Seneca.*

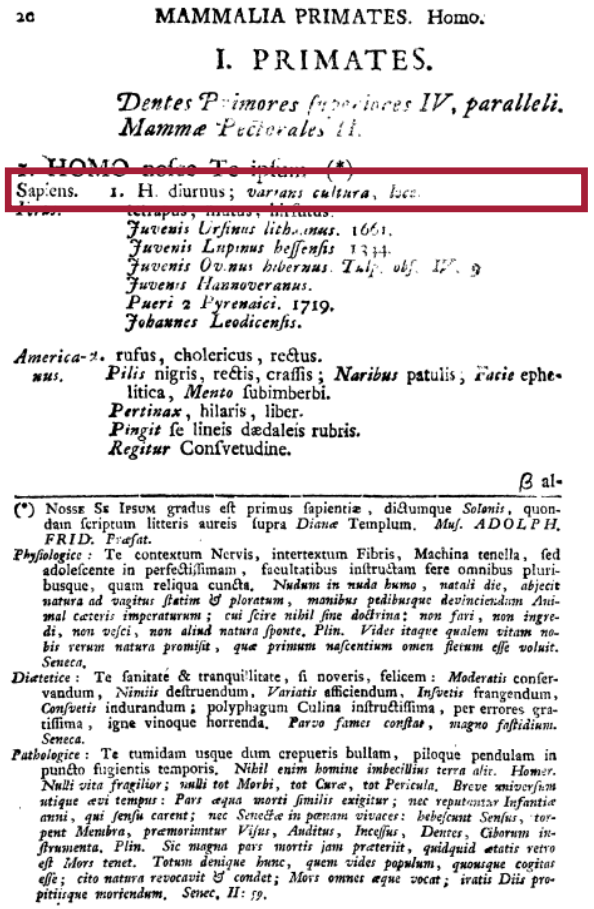
Diætetice: Te ſanitate & tranquillitate, ſi noveris, felicem: *Moderatis* conſervandum, *Nimiis* deſtruendum, *Variatis* afficiendum, *Inſvetis* frangendum, *Conſvetis* indurandum; polyphagum Culina inſtructiſſima, per errores gratiſſima, igne vinoque horrenda. *Parvo fames conſtat, magno faſtidium. Seneca.*

Pathologice: Te tumidam usque dum crepueris bullam, piloque pendulam in puncto fugientis temporis. *Nihil enim homine imbecillius terra alit. Homer. Nulli vita fragilior; nulli tot Morbi, tot Curæ, tot Pericula. Breve univerſum utique ævi tempus: Pars æqua morti ſimilis exigitur; nec reputantur Infantiæ anni, qui ſenſu carent; nec Senectæ in pœnam vivaces: hebeſcunt Senſus, torpent Membra, præmoriuntur Viſus, Auditus, Inceſſus, Dentes, Ciborum inſtrumenta. Plin. Sic magna pars mortis jam præteriit, quidquid ætatis retro eſt Mors tenet. Totum denique hunc, quem vides populum, quousque cogitas eſſe; cito natura revocavit & condet; Mors omnes æque vocat; iratis Diis propitiisque moriendum. Senec. II: 59.*

Homo: know thyself*

*know your wisdom, as told by Solon, written on golden letters on the Diana Temple

What (or who) is the modern human holotype?



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I. PRIMATES.

Dentes Primores superiores IV, paralleli.
Mammæ Pectorales II.

1. HOMO nosce Te ipsum. (*)

Sapiens. 1. H. diurnus; *varians cultura*, luce.

Juvenis Ursinus lithuanus. 1661.
Juvenis Lupinus hessensis 1344.
Juvenis Ovinus hibernus. Tulp. obs. IV. 9
Juvenis Hannoveranus.
Pueri 2 Pyrenaici. 1719.
Johannes Leodicensis.

Americanus. 2. rufus, cholericus, rectus.
Pilis nigris, rectis, crassis; *Naribus* patulis; *Facie* ephelitica, *Mento* subimberbi.
Pertinax, hilaris, liber.
Pingit se lineis dædaleis rubris.
Regitur Consvetudine.

β al-

(*) Nosse Se Ipsum gradus est primus sapientiæ, dictumque *Solonis*, quondam scriptum litteris aureis supra *Dianæ* Templum. *Mus. ADOLPH. FRID. Præfat.*

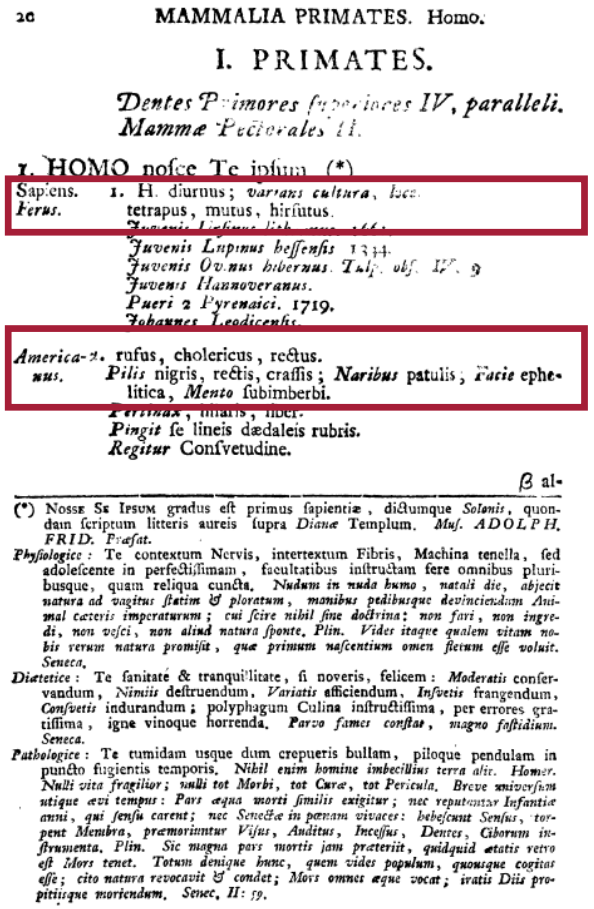
Physiologice: Te contextum Nervis, intertextum Fibris, Machina tenella, sed adolescente in perfectissimam, facultatibus instructam fere omnibus pluribusque, quam reliqua cuncta. *Nudum in nuda humo, natali die, abjecit natura ad vagitus statim & ploratum, manibus pedibusque devinciendum Animal cæteris imperaturum; cui scire nihil sine doctrina; non fari, non ingredi, non vesci, non alind natura sponte. Plin. Vides itaque qualem vitam nobis verum natura promisit, quæ primum nascentium omen fletum esse voluit. Seneca.*

Dietetice: Te sanitate & tranquillitate, si noveris, felicem: *Moderatis* conservandum, *Nimiis* destruendum, *Variatis* efficiendum, *Insvetis* frangendum, *Consvetis* indurandum; polyphagum Culina instructissima, per errores gratissima, igne vinoque horrenda. *Parvo fames constat, magno fastidium. Seneca.*

Pathologice: Te tumidam usque dum crepueris bullam, piloque pendulam in puncto fugientis temporis. *Nihil enim homine imbecillius terra alit. Homer. Nulli vita fragilior; nulli tot Morbi, tot Curæ, tot Pericula. Breve universum utique ævi tempus: Pars æqua morti similis exigitur; nec reputantur Infantiæ anni, qui sensu carent; nec Senectæ in pœnam vivaces: bebescunt Sensus, torpent Membra, præmoriuntur Visus, Auditus, Incessus, Dentes, Ciborum instrumenta. Plin. Sic magna pars mortis jam præteriit, quidquid ætatis vetvo est Mors tenet. Totum denique hunc, quem vides populum, quousque cogitas esse; cito natura revocavit & condet; Mors omnes æque vocat; iratis Diis propitiisque moriendum. Senec. II: 59.*

sapiens: culture, light

What (or who) is the modern human holotype?



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I. PRIMATES.

Dentes Primores superiores IV, paralleli.
Mammæ Pectorales II.

1. HOMO noſce Te ipſum (*)

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Ferus. tetrapus, mutus, hirſutus.
Juvenis Lupinus heſſenſis 1344.
Juvenis Ovinus hibernus. Tulp. obſ. IV. 9
Juvenis Hannoveranus.
Pueri 2 Pyrenaici. 1719.
Johannes Leodicenſis.

America-nus. 2. rufus, cholericus, rectus.
Pilis nigris, rectis, craſſis; *Naribus* patulis; *Facie* ephelitica, *Mento* ſubimberbi.
Pertinax, inanis, fidei.
Pingit ſe lineis dædaleis rubris.
Regitur Conſvetudine.

β al-

(*) Nosse Se Ipsum gradus eſt primus ſapientiæ, dictumque *Solonis*, quondam ſcriptum litteris aureis ſupra *Dianæ* Templum. *Muſ. ADOLPH. FRID. Præfat.*

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sapiens ferus: speechless, hairy

sapiens americanus: red, choleric/reactive,

What (or who) is the modern human holotype?

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Juvenis Urſinus lithuanus. 1661.
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Pertinax, hilaris, liber.
Pingit ſe lineis dædaleis rubris.
Regitur Conſvetudine.

β al-

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MAMMALIA PRIMATES. Homo. 21

Europæus. β. albus, ſanguineus, toroſus.
Pilis flaveſcentibus prolixis. Oculis cæruleis.
Levis, acutiſſimus, inventor.
Tegitur Veſtimentis arctis.
Regitur Ritibus.

Aſiaticus. γ. luridus, melancholicus, rigidus.
Pilis nigricantibus *Oculis* fuſcis.
Severus, faſtuoſus, avarus.
Tegitur Indumentis laxis.
Regitur Opinionibus.

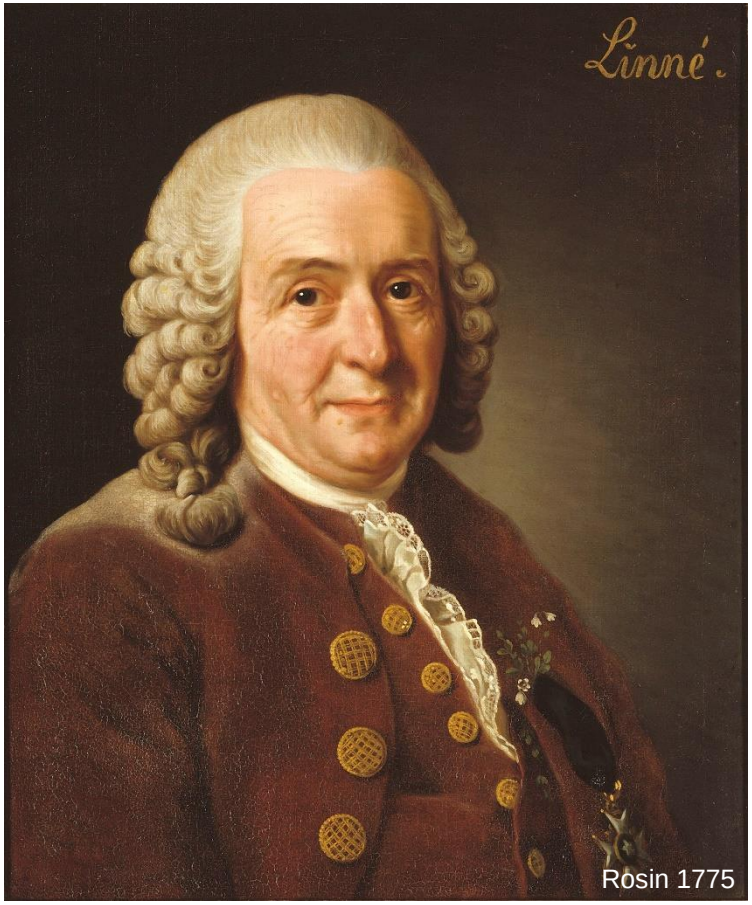
B 3 δ. ni-

Naturaliter: Te audacis naturæ miraculum, Animalium Principem, cujus cauſſa cuncta genuit natura, eſſe animal flens, ridens, melodum, loquens, docile, judicans, admirans, ſapientiſſimum; ſed fragile, nudum, ſuapte natura inerme, ad omnem fortunæ contumeliam projectum, alienæ opis indigens, anxiæ mentis ſollicitæque tutelæ, precarii ſpiritus, pertinacis ſpei, querulæ vitæ, tardæ ſapientiæ. Temporis annihilati emortui contemtorem, præſentis vividi dilapidatorem, futuri dubii æſtimatorem in vita volucri, pretioſiſſima, irrevocabili, ſic optima quæque dies miſeris mortalibus ævi prima fugit; alium ad quotidianum opus laborioſa Egeſtas vocat; alium Luxus incarcerat altilemque ſuffocat; alium Ambitio numquam quieta ſollicitat; alius Divitiis, quas optaverat, metuit, & voto laborat ſuo; alium Solitudo, alium ſemper veſtibulum obſidens turba. Hic ſe habere dolet Liberos, hic ſe perdidiſſe; Lacrymæ nobis deerunt antequam cauſſæ dolendi. Sed quousque nos malos noſtra mala rapuere: circumferre pericula, ru te in ignotos, iratos ſine injuria, ferarum more occidere quem non oderimus, ſecundos optare ventos, quorum felicitas eſt ad bella proferre; parum videlicet ad mortes noſtras terra late patet. *Senec. Cætera animantia congregari contra diſſimilia, at Homini plurima ex homine mala Plin.*

Politice: Te recti loco tenere errorem publicum factum, qui te vix enixum conſvetudinis larva induit, nutrit, educat, alit, regit, ſecundum quam honeſtus, fortis, ſapiens, moratus, pius exiſtimaris; Cum gubernatus Opinione vivas ad Conſvetudinem, nec ad Rationem. Te, inter perituros conſtitutum, cum nulli contigit impune naſci, beneficii loco petere, ut ultimus cervicem præbeas, dum interim, dulci fortuna ebrius, colligendo in craſtinum Lapillos fortunæ certas, verbis in furorem ageris, aliter theoretice pios odio perſequeris, quantosque tumultus excitas, non ut ſervias, ſed cui; nugis irrevocabile tempus conſumis; immortalia æternaque animo volutas, de ſeris nepotibus pronepotibusque diſponis, novas ſpes oblitus conditionis Tuæ ponis, cum interea longa conantem mors opprimit, at in agone oculos aperiens (ἄνθρωπος) ſomnium primo obſervas; *Sic vivimus ut immortales & morimur ut mortales. Senec.*

Moraliter: Te ſub rudi larva Ineptum, Laſcivum, Imitatorem, Ambitioſum, Prodigum, Solicitum, Aſtutum, Auſterum, Invidum, Avarum, *transformari* in Attentum, Caſtum, Conſideratum, Modeſtum, Sobrium, Tranquillum, Sincerum, Mitem, Beneficum, ſuis Contentum. *Uni animantium*

What (or who) is the modern human holotype?



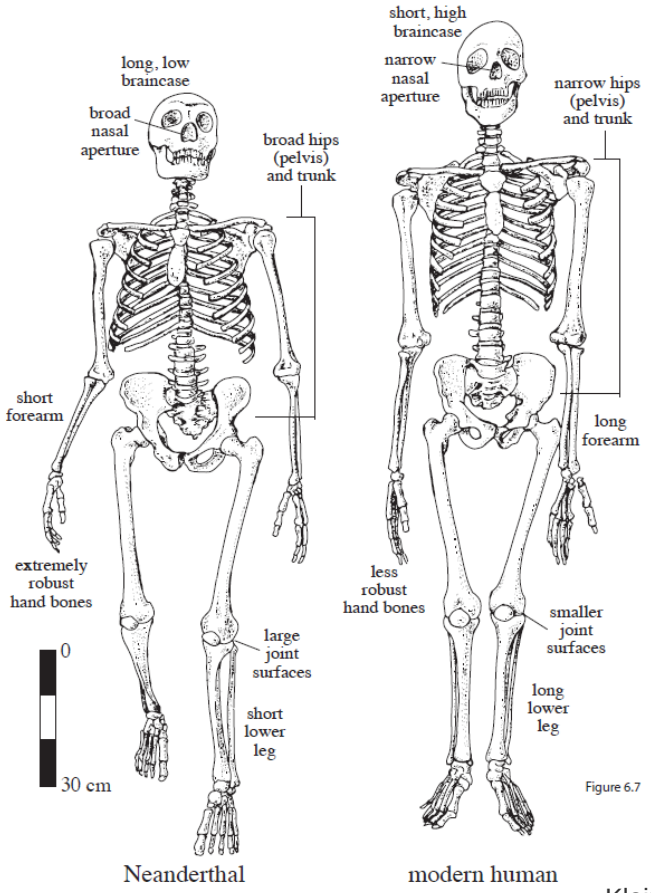
What do people living today look like?

General anatomy:

- ❑ **Globular head**
- ❑ **Long limbs**
- ❑ **Narrow thorax**

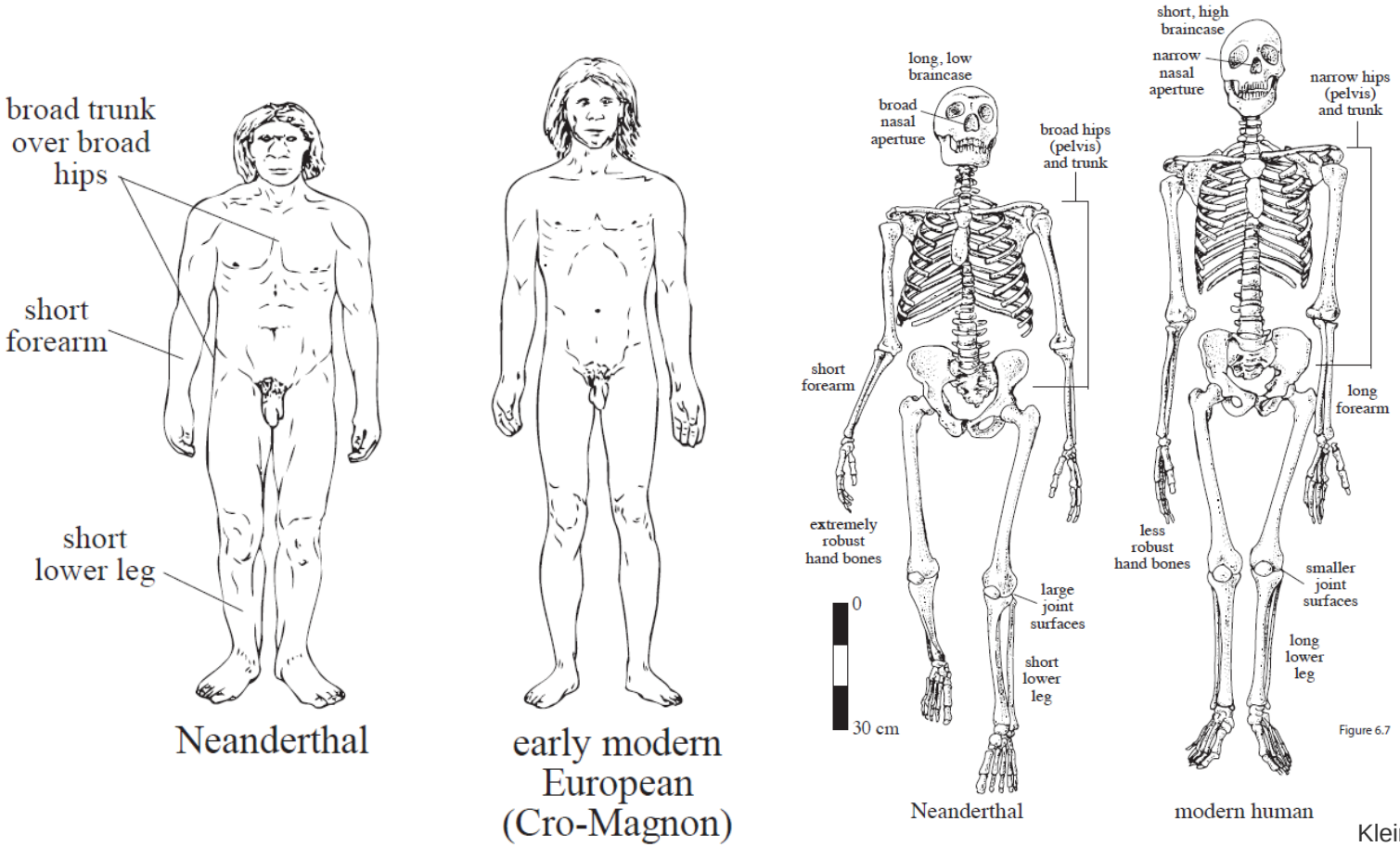
However, variation across world populations due to drift and adaptations.

Cranial and pelvic structure evolves in large portion neutrally, while limbs (and likely thorax) are more plastic and subject to adaptation.



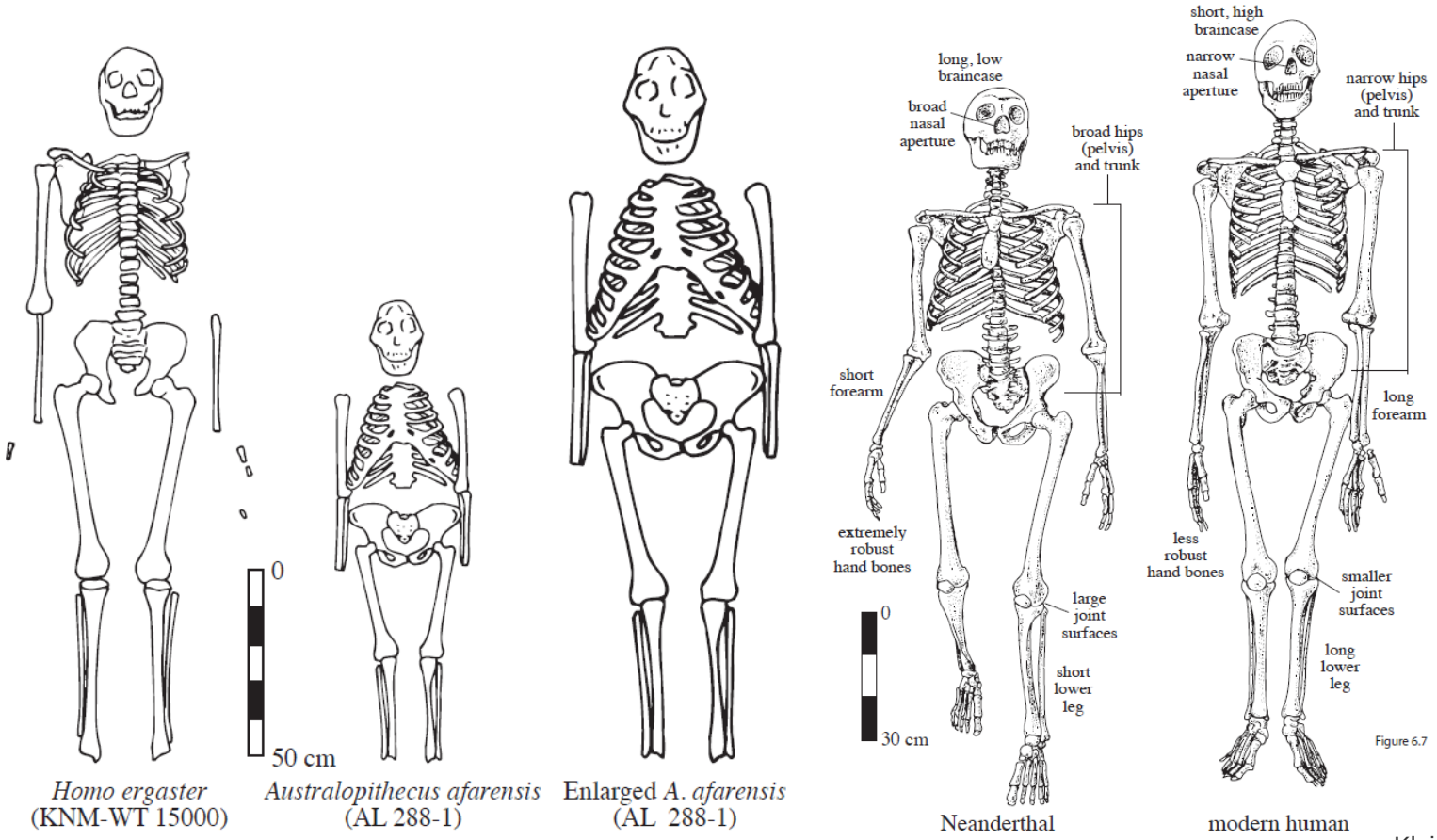
Klein 2009

What do people living today look like?



Klein 2009

What do people living today look like?



Klein 2009

What do people living today look like?

General anatomy:

- Globular head
- Long limbs
- Narrow thorax

However, variation across world populations due to drift and adaptations.

Cranial and pelvic structure evolves in large portion neutrally, while limbs (and likely thorax) are more plastic and subject to adaptation on an evolutionary scale and change on an ontogenetic scale.

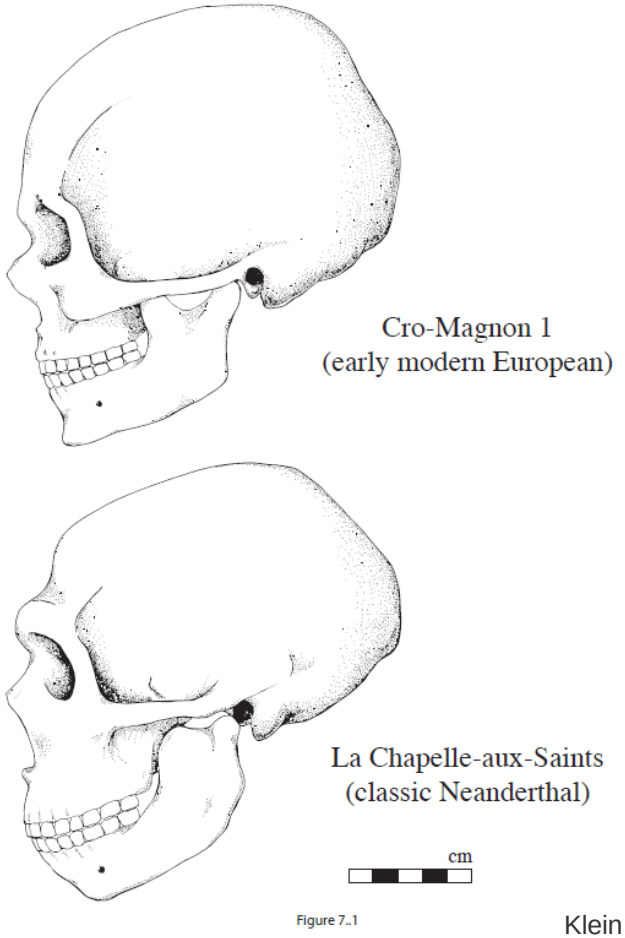


Figure 7..1

Klein 2009

What do people living today look like?

Cranial anatomy:

- ❑ **Globular neurocranium**
  - **Rounded occipital bone**
  - **Elongated parietal bones**
  - **Bossed frontal bone**
  - **Bossed parietal bones**
  - **Mandibular chin**
- ❑ **Orthognathic face**

Note: some anatomical variation due to sexual dimorphism

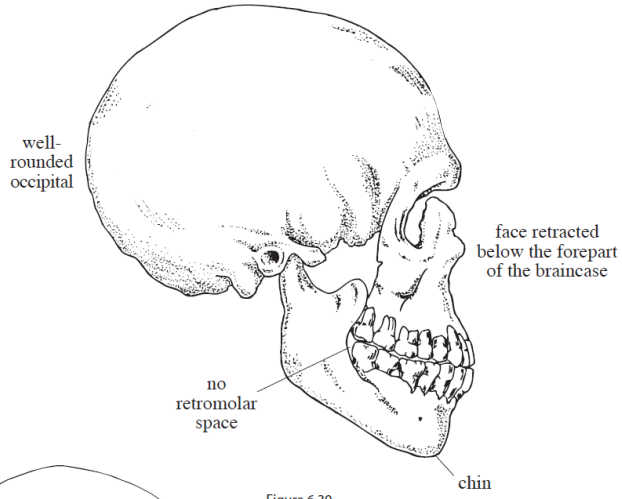


Figure 6.30

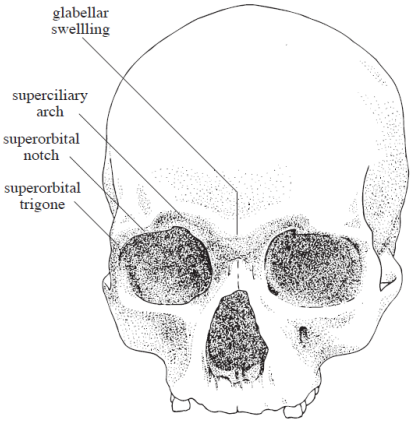
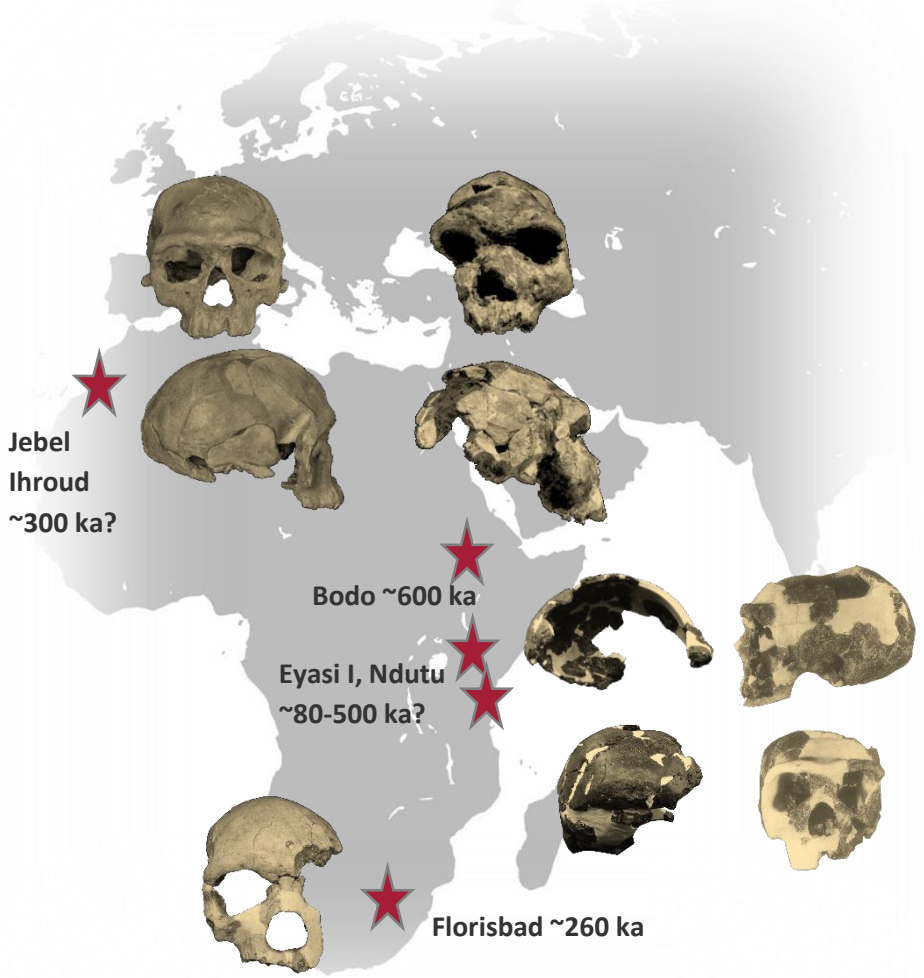


Figure 7.4

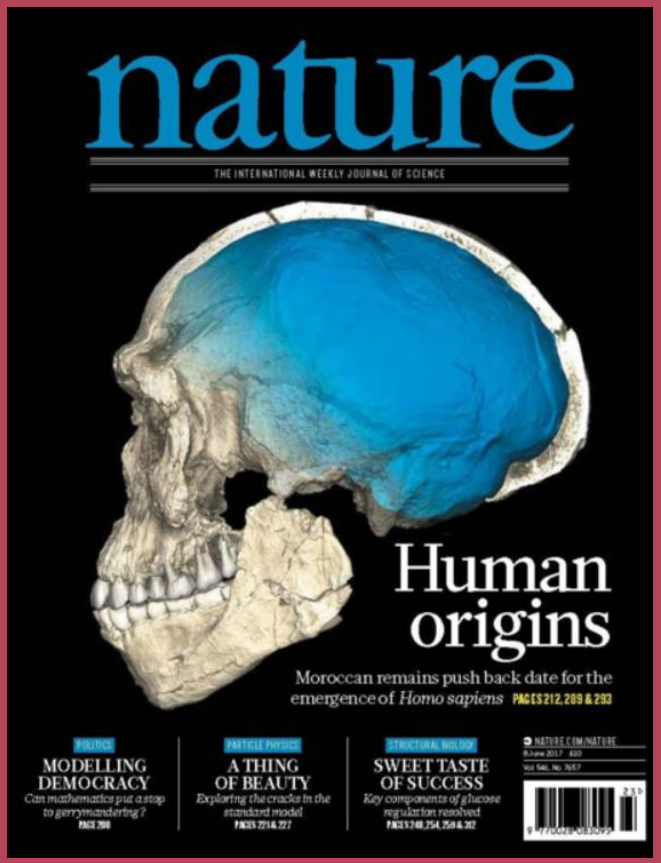
Klein 2009

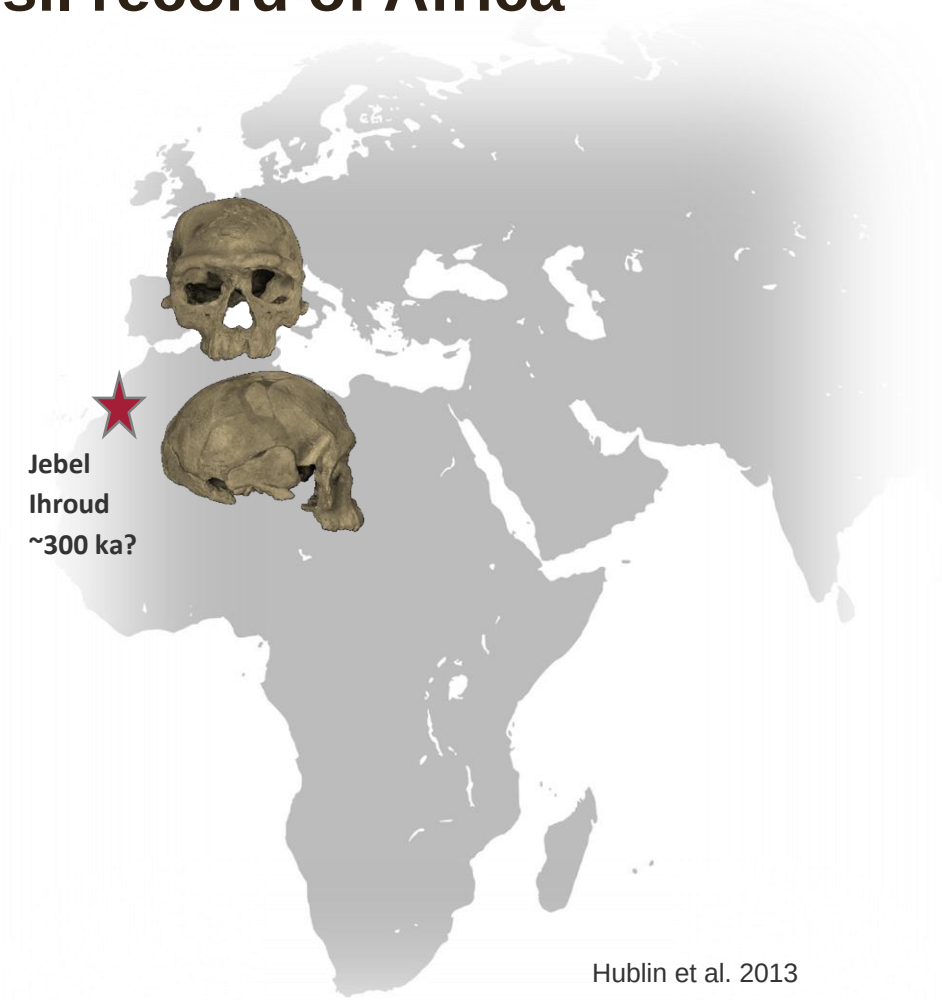
The Middle Pleistocene fossil record of Africa

- Genomics: divergence of modern humans and Neanderthals ~400-800 ka
- Human paleontology: "Muddle in the Middle [Pleistocene]"
  - Mix of plesiomorphic (primitive) and apomorphic (derived) features
  - "Archaic" *Homo sapiens*



The Middle Pleistocene fossil record of Africa

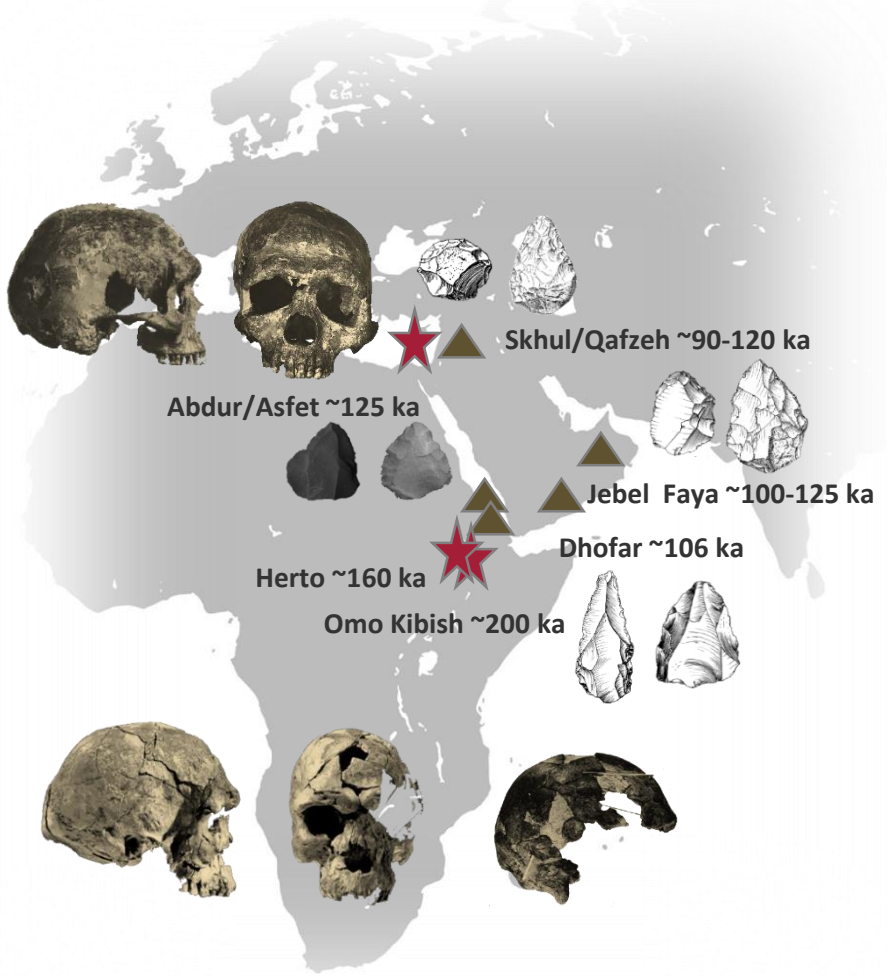




Hublin et al. 2013

The Late Pleistocene fossil record of Africa, Levant

- Omo Kibish, Ethiopia, ~200 ka
- Herto Bouri, Ethiopia, ~160 ka
- Skhul, Israel/Palestine, ~90-120 ka
- Qafzeh, Israel/Palestine, ~90-120 ka



The Late Pleistocene fossil record of Africa

- Omo Kibish, Ethiopia, ~200 ka

Omo Kibish 1

Day 1969

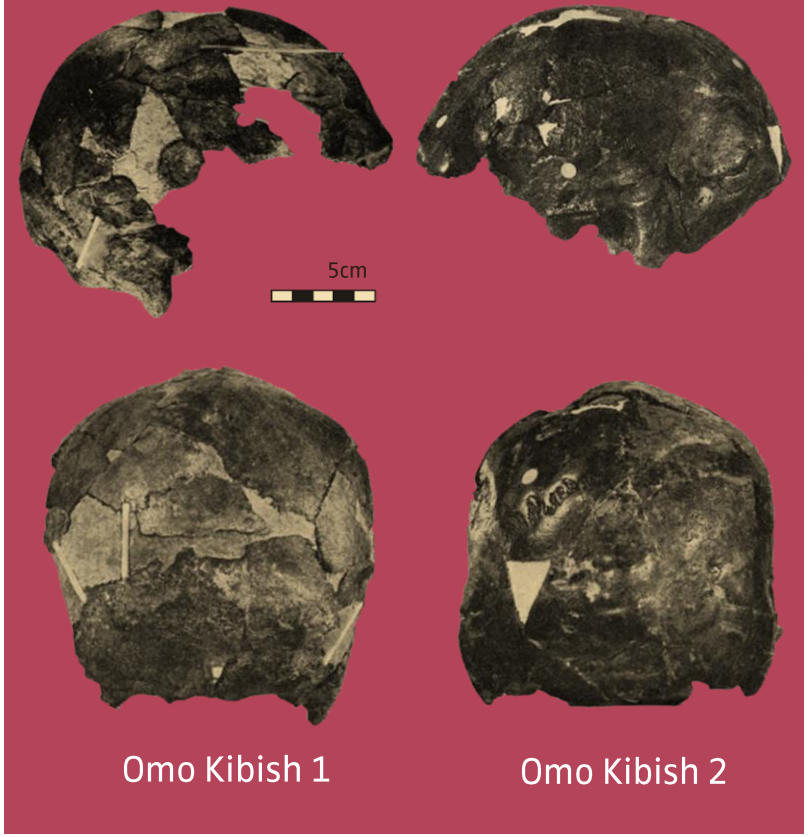
The Late Pleistocene fossil record of Africa

- Omo Kibish, Ethiopia, ~200 ka

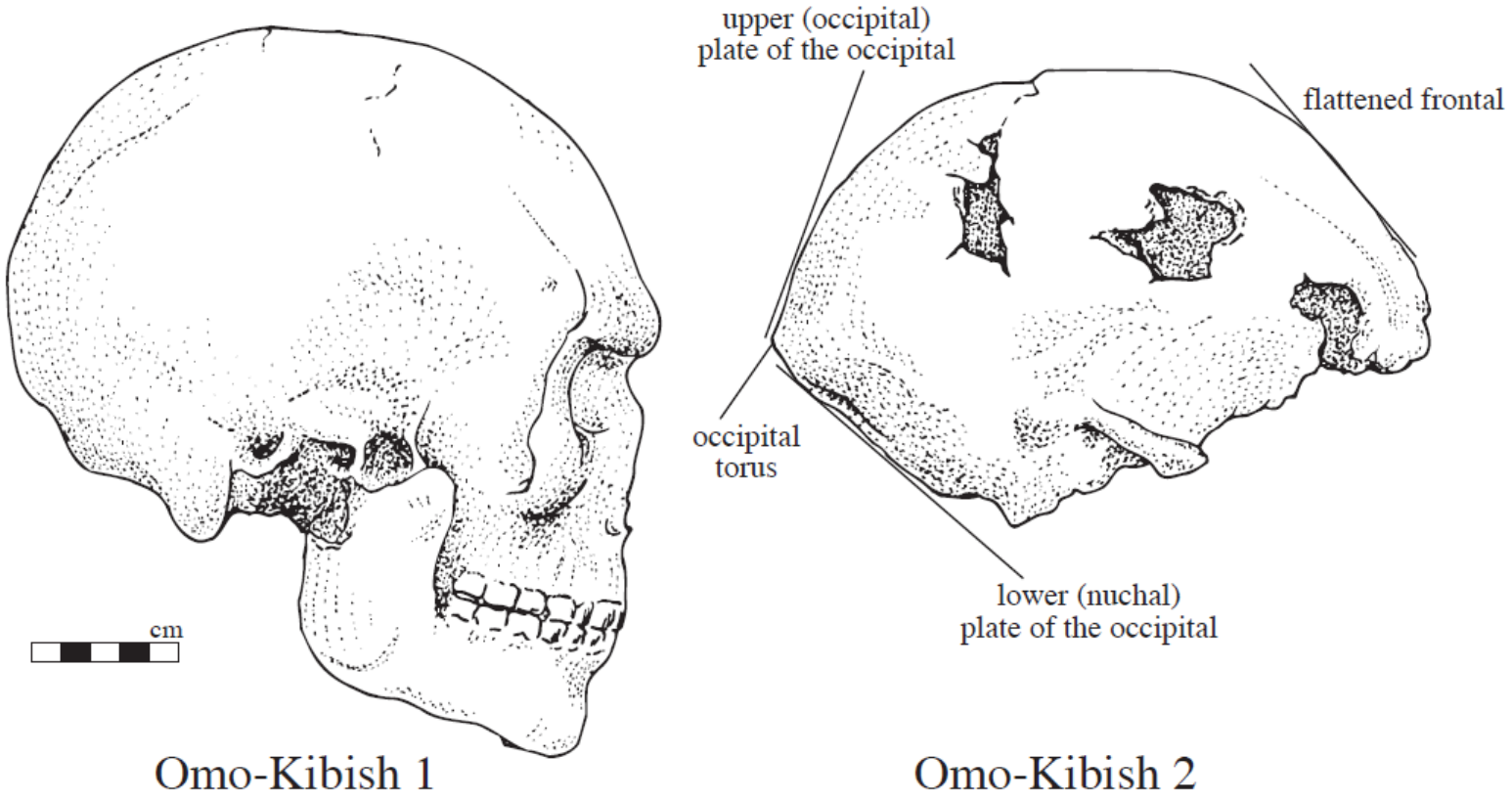
Omo Kibish 2

The Late Pleistocene fossil record of Africa

- Omo Kibish, Ethiopia, ~200 ka



The fossil record of Africa and the Levant

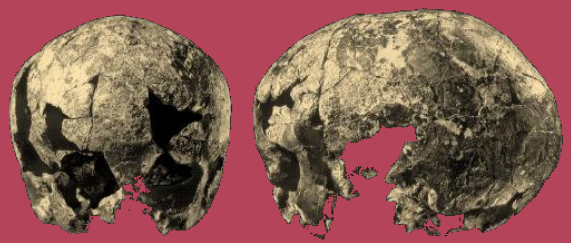


Klein 2009

The Late Pleistocene fossil record of Africa

- Omo Kibish, Ethiopia, ~200 ka
- Herto Bouri, Ethiopia, ~160 ka

Herto BOU-VP-16-1



Herto BOU-VP-16-5

White et al. 2003

The Late Pleistocene fossil record of the Levant

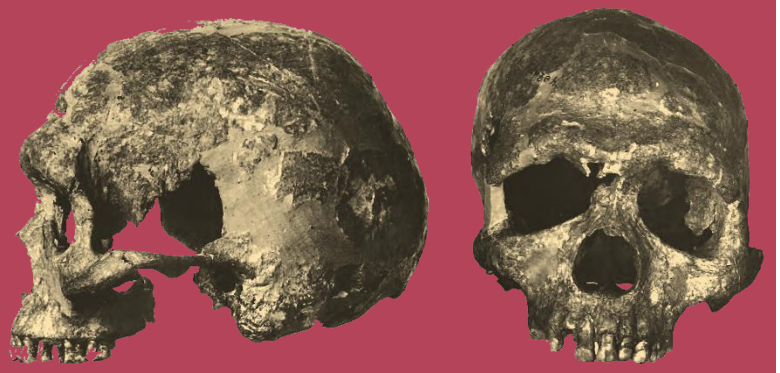
- Omo Kibish, Ethiopia, ~200 ka
- Herto Bouri, Ethiopia, ~160 ka
- **Skhul, Israel/Palestine, ~90-120 ka**

Skhul V

MacCurdy 1936

The Late Pleistocene fossil record of the Levant

- Omo Kibish, Ethiopia, ~200 ka
- Herto Bouri, Ethiopia, ~160 ka
- Skhul, Israel/Palestine, ~90-120 ka
- **Qafzeh, Israel/Palestine, ~90-120 ka**



Qafzeh 6

The fossil record of Africa and the Levant

- Omo Kibish, Ethiopia, ~200 ka
- Herto Bouri, Ethiopia, ~160 ka
- Skhul, Israel/Palestine, ~90-120 ka
- **Qafzeh, Israel/Palestine, ~90-120 ka**

Qafzeh 9

Vandermeersch1972

The Late Pleistocene fossil record of the Levant

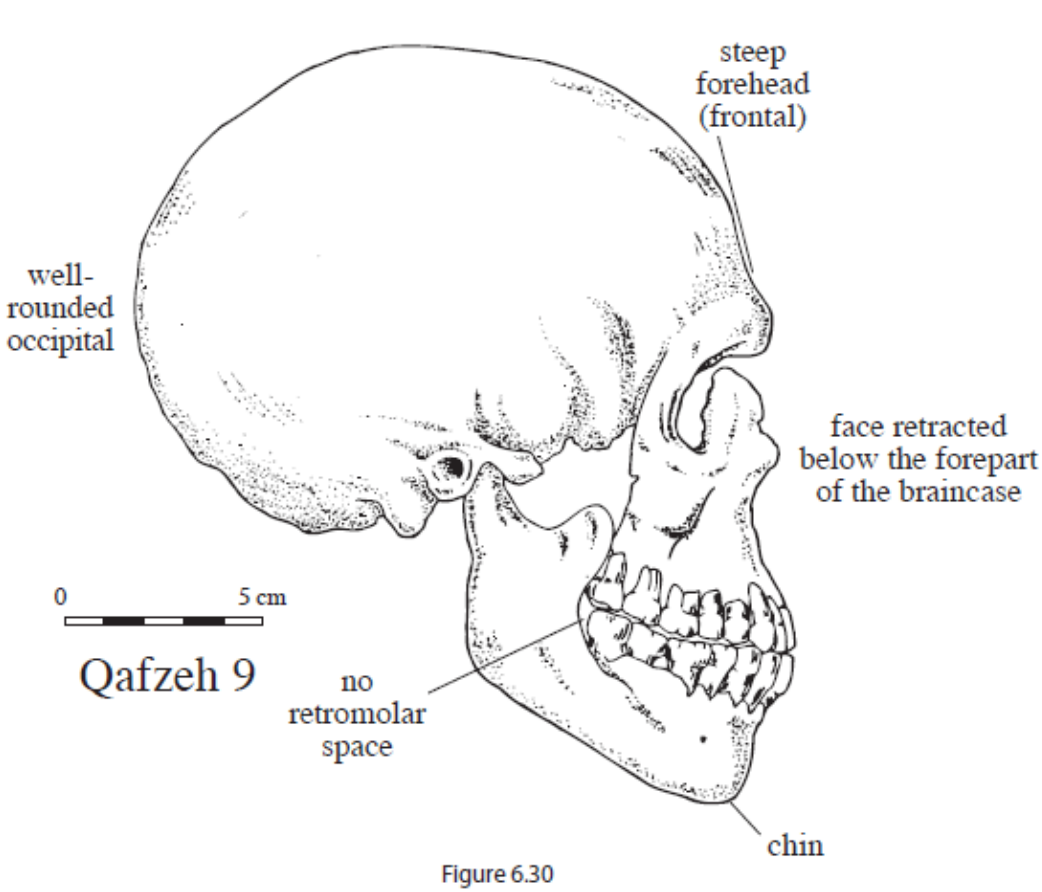
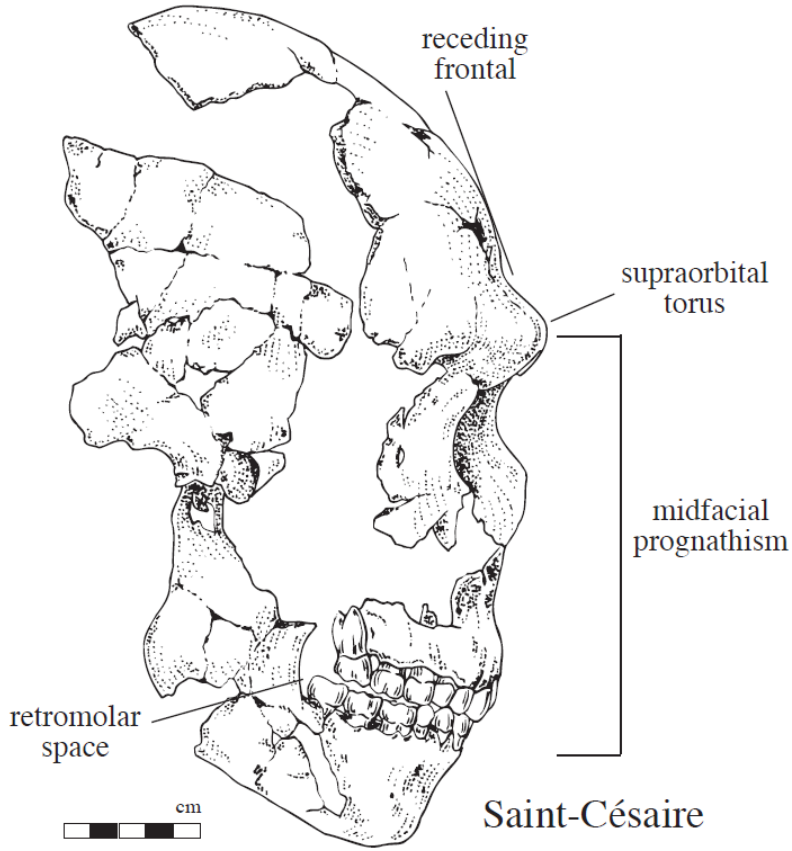


Figure 6.30



Klein 2009

The Late Pleistocene fossil record of the Levant

- Omo Kibish, Ethiopia, ~200 ka
- Herto Bouri, Ethiopia, ~160 ka
- Skhul, Israel/Palestine, ~90-120 ka
- Qafzeh, Israel/Palestine, ~90-120 ka
- **Misliya-1, Israel, ~70-250 ka**

RESEARCH

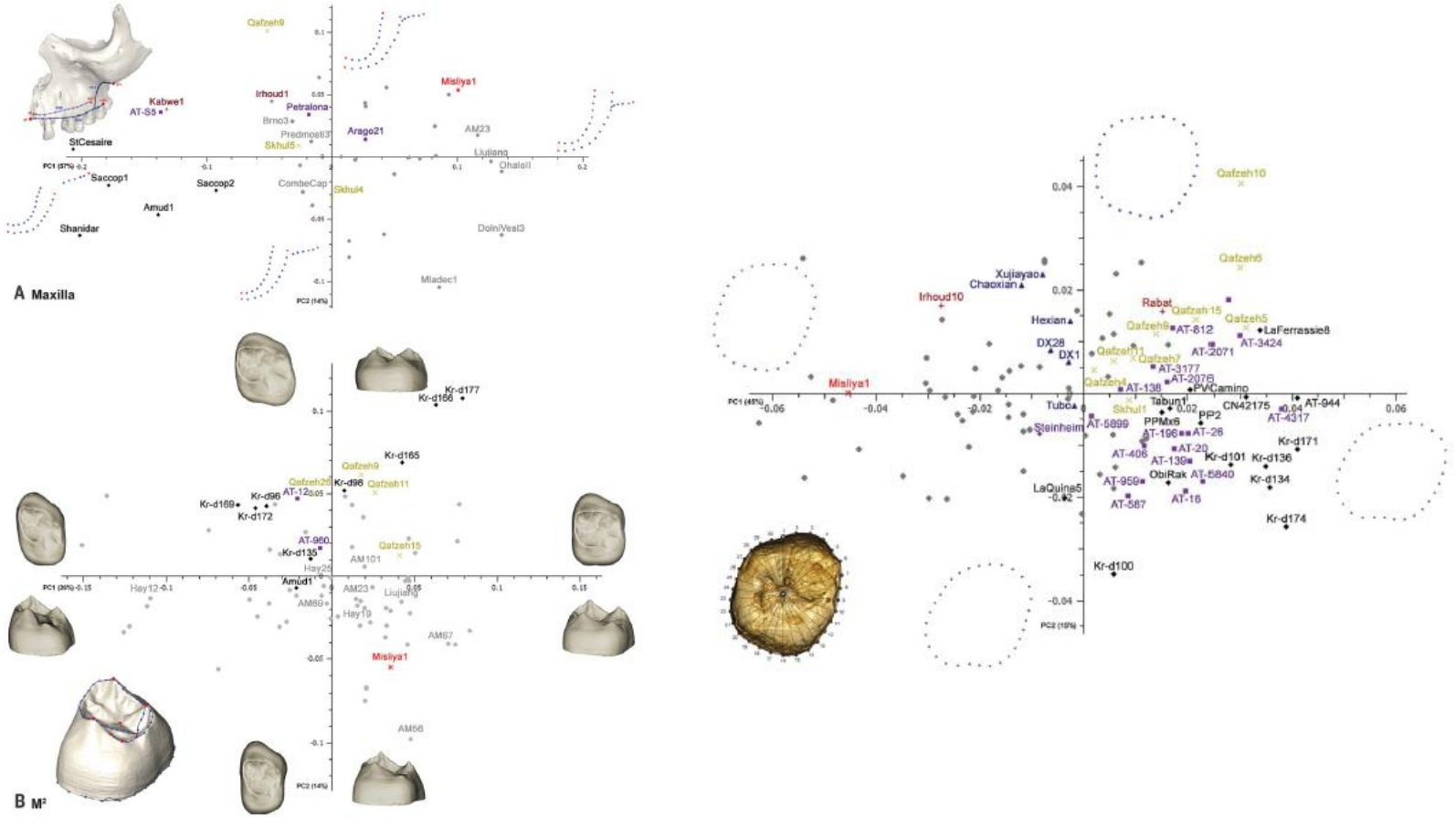
PALEOANTHROPOLOGY

The earliest modern humans outside Africa

Israel Hershkovitz,[1,2*†] Gerhard W. Weber,[3†] Rolf Quam,[4,5,6†] Mathieu Duval,[7,8]

Hershkovitz et al. 2018

The Late Pleistocene fossil record of the Levant

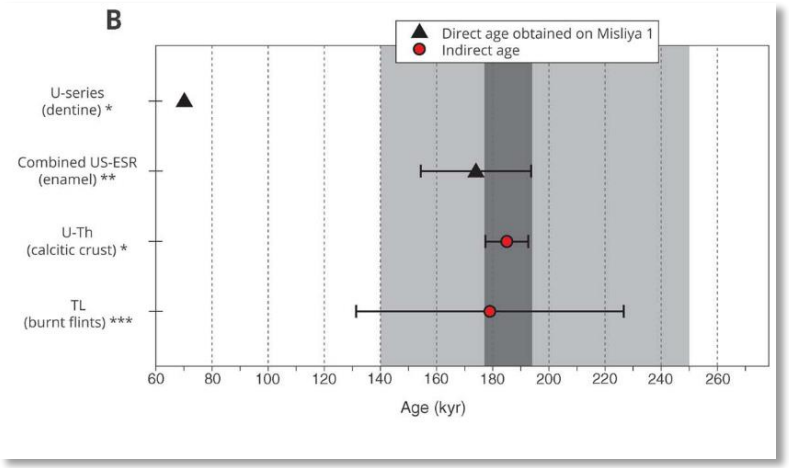


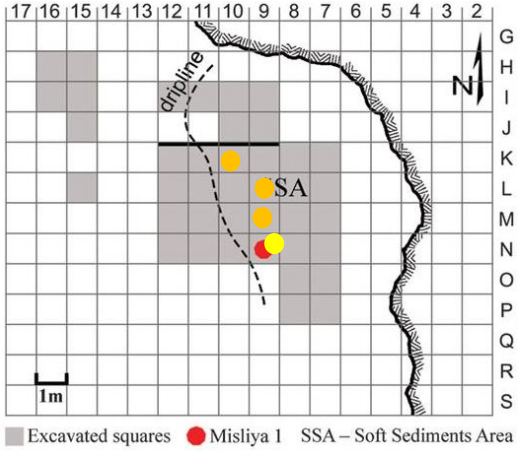
Hershkovitz et al. 2018

The Late Pleistocene fossil record of the Levant

Supplementary Information

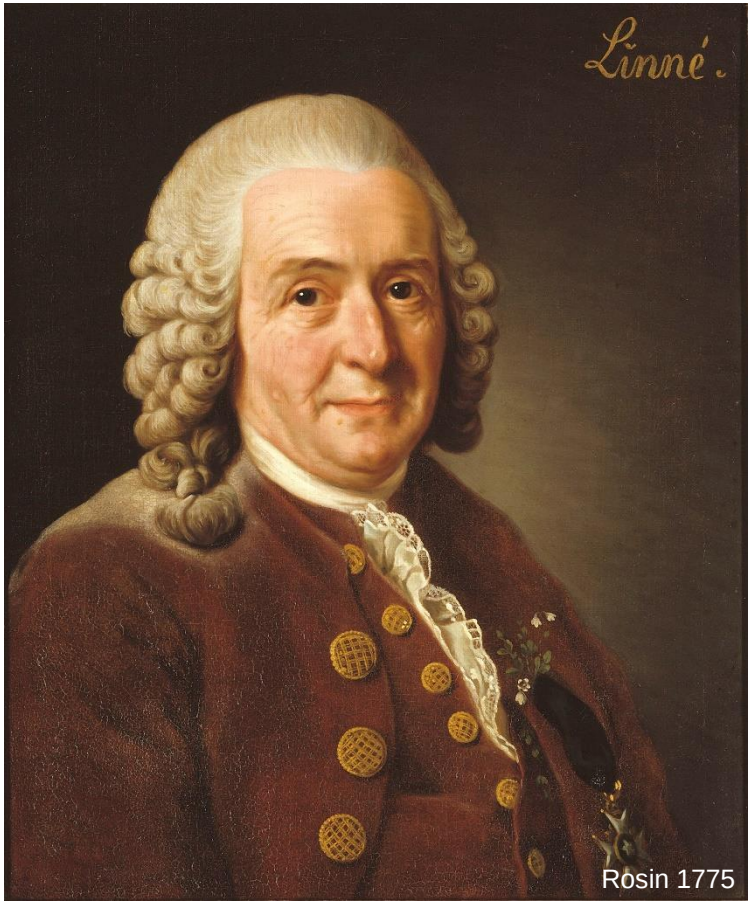
No.	Location	Corrected age (3.8) [ky]
1	Maxilla 1	46
2	Maxilla 2	31*
3	Maxilla 3	19
4	Maxilla 4	70
5	Maxilla 5	24
6	Maxilla 6	185
7	Maxilla 7	58
8	Maxilla 8	61
9	Sq=K11b; Ht=145-150	172
10	Sq=K11b; Ht=100-105 (f)	28
11	Sq=N9b; Ht=121-127 (b)	243
12	Sq=N9b; Ht=105-108 (b)	21
13	Sq=N9b; Ht=82-86 (b)	31
14	Sq=N9b; Ht=108-113 (b)	22
15	Sq=L9b; Ht=128-133 (b)	114
16	Sq=N9b; Ht=113-118 (b)	23
17	Sq=L9b; Ht=105-116 (b)	14
18	Sq=M9b; Ht=108-115 (b)	59
19	Sq=K11b; Ht=185-190 (b)	58
20	Sq=L9 hearth: Ht=155-160	equilibrium





Hershkovitz et al. 2018

What (or who) is the modern human holotype?



Rosin 1775

What (or who) is the modern human holotype?

What (or who) is the modern human holotype?

Methods

Order Primates L., 1758
Suborder Anthropoidea Mivart, 1864
Superfamily Hominoidea Gray, 1825
Family Hominidae Gray, 1825
Homo sapiens idaltu subsp. nov.

Etymology. The subspecies name 'idàltu' is taken from the Afar language. It means 'elder'.
Holotype. BOU-VP-16/1 (Fig. 1), an adult cranium with partial dentition. Holotype and referred material are housed at the National Museum of Ethiopia, Addis Ababa. Holotype from Bouri Vertebrate Paleontology Locality 16 (BOU-VP 16); differentially corrected GPS coordinates: 10°15.5484′ N and 40°33.3834′ E.
Referred material. BOU-VP-16/2 cranial fragments; BOU-VP-16/3 parietal fragment; BOU-VP-16/4 parietal fragment; BOU-VP-16/5 child's cranium; BOU-VP-16/6 R. upper molar; BOU-VP-16/7 parietal fragment, BOU-VP-16/18 parietal fragments; BOU-VP-16/42 upper premolar, BOU-VP-16/43 parietal fragment.
Stratigraphy and age. Bouri Formation, Upper Herto Member. Dated by $^{40}Ar/^{39}Ar$ to between 160,000 and 154,000 years ago (ref. 6).
Diagnosis. On the limited available evidence, a subspecies of *Homo sapiens* distinguished from Holocene anatomically modern humans (*Homo sapiens sapiens*) by greater craniofacial robusticity, greater anterior–posterior cranial length, and large glenoid-to-occlusal plane distance. *Homo sapiens idaltu* is distinguished from the holotype of *Homo rhodesiensis* (Woodward, 1921) by a larger cranial capacity, a more vertical frontal with smaller face, and more marked midfacial topography (for example, canine fossa). We consider the holotypes of *H. helmei* and *H. njarasensis* too fragmentary for appropriate comparisons.

Received 21 November 2002; accepted 14 April 2003; doi:10.1038/nature01669.

White et al. 2003

What (or who) is the modern human holotype?

I. PRIMATES.

Dentes Primores superiores IV, paralleli.
Mammæ Pectorales II.

1. HOMO nosce Te ipsum (*)

Sapiens. 1. H. diurnus; *varians cultura, loca.*

Ferus. tetrapus, mutus, hirsutus.
Juvenis Ursinus lithuanus. 1661.
Juvenis Lupinus hessensis 1344.
Juvenis Ovinus hibernus. Tulp. obs. IV. 8
Juvenis Hannoveranus.
Pueri 2 Pyrenaici. 1719.
Johannes Leodicensis.

Americanus. 2. rufus, cholericus, rectus.
Pilis nigris, rectis, crassis; *Naribus* patulis, *Facie* ephelitica, *Mento* subimberbi.
Pertinax, hilaris, liber.
Pingit se lineis dædaleis rubris.
Regitur Consvetudine.

β al-

(*) Nosse Se Ipsum gradus est primus sapientiæ, dictumque *Solonis*, quondam scriptum litteris aureis supra *Dianæ* Templum. *Mus. ADOLPH. FRID. Præfat.*

Physiologice: Te contextum Nervis, intertextum Fibris, Machina tenella, sed adolescente in perfectissimam, facultatibus instructam fere omnibus pluribusque, quam reliqua cuncta. *Nudum in nuda humo, natali die, abjecit natura ad vagitus statim & ploratum, manibus pedibusque devinciendum Animal cæteris imperaturum; cui scire nihil sine doctrina; non fari, non ingredi, non vesci, non aliud natura sponte. Plin. Vides itaque qualem vitam nobis rerum natura promisit, quæ primum nascentium omen fletum esse voluit. Seneca.*

Diætetice: Te sanitate & tranquillitate, si noveris, felicem: *Moderatis* conservandum, *Nimiis* destruendum, *Variatis* efficiendum, *Insvetis* frangendum, *Consvetis* indurandum; polyphagum Culina instructissima, per errores gratissima, igne vinoque horrenda. *Parvo fames constat, magno fastidium. Seneca.*

Pathologice: Te tumidam usque dum crepueris bullam, piloque pendulam in puncto fugientis temporis. *Nihil enim homine imbecillius terra alit. Homer. Nulli vita fragilior; nulli tot Morbi, tot Curæ, tot Pericula. Breve universum utique ævi tempus: Pars æqua morti similis exigitur; nec reputantur Infantiæ anni, qui sensu carent; nec Senectæ in pœnam vivacer: hebescunt Sensus, torpent Membra, præmoriuntur Visus, Auditus, Incessus, Dentes, Ciborum instrumenta. Plin. Sic magna pars mortis jam præteriit, quidquid ætatis vetvo est Mors tenet. Totum denique hunc, quem vides populum, quousque cogitas esse; cito natura revocavit & condet; Mors omnes æque vocat; iratis Diis propitiisque moriendum. Senec. II: 59.*

Europæus. β. albus, sanguineus, torosus.
Pilis flavescentibus prolixis. Oculis cæruleis.
Levis, acutissimus, inventor.
Tegitur Vestimentis arctis.
Regitur Ritibus.

Asiaticus. γ. luridus, melancholicus, rigidus.
Pilis nigricantibus *Oculis* fuscis.
Severus, fastuosus, avarus.
Tegitur Indumentis laxis.
Regitur Opinionibus.

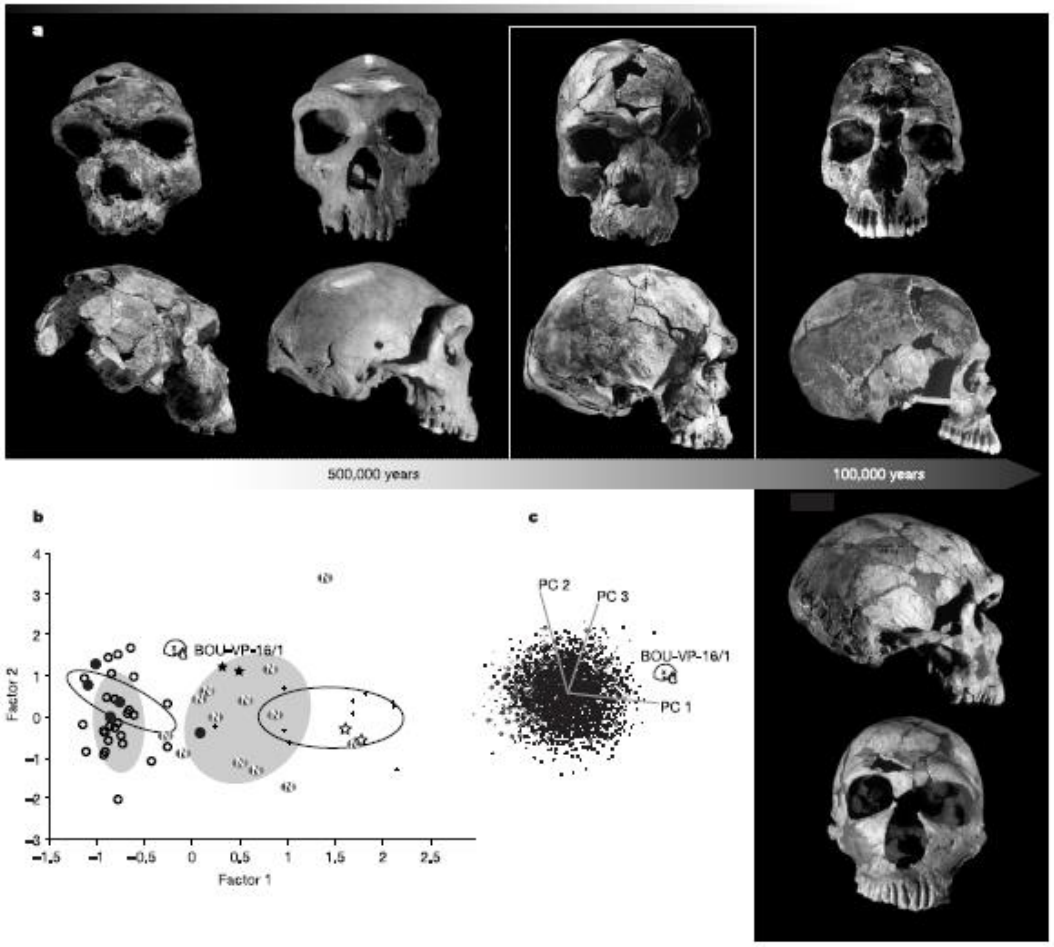
B 3 ♂ ni-

Naturaliter: Te audacis naturæ miraculum, Animalium Principem, cujus causa cuncta genuit natura, esse animal flens, ridens, melodum, loquens, docile, judicans, admirans, sapientissimum; sed fragile, nudum, suapte natura inerme, ad omnem fortunæ contumeliam projectum, alienæ opis indigens, anxiæ mentis sollicitæque tutelæ, precarii spiritus, pertinacis spei, querulæ vitæ, tardæ sapientiæ. Temporis annihilati emortui contemtorem, præsentis vividi dilapidatorem, futuri dubii æstimatorem in vita volucri, pretiosissima, irrevocabili. sic optima quæque dies miseris mortalibus ævi prima fugit; alium ad quotidianum opus laboriosa Egestas vocat; alium Luxus incarcerat. altilemque suffocat; alium Ambitio numquam quieta sollicitat; alius Divitiis, quas optaverat, metuit, & voto laborat. Isto; alium Solitudo, alium semper vetibulum obsidens turba. Hic se habere dolet Libros, hic se perdidisse; Lacrymæ nobis deerunt antequam causæ dolendi. Sed quousque nos malos nostra mala rapuere: circumferre per cuncta, ru re in ignotos, iratos sine injuria, ferarum more occidere quem non oderimus, secundos oprare ventos, quorum felicitas est ad bella p rferre; parum videlicet ad mortes nostras terra late patet. *Senec. Cætera animantia congregari contra dissimilia, at Homini primum ex homine mala Plin.*

Politice: Te recti loco tenere errorem publicum factum, qui te vix enixum consvetudinis larva induit, nutrit, educat. alit, regit, secundum quam honestus, fortis, sapiens, moratus, pius existimaris; Cum gubernatus Opinione vivas ad Consvetudinem, nec ad Rationem. Te, inter perituros constitutum, cum nulli contigit impune nasci, beneficii loco petere, ut ultimus cervicem præbeas, dum interim, dulci fortuna ebrius, colligendo in crastinum Lapillos fortunæ certas, verbis in furorem ageris, aliter theoretise pios odio persequeris, quanrosque tumultus excitas, non ut servias, sed cui; nugis irrevocabile tempus consumis; immortalia æterneque animo volutas, de seris nepotibus proneporibusque disponis, novas spes oblitus conditionis Tuæ ponis, cum interea longa conantem mors opprimit, at in agone oculos aperiens (ἀνὴρ ὡρωπος) somnium primo observas; *Sic vivimus ut immortales & morimur ut mortales. Senec.*

Moraliter: Te sub rudi larva Ineptum, Lascivum, Imitatorem, Ambitiosum, Prodigum, Solicitum, Astutum, Austerum, Invidum, Avarum, *transformasi* in Attentum, Castum, Confideratum, Modestum, Sobrium, Tranquillum, Sincerum, Mitem, Beneficum, suis Contentum. *Uni animantium*

What (or who) is the modern human holotype?



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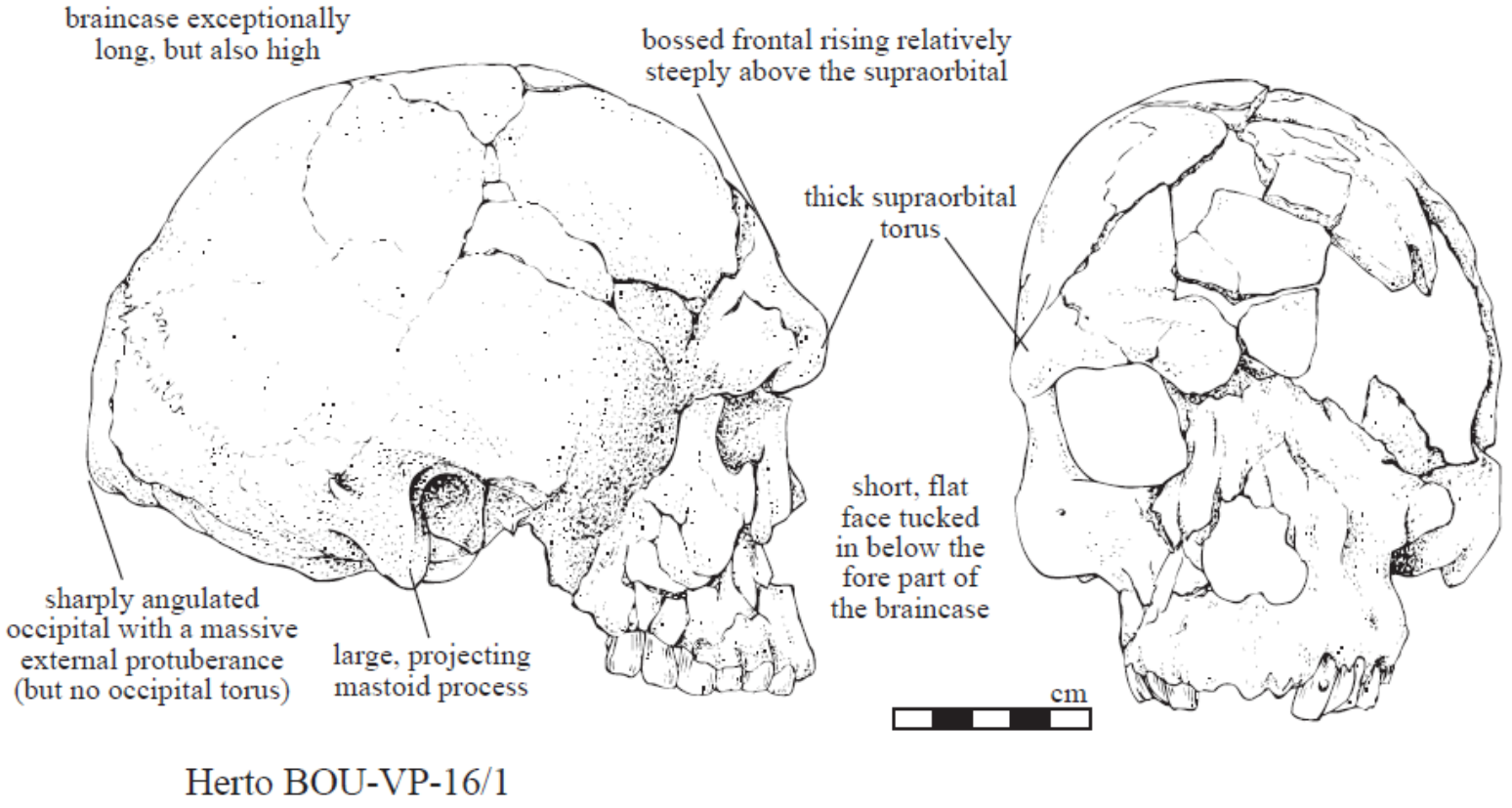
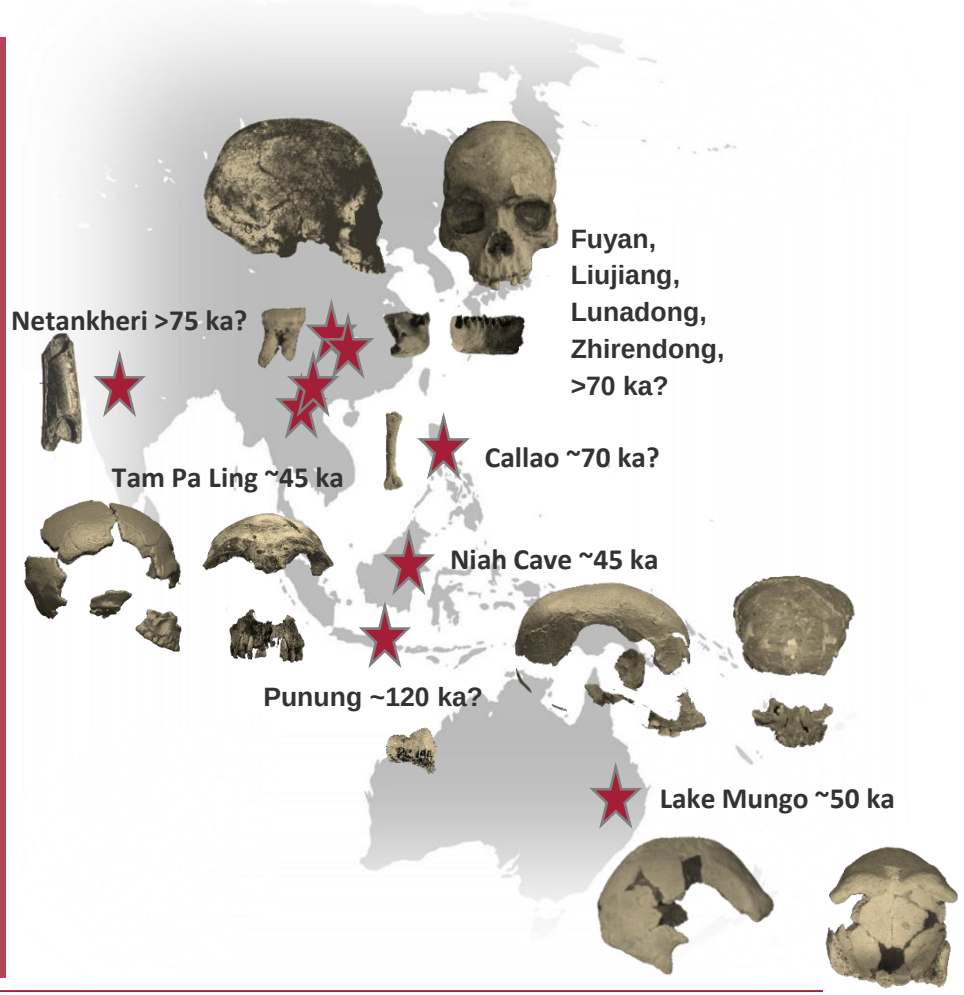


Klein 2009

The fossil record of Eurasia and Australia

- Tam Pa Ling, Laos ~45 ka
- Niah Cave, Borneo ~45 ka
- Lake Mungo, Australia ~50 ka



Classification and taxonomy

- Classifying the natural world
- Linnean hierarchical classification
- Numerical taxonomy
- Cladistics
- Phylogenetics

Are modern humans:

- ***Homo sapiens***
- ***Homo sapiens idaltu***
- ***Homo sapiens sapiens*** **?**

What about the Neanderthals?

What about the ergasterines / *erectus*?

White et al. 2003

Populations and demes

Should we think about populations rather than species?

Classification and taxonomy

- Classifying the natural world
- Linnean hierarchical classification
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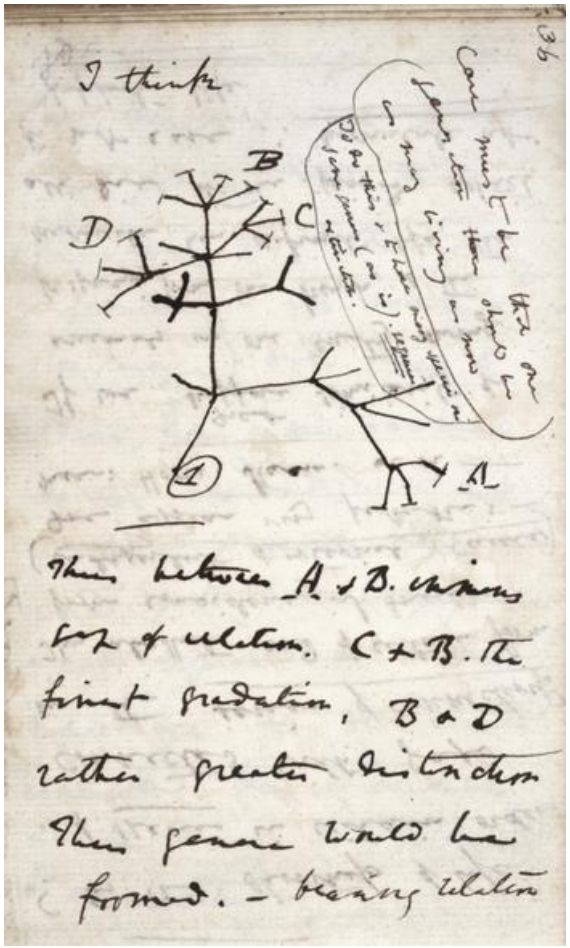
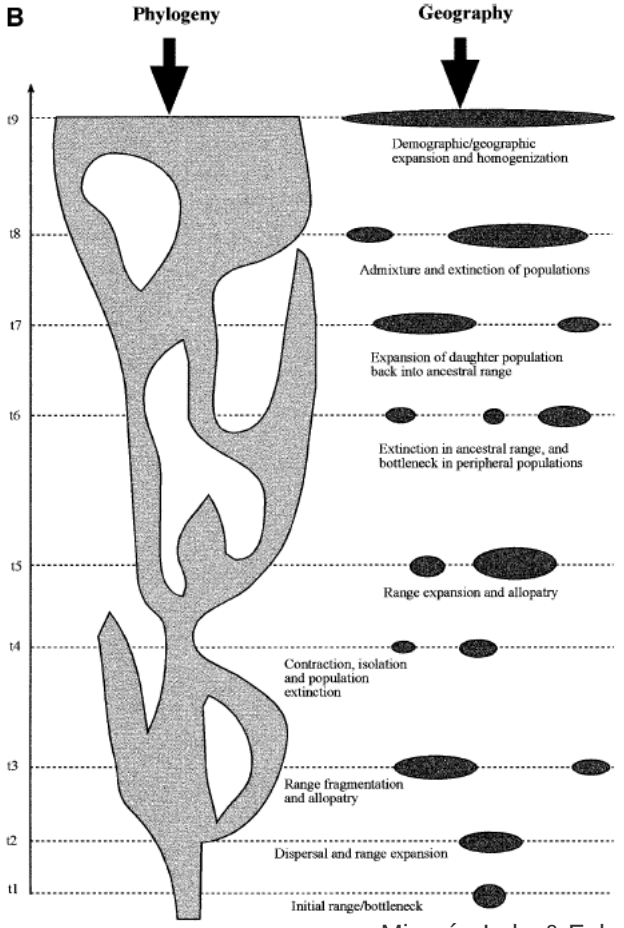


Populations and demes

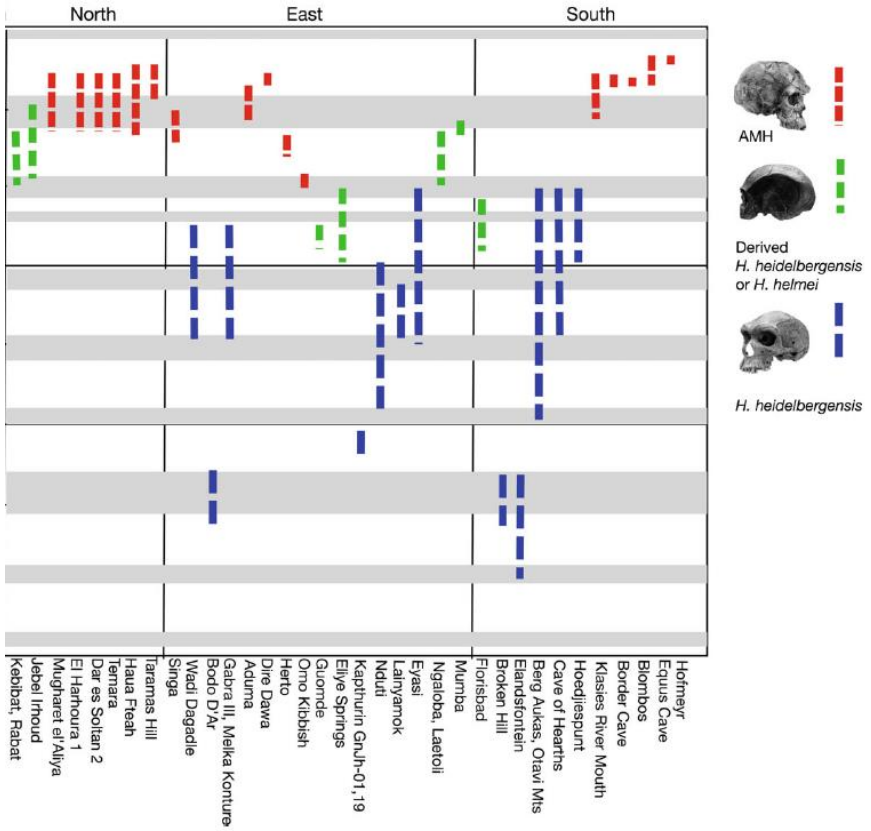
- A population is bound by common external characters (ecological niche, behavior) that retain internal similarities
- A deme generally refers to a local population of a polytypics species that can interbreed with one another but retain a distinct gene pool
- When demes are isolated for a long time, they can become distinct subspecies
- Geographical constraints are implicit



Mirazón Lahr & Foley 1998

Populations and demes

- Paleo-demes refer to chronologically and spatially constrianed groups of fossils
- Accurate dating is crucial for formulating paleo-demes



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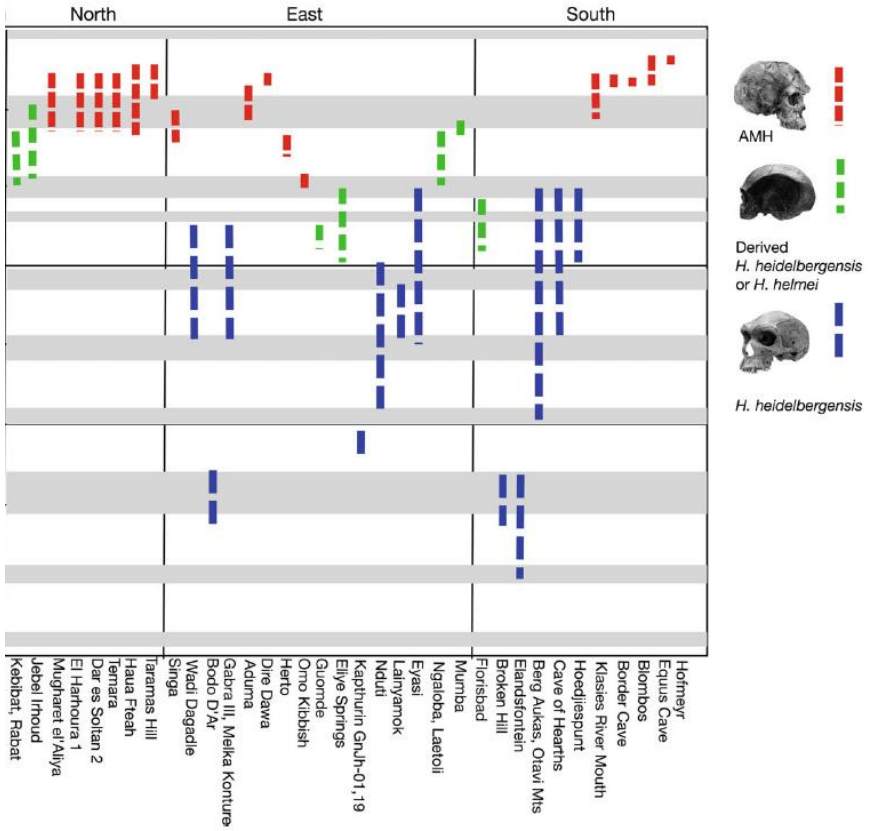

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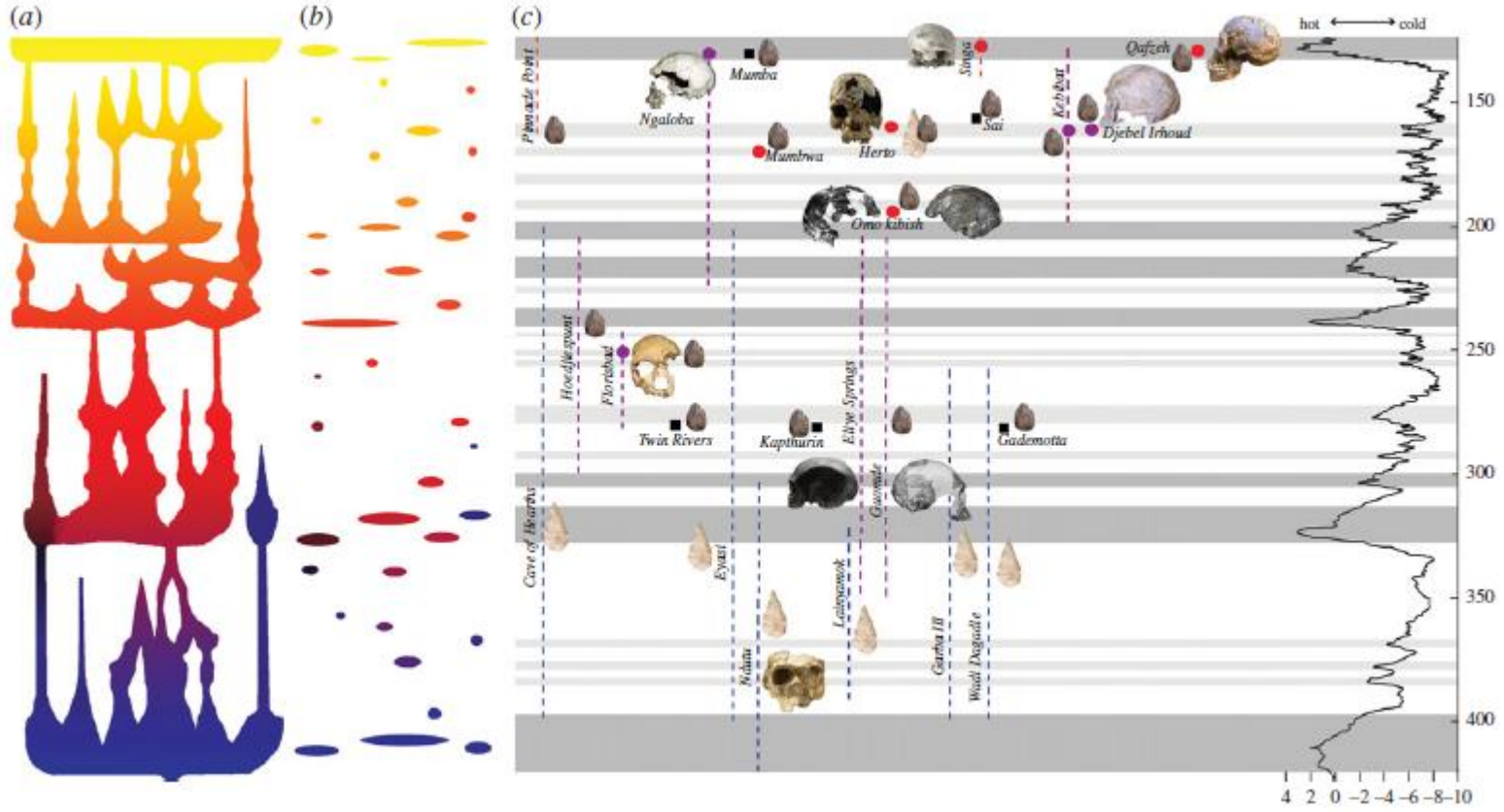
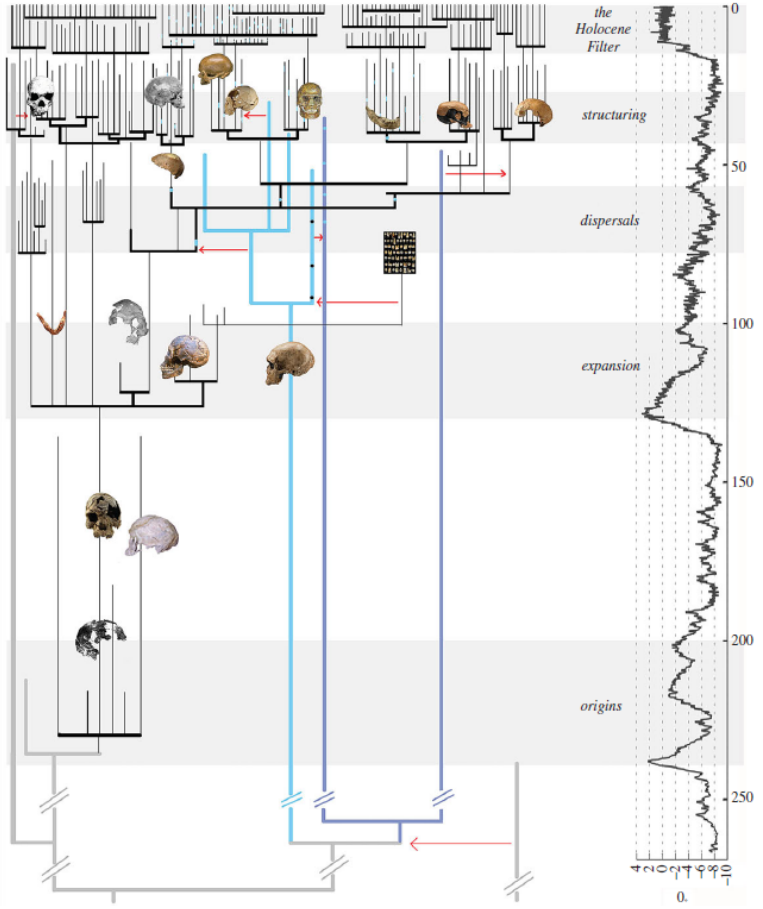


Mirazón Lahr 2016

Populations and demes



Mirazón Lahr 2016

For next week's lecture:

- **Genomics of modern human origins**
  How does (ancient) DNA inform the debates on modern human origins?
- **Models of anthropogeny**
  What model of modern human origins is best supported with the current fossil and genomic evidence?
- **Modern human dispersals**
  When, how, and why did anatomically modern humans disperse out of Africa?

EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

DFG

DFG Center Colloquium TOMORROW

12:30-13:30
INA, Room 602

Dr. Andrea Benazzo & Prof. Silvia Ghirotto
University of Ferrara

A new Approximate Bayesian Computation framework to distinguish among complex evolutionary models using complete genomes data