

Evolution of Man

THE SCIENCE OF WHO WE ARE AND WHERE WE COME FROM



The Darwinian revolution forced people to face the fact that humans are part of nature, not above nature.

But anthropologists struggled with explaining the special features of Homo sapiens -intelligence, our sense of right and wrong, our esthetic sensibilities. Since the latter part of the 20th century idea of naturalistic explanations of our special qualities embraced.

- Every extinct and extant (still living) species on earth have resulted from the **same evolutionary processes** determining the way they are through shaping their morphology, physiology, and behavior.
- The traits specific for the human species are the result of the **same evolutionary processes responsible for any other living creature.**
- **Theories of human evolution** refers to the complex defining methods, practices, hypotheses, models, explanations, and interpretations of data, answering the question what makes us human from an evolutionary perspective.

- Interdisciplinary endeavour-- anatomy, anthropology, archaeology, botany, climate sciences, ecology, genetics including ancient DNA studies and geogenomics, geology, history, linguistics, paleoanthropology, paleontology with related subdisciplines, phylogeny, physiology, primatology, and a number of different disciplines specializing in dating.
- Classically 4 important questions: **terrestriality, bipedalism, encephalization, and civilization**
- **With time key questions have expanded**
- The first broad theory of evolution was proposed by the French naturalist Jean-Baptist de Monet, chevalier de Lamarck (1744–1829). In his *Philosophie zoologique* (1809; translated as *Zoological Philosophy*)
- Acquired characteristics: Experiments with fowls, salamander
- Lamarckism was disproved in 20th century

Young Charles Darwin

Charles Darwin is more famous than his contemporary Alfred Russel Wallace who also developed the theory of evolution by natural selection.

PHOTOGRAPH BY JAMES L.
STANFIELD

Influenced by geologist
Charles Lyell

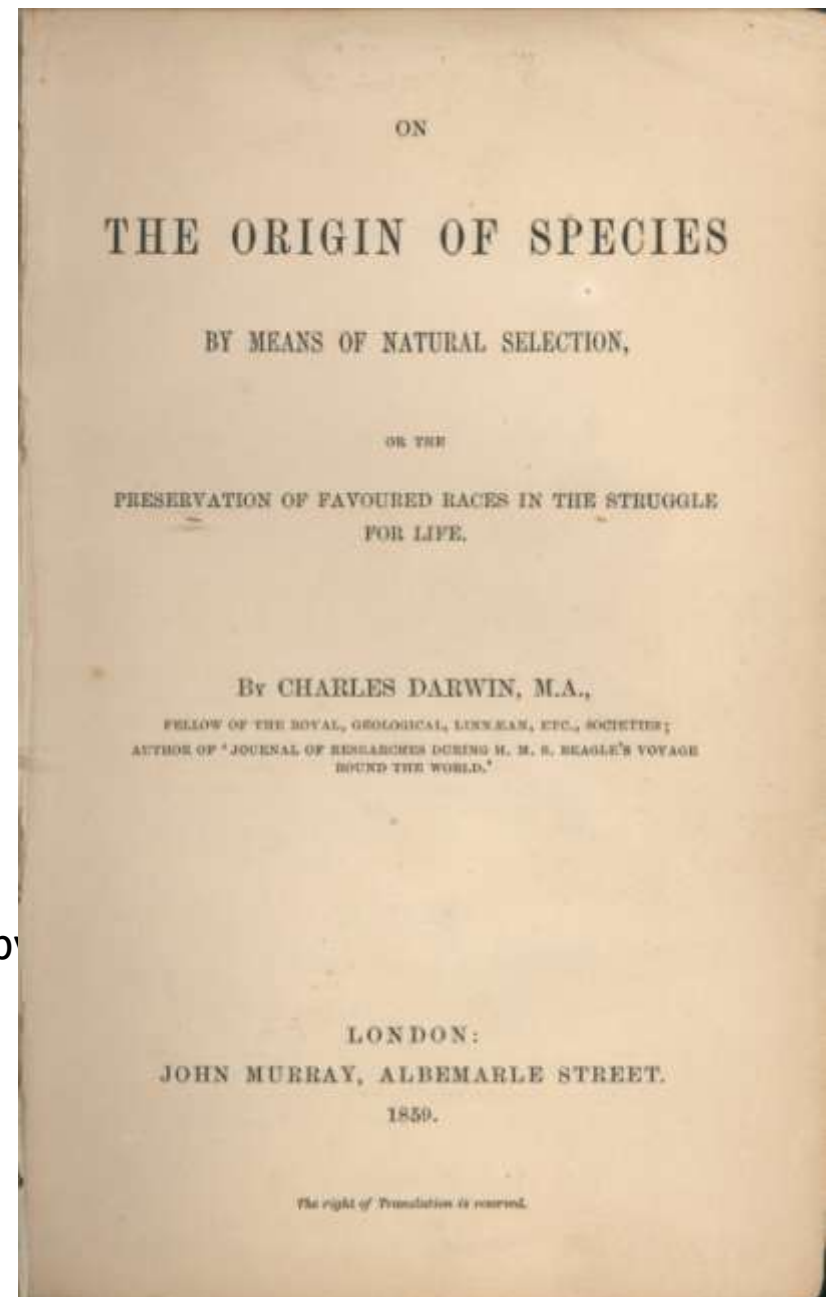
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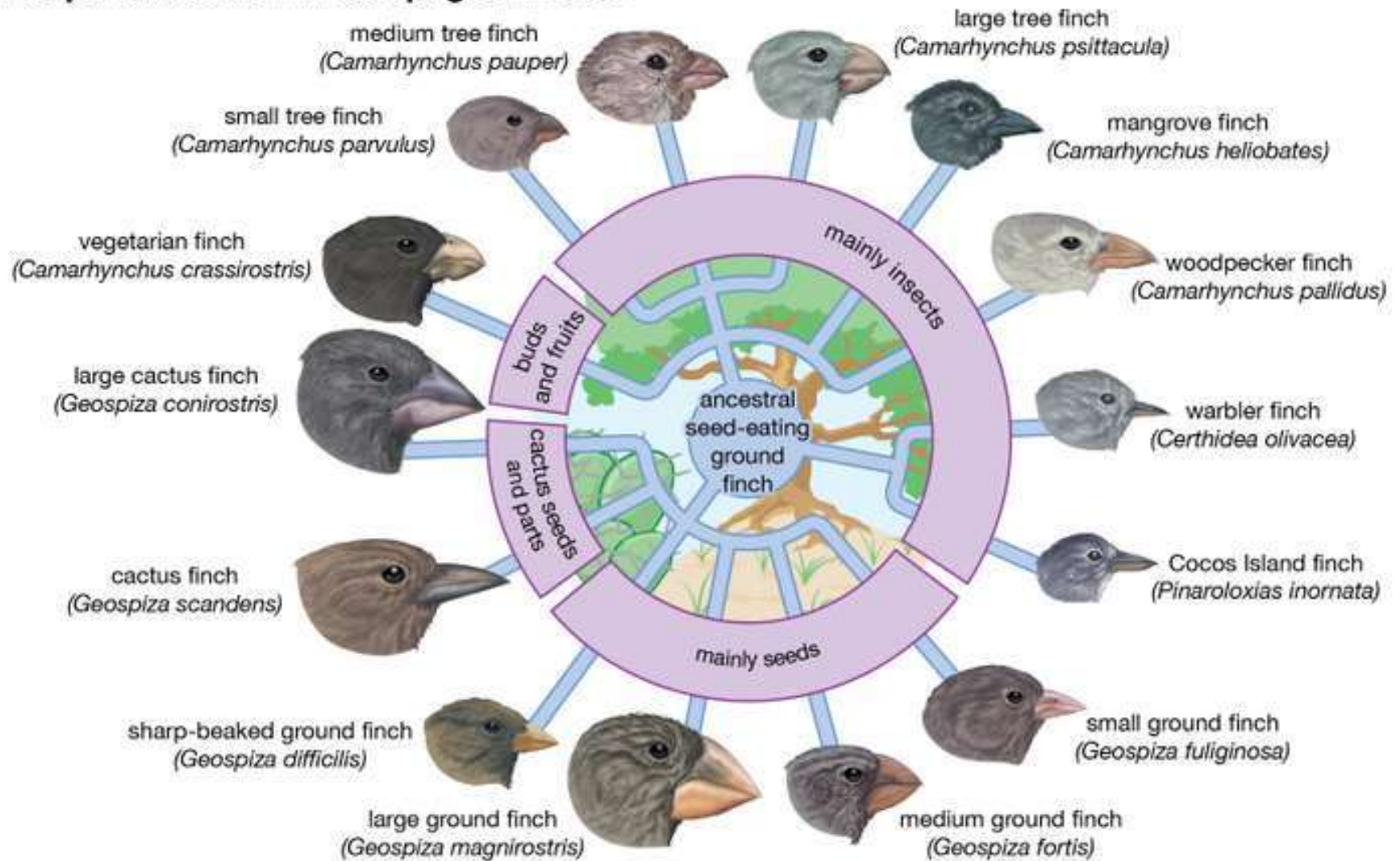


Beagle anchoring at [Tierra del Fuego](#) in 1832; painting by the ship's draughtsman [Conrad Martens](#)

[Source:](#)
https://en.wikipedia.org/wiki/Second_voyage_of_HMS_Beagle



Adaptive radiation in Galapagos finches



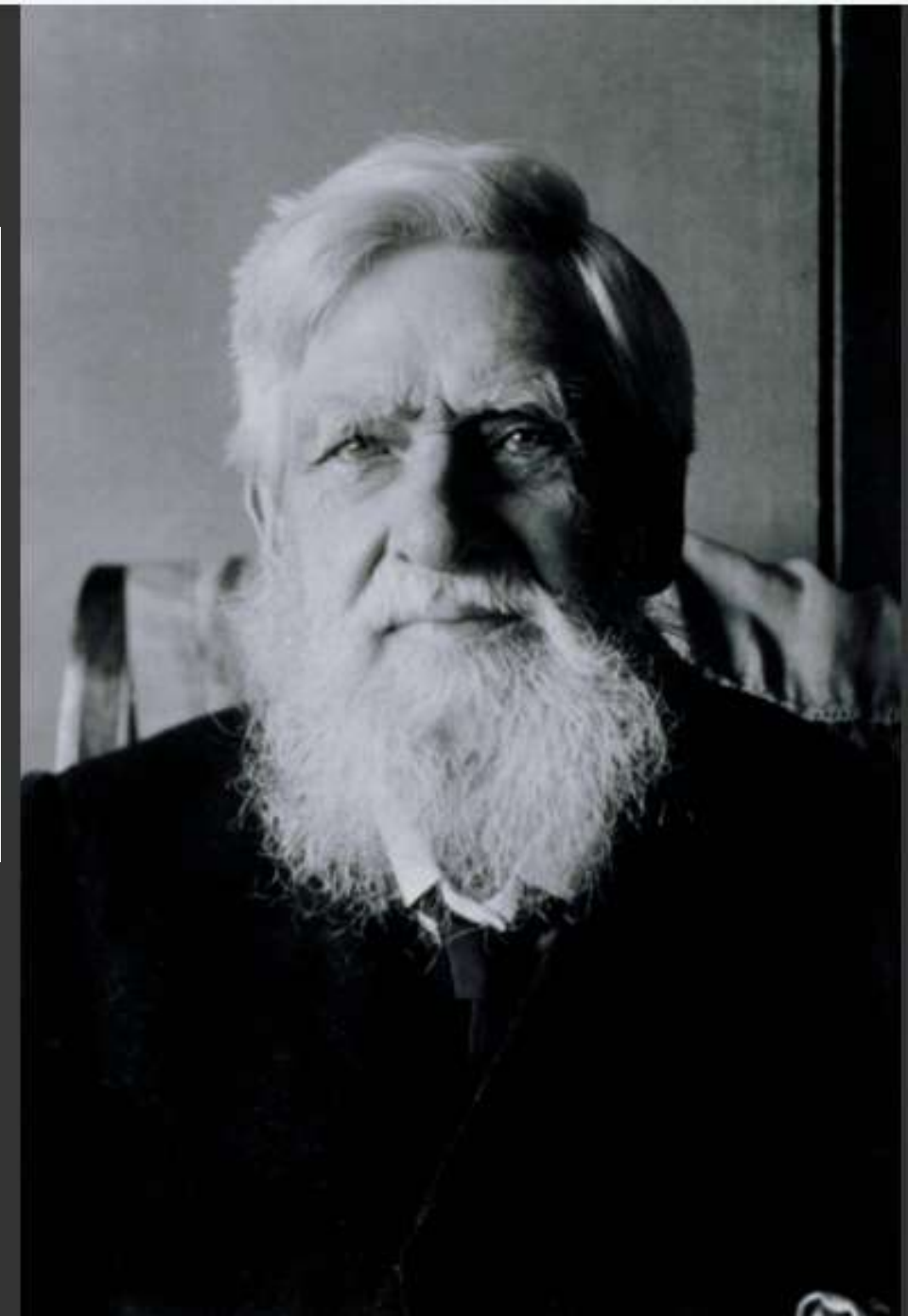
(1) Hereditary variations occur, some more favorable than others to the organisms; (2) more organisms are produced than can possibly survive and reproduce; and (3) organisms with more favorable variations will survive and reproduce more successfully.

Two consequences follow: (1) organisms are adapted to the environments where they live because of the successful reproduction of favorable variations and (2) evolutionary change will occur over time.

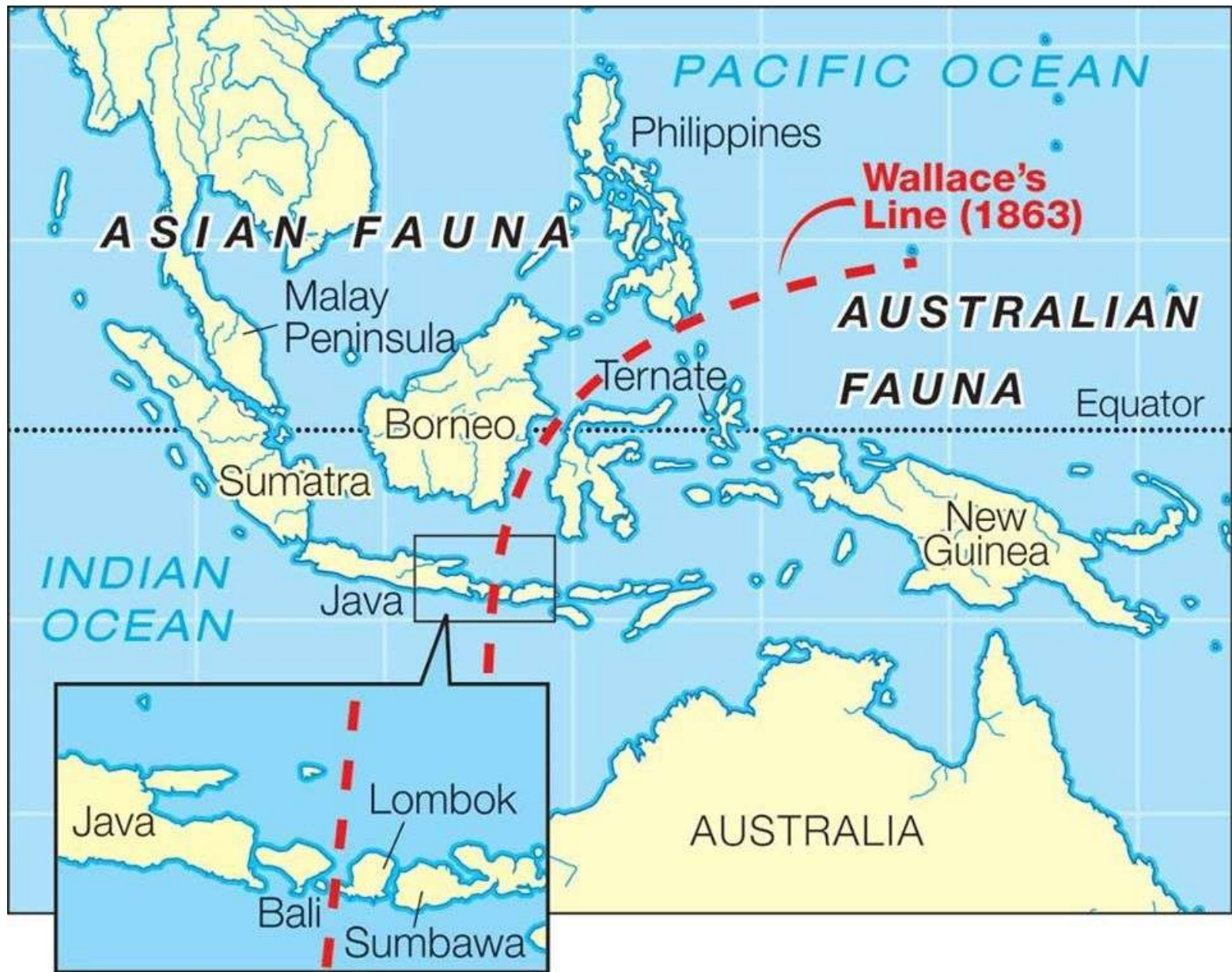
Alfred Wallace

British naturalist, Alfred Wallace co-developed the theory of natural selection and evolution with Charles Darwin, who is most often credited with the idea.

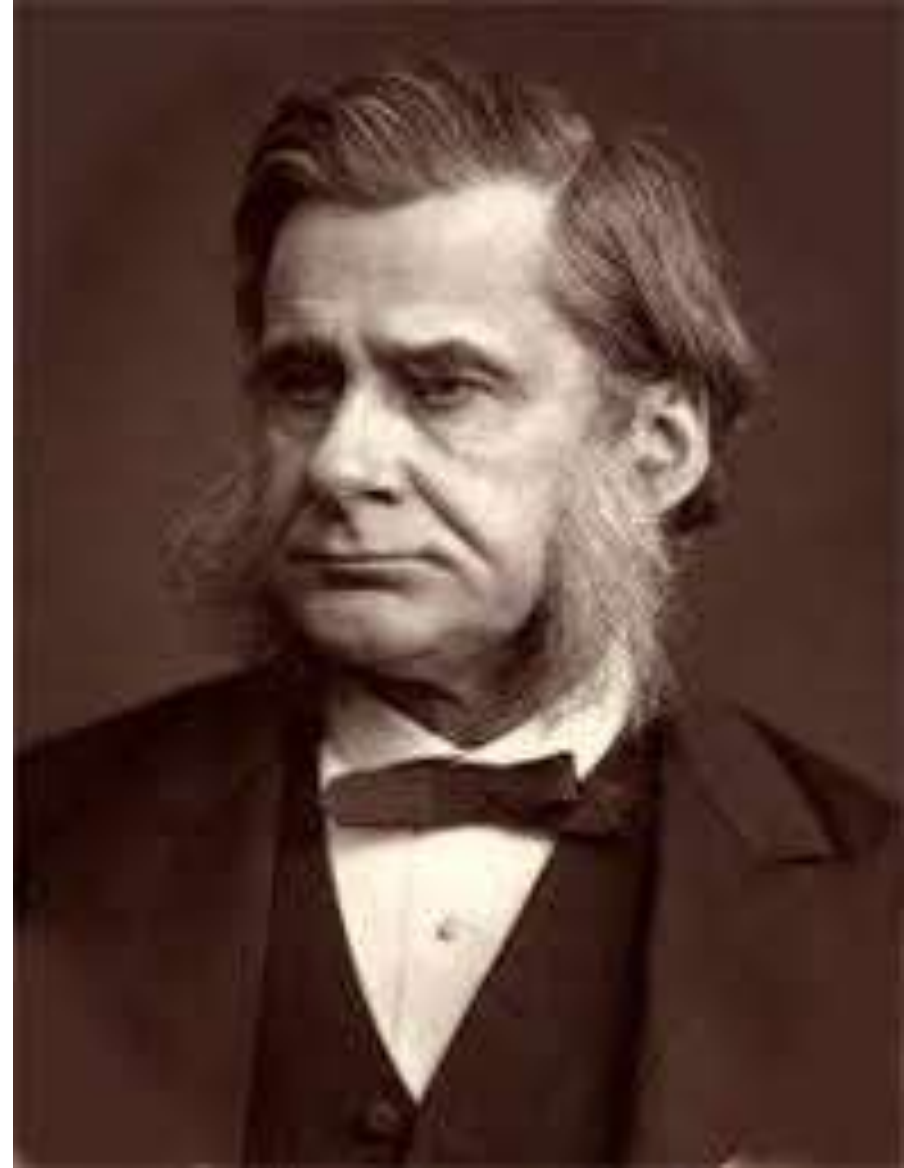
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- ***Evidences as to Man's Place in Nature.***
- *Thomas Henry Huxley*
- Huxley's conclusion-that humans share a close evolutionary relationship with the great apes, particularly the African apes-was a key element in a revolution in the history of Western philosophy: humans were to be seen as being a part of nature, no longer as apart from nature.



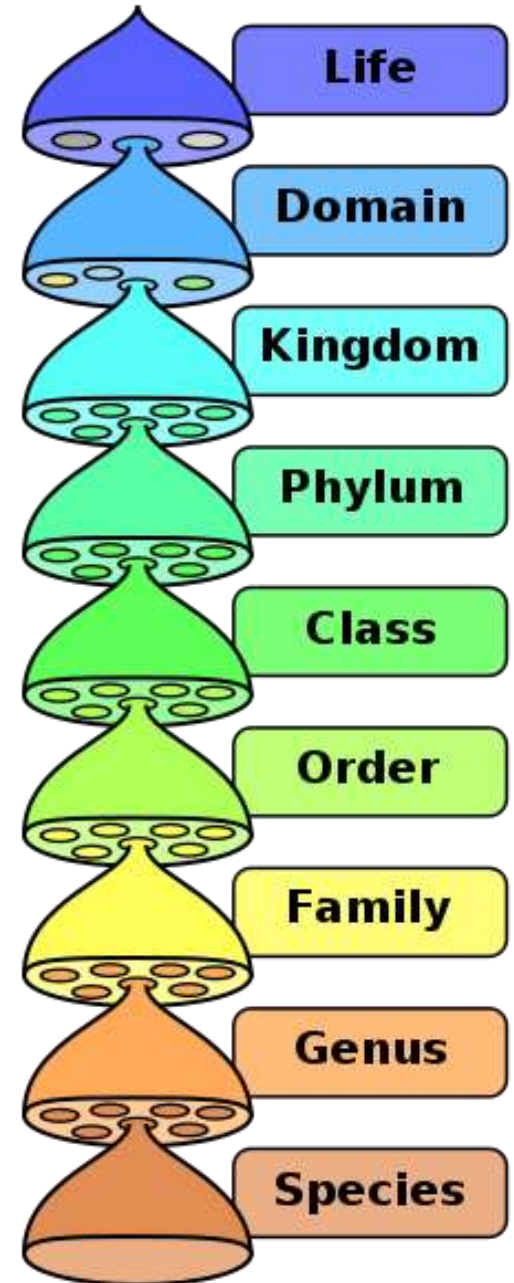
Taxonomic terms

Taxonomy is the science that seeks to classify and organize living things, expressed as a series of mutually exclusive categories.

All living organisms are related to each other through a common ancestor.

Taxa (groups), Binomial nomenclature, genetic similarity

Given by Swedish scientist Carl Linnaeus (100 years before Darwin)



- **Domain:** Added in 1990's
- **Archea and Eubacteria** (No nucleus), **Eukaryota** (nucleus and membrane).
- Archea and Eubacteria differentiated –biochemical composition and RNA markers distinction
- **Kingdom: Protista** (Heterotrophs+autotrophs, locomotion by cilia, flagella), **Fungi** (saprotrophs), **Plantae** (autotrophs), and **Animalia** (heterotrophs)
- **Phylum: Example: Chordata, Anthropoda**
- **Class: Example for Chordata:** organ systems are into distinct regions or sub-organs...Birds, Amphibians, Reptiles, **Mammals**, Fish
- **Order:** Example for Mammals-Primates, Carnivora in Class mammalia

- **Family---Sub-family:** Example Carnivora include Canidae, Felidae, Ursidae.
- **Genus:** Generic name. While writing its capitalised; binomial system of naming. Species that are ancestrally related, are distinct from other genera
- Canidae represent the dog-like creatures. In each family lies many genera of each type. Wolves, for instance are in the genus *Canis*, while foxes are in the genus *Vulpes*.
- **Species:** reproductively isolated. Single or multiple – sapiens and variety of fish

LINNAEAN CLASSIFICATION OF HUMANS

Kingdom: **Animalia**

Phylum: **Chordata**

Subphylum: **Vertebrata**

Class: **Mammalia**

Subclass: **Theria**

Infraclass: **Eutheria**

Order: **Primates**

Suborder: **Anthropoidea**

Superfamily:

Hominoidea (great apes, gibbons and [humans](#))

Subfamily Homininae (African apes and

humans) **Tribes**: Gorillini, [Hominini](#),

sapiens

Family: Hominidae (great apes,

Genus: **Homo** and [humans](#))

Species:

Order	Superfamily	Family	Subfamily	Tribe	Genus	Species
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Primates (primates): monkeys, apes, humans, lemurs, lorises, tarsiers, and their ancestors

Hominoidea (hominoids): lesser apes, great apes and humans, and their fossil relatives

Hominidae (hominids): great apes and humans plus their fossil relatives

Homininae (hominines): African apes and humans including their ancestors

Lemur



Tarsiers

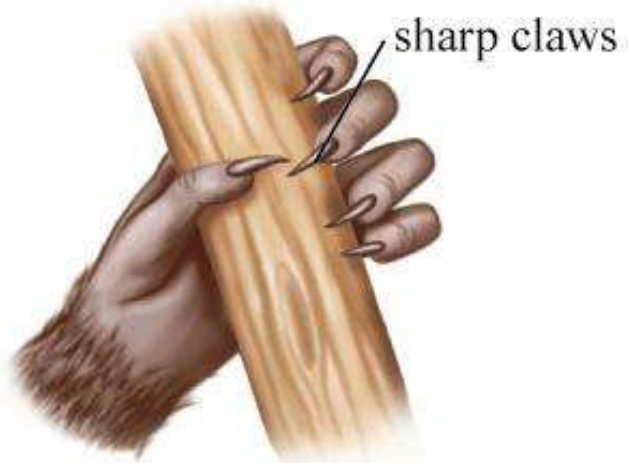
Lorises



Primates Characteristics

- Our closest relatives in nature
- Opposable thumb • Stereoscopic vision (depth perception) • Well-developed brain • Reduced number of offspring (usually a single birth) with an increased period of parental care • Emphasis on learned behavior and social interactions
- Two suborders:
 - Prosimians – includes lemurs, tarsiers, and lorises
 - Anthropoids – includes monkeys, apes, and humans

Primate Hands



a. Tree shrew



c. Tarsier

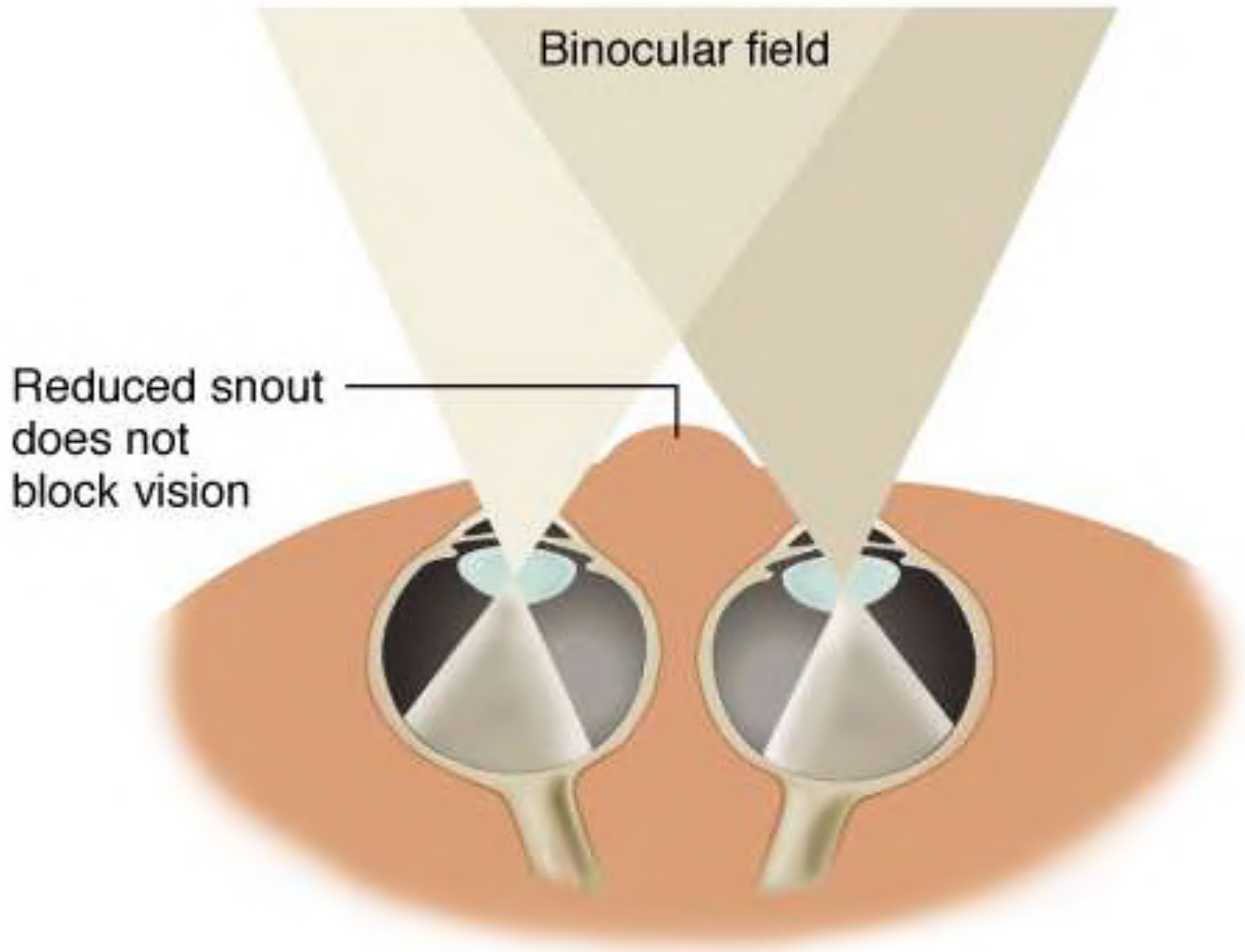


b. Macaque



d. Human

Binocular Color Vision



ANTHROPOIDS

2. Anthropoids = monkeys + apes + man

a. Monkeys:

- Old world monkeys
- New world monkeys

New World Monkey:

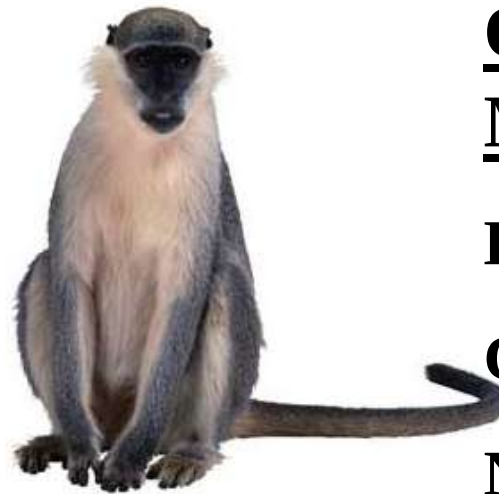
Flat face

Wide nostrils

Prehensile tail



Spider monkey



Langur

Old World Monkey:

Long snout

Close nostrils

Non-prehensile
tail



Great Apes

Lesser Apes

Siamangs



Gibbons



Order- *Primate*: monkeys, apes, humans, lemurs, lorises, tarsiers, and their ancestors

Super Family-Hominoidea (hominoids): Great Apes, Lesser Apes humans, and fossil relatives

Family-Hominidae (hominids): G.apes, humans, and fossil relatives

Sub-family-Homininae (hominines): African apes and humans, and fossil relatives

Tribe Hominini (hominin)

Other Tribe-Gorillini (gorillins): lineage of fossil and living gorillas-

Genus Gorilla-Species G.gorilla, G.beringei

Gorillini (gorillins): lineage of fossil and modern gorillas

Gorilla

G. gorilla

G. beringei

Panini (panins): lineage of fossil and modern chimpanzees

Pan

P. paniscus

P. troglodytes

Hominini (hominins): lineage of fossil and modern humans

Sahelanthropus

S. tchadensis

Orrorin

O. tugenensis

Ardipithecus

Ar. kadabba

Ar. ramidus

Australopithecus

Au. anamensis

Au. afarensis

Au. africanus

Au. sediba

Au. garhi

Paranthropus

P. aethiopicus

P. robustus

P. boisei

Kenyanthropus

K. platyops

Homo

H. habilis

H. rudolfensis

H. ergaster

H. erectus

H. floresiensis

H. antecessor

H. heidelbergensis

H. sapiens

Phylogeny and Taxonomy

- Shuffling of term ***hominids*** of family Hominidae-
- **Now includes? Great apes and humans**
- Earlier only included humans
- Based on new genetic evidence
- Great apes were placed in family Pongidae

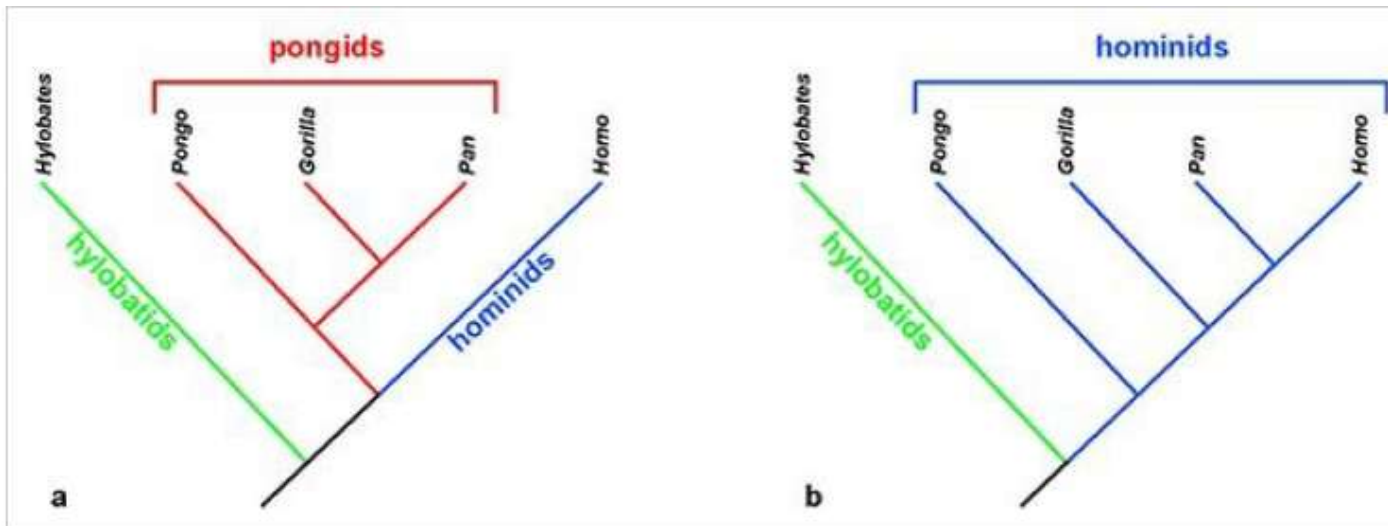


Figure 2: Changing phylogeny of the apes and implications for taxonomy.

- **Subfamily ranks** are also modified
- E.g.: Subfamily **Homininae** **excludes** orangutans
- New genetic evidence helps to modify the taxonomic models

Hominin Taxonomy and Phylogeny

- More of a hypothesis than a robust conclusion
- Relationships between various species and genus is yet not fully resolved
- We will discuss three major **issues- ancestry, variation, biological complexity**

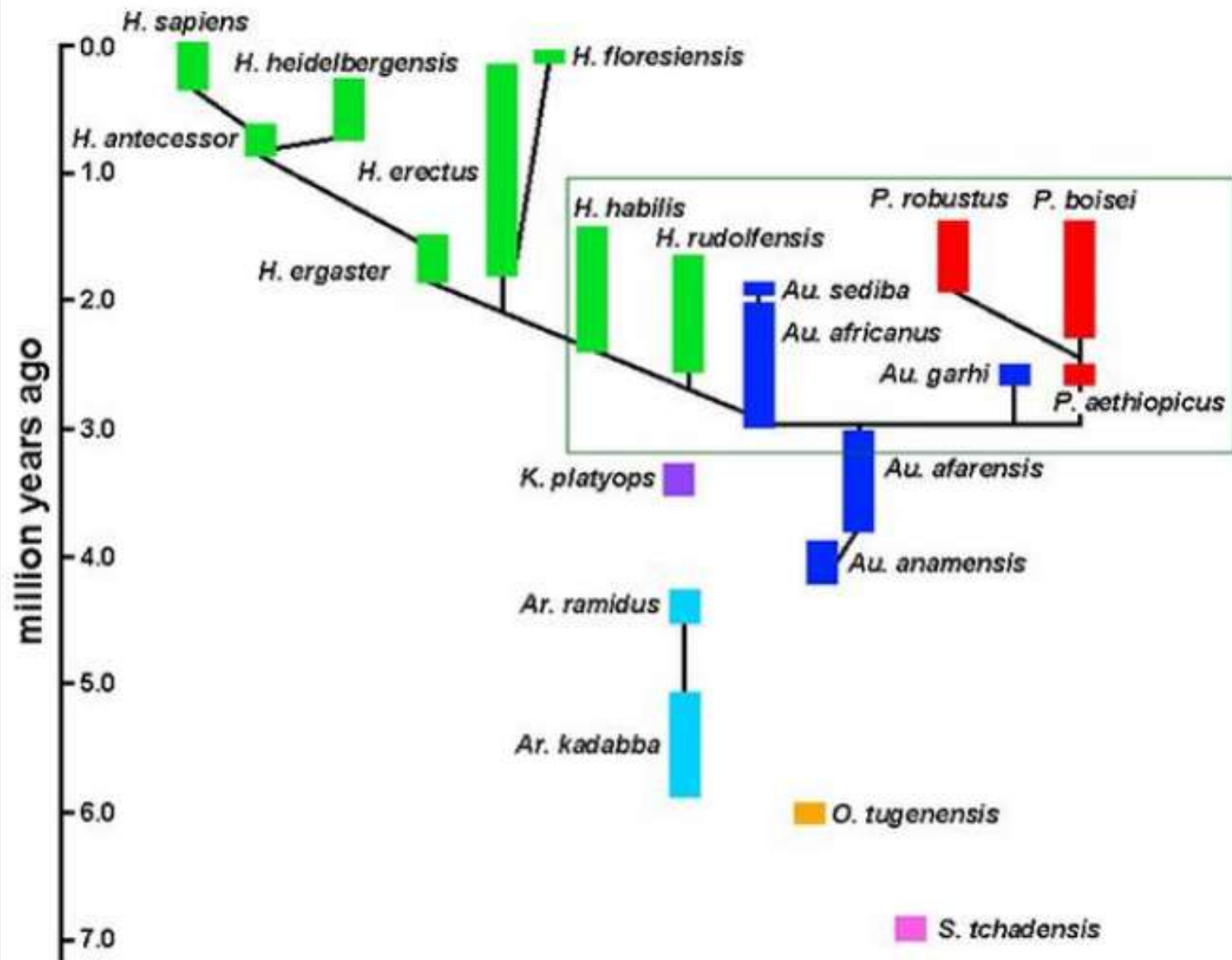
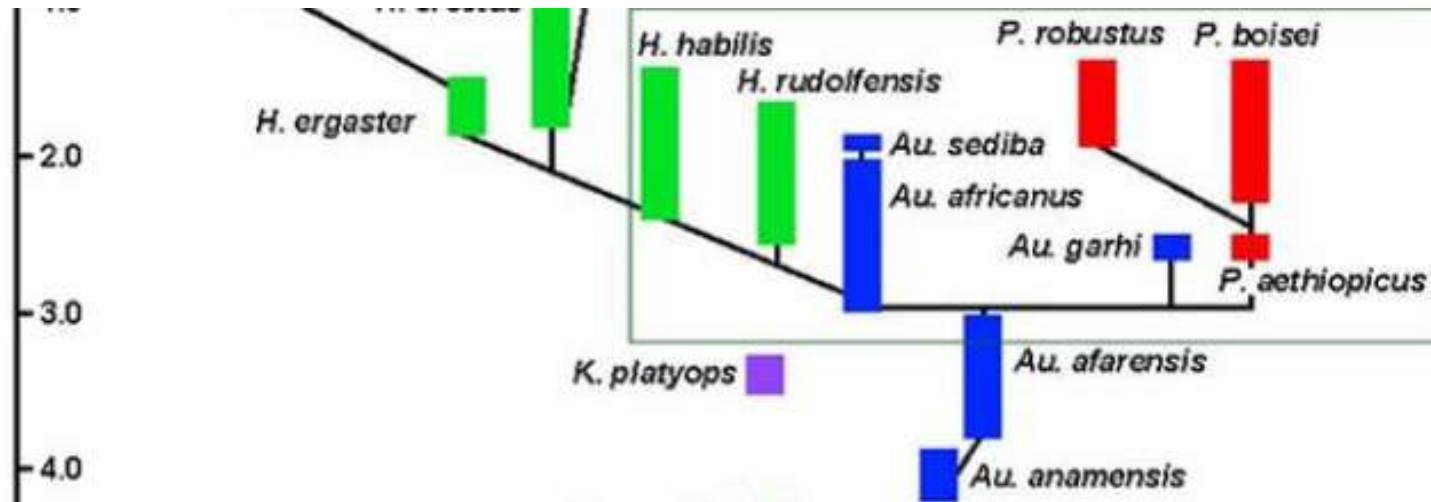


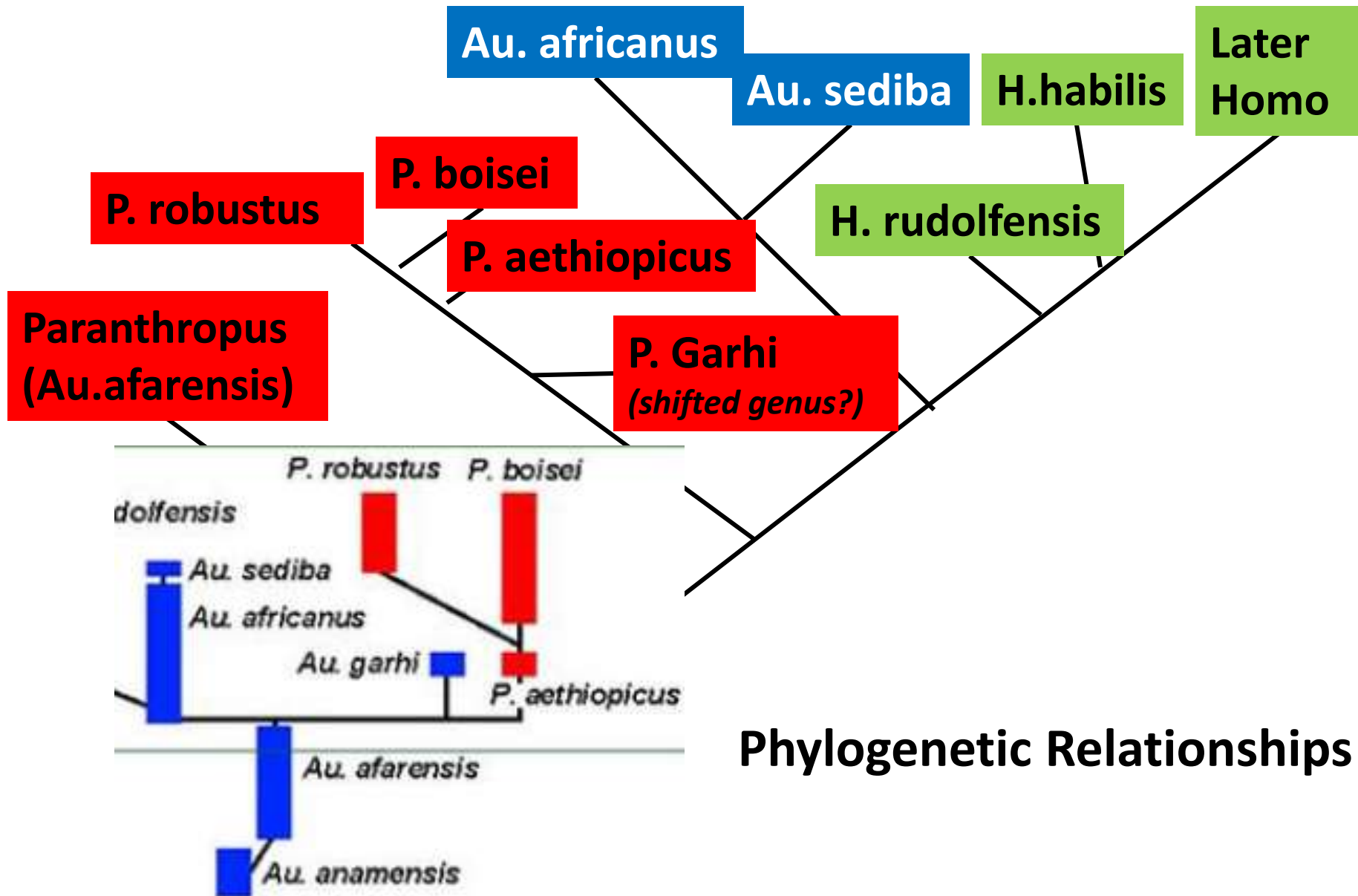
Figure 3: A phylogeny of hominin species.

Approximate geological age ranges are included for each. Black lines indicate a phylogenetic connection, though these relationships are proposed primarily for discussion and are not well-tested hypotheses. Several species are left unconnected

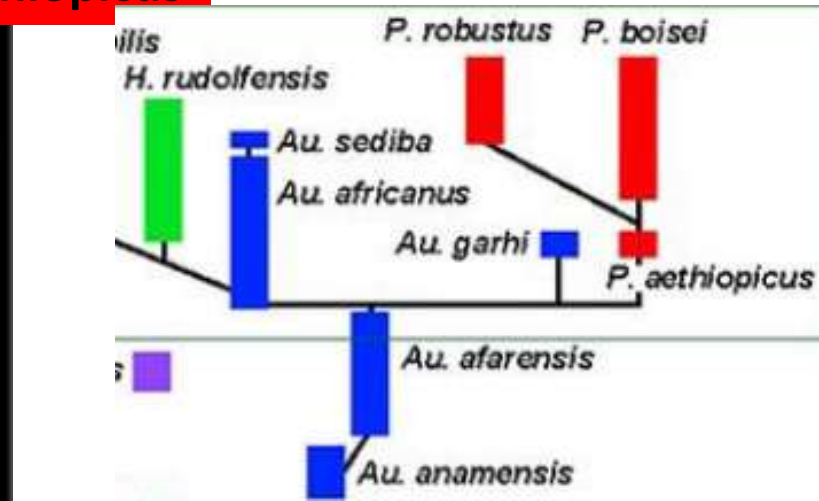
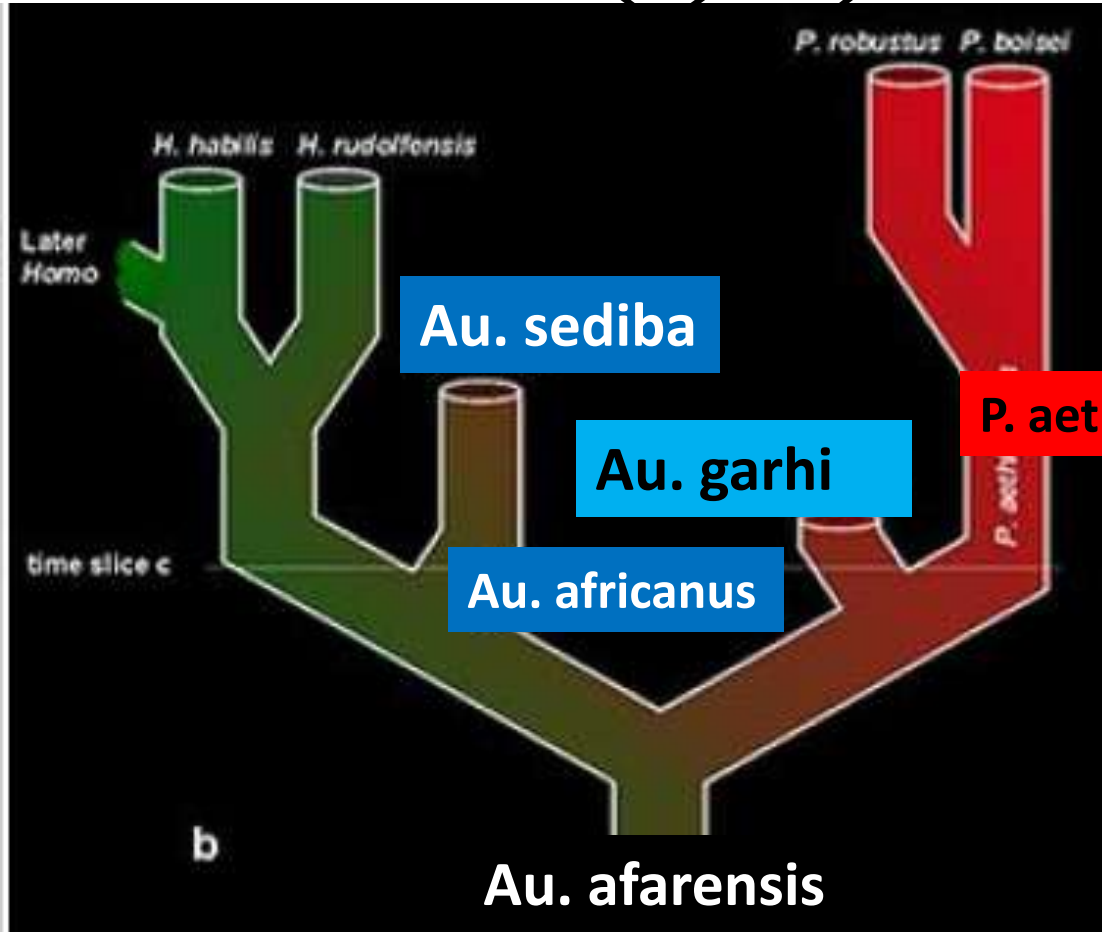
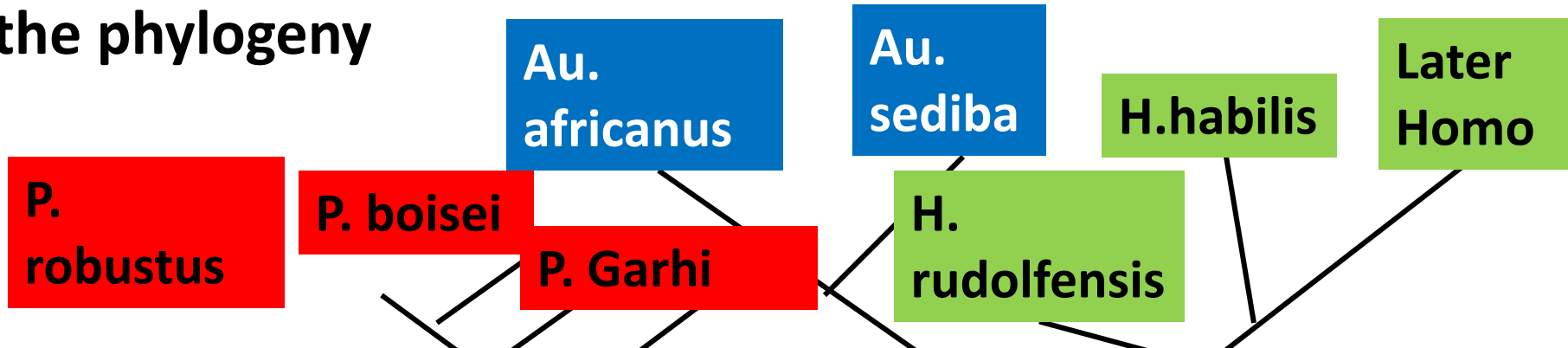
- **Example of Genus Australopithecus (in tribe Hominini)**



- 5 species (for now)
- *Au. afarensis* and *Au. anamensis* represent a broad lineage—but other relationships are not clear
- One of the hypothesis regarding the genus *Australopithecus*
 - It is a combination of stem species (key species giving rise to branches) which were not closely related
 - Other genera like **Paranthropus** and **Homo** evolved from *Au.* Like ancestor (s)
- How to reflect evolutionary relationships correctly? e.g. *Au. africanus* and *Au. garhi*.



Let's Introduce evolution in the phylogeny



Robust conclusions and ambiguities

- **Three genera—Australopithecus, Paranthropus, Homo**
 - Specific relationships, phylogenetic relations need more study
 - New fossils will impact our understanding
 - Hylobatids are a separate lineage
 - One should do phylogenetic classification

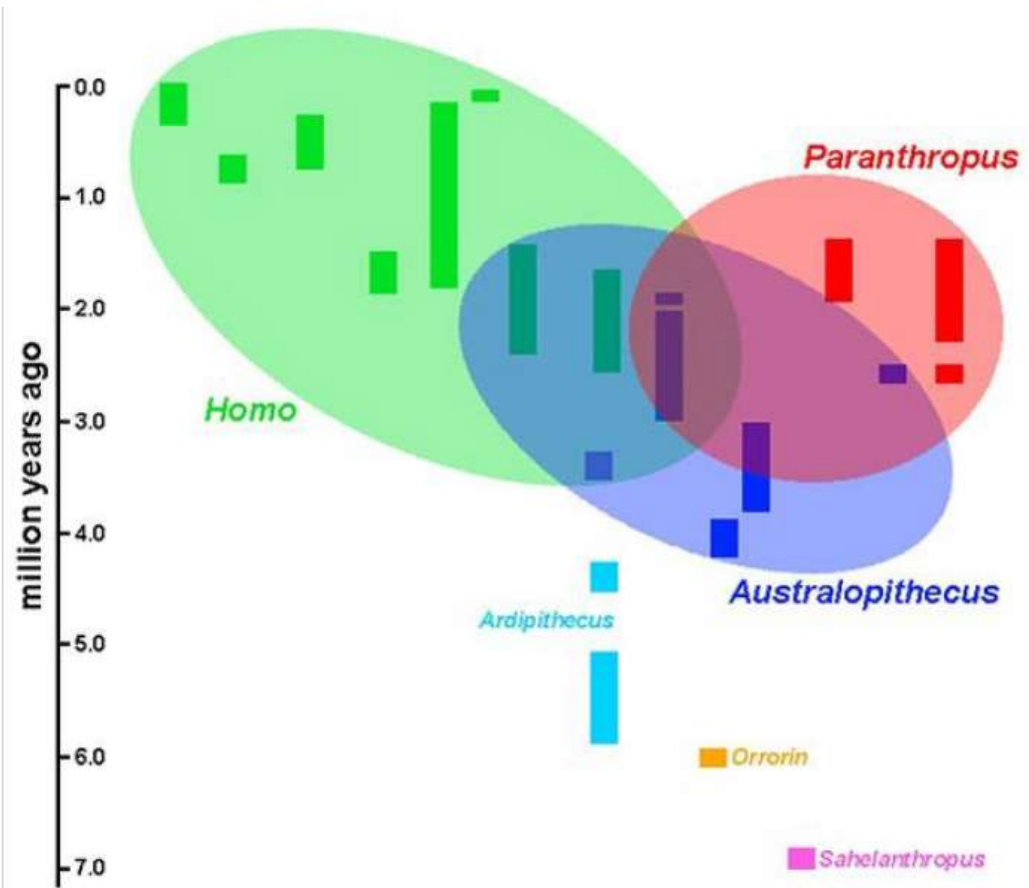


Table 3. A genealogical classification of extant and extinct species within the genus *Homo* (Goodman et al. 2001).

Homo

H. (Pan)

H. (P.) paniscus

H. (P.) troglodytes

H. (Homo)

H. (H.) ramidus

(*Ardipithecus ramidus*, 4.4 My)^a

H. (H.) anamensis

(*Australopithecus anamensis*, 4.2-3.9 My)^a

H. (H.) afarensis

(*Australopithecus afarensis*, 3.6-2.8 My)^a

H. (H.) africanus

(*Australopithecus africanus*, 2.8-2.4 My)^a

H. (H.) boisei

(*Australopithecus boisei*, 2.4-1.3 My)^a

H. (H.) robustus

(*Australopithecus robustus*, 2.0-1.6 My)^a

H. (H.) habilis

(*Homo habilis*, 1.9-1.8 My)^a

H. (H.) erectus

(*Homo erectus*, 1.8-0.9 My)^a

H. (H.) sapiens neanderthalensis

(*Homo neanderthalensis*, 0.5-0.1 My)^a

H. (H.) sapiens sapiens

(*Homo sapiens*, 0.5-0.0 My)^a

^a Shown in parenthesis is the species' name and age from Yoon (1995) for each species that are treated as a member of subgenus *Homo* (*Homo*).

Assignment

Write short notes within the prescribed word limit-

- 1. Definition of Taxonomy and Phylogeny (50 words each)**
- 2. Which one is better to explain human evolution and why? (100 words)**
- 3. There is a connection between taxonomy and phylogeny. It means that new discoveries or other data change our understanding of evolutionary history often result in the shuffling of taxa and of taxonomic names. Discuss the above statement by giving examples of the term “hominid” and “hominin”. You can support your answer by using diagrams. (250 words)**
- 4. Discuss the problem of the ancestry of Australopethicus using a cladogram. (250 words)**
- 5. Neanderthals is argued to be both as separate species and also part of our direct ancestry. Elaborate on this statement (250 words)**

Table 1. Current scheme of the primate superfamily.

Superfamilia *Hominioidea*

Familia *Hylobatidae* Gibbons

Familia *Pongidae* orangutans.

Familia *Hominidae* great apes, humans

Gorilla, chimpanzees and humans Subfamilia *Homininae*

Tribe *Gorillini*

chimpanzees and humans Tribe *Hominini*

Genus *Ardipithecus*

Genus *Australopithecus*

Genus *Paranthropus*

Genus *Kenyanthropus*

Genus *Homo*

• **Archeological evidence**

• **Comparative anatomy**

• **Fossil evidence**

Clade-Species in same branch of tree with common ancestor

Stem species-that gave rise to a branch and its descendents

Adaptive grade-Related species but **not** common ancestor