

# A Historical Review of Paleoanthropology 500 BCE to 1960

OLLI

CHARLES J. VELLA

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THANKS TO ERIK TRINKAUS, PAT SHIPMAN, IAN TATTERSALL,  
STEVE JONES, DON JOHANSON, JOHN READER, ETC.

MANY PHOTOS: DAVID BRILL

# My background

- ▶ My name is Charles J. Vella, PhD and I am a neuropsychologist and an amateur human evolution enthusiast. I received my PhD in Psychology at UC Berkeley and I worked at Kaiser Hospital, Dept. of Psychiatry for 35 years as Chief Psychologist and Director of the Neuropsychology Service. I am an expert in most brain related psychological topics and do public lectures in this area.
- ▶ Since my retirement in 2009, I have been an active docent at the California Academy of Science, specializing in the area of human evolution.
- ▶ I am not an anthropologist, but I have become an amateur expert in the field of human evolution.
- ▶ In the last 10 years, I have read extensively on most of the topics in human evolution, taken 8 online courses on this topic, and have taught a variety of docent classes in this area at the Academy.

# This course

- ▶ This course was conceived as an attempt to cover half of the history of the study of Human Evolution.
- ▶ There is clearly too much information to cover the entire history in only 12 hours.
- ▶ So this is Part 1 of an eventual 2 part series: Human Evolution: The First 150 Years of Discovery, up to 1960.
- ▶ Part 2, Human Evolution: What we have learned since 1960, will be offered in the near future at Olli.
- ▶ I hope you will do not feel misled by this announcement

# Human Evolution: The First 150 Years of Discovery

- ▶ This course will attempt to bring you up to date with all the major historical (and some recent) discoveries in human evolution research up to approximately 1960.
  - ▶ Week 1: A Historical Biographical Review of Paleoanthropology to 1960
  - ▶ Week 2: General Evolution (concept of evolution, creationism, evolutionary processes, etc.)
  - ▶ Week 3: Basics of human evolution (dating techniques, fossilization, etc.)
  - ▶ Week 4: Early Hominins: The *Australopithecines*, *Sahelanthropus*, *Orrorin*, & *Ardipithecus*
  - ▶ Week 5: Early *Homo*: *Homo habilis*, the 1470 and 1812 groups, the Ledi-Geraru *Homo* & Early *Homo erectus*
  - ▶ Week 6: *Homo erectus* & *Homo heidelbergensis*



# Downloads of class material and pdfs of lectures

- ▶ [www.charlesjvellaphd.com](http://www.charlesjvellaphd.com)
  - ▶ 2018 OLLI: Human Evolution: The First 150 Years of Discovery
  - ▶ or [http://www.charlesjvellaphd.com/Olli Human Evolution Class 2018.htm](http://www.charlesjvellaphd.com/Olli%20Human%20Evolution%20Class%202018.htm)
- ▶ Papers available on website:
  - ▶ Human Evolution Bibliography
  - ▶ Glossary of Evolutionary, Anatomical and Paleontological Terms
  - ▶ List of all Major Hominins Table
  - ▶ Continued Human Evolution - examples
  - ▶ Who's Who in Hominid Evolution – short identifications
  - ▶ Original Hominid Species Type Journal Articles

# Rules of the game

- ▶ I need to cover a lot of material, so this course is primarily a series of lectures with some time for discussion.
- ▶ 1 – During first class, I would like you to write out for me what you hope to get out of this course: topics, people, etc. Anything you would like me to cover.
- ▶ 2 – If you do not understand terminology I use, raise your hand and say the word. I will define. If you do not understand it, probably a number of people do not.
- ▶ 3 – If you ask a question about a topic that I will cover more fully later, I will say To Be Discussed
- ▶ 4 – Please let me know if you are concerned about anything about the course, in person, or by email: [charlesvella@comcast.net](mailto:charlesvella@comcast.net)

# Human Evolution, The first 150 years of discovery

Pds (Adobe reader) will be available online after each class:  
Two versions: Full & actual lecture (briefer)

Week 1: A Historical Biographical Review of Paleoanthropology to 1960

Week 2: General Evolution (belief in evolution, creationism, processes, etc.)

Week 3: Basics of human evolution (dating techniques, fossilization, etc.)

Week 4: Early Hominins: The *Australopithecines*, *Sahelanthropus*, *Orrorin*, *Ardipithecus*

Week 5: Early *Homo*: *Homo habilis*, the 1470 and 1812 groups, the Ledi-Geraru *Homo*  
& Early *Homo erectus*

Week 6: *Homo erectus* & *Homo heidelbergensis*

## Issue of number of slides per lecture

- ▶ I love Powerpoint. I love slides. Usually do 200-300 in 2 hours.
- ▶ I normally use a slide to make 1 or 2 points then go to next slide, no matter how much material is on slide. Rest is for reading in pdf of lecture.
- ▶ I agreed to a certain number of slides per lecture. But that limit is too limited for amount of material I want to cover.
- ▶ Your choice: two options
  - ▶ 1 – Let me do as many slides as I think I need
  - ▶ 2 – Will show 100-150 on 1 computer via monitor & lecture off a different computer

Charlie Vella PhD, Docent, California Academy of Science, 2<sup>nd</sup>  
4<sup>th</sup> and 5<sup>th</sup> Mondays, 10AM to 1PM





# This project

- ▶ I have been a docent at California Academy of Science since 2009. I specialize in hominin evolution
- ▶ I wanted to offer all the information that I wanted to have when I began docenting, and did not learn until later.
- ▶ This is my personal compendium (but accuracy confirmed via textbooks)
- ▶ There is much I know about human evolution, but also much I do not know. If I do not know something, I will tell you. It may be that you know it and can contribute.
- ▶ Please note any factual errors for me
- ▶ My pronunciation of French is nonexistent!

# Acknowledgements

- ▶ Thanks to Bernard Wood, Erik Trinkaus, Pat Shipman, Ian Tattersall, Wikipedia, Steve Jones et al., Don Johanson, UC Berkeley's online Evolution website
- ▶ Many Photos: David Brill, Great Courses, Online courses
- ▶ See Bibliography for sources
- ▶ All the works by Ian Tattersall of AMNH
  - ▶ *The Fossil Trail*
  - ▶ *Masters of the Planet*
  - ▶ *The Strange Case of the Rickety Cossack*
- ▶ John Reader
  - ▶ *Missing Links*

# Human Evolution online courses I have taken

- ▶ Great Courses Lecture series, 2011: *The Rise of Humans* by John Hawks, PhD, Univ. of Wisconsin
- ▶ Univ. of WI: Human Evolution: Past and Present by John Hawks
- ▶ Wellesley College: WellesleyX: ANTH207x Introduction to Human Evolution by Adam Van Arsdale, 2015
- ▶ Multiple online video documentaries on human evolution by well known researchers
- ▶ Center for Cognitive Archaeology, Univ. of Colorado: Full semester courses
  - ▶ Neandertal Cognition – Frederick L. Coolidge and Thomas Wynn
  - ▶ Paleoneurology – Emilio Bruner
  - ▶ Cognitive Evolution - Coolidge & Wynn
- ▶ Carta online lecture series:
  - ▶ Ancient DNA and Human Evolution
  - ▶ Origins of Genus Homo
  - ▶ Behaviorally Modern Humans: The Origin of Us
  - ▶ Early Hominids
  - ▶ The Rise and Fall of Homo erectus
  - ▶ The Origin and Fate of the Neanderthals



# Human Evolution Course

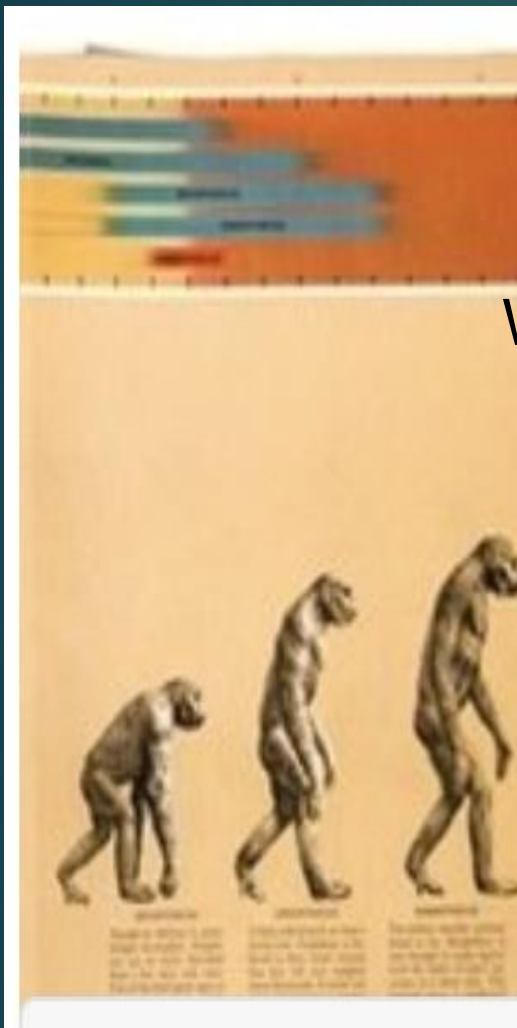
- We will learn about the **major researchers** who have shaped our understanding of human evolutionary history,
- We will **visually** explore the **human fossil record**.
- We'll talk about **how we developed** knowledge from the human fossil **record**, and we'll learn about **key fossil localities**
- And we will try to understand **how and why we know** the things we **know** about our evolutionary past.
- We will explore **how we came to be human**.

# Class model

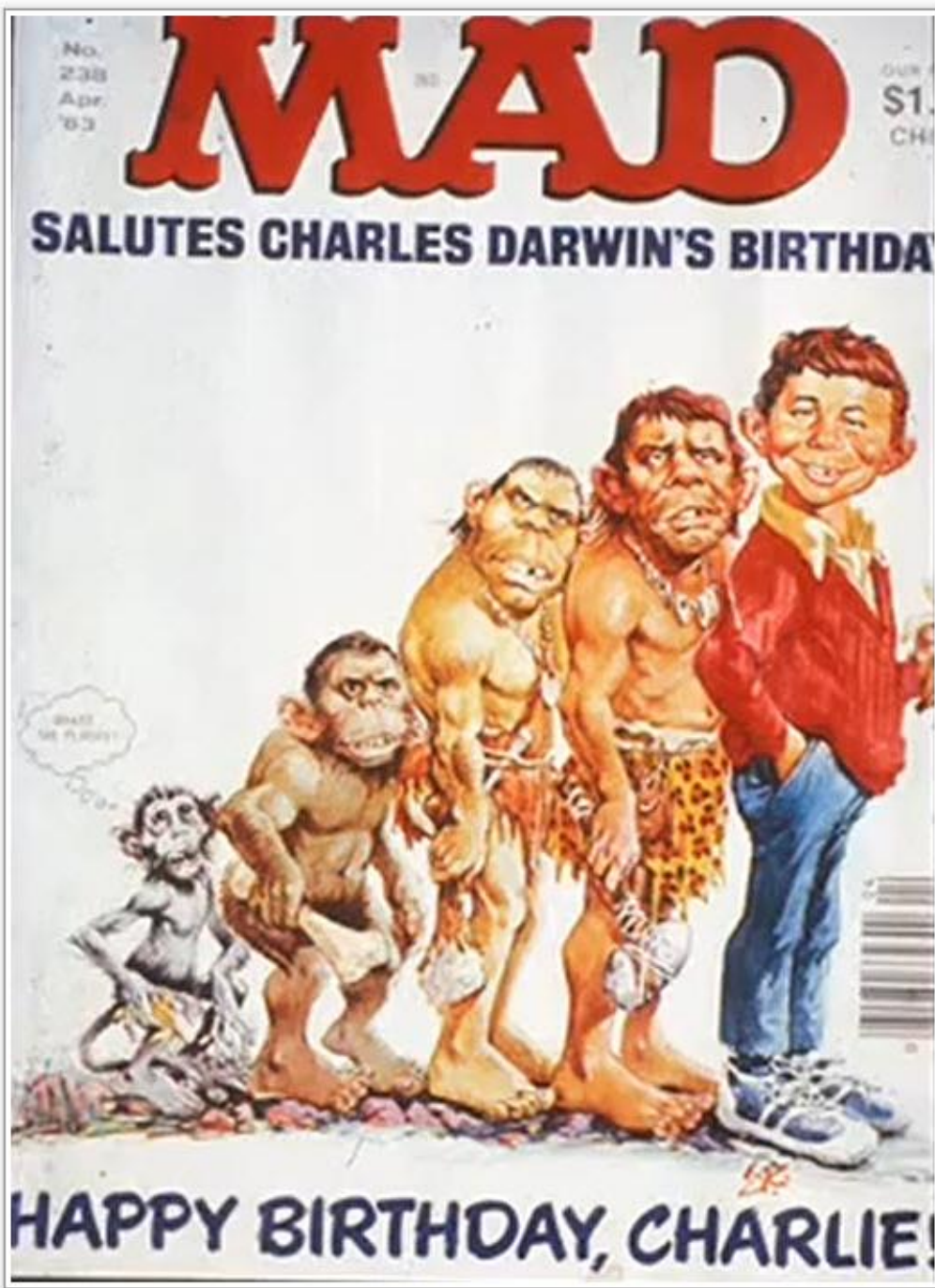
- ▶ Review basics of evolutionary theory
- ▶ Review basic research processes
- ▶ Identify who discovered the species
- ▶ Identify hominin species, including name and photos
- ▶ Clarify what is unique about each species
- ▶ Identify controversies
- ▶ Answer questions you have

What got Charlie

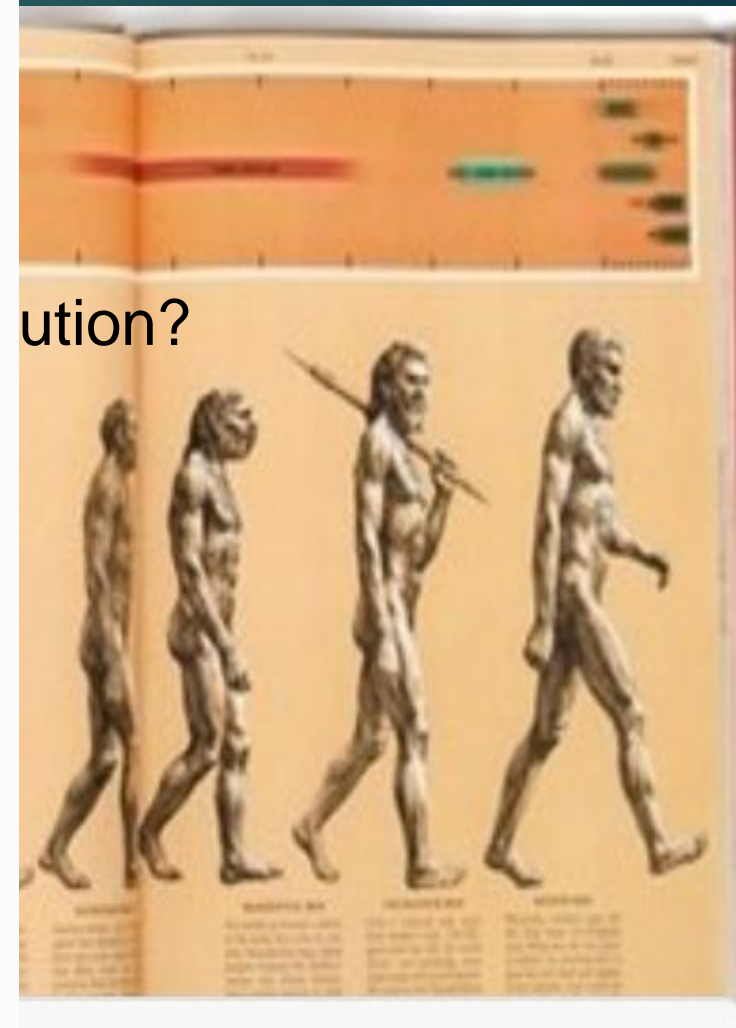
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*The March of Progress  
Early Man volume*



ution?



*ed by Rudolph Zallinger;*

# Congratulations

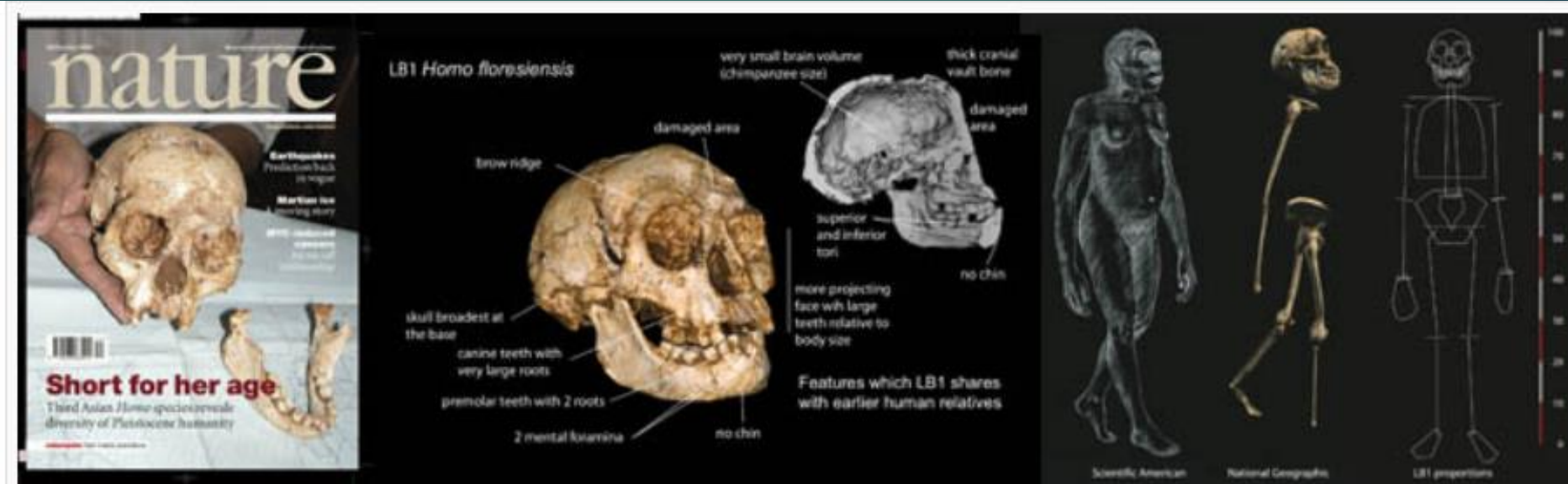
- ▶ By being here today in this class, alive, you are one of history's winners -- the culmination of an evolutionary success story four billion years in the making. You are one of life's 1 percent.
- ▶ The losers, the other 99 percent of species who have ever lived on earth are dead -- killed by fire, flood, asteroids, ice, heat and the cold math of natural selection.
- ▶ Your ancestors, back to earliest fishes and bacteria, due to natural selection, survived.
- ▶ You are here because of the golden opportunities that mass extinctions made possible.



# Historical Bomb Shells in Paleontology

- ▶ Fossil discoveries that were fundamentally inconsistent with prevailing paradigm about the course of human evolution & responses to them:
- ▶ 1856: Neandertal (*H. neandertalensis*): a Mongolian Cassock with rickets
- ▶ 1891: Java man (*H. erectus*): an ape
- ▶ 1912: *Eoanthropus dawsoni*: large brain
- ▶ 1924: Taung child (*A. africanus*): small brain, therefore an ape
- ▶ 1974: Lucy (*A. afarensis*): bipedality at 4 Ma?
- ▶ 1991-2005: *Dmanisi* (*H. erectus*): brain too small to be *erectus*
- ▶ 2004: *Homo floresiensis*: microcephalic *H. sapiens*?
- ▶ 2016: *Homo naledi*: burial practice in small brained hominin?

# Nature, 2004 & 2009



# Paleoanthropological Superstars: Humans & Hominins

- ▶ I plan to highlight **my choices for paleoanthropological superstars**, both famous human paleoanthropologists and hominin discoveries:
- ▶ The Old Man, the Neandertal of La Chapelle: N as brute
- ▶ Taung Child: A large brain was not first hominin feature
- ▶ Piltdown Man: The great hoax; first media sensation
- ▶ Eugene Dubois & *H. erectus*: Was Asia vs. Africa our homeland?
- ▶ Leakeys & *Zinj*: The answer: Africa

# Paleoanthropological Superstars

- ▶ Don Johanson & *Lucy*: The comparison species for all future studies
- ▶ Tim White & *Ardi*: Science at its most secret, slowest, and best
- ▶ Dmanisi *H. erectus*: First global traveler
- ▶ Lee Berger & *A. sediba*: Ancestral to *Homo*?
- ▶ Flo the Hobbit: Did an australopith leave Africa?
- ▶ *Homo naledi*: Paleoanthropology is alive & well, and very public



# Study of Human Evolution

- ▶ Fundamental question of “Where do we come from?”
- ▶ Many cultures have origin myths: see website [BigMyth.com](http://BigMyth.com)
- ▶ Not one is correct.
- ▶ Darwin: *On the Origin of Species*, 1859: “Much light will be thrown on the origin of man and his history.” (His only reference to human evolution in this book.)
- ▶ *The Descent of Man*, 1871: Darwin recommended using **reason & evidence** – core of the scientific method

Pre-Darwinian Theories of  
Human Evolution:  
Seeds of (R)evolution

# Pre-Darwinian

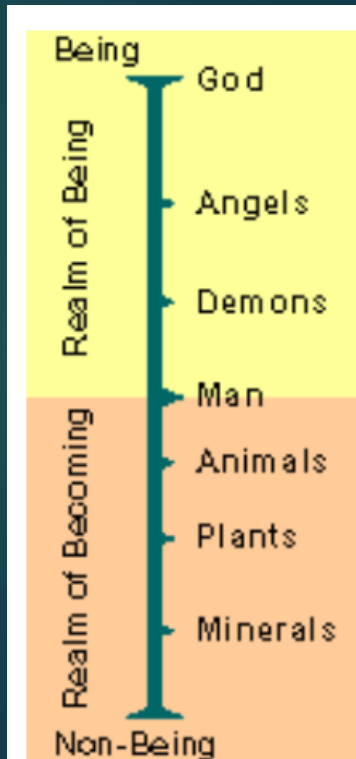
- Fossil = Latin *fossus* (past participle of *fodere*, to dig)
- 5<sup>th</sup> century BCE: Sicilian philosopher **Empedocles** - saw humans as part of the natural world (ideas of fitness for survival); rejected by Aristotle
- 3<sup>rd</sup> century BCE: Chinese philosopher **Zhuangzi** – all life adapted to environment and transformed from simpler to more complex
- 1<sup>st</sup> century BCE: **Lucretius** - human ancestors were brutish cave dwellers
- **Classical Greek and Roman thinkers** - tool and fire making and use of verbal language as crucial to being human; idea that humans had evolved from earlier, more primitive form

# Pre-Darwinian

- **5<sup>th</sup> to 12<sup>th</sup> centuries CE:** Biblical interpretation predominates: Genesis narrative (faith based explanation: God creates universe & all species; humans did not evolve; biblical flood (antediluvian = before the flood))
- **8<sup>th</sup> century CE:** Islamic scholar, **Al-Jahiz** - concept of struggle for survival
- **13<sup>th</sup> century CE:** **Thomas Aquinas** reconciles Greek ideas with the biblical narrative; use of reason important; believes God created universe, what happens after is not delineated; natural change is acceptable; did not take a literal view of Genesis
- Prior to the 19<sup>th</sup> century, there were no “ancient” hominins.

# Medieval Concepts of Earth History

- ▶ From Classical times until long after the Renaissance, **species were considered to be special creations** (by God), **fixed for all time**.
- ▶ Two great, opposing concepts of the history of the Earth and life dominated thought throughout the Middle Ages:
  - ▶ The first was the **Biblical account of creation**: the world and its life were formed by God a few thousand years before the present
  - ▶ The second was the **philosophy of Aristotle** and his commentators: the world, animals and plants living on it, were eternal, uncreated, and unchanging.
- ▶ There were no “ancient” hominins.



# Before Darwin: Historical concept of fixed species

Michelangelo's fresco on the ceiling of the Sistine Chapel



[en.wikipedia.org/wiki/The\\_Creation\\_of\\_Adam](https://en.wikipedia.org/wiki/The_Creation_of_Adam)

From Classical times until long after the Renaissance, species were considered to be **special creations** (by God), fixed for all time.



# Pre-Darwinian thought

- ▶ Aristotle (384-322 BCE)
  - ▶ Greek philosopher and naturalist
  - ▶ All species were eternal, uncreated, and unchanging.
  - ▶ *Historia Animalium* describes similarities between man, apes, and monkeys
  - ▶ Differences in organisms attributed to position in the *scala naturae* (Great Chain of Being)

# The Great Chain of Being

- Every animal that could exist, did exist
- Every species can be organized along a line
- Every species on that line grades imperceptibly into the species above and below it



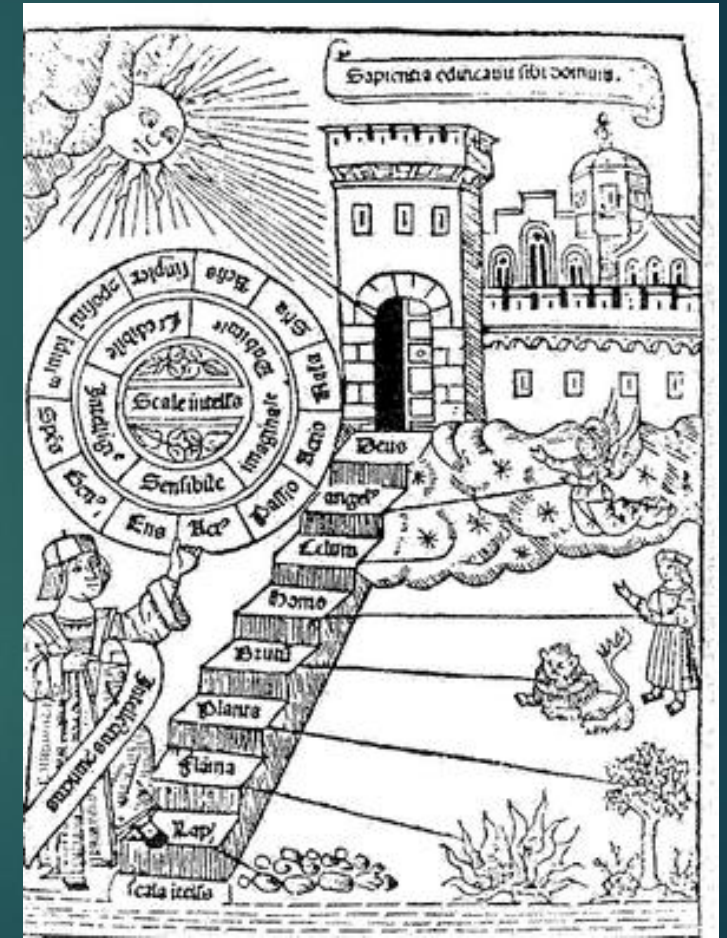
1579 drawing of the great chain of being  
from Didacus Valades, *Rhetorica Christiana*



# Aristotle & Plato:

## Great Chain of Being: Idea of Progress

- ▶ The **great chain of being** (Latin: *scala naturae*, literally "ladder/stair-way of nature"), is a concept derived **from Plato and Aristotle**.
- ▶ It details a **strict, religious hierarchical, progressive structure of all matter and life, believed to have been decreed by God**. The chain starts from God and progresses downward to angels, demons (fallen/reneegade angels), stars, moon, kings, princes, nobles, men, wild animals, domesticated animals, trees, other plants, precious stones, precious metals, and other minerals



# The Great Chain

- ▶ The idea of the Great Chain
  - ▶ as well as the derived "missing link"
  - ▶ was abandoned in the early 20th century science.
- ▶ The idea of a progressive ordering of living organisms
- ▶ is antithetical to modern biological classification,
- ▶ esp. one based on teleology (explanation by reference to some purpose, end, goal; final causality)

# Medieval Concepts of Earth History

- ▶ Two great, opposing concepts of the history of the Earth and life dominated thought throughout the Middle Ages.
- ▶ The first was the Biblical account of creation: the world and its life were formed by God a few thousand years before the present. (Bishop Ussher's date of Creation, 4004 BC)
- ▶ The second was the philosophy of Aristotle and his commentators: the world, and the animals and plants living on it, were eternal, uncreated, and unchanging.
- ▶ There are no “ancient” hominids.

# Development of Evolutionary Thought

- ▶ Ancient roots – differences and origins of humans
- ▶ Renaissance – empiricism and science
- ▶ 17<sup>th</sup>-18<sup>th</sup> centuries – naturalism
- ▶ 1800-1859 – Racial origins - Craniometry
- ▶ 1859-1900 – Evolution and racial origins
- ▶ 1900-1950 – Description and classification
- ▶ 1950-present – New Physical Anthropology

# 1654: Ussher's biblical chronology: Earth is 6000 years old

- ▶ In 1654, James Ussher, an Anglican archbishop in Ireland, published his Biblical chronology of the world. By adding up the number of “begats” in Genesis (the reigns of the kings and lifespans of the patriarchs) and comparing them with the dates of known historical events, Ussher concluded that the world came into existence on Sunday, October 23, 4004 BCE, at 9 AM.
- ▶ Ussher's proposed date of creation was close to that calculated by his contemporaries, including such luminaries as Johannes Kepler and Isaac Newton.
- ▶ Some pointed to 2 Peter 3:8, which states that "one day is with the Lord as a thousand years, and a thousand years as one day."
- ▶ Ussher remains extremely popular amongst creationists, even though they reject his methodology of using the most up to date contemporary scientific, chronological, historical and biblical scholarship to date the age of the world.



# Creationists show up in unexpected places: Rim of Grand Canyon



# Ussher's calculations

**CANON CHRONICVS. 307**

I. A Mundo cordi coepto mensis i. die 1.º (23.º scilicet) Anni. Menses. Dies.  
 Octobris anni Periodi Juliane 710. usq. ad verum 1056. 0. 0.  
 vium finitum eodem ejusdem mensis die sunt  
 Mundi veteris anni

II. Hinc ad protectionem Abrahami ex urbe Chanaan in terram Chanaan (unde per circumcisions Hebraeorum ducuntur initium) mensis 7.º die 15.º 426. 6. 14.

III. Hinc ad exitum Hebraeorum de Aegypto mensis i.º die 15.º (sic enim ab hoc tempore mensis 7.º usque antiquorum appellatus est) die 15.º 430. 0. 0.

IV. Hinc ad jacta fundamenta Templi Salomonici mensis 2.º die 2.º anno 4.º regni Salomonis 479. 0. 17.

V. Hinc ad ejusdem Templi conflagrationem mensis 5.º die 10.º anno 19.º regni Nabuchodonosor 424. 3. 8.

VI. Hinc ad finitum Templum secundum, anno Dary filii Hystaspis 6.º (desinente) mensis 12.º die 3.º 72. 6. 23.

VII. Hinc ad Kalendas Januariarum anni primi vulgariæ Christianae (sive anni Periodi Juliane 4714.) 514. 9. 9.

Summa	4003. 2. 11
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Ab initio Mundi ad verum Natalem Messiae anni sunt 3999. menses 2.º et dies 7.º. a vero Natali Messiae usq. ad Kalendas Januariarum anni primi vulgariæ Christianae anni 4.º et dies 7.º. Christum enim natum supponimus 25.º die Decembris anni Periodi Juliane 4709. (desinente) currente anno Mundi 4000.

Periodus Juliana est Cyclos postulativus annorum 7980. Julianorum: quorum singuli per 15.º 19.º et 28.º divisi, Indictionem Romanam, Cyclum Lunarem et Cyclum Solarem exhibent. Ad ejus caput usq. ad Kalendas Januariarum anni primi vulgariæ Christianae, annos 4713. decurrisse fingimus. Datam hanc hypothesein pro communem omnium variantium temporum mensuram demde assumentes.

Ex ea hypothesei, a capite Periodi Juliane usq. ad initium Mundi, anni numerandi fuerint 709. menses 9.º cum diebus 19.º circiter.



## 1659: Ussher's biblical chronology: Earth is 6000 years old

- ▶ In *Annalium pars posterior*, published in 1654, James Ussher, an Anglican archbishop in Ireland, published his Biblical chronology of the world. By adding up the number of “begats” in Genesis (the reigns of the kings and lifespans of the patriarchs) and comparing them with the dates of known historical events, Ussher concluded that the world came into existence on nightfall of October 22, 4004 BCE. Ussher's work is now used to support Young Earth Creationism.
- ▶ This ratio was tied to the six days of creation in the book of Genesis, leading them to conclude that the total lifespan of the world was 6,000 years.
- ▶ Ussher remains extremely **popular amongst creationists, even though they reject his methodology of using the most up to date contemporary scientific, chronological, historical and biblical scholarship to date the age of the world.**



**Nicholas Steno (Niels Stensen) (1638-1686):**  
**History of the world is written in stone.**

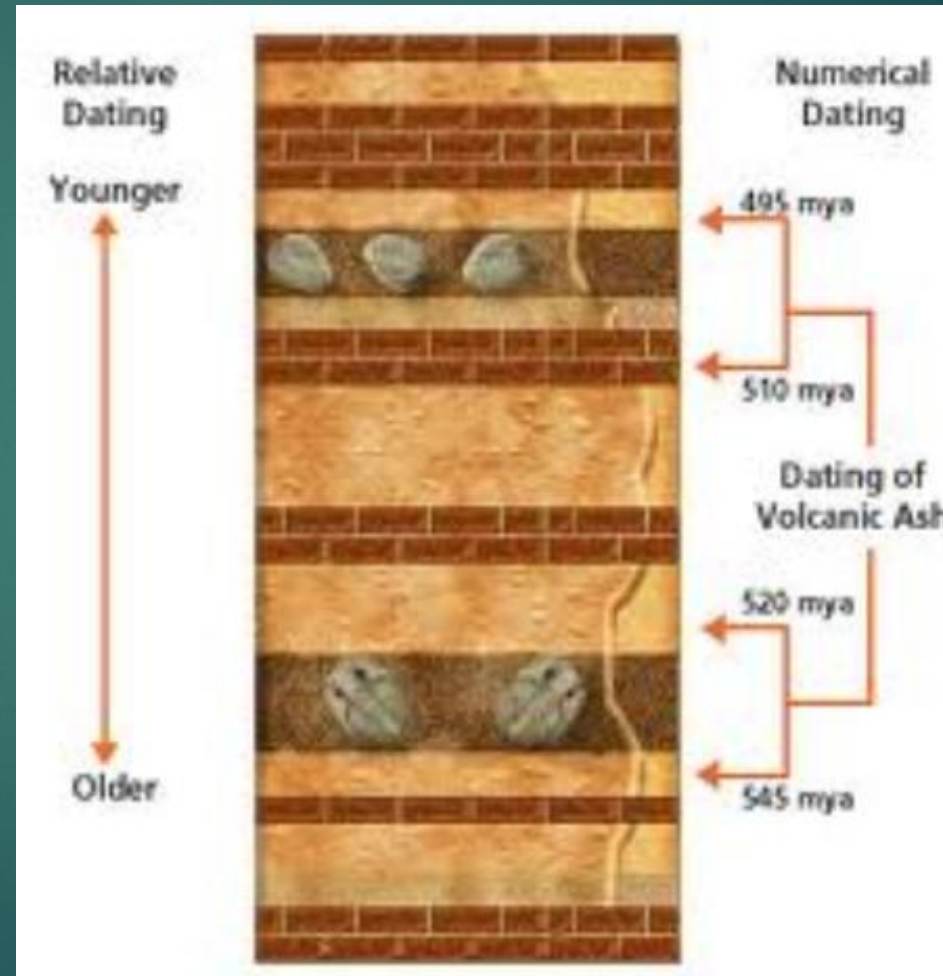
- ▶ 1666: Birth of paleontology: Fossils are the remains of living organisms from previous geologic eras; “tongue stones” are fossil shark teeth
- ▶ One of the founders of modern stratigraphy and modern geology.
- ▶ Steno’s Law of Superposition: lower geological layers are older
- ▶ Influenced the development of James Hutton's theory of infinitely repeating cycles of seabed deposition, uplifting, erosion, and submersion
- ▶ It was only in 1956 that geochemist Clair Patterson, using lead isotopic data from a meteorite, concluded that the earth was about 4.5 billion years old



17th century  
Danish  
anatomist and  
geologist

# Nicholas Steno (1638-1686): Lower geological layers are older

- ▶ Fossils are the remains of living organisms from previous geologic eras,
- ▶ Teeth of ancient sharks, deposited there when the continent lay beneath the ocean.
- ▶ Different strata contain different kinds of fossil



# Nicolas Steno: The saint who undermined creationism

- ▶ Don't feel bad if you've never heard of Nicolas Steno.
- ▶ Even though the 17th century Danish anatomist and geologist made a number of discoveries that are now seen as self-evident – namely, that the heart is a muscle that pumps blood, that tears are formed in the eye, that fossils are the remains of living organisms from previous geologic eras, and that older rocks tend to lie deeper in the earth than younger ones – his legacy, like the mysterious stones that he examined, have since been obscured by layers of historical sediment.
- ▶ Steno's geological breakthrough came in 1666, when, serving as a researcher for the Grand Duke of Tuscany in Florence, he was given the opportunity to examine the head of a great white shark. The young anatomist was struck by the similarity of the shark's teeth to curious objects found embedded in rocks throughout Europe. Steno concluded that those objects actually were the teeth of ancient sharks, deposited there when the continent lay beneath the ocean.

## Steno: model of scientific inquiry

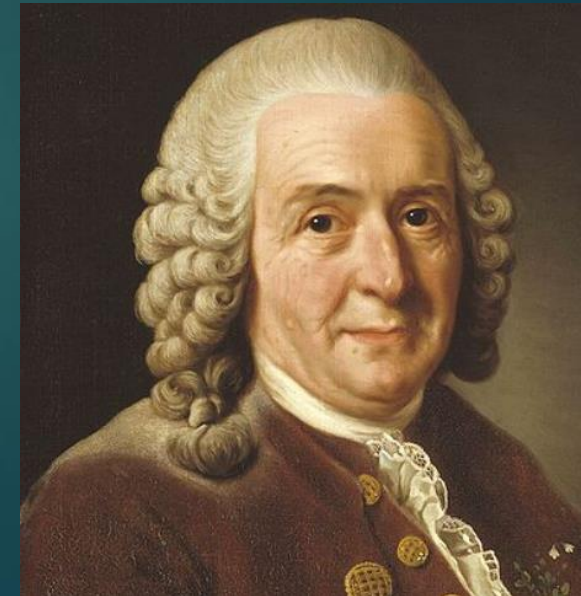
- ▶ Published in 1669, the principles in Steno's 78-page text, "On Solids," are still taught in geology classes today. A commitment to scientific observation, not authority.
- ▶ A Lutheran convert who became a Danish Catholic bishop and scientist and a pioneer in both anatomy and geology. Ultimately volunteered, in poverty, to minister to the poor.
- ▶ On October 23, 1988, exactly 5,992 years after Archbishop Ussher's proposed date of creation, Pope John Paul II beatified Nicholas Steno.



# Carolus Linneaus (1707-1778):

Great classifier; *H. sapiens* is a primate

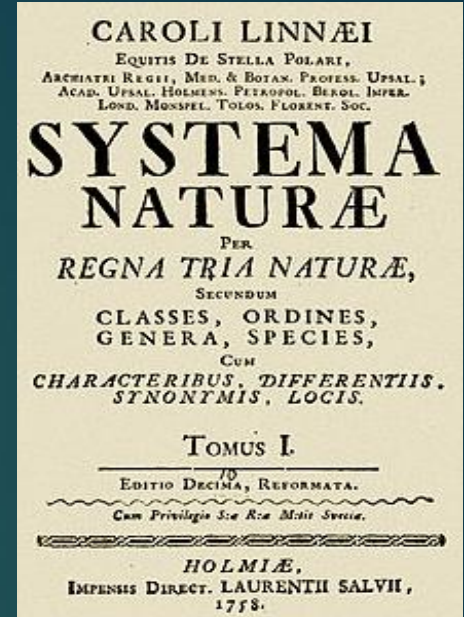
- ▶ Swedish biologist
- ▶ Assembles first comprehensive taxonomy of living organisms and establishes *Homo sapiens* as the binomial name for modern humans
- ▶ Founder of taxonomy (focus on description and classification)
- ▶ Non-evolutionist; species as fixed & divinely created; but his taxonomy of nested species had evolutionary implications (common descent)





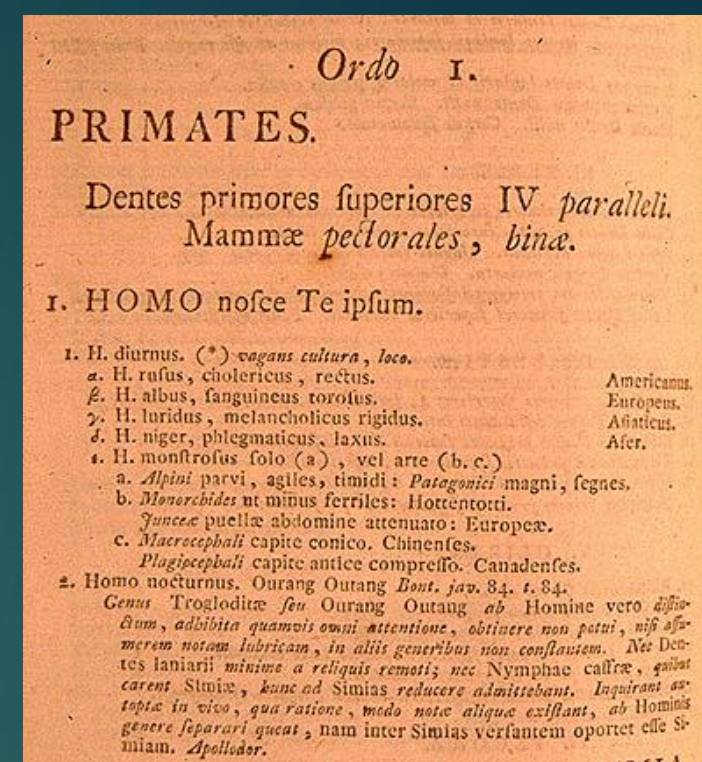
# Carolus Linneaus: *Systema Naturae*

- ▶ *Systema Naturae* (1735-1766): 12 editions.
- ▶ Modern systematics takes his 10<sup>th</sup> edition (1758) as starting point.
- ▶ Species is basic unit: morphologically similar animals that can breed with each other
- ▶ Identified two-dimensional structure of nature, as opposed to one-dimensional “Great Chain”:
  - ▶ Binomial system in which each species has generic (Family) and specific (Species) name (e.g. *Homo sapiens*)

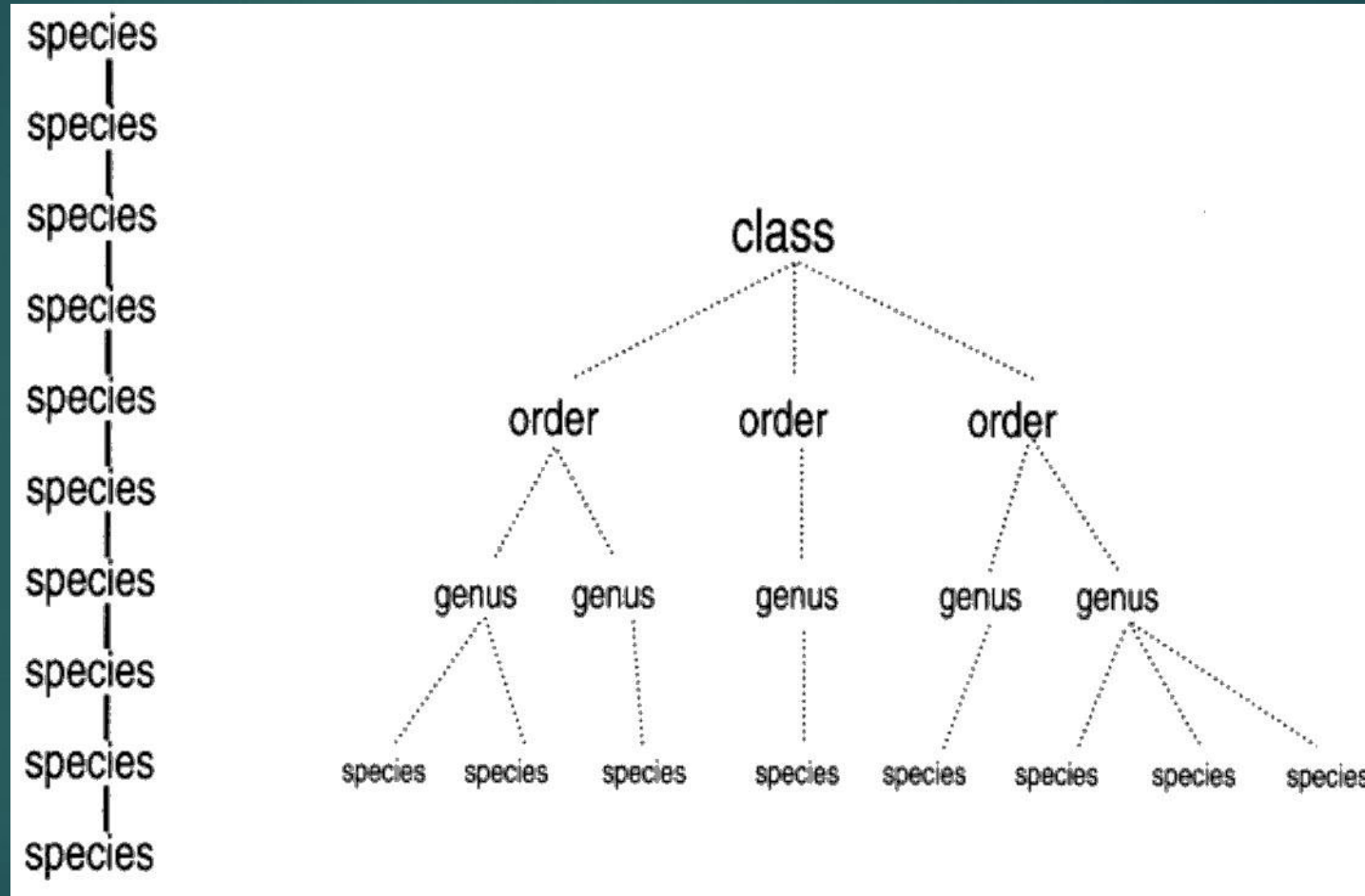


# Linnaeus's Classification of Humans

- ▶ 1758: placed humans in *Homo sapiens* in the order *Primates*
- ▶ No type specimen of *H. sapiens*
- ▶ Modern humans: species *H. sapiens*, genus *Homo*, tribe *Hominini*
- ▶ Four geographic varieties of humans mix culture and biology
  - ▶ *H. sapiens europaeus*
  - ▶ *H. sapiens asiaticus*
  - ▶ *H. sapiens americanus*
  - ▶ *H. sapiens afer* (Sub-Saharan)



# Great Chain vs Linnaean Taxonomy



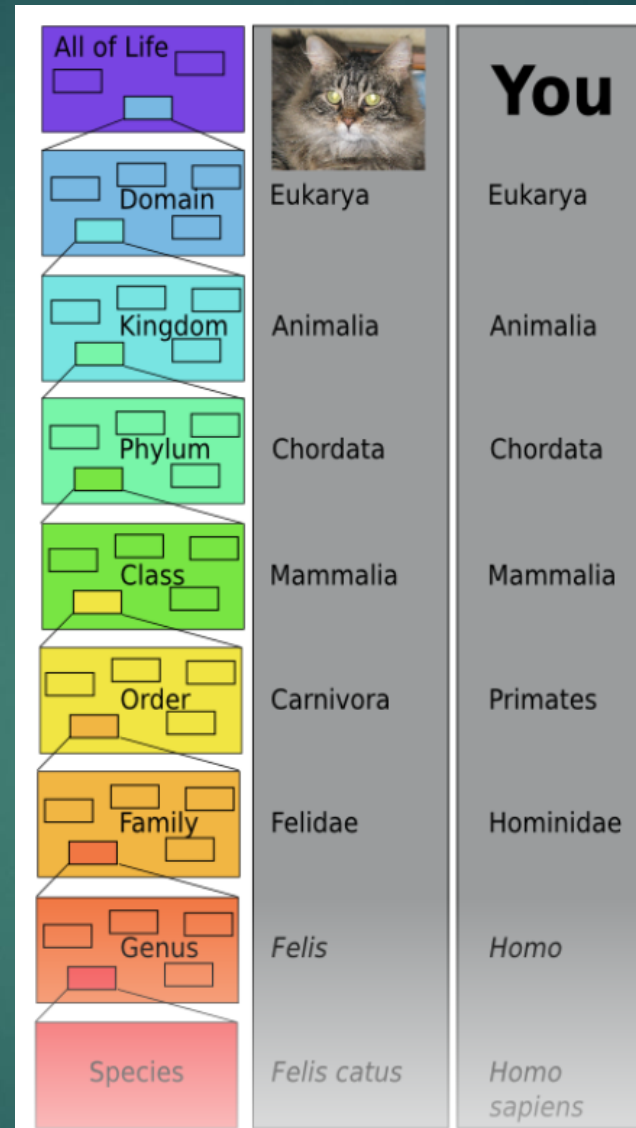
Source: Marks (1995) *Human Biodiversity*

# Linnaean nomenclature

- ▶ When new species (taxon) is introduced, 1 fossil is chosen as its “type” specimen; usually a well-preserved fossil selected. Does not have to be typical or average member of species
- ▶ Significance of type specimen is that the **taxon** (its classification group) **name is irrevocably attached to it**
- ▶ Age counts in nomenclature; **if 2 type specimens end up later in same species, oldest name gets preference**
- ▶ If new fossil found, must decide if it belongs to existing hominin taxon; if it does not belong, then it gets new species name
- ▶ **Taxonomy is based on assessment of external and internal morphology of fossil**
- Can abbreviate name of genus, but not species: *H. sapiens*
- **King Philip Came Over For Good Soup:** mnemonic for Kingdom, phylum, class, order, family, genus, and species

# Linnaean classification

- **Binomial system:** Genus and species in Latin i.e. *Homo sapiens*, *Pan troglodytes*
- Can abbreviate name of genus, but not species: *H. sapiens*
- Kingdom, phylum, class, order, family, genus, and species, which, among other possibilities, has the handy mnemonic **King Philip Came Over For Good Soup**



## Binomial Nomenclature

Before Linnaeus came up with a standardized system of naming, there were often many names for a single species, and these names tended to be long and confusing. Linnaeus decided that all species names should be in Latin and should have two parts. Remember, this 2-part system is called binomial nomenclature. It is still used today and gives every species one unique 2-part scientific name.

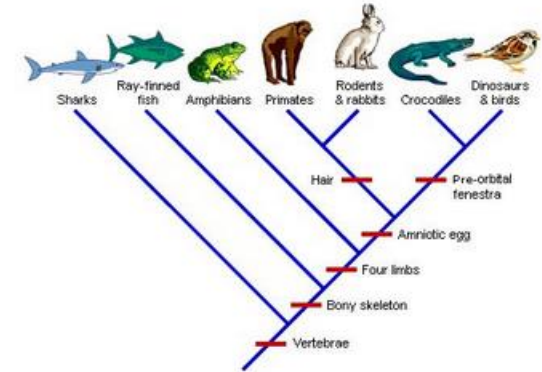


# Modern phylogenetic nomenclature

- ▶ **Phylogeny** is an evolutionary tree of a genetically related group of organisms, i.e. vertebrates
- ▶ **Clade**: group consisting solely of an ancestor and all its descendants, i.e. mammals, birds
- ▶ Phylogenetic nomenclature **ties names to clades**

## Reading phylogenetic trees: A quick review

(Adapted from evolution.berkeley.edu)



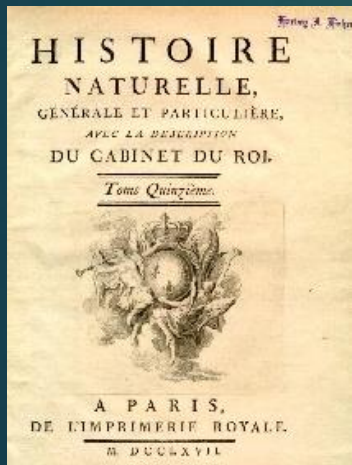
- A phylogeny, or evolutionary tree, represents the evolutionary relationships among a set of organisms or groups of organisms, called taxa (singular: taxon) that are believed to have a common ancestor.

# George Louis Leclerc, Comte de Buffon (1707-1788):

Biological change; Humans originate in Asia



- ▶ French naturalist
- ▶ Greatest naturalist of 18<sup>th</sup> century
- ▶ Influenced Jean-Baptiste Lamarck and Georges Cuvier
- ▶ 36 volume *Histoire naturelle, générale et particulière* (1749–1788)
- ▶ An **advocate** of the Asia hypothesis
- ▶ Opposed Linnaeus (rejected classification as goal of study)
  - ▶ No unit higher than species
  - ▶ Species comprise Great Chain of Being
  - ▶ Dismissed evolutionary implications of Linnaean ideas
- ▶ **Posited microevolution (minor changes) in response to environment**, but denied macroevolution (species remained unchanged since formation)

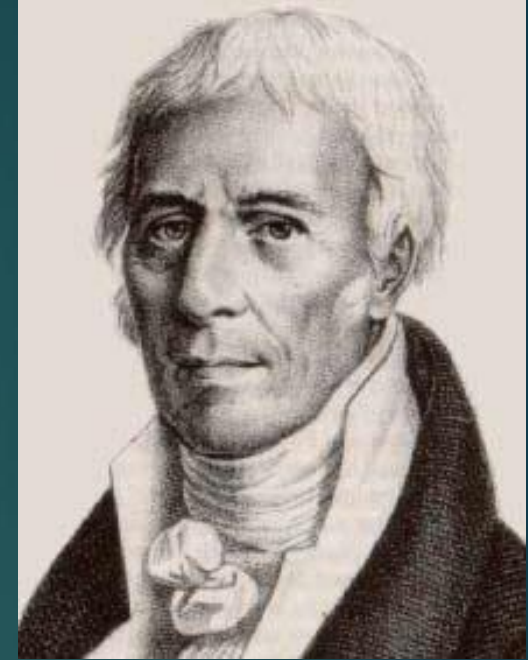


# Buffon and Human Variation

- ▶ Buffon rejected classification as goal of study; he aimed to describe and explain diversity
- ▶ *Varieties of the Human Species* (1749)
  - ▶ What explains patterns of variation?
- Buffon and Linnaeus represent two strains of thought in 20<sup>th</sup> century anthropology

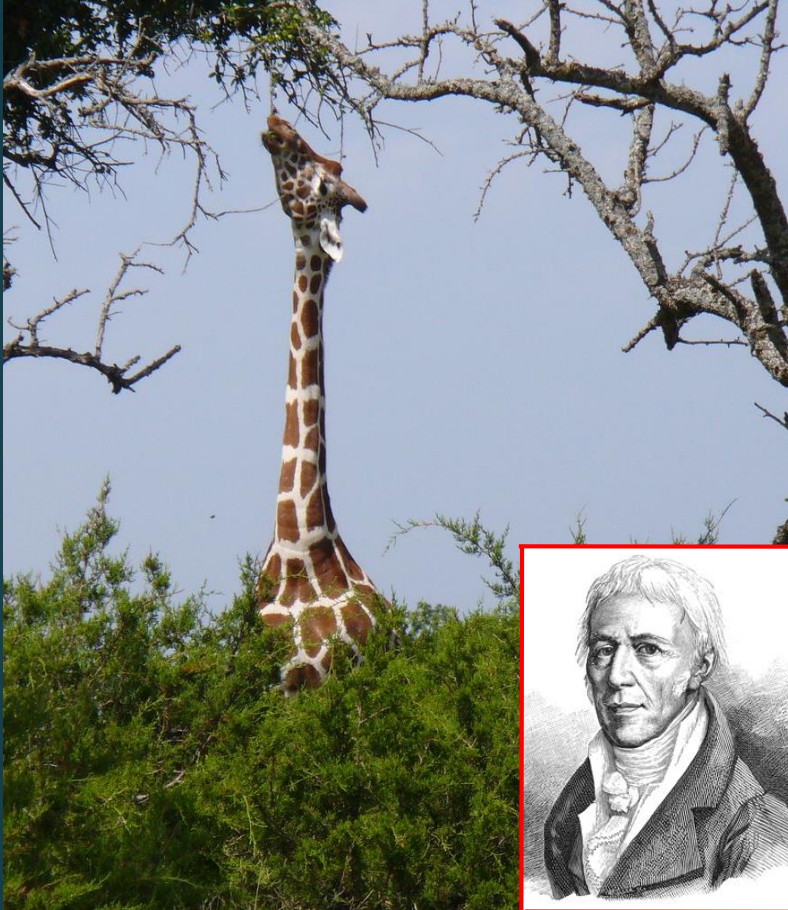
# Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck (1744-1829): Evolution thru inheritance of acquired characteristics

- ▶ French botanist & professor of invertebrate zoology,  
Museum Nationale d'Histoire Naturelle
- ▶ \*\* Regarded classification as sterile and theorized about  
process of evolutionary change = evolution through  
inheritance of acquired characteristics
- ▶ \*\* Ground breaking observations of change in  
connected lineages and mutability of species: noted that  
mollusks could be arranged in gradually modifying  
series from older to younger
- ▶ One of founders of evolutionary biology





# Evolution, species can change (Transmutation)

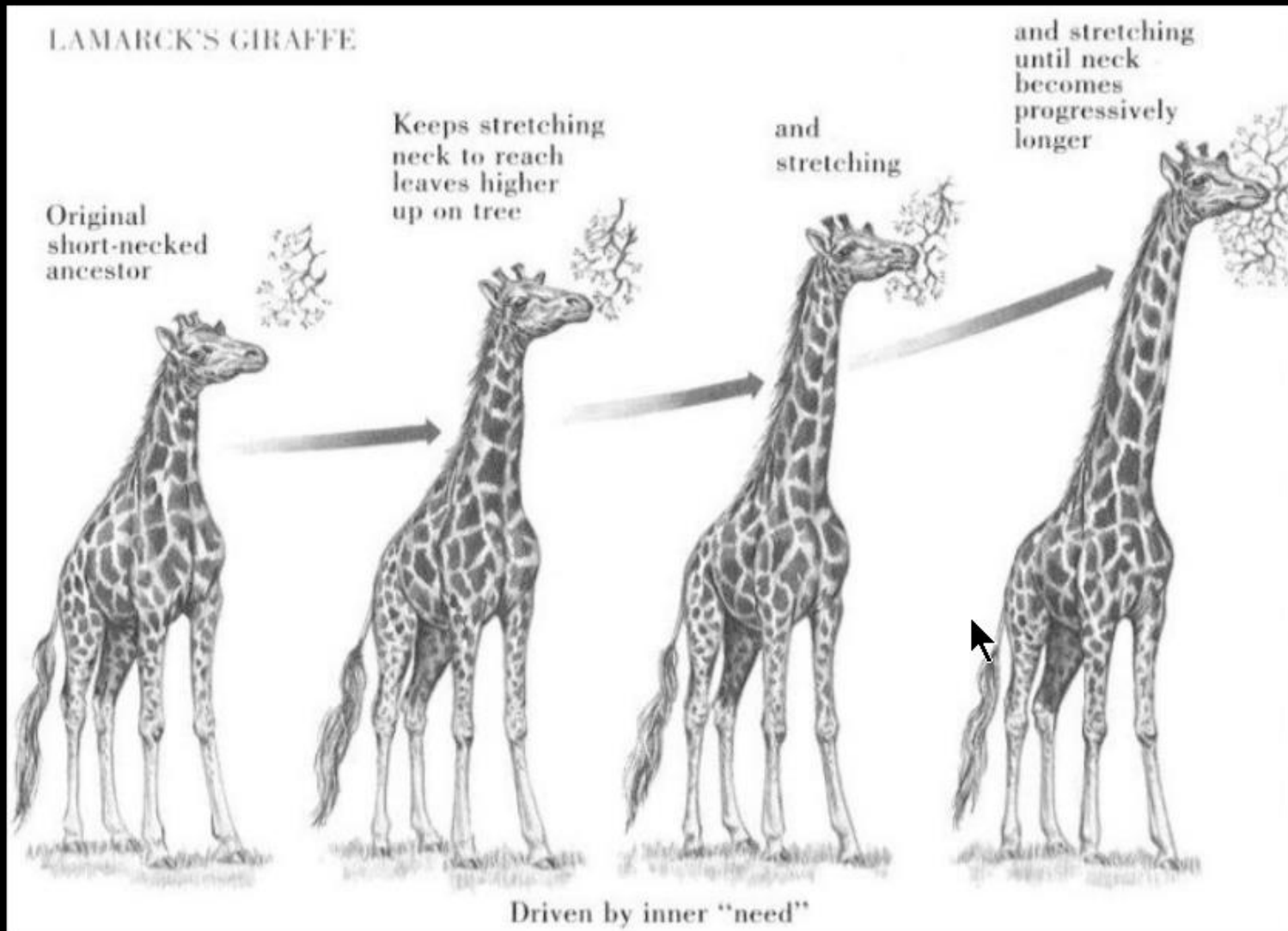


Jean Baptiste de Lamarck

- Around 1800, scientists began to wonder **whether species could change or transmute.**
- It's 1809, no hominin fossils; Lamarck thought that **if an animal acquired a characteristic during its lifetime, it could pass it onto its offspring.**
- Hence giraffes got their long necks through generations of straining to reach high branches.
- **Darwin** read his most famous work, *Philosophie Zoologique*, on the *Beagle*.
- **Most scientists of his day thought that Lamarck was wrong.**



# About “Bimana” (2 handed humans and their ancestors)



Lamarck, 1809:  
“Moreover, if the individuals I am talking about, moved by the **need to grow higher** so as to see all at once far and wide, were forced **to hold themselves upright** and **acquired** from that a constant habit from one generation to the next...”

# Jean Baptiste, Chevalier of Lamarck

## ▶ Inheritance of acquired characteristics

- ▶ Organism altered during lifetime by environment and behavior
- ▶ Change inherited by offspring
- ▶ The problem with Lamarckian evolution is acquired characteristics cannot be inherited – they don't affect the gametes.

## ▶ Correct about evolution, wrong method

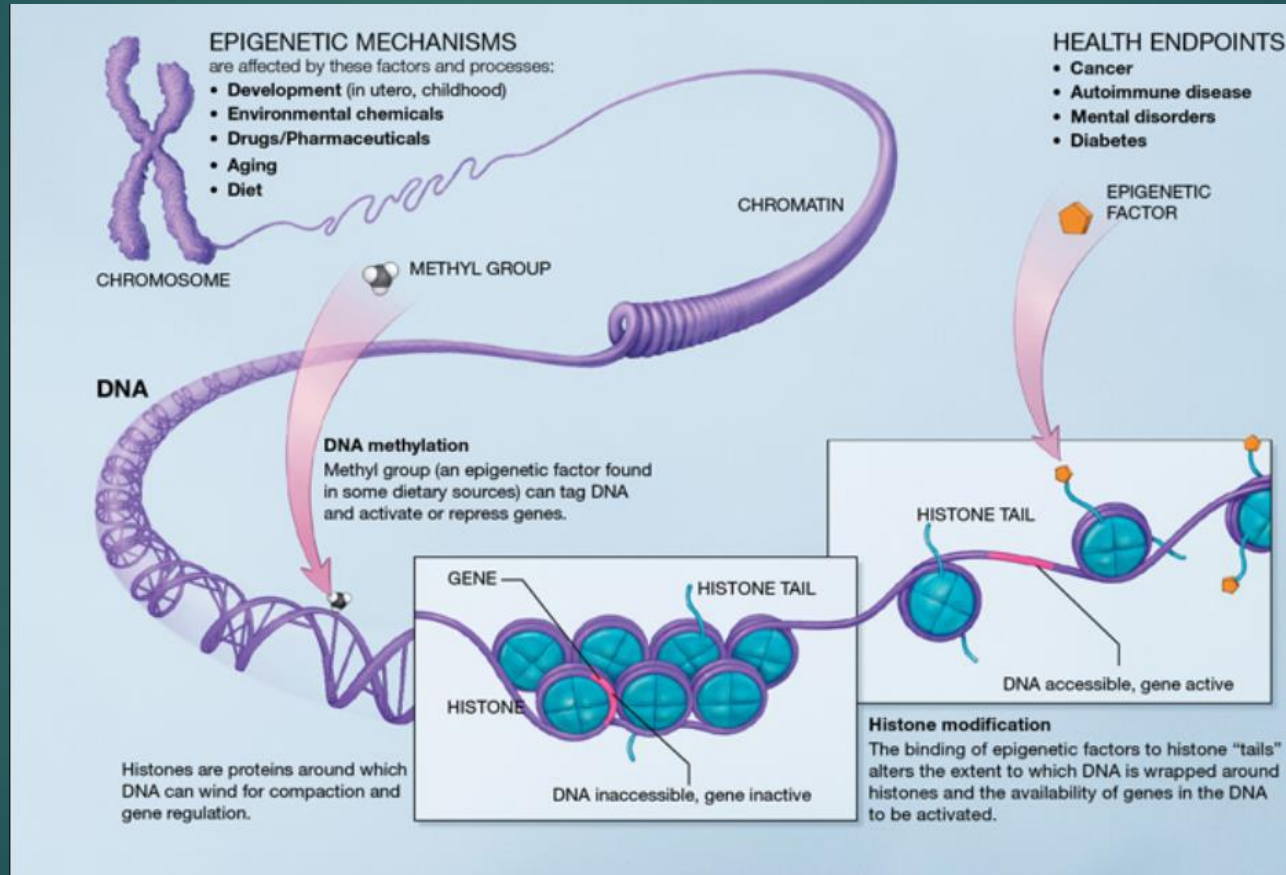
- ▶ Early epigenetics?: heritable changes in gene activity that are *not* caused by changes in DNA, but by environmental experience; Lamarck isn't entirely dead:
  - ▶ Pigliuicci's review of "Evolution in four dimensions" -- *Nature* **435**, 565-566 (2 June 2005)
  - ▶ Balter, M. 2000. Was Lamarck just a little bit right? *Science* 288:38.

# Lamarck

- ▶ Set out the first scientific explanation of the Tree of Life: first branching tree of animals in his *Philosophie Zoologique* (1809). It was an upside-down tree starting with worms and ending with mammals.
- ▶ However, Lamarck did not believe in common descent of all life. Instead, he believed that life consists of separate parallel lines advancing from simple to complex
- ▶ But his explanation for changing lineages destroyed his scientific reputation: French school of *Transformationism*: Idea that an organism can pass on characteristics that it acquired during its lifetime to its offspring; known as heritability of acquired characteristics

# Epigenetics:

heritable changes in gene activity that are *not* caused by changes in DNA



Methyl tags on genes & histone modification control gene expression

# Epigenetics: influence of experience on DNA expression

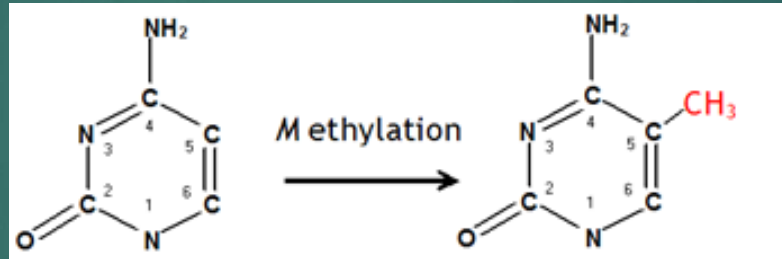
- How is molecular control of gene expression exerted?
  - DNA code remains unchanged
  - Epigenetics are another layer of information laid on top of the DNA code
  - Two main mechanisms:
    - DNA methylation
    - Histone (chromatin) modification
- Molecular link between genes and environment



# Molecular Mechanisms

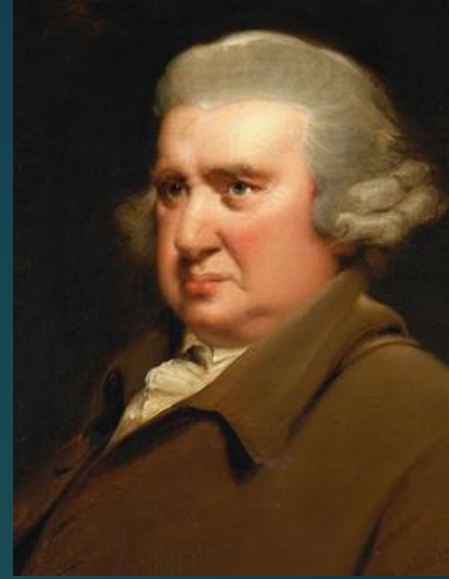
## – DNA methylation

- DNA sequence made up of 4 chemical bases; adenosine, guanine, tyrosine and cytosine (A,G,T,C)
- One base, cytosine is epigenetically modified by DNA methylation



- Encoded DNA information (i.e. 'C') remains the same
- Epigenetic code has changed...
- DNA methylation generally = suppression of gene activity

# Erasmus Darwin (1731-1802)



- ▶ At that time, only a few radical thinkers like Charles Darwin's grandfather, Erasmus, agreed that species could change over time ("Transmutation") and that there was common descent.
- ▶ **In his *Botanic Garden* 1791:** "As all the families both of plants & animals appear in a state of perpetual improvement or degeneracy, it becomes a subject of importance to detect the causes of these mutations."
- ▶ **In *Zoonomia* (1794):** "The power of acquiring new parts, attending with new propensities, directed by irritations, sensations, volitions, and associations; and thus possessing the faculty of continuing to improve by its own inherent activity, and of delivering down these improvements generation by generation to its posterity, world without end."

# Georges Cuvier (1769-1832): Catastrophist/punctuated equilibrium

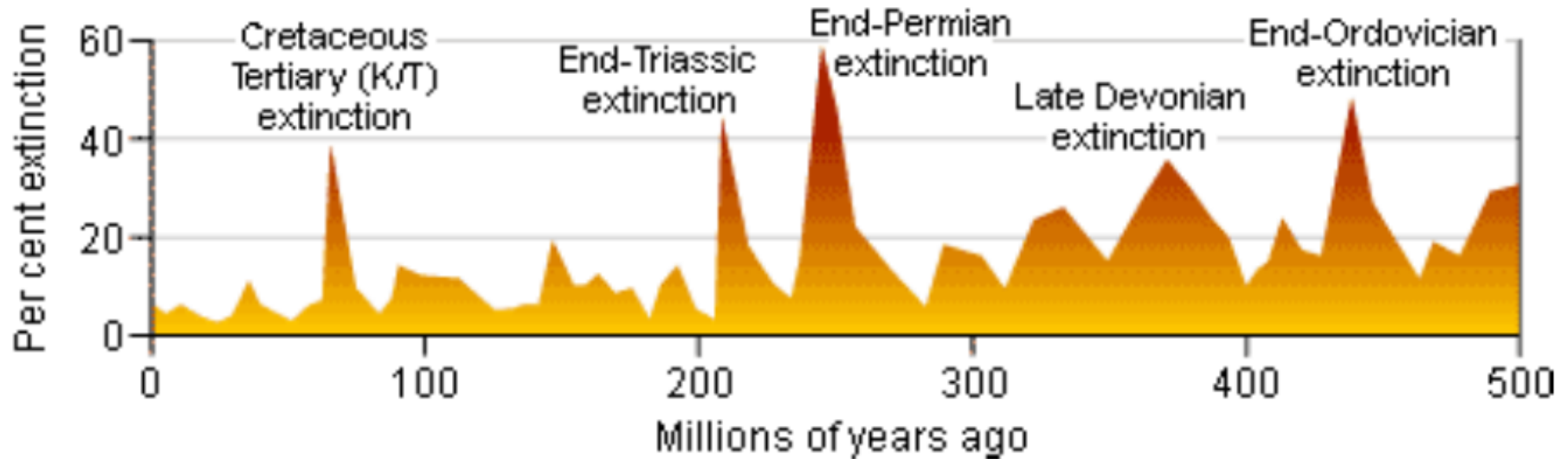
- ▶ Comparative anatomist, zoologist; Premiere mammalian paleontologist at Museum d'Histoire Naturelle in Paris
- ▶ Creates principles of scientific paleontology; Father of vertebrate paleontology
- ▶ Foremost proponent of catastrophism:
  - ▶ catastrophic events caused mass extinctions; repopulation gives appearance of change.
- ▶ Anti-evolutionist: Embraced Linnaeus's nested hierarchy, but not evolutionary implications; anti-Lamarck
- ▶ Believed that forms abruptly appeared in the fossil record, and persisted unchanged to the time of its extinction (first "punctuated equilibrium" idea).



# Georges Cuvier

- ▶ Foremost proponent of catastrophism:
  - ▶ catastrophic events caused mass extinctions
  - ▶ repopulation gives appearance of change.
- ▶ Anti-evolutionist and anti-Lamarck: Embraced Linnaeus's nested hierarchy, but not evolutionary implications.
- ▶ Believed that forms abruptly appeared in the fossil record, and persisted unchanged to the time of its extinction (first "punctuated equilibrium" idea).
- ▶ Cuvier helped discredit Lamarck's evolutionary theory

# Modern Catastrophism: Reality of Mass extinctions



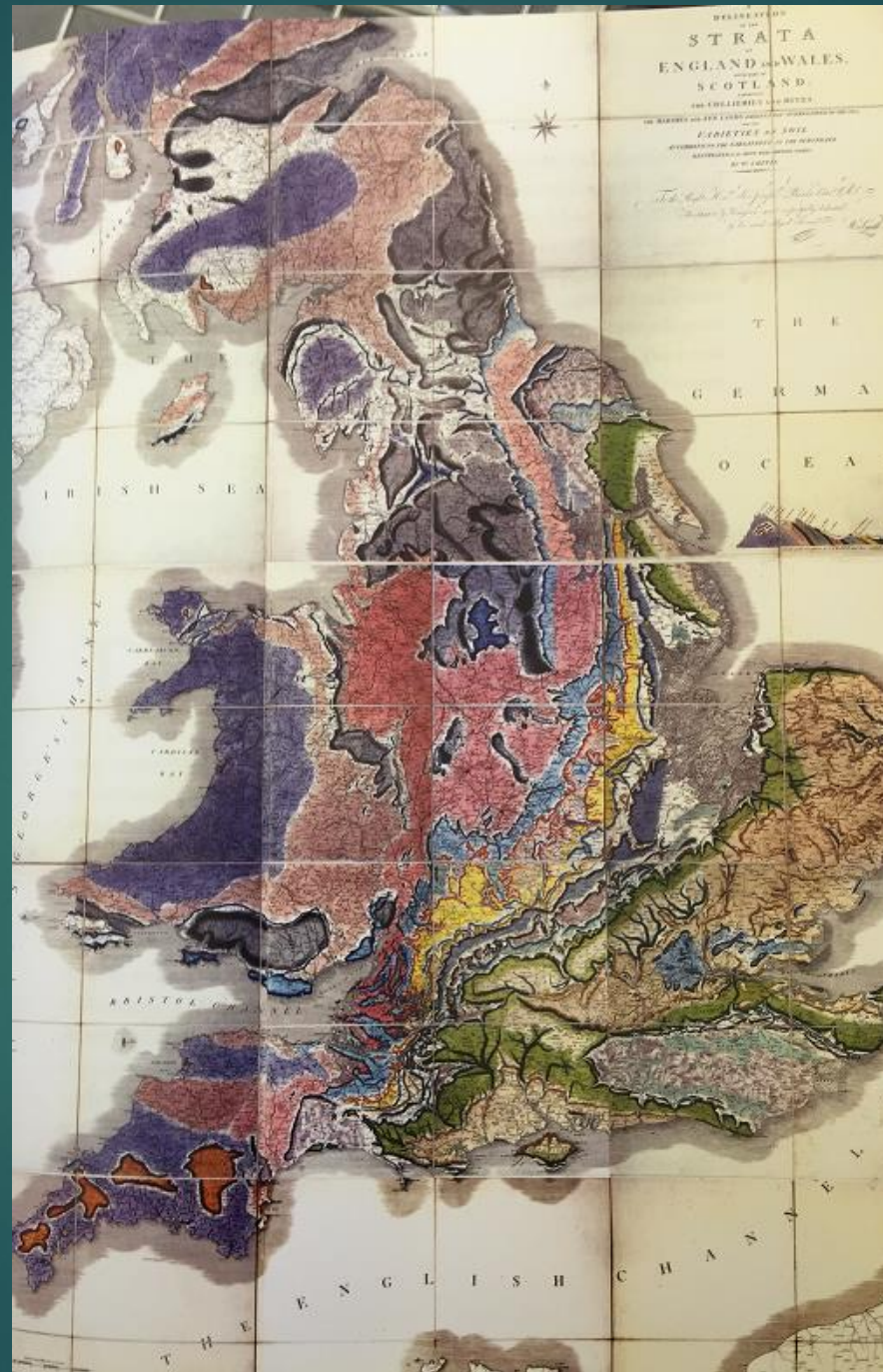
Life's history has been marked by both catastrophic extinction events (red spikes) and constant background extinction (yellow).

99% of all species have gone extinct;

Cuvier was partially correct: 5 mass extinctions wiped out 50% of all living species;  
6<sup>th</sup> mass extinction is current

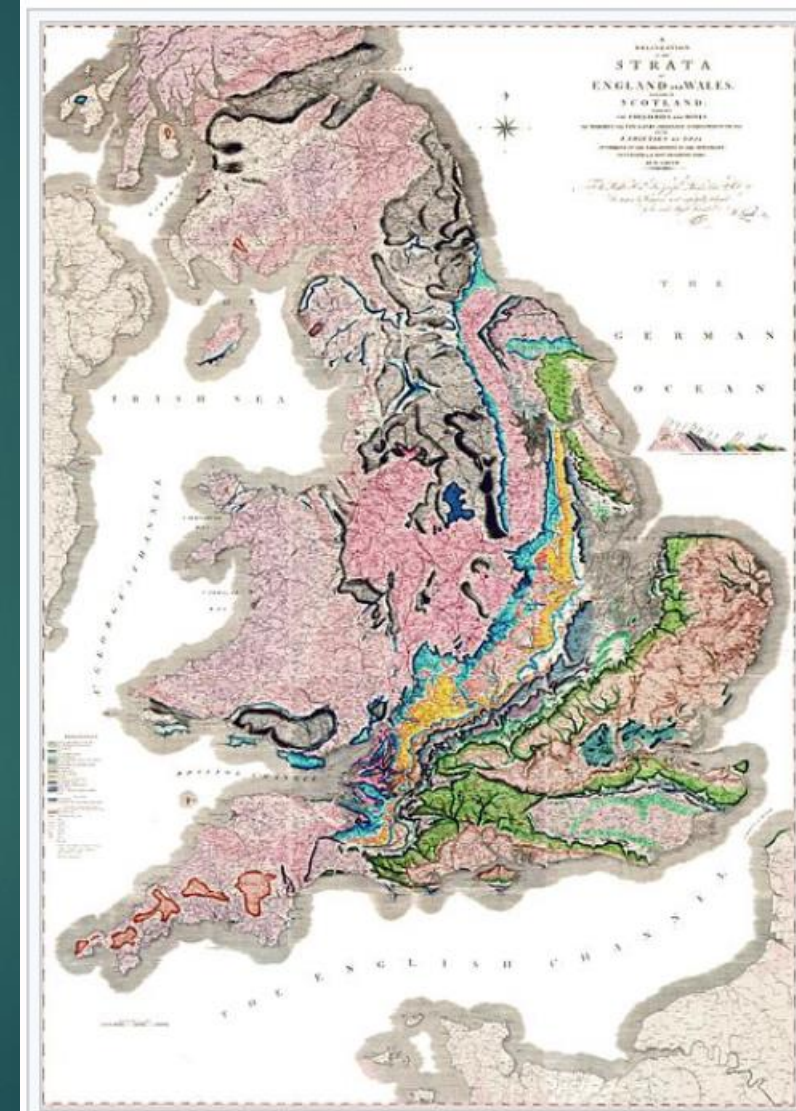
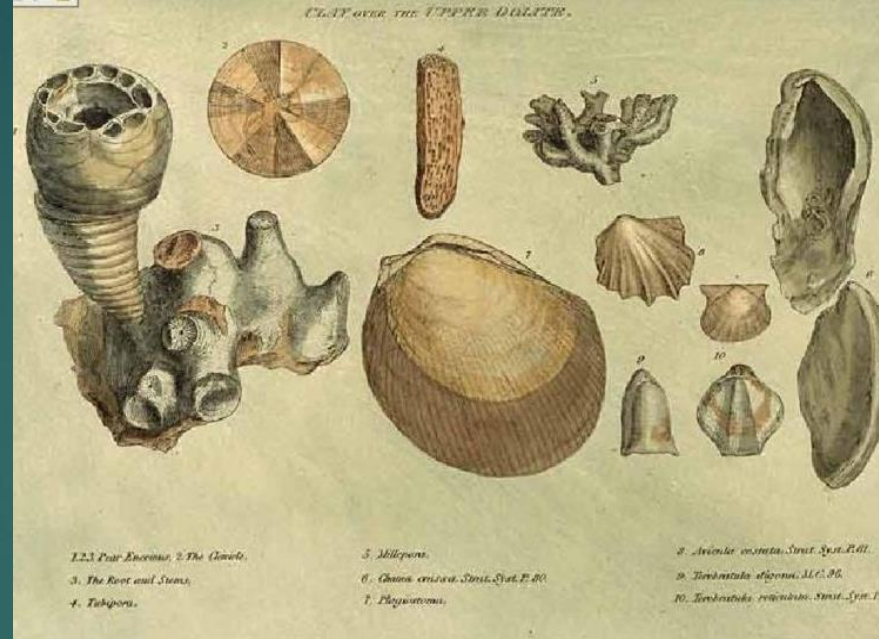


# First geological map of England





# William Smith (1769-1839): "Father of English Geology"

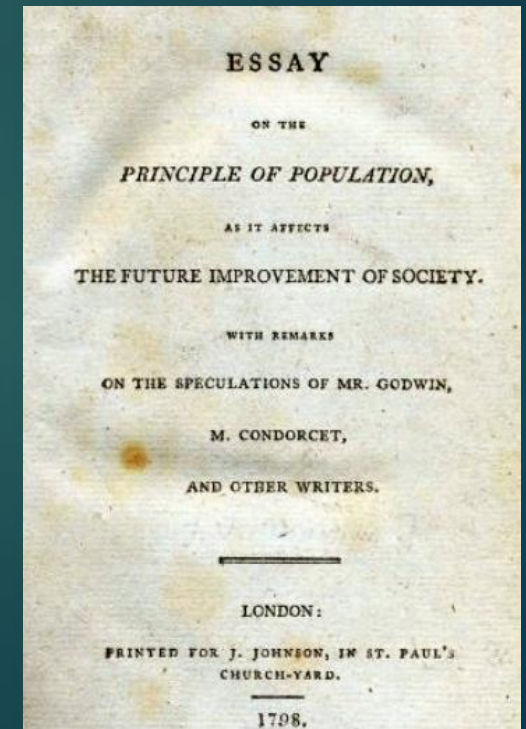


Map that changed the world.

- William Smith did geological mapping of the rocks and fossils of Britain.
- 1815: He noted that various strata could always be found in the same relative positions. Each particular stratum could be identified by the fossils it contained,
- He was able to show that rocks were laid down in a certain order and that the different fossils in different layers lived at different intervals of geological time.
- Evidence that different species existed in the past compared with today

# Thomas Malthus (1766-1834): Population outruns food supply

- ▶ English clergyman & economist
- ▶ 1798: *Essay on the Principles of Population* :  
Potential to produce offspring exceeds growth of resources needed to support them
- ▶ Helped Darwin come to theory of natural selection  
(inherited differences in chances of surviving in struggle between population & resources).

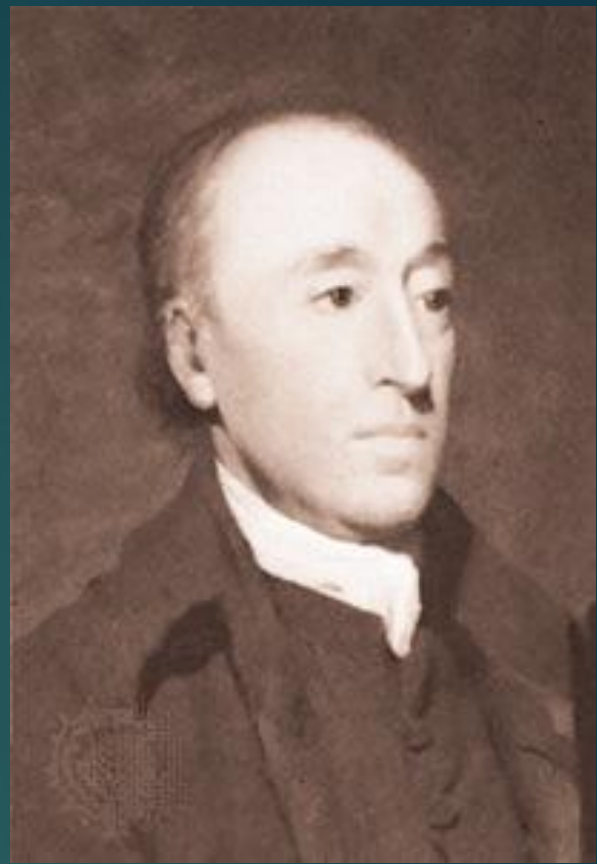




James Hutton (1726-1797):

Geological Uniformitarian: Replacing mythology with geology

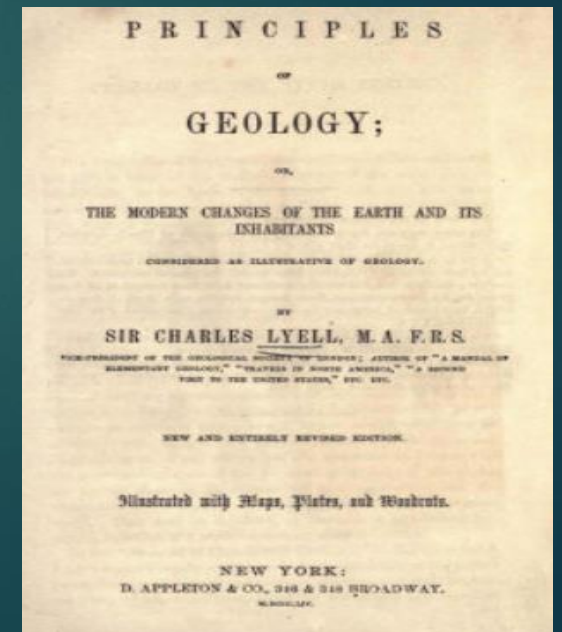
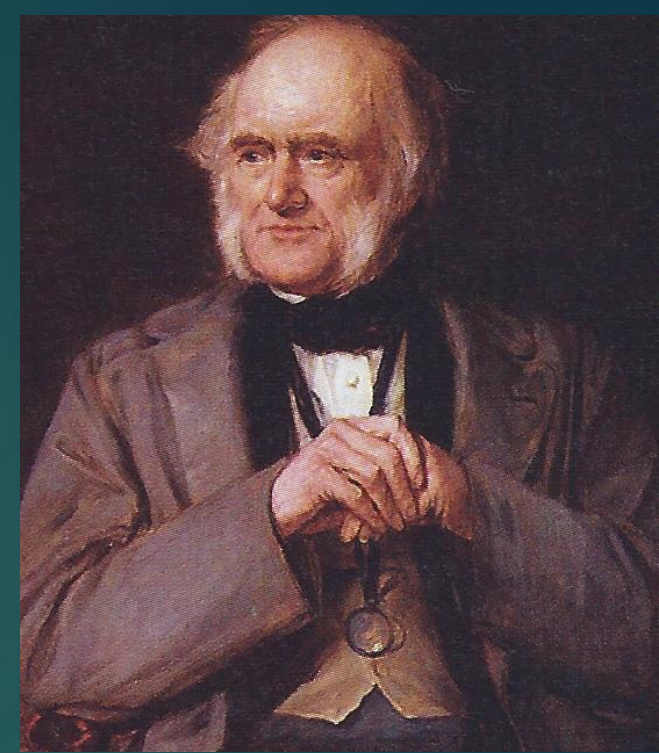
- ▶ Scottish geologist
- ▶ 1785: Developed principle of uniformitarianism (1785)
  - ▶ Same geologic processes (erosion, lava cooling to form layers of basalt) operate today as in the past
  - ▶ Earth has very long history
  - ▶ Supernatural theories not required to explain history
  - ▶ Earth's geology shaped by processes observable today
    - ▶ e.g. Deep soils formed by the weathering of bedrock over 1000s of years



# Sir Charles Lyell (1797-1875):

Modern Geology, geological gradualism

- ▶ Scottish geologist; Founder of modern geology
- ▶ 1830: Principles of Geology (1830-1833), 3 volumes
  - ▶ Covered Tertiary period (last 65 M years)
- ▶ Friend and mentor of Charles Darwin (“I see through his eyes”); His concept of gradualism lead Darwin to idea of natural selection; Darwin – “I always feel as if my books came half out of Lyell’s brain.”
- ▶ One of first scientific versions of the origin of the Earth: deep time and geological gradualism





# Charles Lyell

- ▶ Fluvialism: erosion by rivers and streams eroded height of mountains and created valleys
- ▶ Promoted and extended principle of uniformitarianism: geological processes of past (erosion and volcanism) still exist
- ▶ Steno's Law of Superposition: rocks and strata generally increase in age the farther down they are in any relatively simple geological sequence. Lower in a sequence of rocks a fossil or stone tool is, the older it is.
- ▶ His concept of gradualism lead Darwin to idea of natural selection; Darwin – “I always feel as if my books came half out of Lyell's brain.”
- ▶ Studied stone tools in Somme Valley: “The Geological Evidence for the Antiquity of Man”

# From watches to watchmakers: Pre-Darwinian evolution theories

- ▶ William Paley (1741-1805) & design in nature: **watchmaker argument**: when we find a complex object like a watch, we assume existence of a watchmaker; so when you see complexity in nature, we are compelled by analogy to a belief in divine watchmaker
- ▶ By 1830s, **English theories of evolution** by: Francis Bacon, Isaac Newton, Erasmus Darwin, Thomas Malthus, William Paley, Charles Lyell
- ▶ **Theories of natural selection** by: Jean-Jacques Rousseau, Johann Herder, Erasmus Darwin, James Hutton, William Paley; Darwin himself acknowledges William Wells and Patrick Matthews as influences

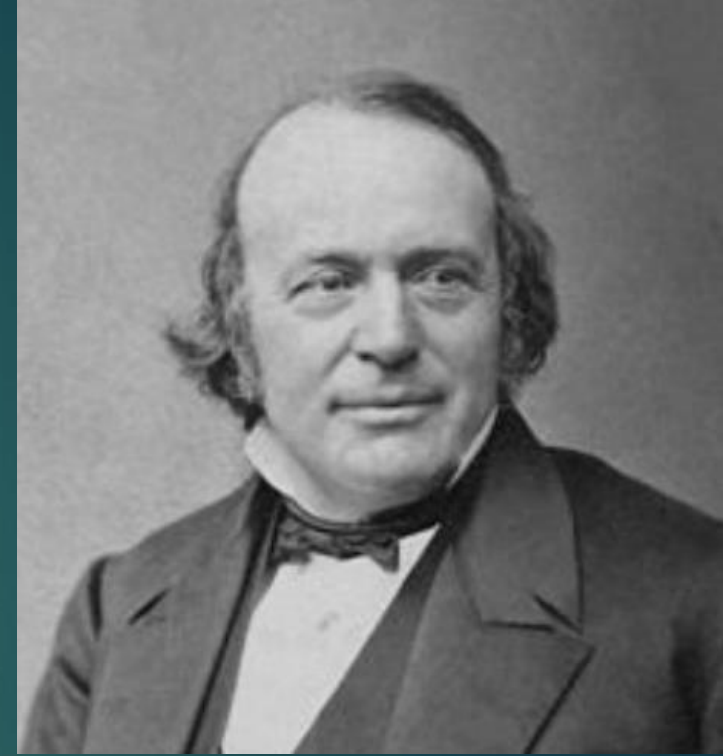
# Alexander von Humboldt (1769-1859)



- ▶ Prussian polymath, geographer, naturalist, explorer, and influential proponent of science
- ▶ Darwin: “the greatest traveling scientist who ever lived”
- ▶ 30 years before Darwin traveled, Humboldt explored Latin America; did quantitative work on botanical geography laid the foundation for the field of biogeography; phenomenon and cause of human-induced climate change; laid the foundation of the sciences of physical geography, plant geography, and meteorology
- ▶ Best seller multi-volume *Personal Narrative of Travels to the Equinoctial Regions of America*; which Darwin, Thoreau, Haeckel and Muir read.
- ▶ Considered the greatest European of his age
- ▶ 5 volume *Kosmos* – unification of all scientific knowledge
- ▶ His name is all over the Americas
- ▶ **See:** *The Invention of Nature: Alexander von Humboldt's New World* by Andrea Wulf

# Louis Agassiz (1807-1873): Ice Ages

- ▶ Swiss geologist & naturalist
- ▶ Founded Museum of Comparative Zoology at Harvard
- ▶ 1837: Agassiz was the first to scientifically propose that the Earth had been subject to past ice ages
- ▶ Strongly anti-evolution; belief in “ideal” for each species; repeated creation events after catastrophic extinctions caused by ice ages
- ▶ Stanford University, 1906: 'Agassiz was great in the abstract but not in the concrete'”





# Concept of Ice Ages



Rocks polished and striated by a glacier, from Louis Agassiz, *Études sur les glaciers*, 1840.



Hugi's hut on a medial moraine of the lower Aar glacier, from Louis Agassiz, *Études sur les glaciers*, 1840.



Partie Moyenne



Flanc de l'extremite inferieure



## Enter the Antiquarians: discovery of first archeological data

- ▶ **Flaked flint tools** had been known in Europe from time immemorial
- ▶ First publication about “thunderbolts” (fossilized cuttlefish) was in **1655**: Isaac de la Peyrere of Bordeaux; he was seized by Inquisition and book was burned
- ▶ Continued reluctance to confirm the ancientness of fossil findings.
- ▶ Explained as “anti-diluvian” (before the biblical Flood)

1800



# John Frere (1740 – 1807):

## English Paleolithic handaxes at Hoxne

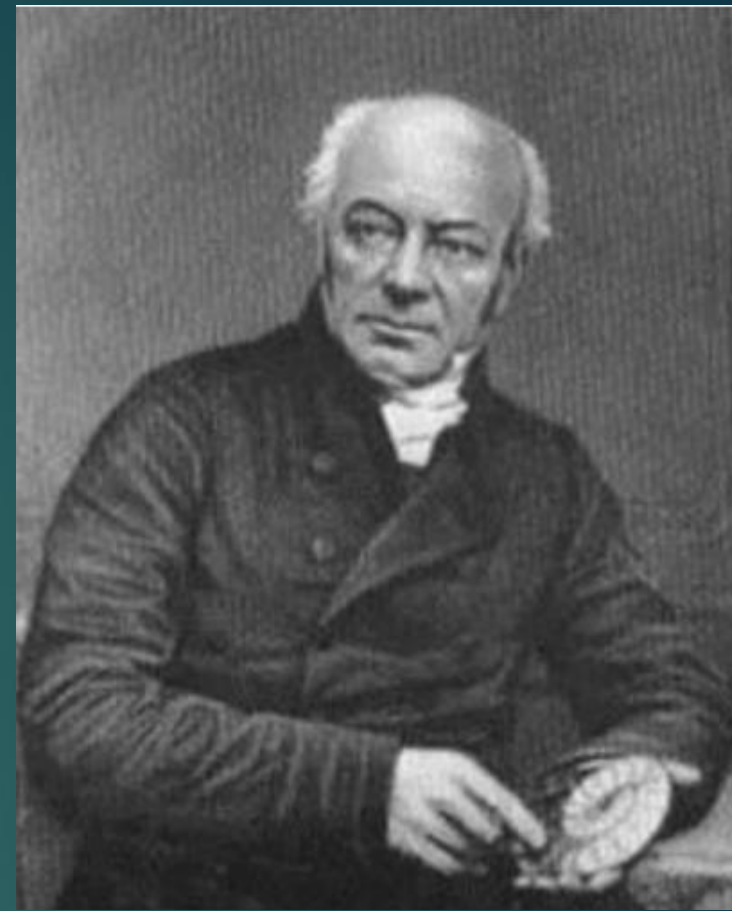
- ▶ English antiquary
- ▶ 1797: A pioneering discoverer of Old Stone Age or Paleolithic (“old stone”) tools in association with large extinct animals at brickyard in Hoxne, Suffolk
- ▶ First to recognize and publish on stone tools from England
- ▶ Described juxtaposition of artifacts, animal remains and stratigraphic evidence.
- ▶ 3<sup>rd</sup> great grandfather of Mary Leakey



Acheulean handaxe

# Rev. William Buckland (1784 – 1856): First *Homo sapiens* discovery

- ▶ Oxford professor of geology
- ▶ Theory of global catastrophes
- ▶ First hominin fossil discovery
- ▶ 1823: First found fossils of *Homo sapiens* (Red Lady of Paviland) the bones of a young man, 29K, in Goat's Hole Cave, Paviland, on the Gower Peninsula in Wales, which remains the oldest anatomically modern human found in the United Kingdom; now dated to 33K
- ▶ Trained Charles Lyell



# 1823: Red Lady of Paviland



Found with beads and initially described as a woman; **actually a young man**

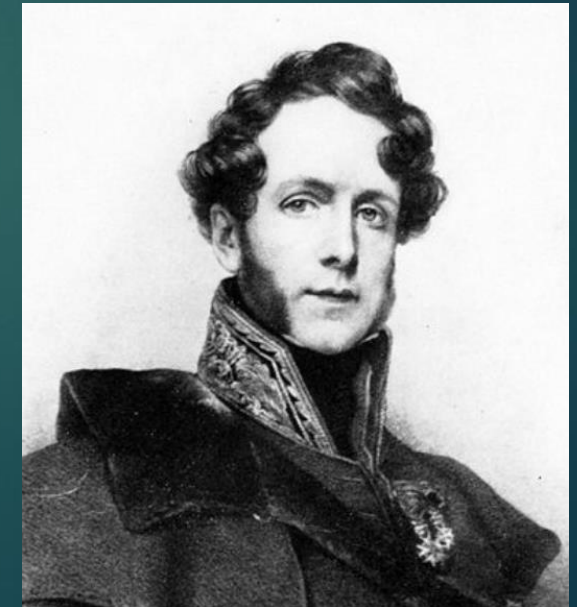
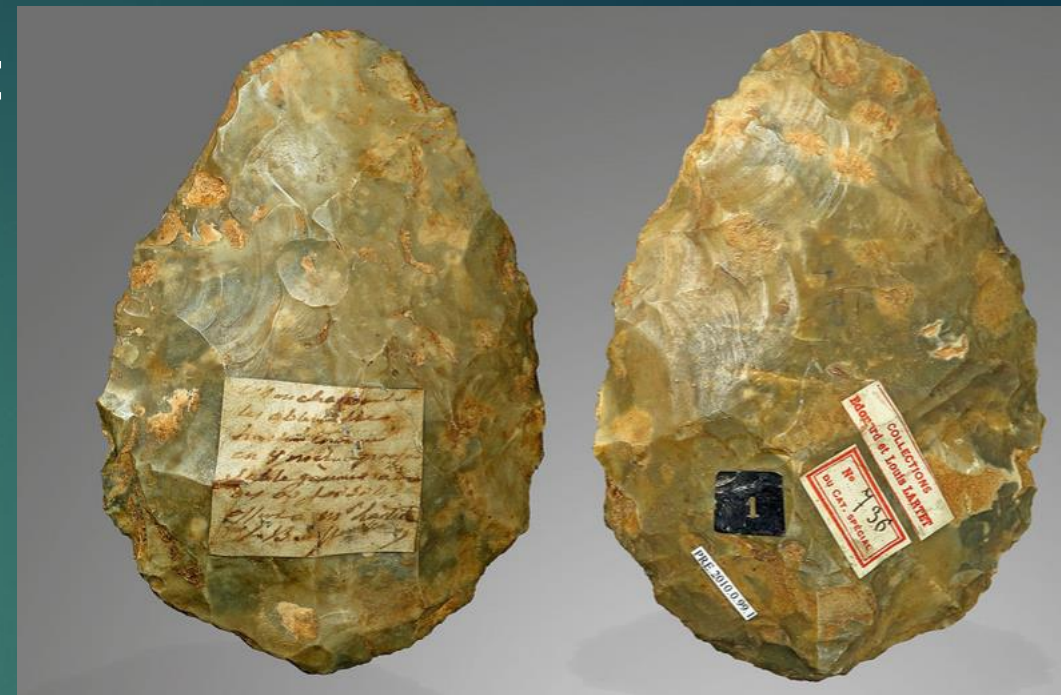
First *Homo sapiens* fossil discovery;  
Rev. William Buckland





# Jacques Boucher de Perthes (1788-1868): French prehistoric hand axes

- ▶ Described early flint tools from Abbeville, France in late 1830s; proved existence of flaked stone tools
- ▶ Discovered early handaxes near bones of extinct elephant bones in valley of Somme
- ▶ In **1847** he commenced the issue of his monumental three volume work, *Antiquités celtiques et antédiluviennes*, a work in which he was the **first to establish the existence of man in the Pleistocene (2.5M to 12K).**



# Palaeolithic Hand Axes, Acheulean, ca. 500 K

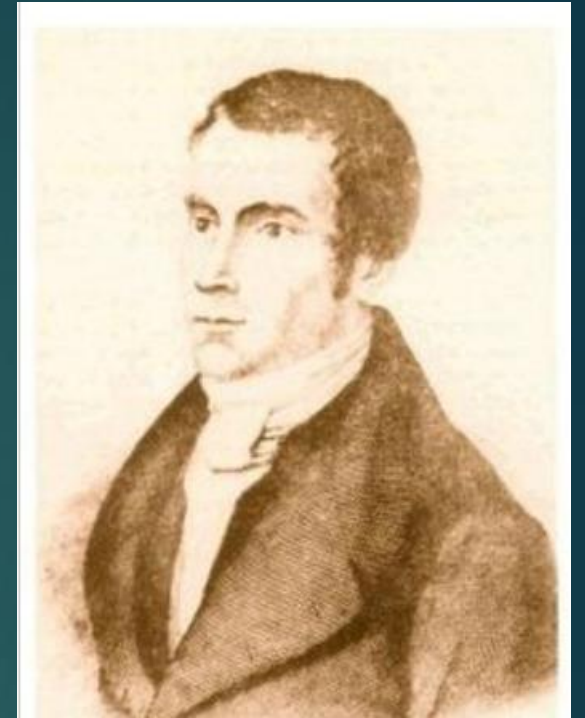


From: Abbeville, Northern France. Excavated by Jacques Boucher de Perthes, 1830-40s

# Philippe-Charles Schmerling (1791-1836):

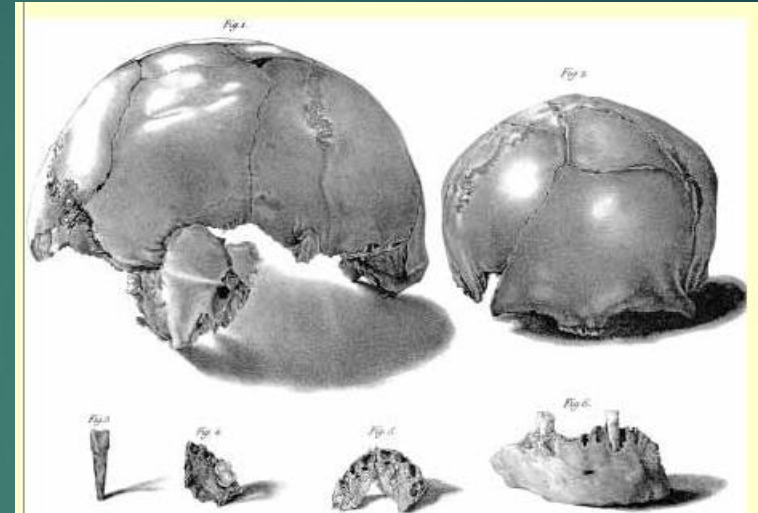
## First Neandertal discovery, Engis, Belgium

- ▶ Belgian physician, prehistorian, pioneer in paleontology, paleoanthropology, paleopathology and geologist.
- ▶ Some consider him the founder of paleontology
- ▶ Helped to prove that ancient humans and tools coexisted with ancient animals
- ▶ \*\*1829: he found part of a cranium at Awir Cave II near Engis in Belgium and belonged to an infant; published in 1833.
- ▶ It was not recognized as a Neandertal until 1936, when Charles Fraipont authored a monograph on this child fossil.

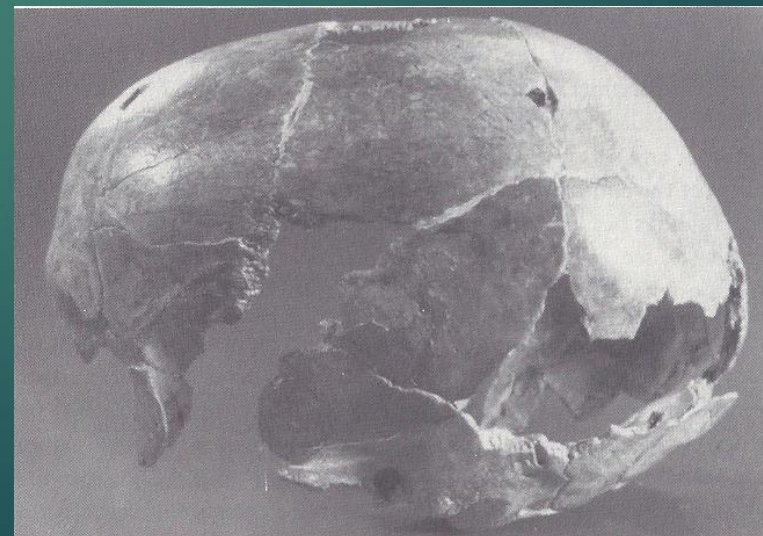




# 1829: Engis (Belgium) juvenile Neanderthal cranium



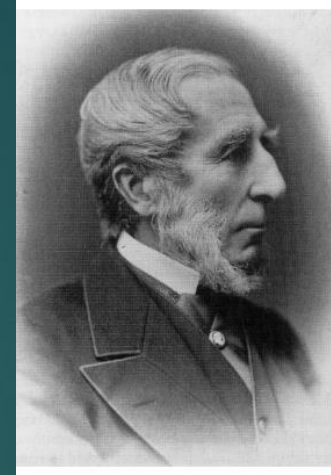
1<sup>st</sup> Neanderthal found;  
2nd discovered fossil hominin





# Captain Edmund Flint: 2<sup>nd</sup> Neanderthal discovery

- ▶ **1848: Gibraltar 1** is the specimen name of a Neanderthal skull found at Forbes' Quarry in Gibraltar, by Captain Edmund Flint, a British officer with the Royal Navy.
- ▶ First known adult Neanderthal skull, and only the second Neanderthal fossil ever to be found (but not identified as Neanderthal until 1907).
- ▶ **1865**: British paleontologist Hugh Falconer (1808-1865) & George Busk (1807-1886) named Gibraltar Neanderthal 1 as *Homo calpicus* (Busk, 1865); Busk thought it was similar to Neander skull, but classified it as a distinct species

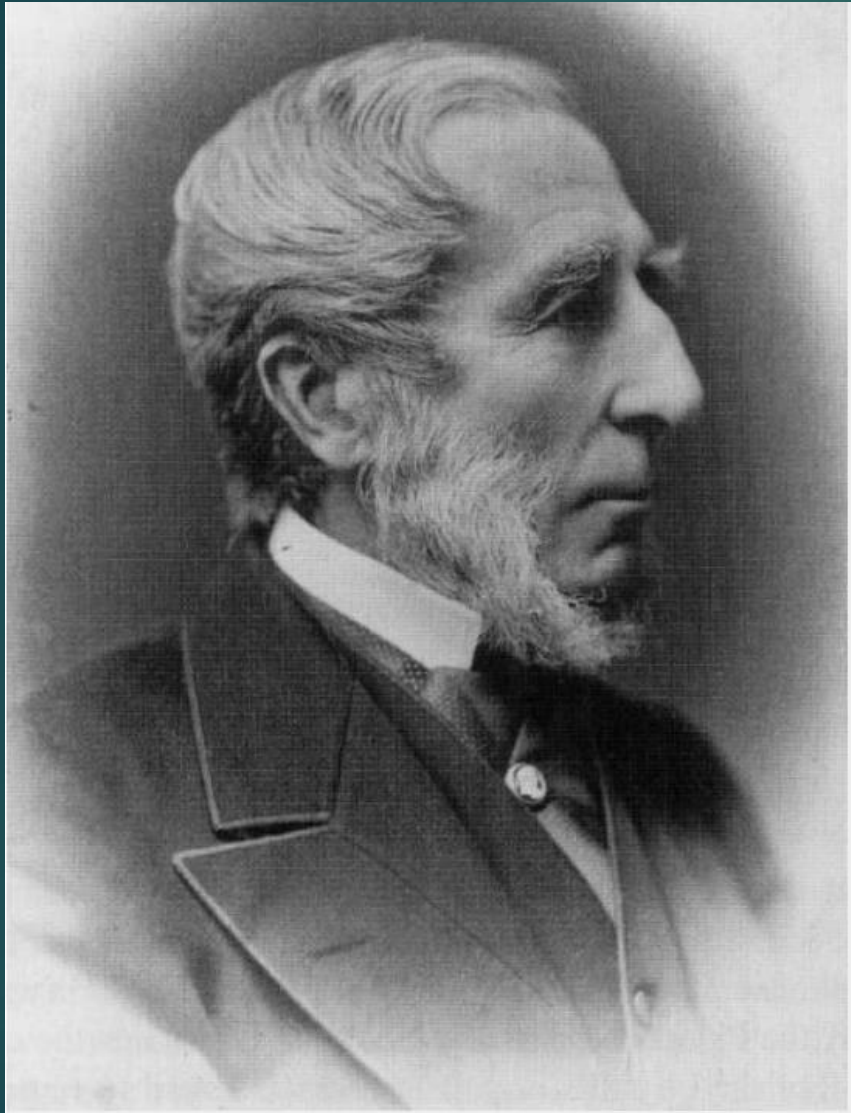


G. Busk



H. Falconer

# George Busk



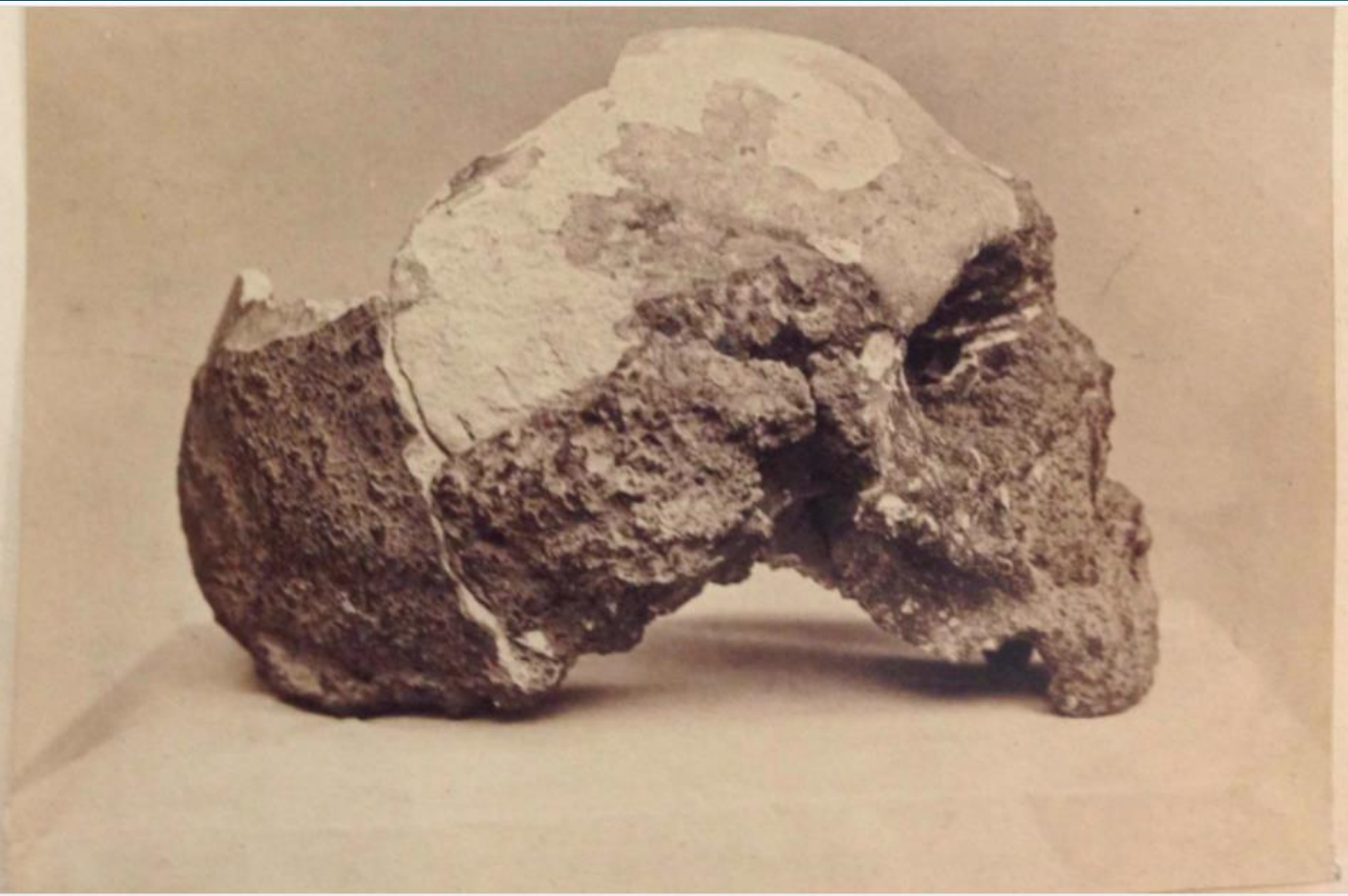
George Busk



1848)



# Forbes Quarry, Gibraltar, 1848

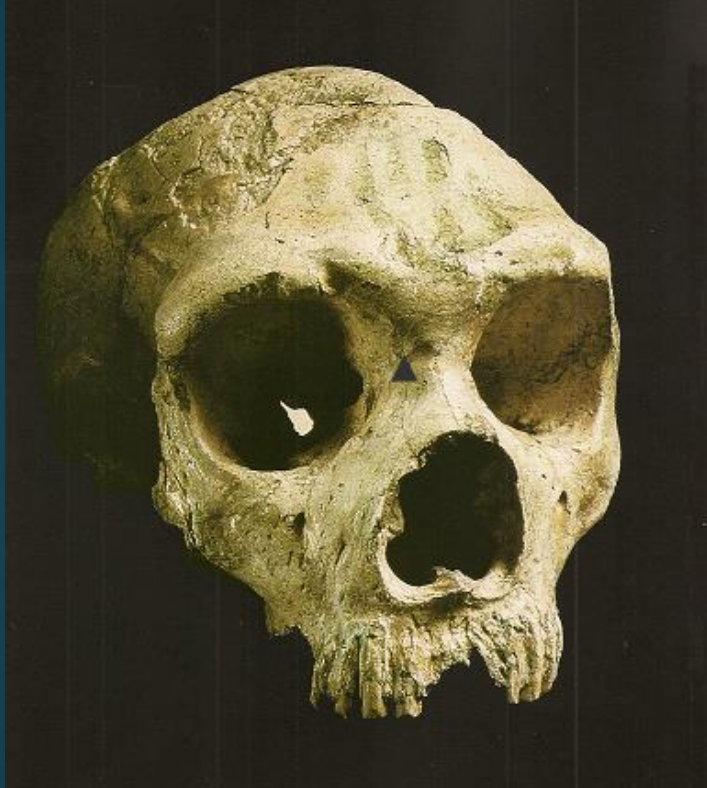


Gibraltar Neanderthal from Busk's papers, Royal College of Surgeons London





# 1848: Gibraltar I, 2<sup>nd</sup> Neandertal discovery, 1<sup>st</sup> complete N adult skull; a female



Gibraltar Neanderthal from Busk's papers, Royal College of Surgeons London



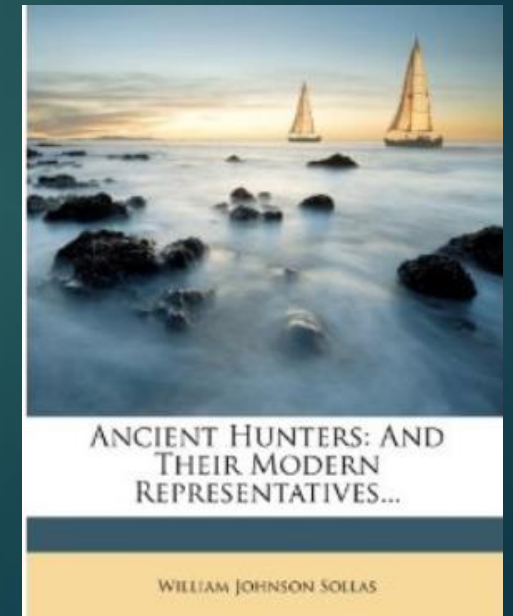
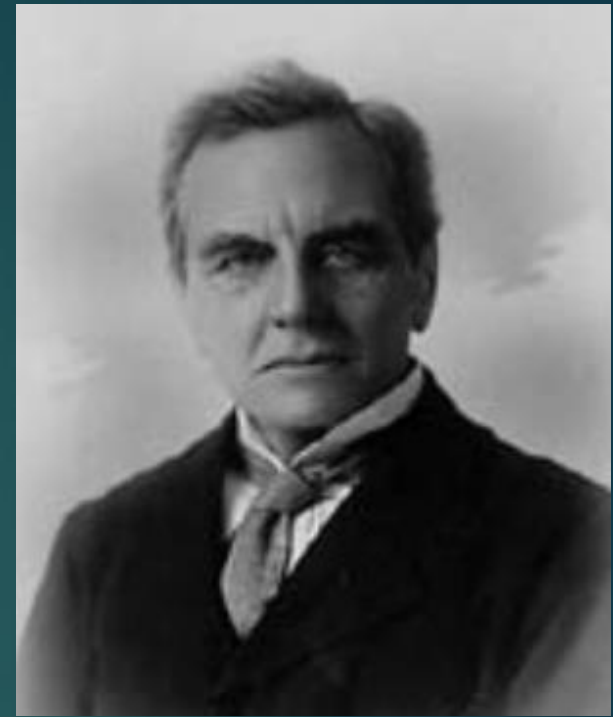
*Homo neanderthalensis*  
(Gibraltar 1)

Discoverer: Captain Edmund Flint  
Locality: Forbes' Quarry, Gibraltar  
Age: unknown; Date: 1848



# William Johnson **Sollas** (1849–1936): **Identifies Gibraltar I as Neandertal**

- ▶ British geologist and anthropologist. Professor of Geology at the University of Oxford
- ▶ 1907: William Sollas analyzed Gibraltar skull; and recognized it as Neanderthal.
- ▶ A shift towards a branching model of human evolution, rather than a straight line.
- ▶ Supported Raymond Dart; Hated Arthur Keith



# Johann Karl Fuhlrott (1803-1877): Discovery of “1<sup>st</sup>” Neandertal from Feldhofer

- ▶ Schoolteacher from Elberfeld, Germany
- ▶ 1856: Given the original Neandertal 1 bones “as cave bear bones”.
- ▶ Recognized them as belonging to ancient human, “artificially flattened head”
- ▶ First recognized it as early human fossil: A 40 Ka type specimen “Neandertal 1”, including a skullcap and 16 bones, discovered at the Kleine Feldhofer Grotte in the Neander Valley near Düsseldorf, Germany.



# Neanderthal Debut: In 1856, Neandertal 1; type specimen



*Homo neanderthalensis*  
(Neandertal 1, type)  
Discoverer: Local workers  
Locality: Feldhofer grotto,  
Neander Valley, Germany  
Age: 40K  
Date: 1856

Skull discovered by quarryman, who dropped it down a cliff while shoveling the bones out of cave entrance.

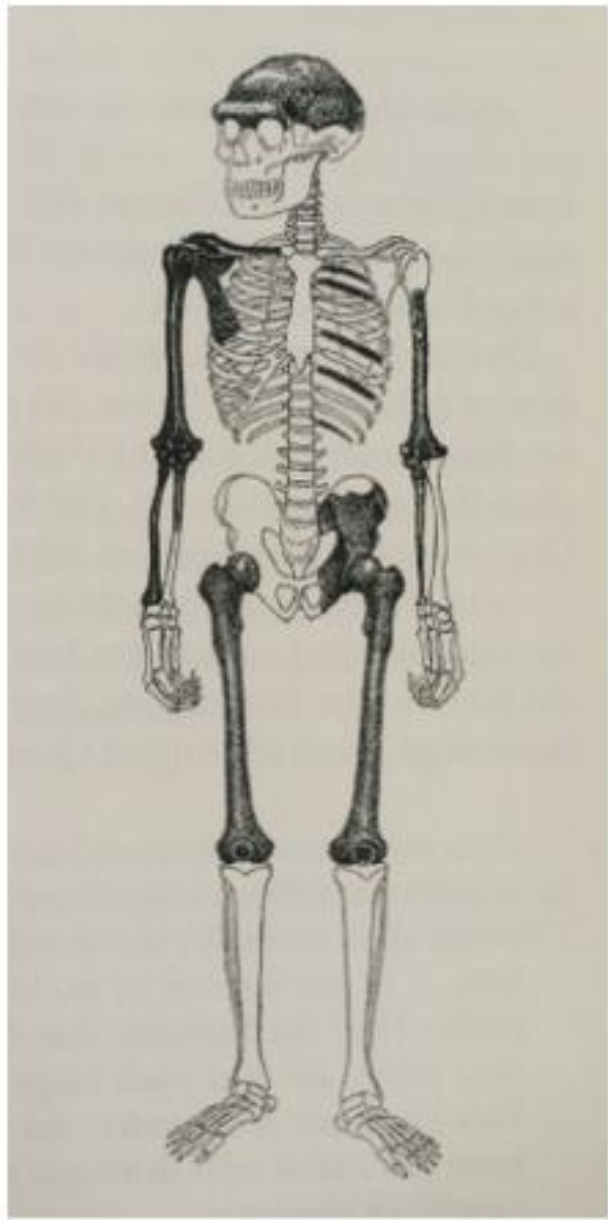


# Neandertal 1 skeleton



Dear Charles Vella.



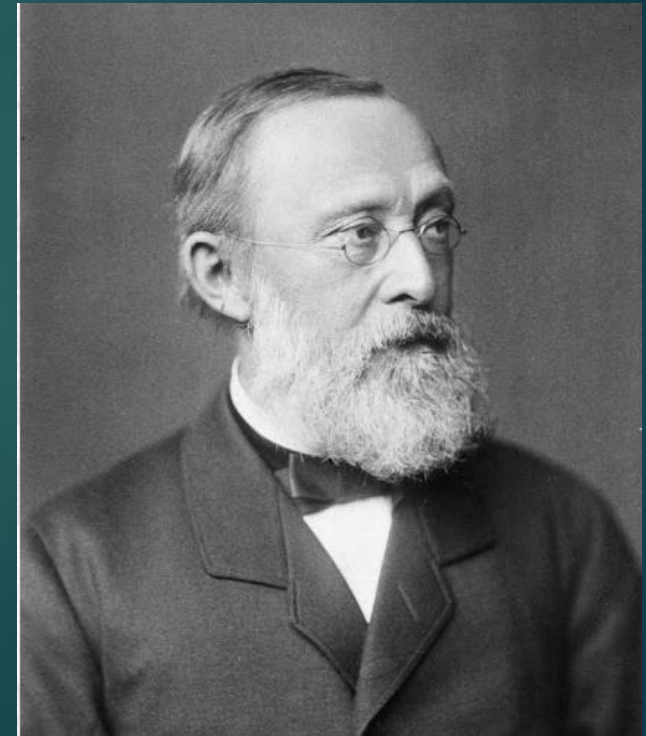
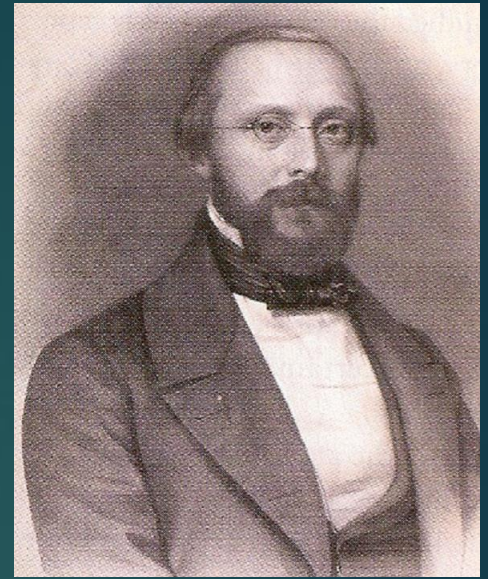


The bones of Schaaffhausen's  
Neanderthal



# Rudolf Virchow (1821-1909): Neandertal 1 is a Idiot or a Cassock!

- ▶ German physician
- ▶ Foremost German physical anthropologist in last half of 19<sup>th</sup> century; **Father of modern pathology**
- ▶ Deeply opposed idea of human evolution
- ▶ Insisted **Neanderthal was modern man with disease induced deformities of a pathological (microcephalic) idiot or Russian soldier**; skeleton of a lost, bowlegged Cossack with rickets.
- ▶ The peculiar bony ridge over the man's eyes was a result of the poor Cossack's perpetually furrowing his brow in pain — because of rickets.
- ▶ Rejected Aryan race theories

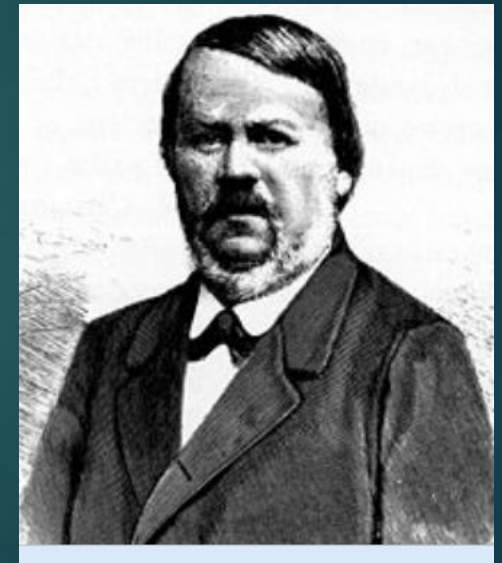


# When a fossil goes vs current paradigm, plead “due to pathology”

- ▶ **Neanderthal 1**: Cossack with rickets?
  - ▶ Thomas Huxley: “how had a dying Cossack climbed a 60 foot vertical cliff and bury himself, naked, under 5 feet of mud?”
- ▶ **La Chapelle-aux-Saints**: N as brute, but actually due to osteoarthritis
- ▶ Response similar to discovery of *Homo floresiensis* in 2003

# Hermann Schaaffhausen (1816-1893): First published description of Neandertal I

- ▶ Professor of anatomy at the University of Bonn
- ▶ 1857: With Johann Fuhlrott, Schaaffhausen described the original Feldhofer Neanderthal using quantitative craniometry; concluded skull was outside MH variation & brain was large (>1000cc); but was unable to date
- ▶ In 1860, Charles Lyell, the geologist, reached same conclusions; & made plaster cast of skull; Thomas Huxley & George Busk reached same conclusion of its ancient age, but noted ape-like features of the specimen (browridge)



H. Schaaffhausen, *Verh. naturhist. Ver. preuss. Rheinl.* 14, Corr. Bl., 50–52. (1857)  
Schaaffhausen, H. On the crania of the most ancient races of man. *Müllers Archiv* 1858:453.



# Thomas Huxley: *Evidence as to Man's Place in Nature*, 1863

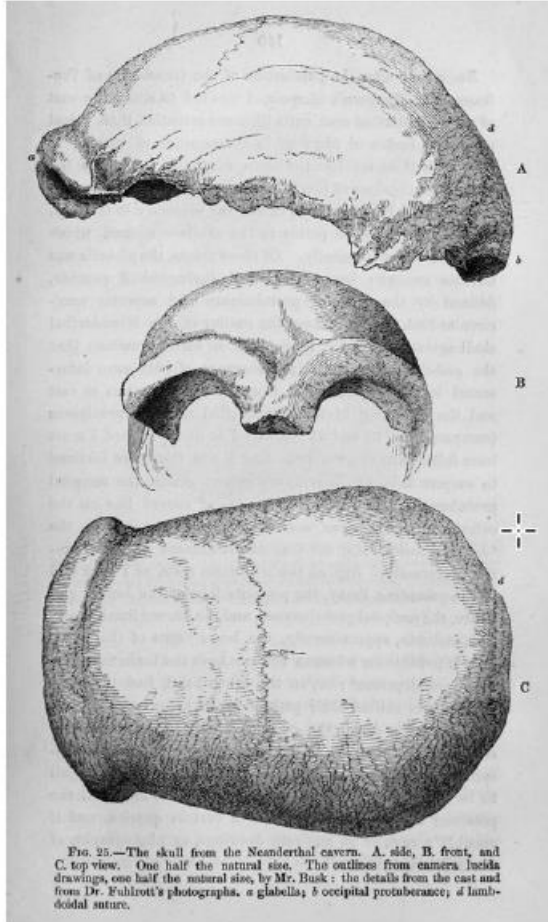


FIG. 25.—The skull from the Neanderthal cavern. A, side, B, front, and C, top view. One half the natural size. The outlines from camera lucida drawings, one half the natural size, by Mr. Busk; the details from the cast and from Dr. Fuhrmann's photographs. a glabella; b occipital protuberance; c lambdoidal suture.

Figure 4. The Neanderthal skull, from Thomas Henry Huxley, *Evidence as to Man's Place in Nature*, London: Williams and Norgate, 1863, p. 138.



Huxley's Neanderthal, 1864

Humans related to primates and to apes

Cites Engis and Feldhofer skulls; human, but not different

Used brain size as criterion for humanity

Neanderthal 1  
1863 photo by  
Huxley

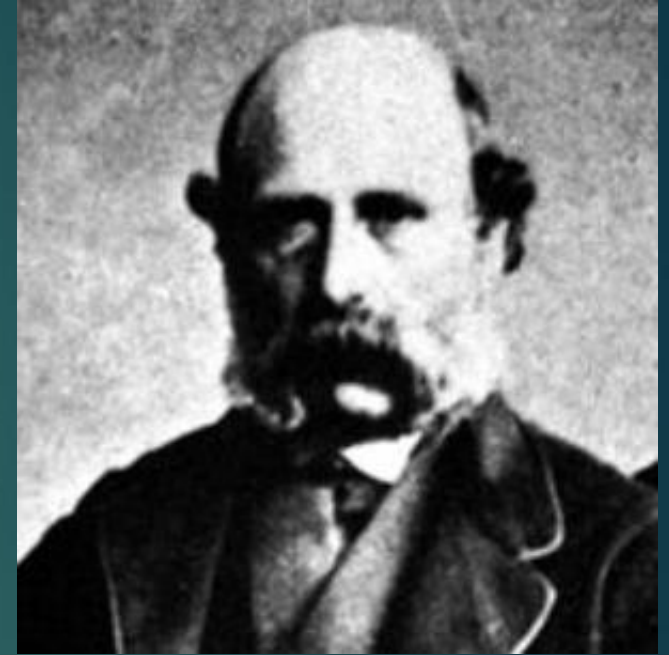


Figure 1. A photograph of the Neanderthal cranium, viewed from above. Huxley Papers, Imperial College London, 1863, Volume 105, Box no 105, Series 19.

William King (1809-1866):

Names first extinct human species;  
first fossil hominin

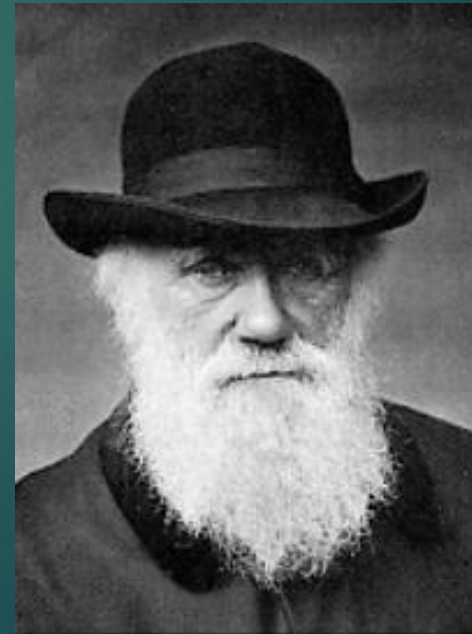
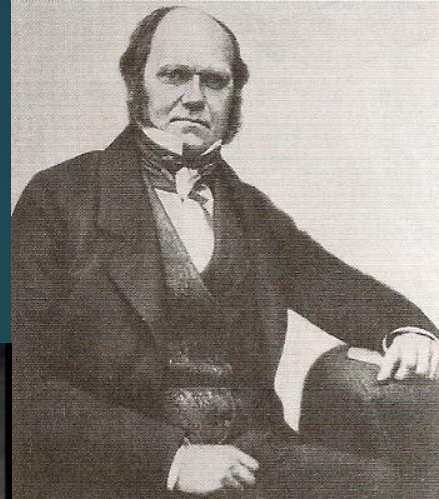
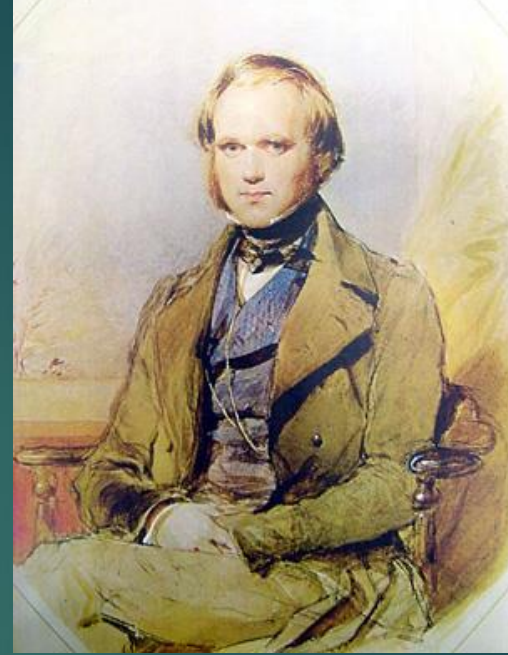
- ▶ Professor of geology at Queen's College, Ireland
- ▶ 1864: *Homo neanderthalensis* becomes the first fossil hominin species to be named.
- ▶ Idea that Neandertal is a completely separate species from *Homo sapiens sapiens*.
- ▶ Racist interpretation: skull like savage Africans





# Charles Darwin (1809-1882): Evolution by natural selection

- ▶ Founder of modern evolutionary biology
- ▶ **Charles Darwin** was born on February 12, 1809 in Shrewsbury, England; into intellectual family.
- ▶ Enrolled in medicine, Univ. of Edenborough; too squeamish; then graduated in theology from Cambridge; good field naturalist
- ▶ From 1831 to 1836 Darwin served as “unpaid gentleman scholar and naturalist “ aboard the H.M.S. Beagle under Cpt. Robert FitzRoy on a British science expedition around the world



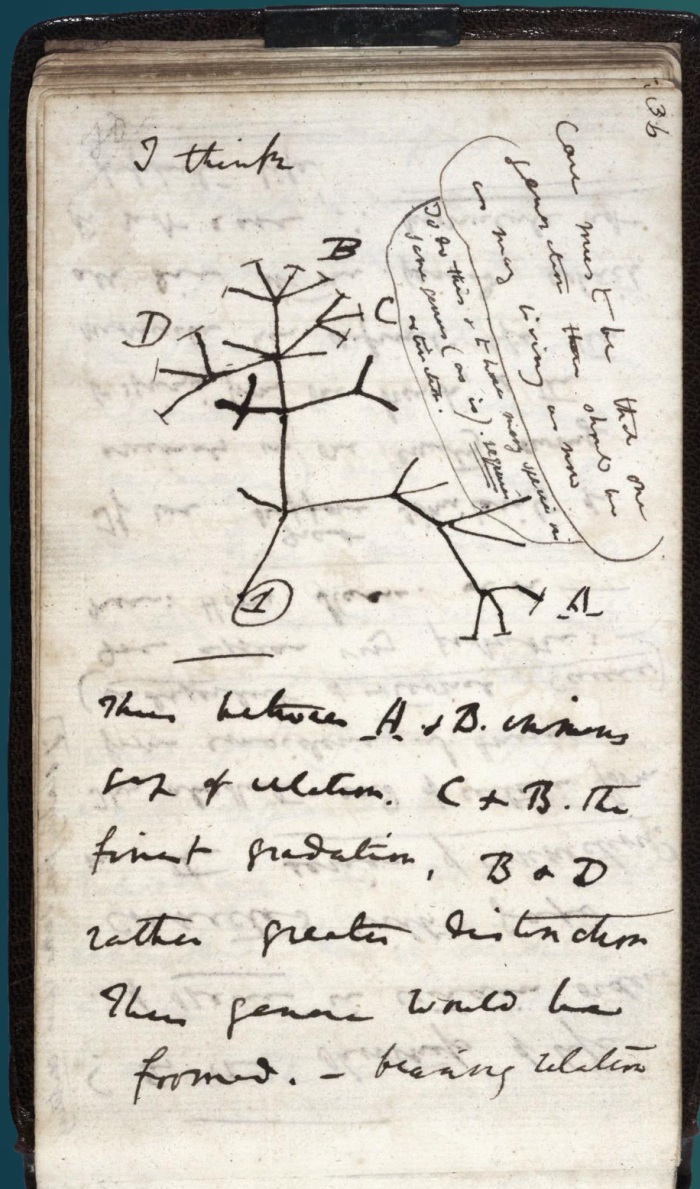


# Voyage of the HMS Beagle

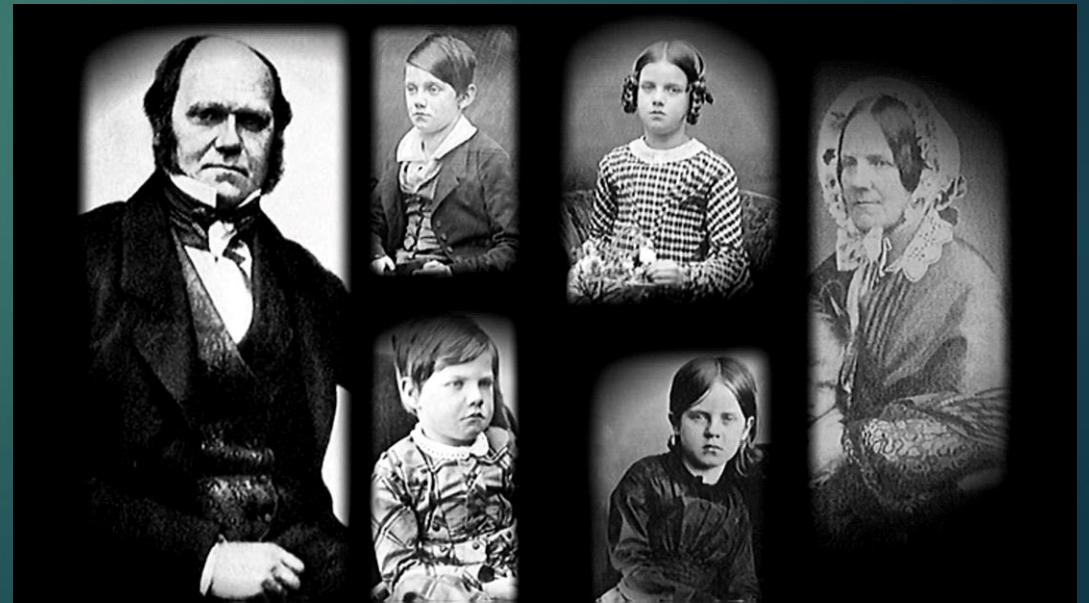


- 5 year voyage: he was dazzled by the amazing diversity of life, including some amazing fossils such as rodents the size of hipopotamuses, giant ground sloths, giant armadillos, marine fossils on top of mountains; concluded that they were ancestors of living species & that species had changed
- Collected different finches and tortoises on 13 Galapagos islands; different tortoise shells
- He started to wonder how such diversity might have originated. FitzRoy gave him Lyell's Geology.


# 1837 notebooks: first sketch of an evolutionary tree in notebook



- Darwin studied dog and animal breeding (selection for traits), pigeons, barnacles
- Realized nature could also do selection
- Struggle for survival in nature
- Creatures that survived were best adapted to their environment
- Galapagos finches' s beaks are their adaptation to different food sources







“I have been now ever since my return engaged in a very presumptuous work & which I know no one individual who wd not say a very foolish one.— I was so struck with distribution of Galapagos organisms &c &c & with the character of the American fossil mammifers, &c &c that I determined to collect blindly every sort of fact, which cd bear any way on what are species. — I have read heaps of agricultural & horticultural books, & have never ceased collecting facts — At last gleams of light have come, & I am almost convinced (quite contrary to opinion I started with) that species are not (it is like confessing a murder) immutable. Heaven forfend me from Lamarck nonsense of a “tendency to progression” “adaptations from the slow willing of animals” ... but the conclusions I am led to are not widely different from his — though the means of change are wholly so — I think I have found out (here’s presumption!) the simple way by which species become exquisitely adapted to various ends.”

# Letter to Hooker



The Darwin Project  
<http://www.darwinproject.ac.uk/>

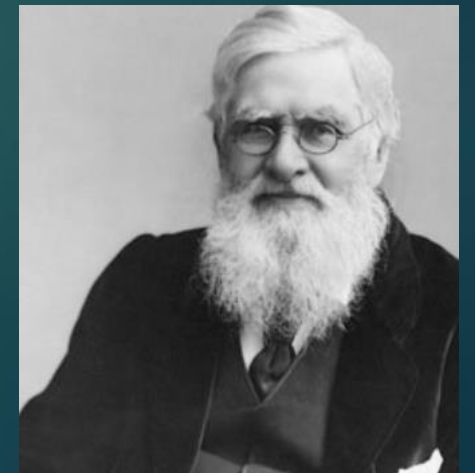
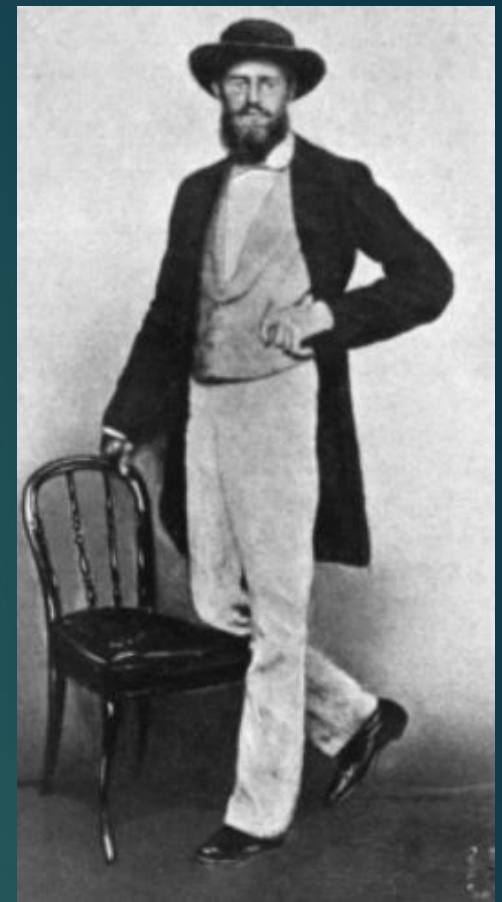
# Darwin's ethical dilemma

- In 1842 Darwin wrote a 35 page abstract of his theory; 2 years later, a 230 page version; In 1846 he put it aside to study barnacles
- A letter Darwin received on 18 June 1858 precipitated the publishing of *The Origin of Species*.
- Alfred Russel Wallace, exploring in Asia, had come to the same conclusion as Darwin and sent him a 12 page summary.
  - “On the Tendencies of Varieties to depart Independently from the original type.”, 1858
  - Darwin: “a precis of my theory...he could not have written a better short abstract”
- 1858: Alfred Russel Wallace and Darwin independently conclude that evolution is best explained by natural selection.



# Alfred Russel Wallace (1823-1913): Co-discovery of theory of Evolution

- ▶ Welsh naturalist and traveler
- ▶ Co-discoverer of idea of evolution by natural selection
- ▶ Noted distribution of species and noticed discontinuity in Malay archipelago (Wallace's line) which separated fauna of Asia from that of Australia.
- ▶ Like Darwin, came up with idea of natural selection after reading Thomas Malthus's essay on population.
- ▶ Darwinist, socialist, spiritualist



## Darwin's Letter to Wallace

**To Wallace:** “By your letter & even still more by your paper in Annals, a year or more ago, I can plainly see that we have Thought much a like & to a certain extent have come to similar conclusions.”

**To Lyell, 1858:** “You said this when I explained to you here very briefly my views of “Natural Selection” depending on the Struggle for existence. – I never saw a more striking coincidence. If Wallace had my M.S. sketch written out in 1842 he could not have made a better short abstract! Even his terms now stand as Heads of my Chapters.

# Darwin and Wallace



Alfred Wallace  
1823-1913

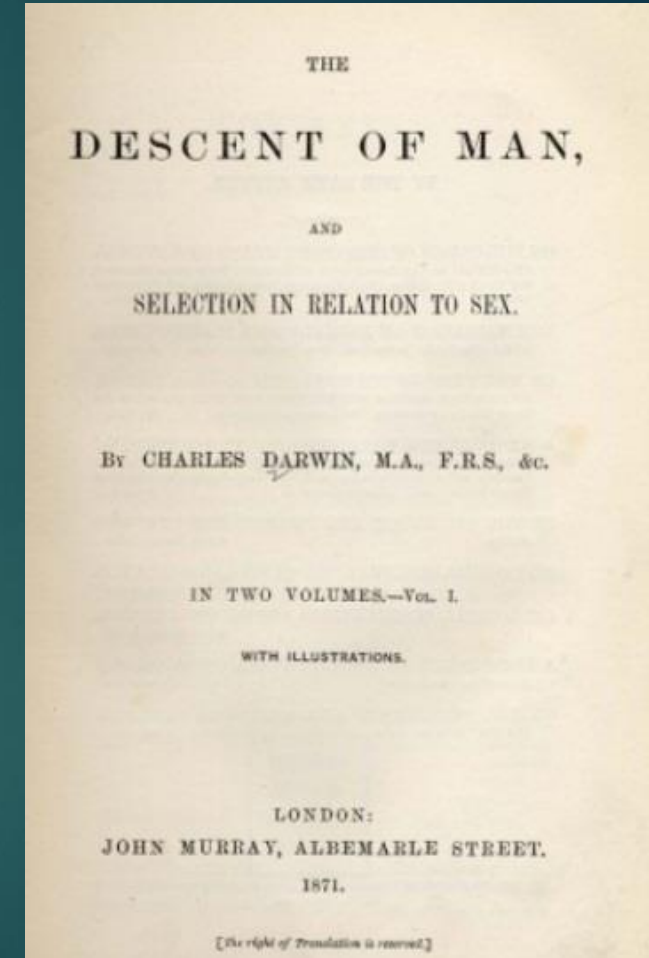
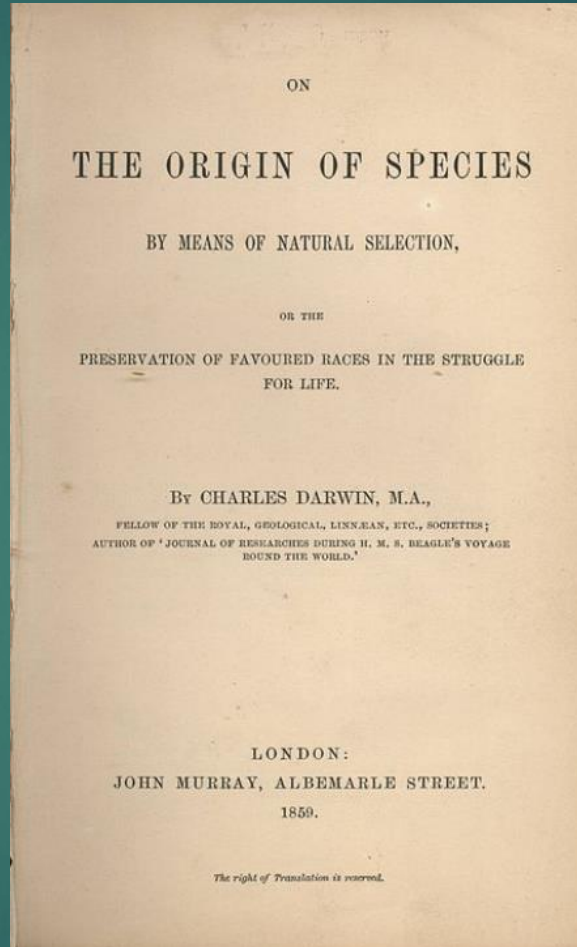
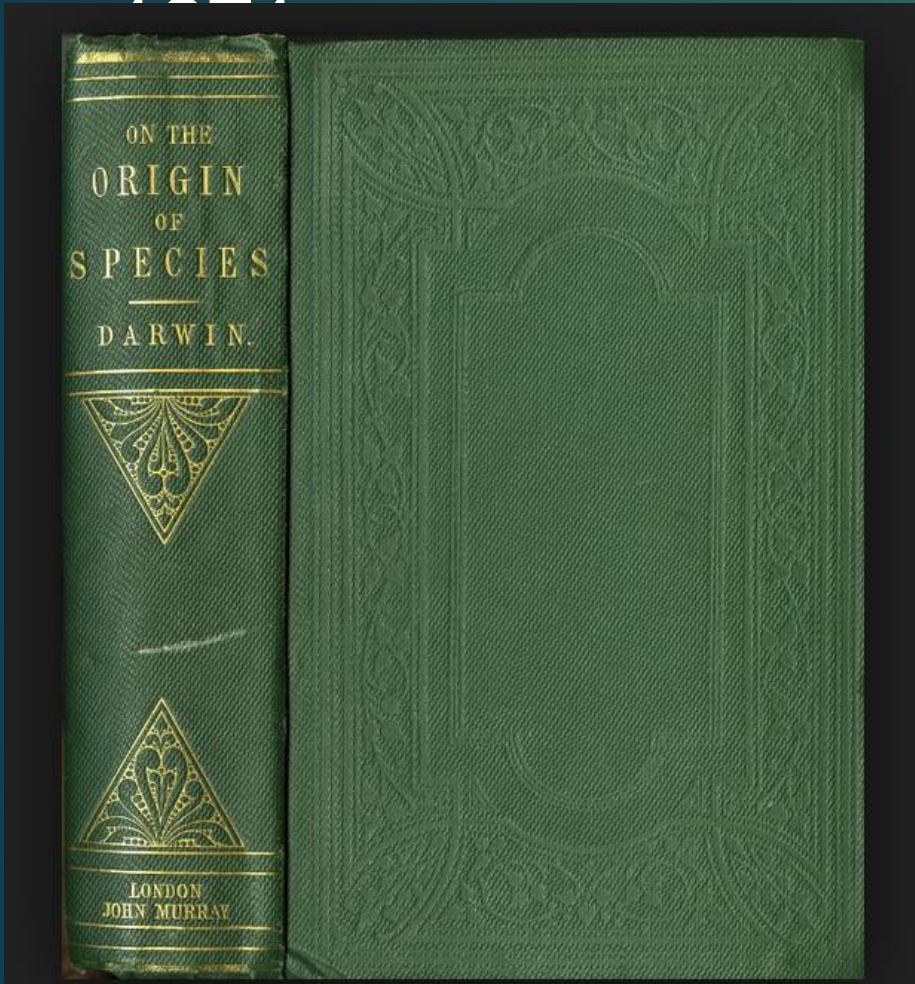
- ▶ 1836: On his voyage, Darwin observed much variation in related or similar species of plants and animals that were geographically isolated from each other. These observations were the basis for his ideas.
- ▶ 1837: Darwin outlined theory of natural selection
- ▶ 1857: 20 years later young Wallace developed same theory
- ▶ July 1, 1859: Darwin, with a strong sense of honor, arranged for a simultaneous reading of his and Wallace's papers before the Linnean Society of London. The readings were met with silence, so Darwin decided to publish the full text of his ideas.
- ▶ Nov 12, 1859: Darwin published *On the Origin of Species*

# Charles Darwin

- ▶ He observed much variation in related or similar species of plants and animals that were geographically isolated from each other. These observations were the basis for his ideas.
- ▶ 1859: Author of *Origin of Species by Means of Natural Selection*
- ▶ 1871: Author of *The Descent of Man*



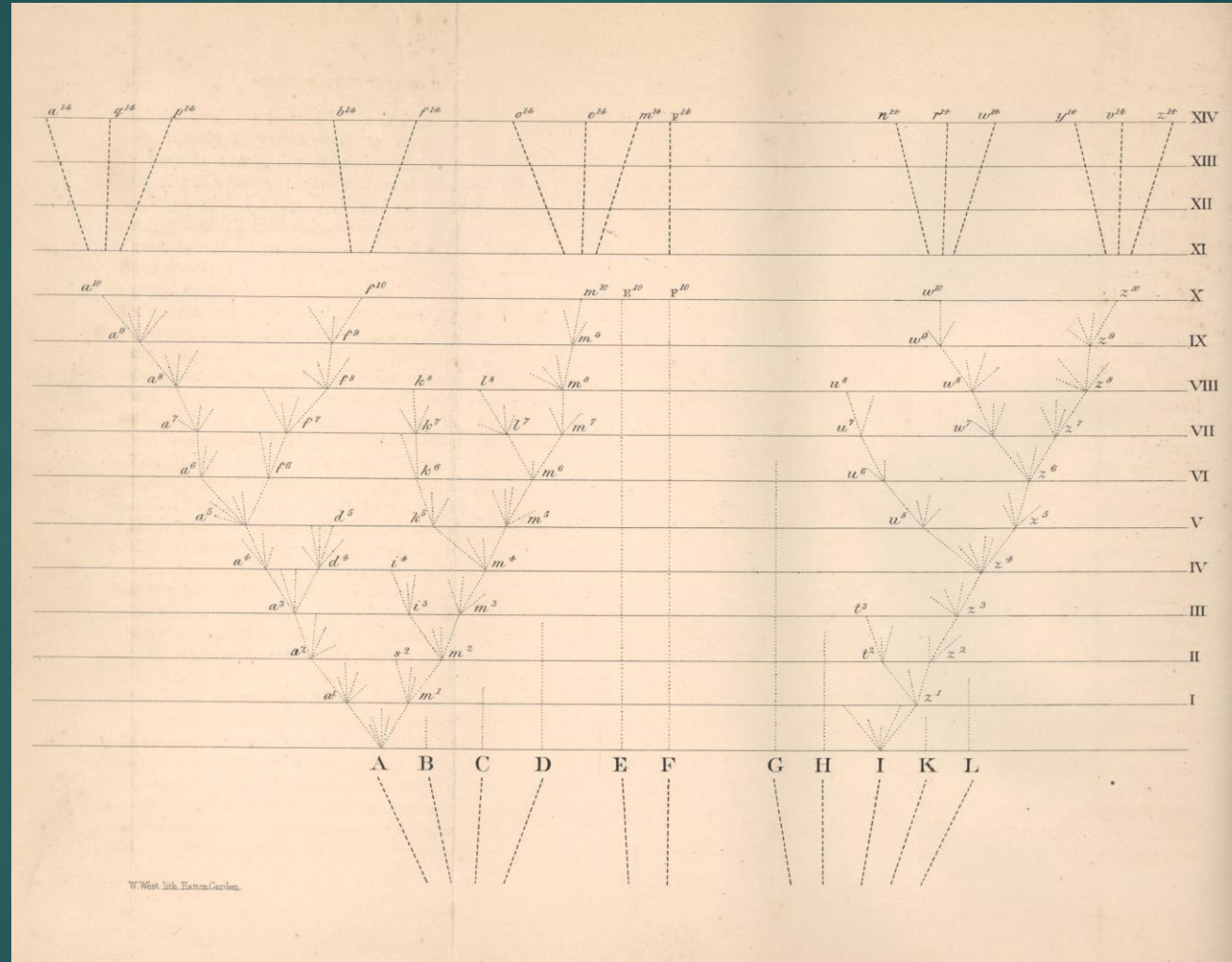
November 12, 1859



1250 copies in 1<sup>st</sup> edition; cost 5 schillings  
6 editions; best seller; 104 K before copyright  
expired in 1901

A Scientific Theory based on facts and observation

# Darwin's Tree of Life: only illustration in *Origin of Species*

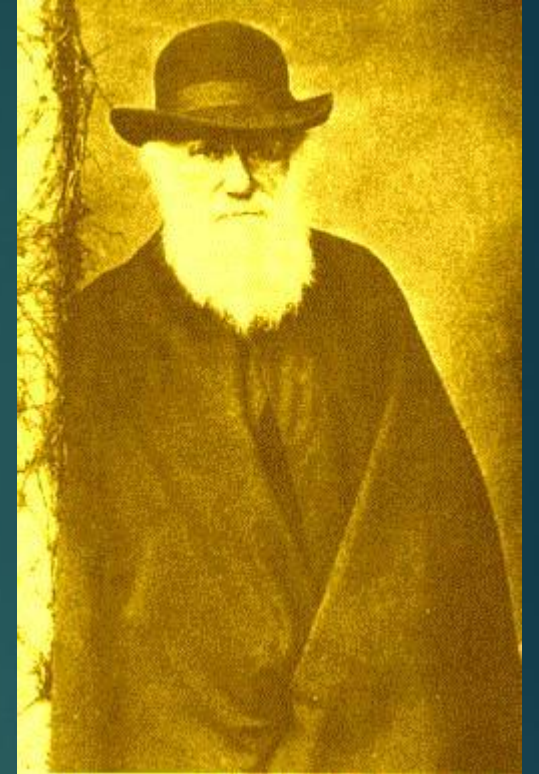


“The affinities of all the beings of the same class have sometimes been represented by a great tree. I believe this simile largely speaks the truth.”



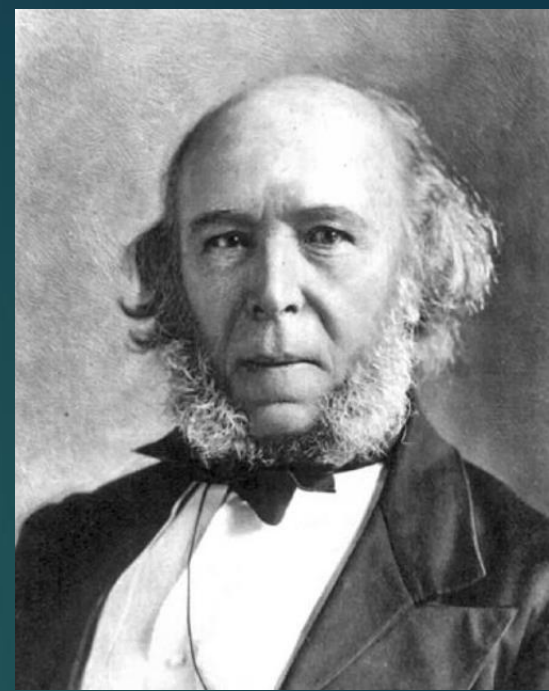
# Darwin: Endless forms most beautiful

- ▶ *“There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved.”*
- ▶ Only use of the “e” word in the entire text of 1859 text; “evolution” not used in 1<sup>st</sup> edition.



# Herbert Spencer (1820-1903): Survival of the fittest

- ▶ English philosopher, biologist, anthropologist, sociologist, and prominent classical liberal political theorist of the Victorian era.
- ▶ **Developed a universal theory of evolution:** that all structures in the universe develop from a simple, undifferentiated, homogeneity to a complex, differentiated, heterogeneity; primary mechanism of species transformation that he recognized was Lamarckian use-inheritance; teleological
- ▶ **\*\* Spencer is best known for the expression "survival of the fittest", which he coined in *Principles of Biology* (1864), after reading Charles Darwin's *On the Origin of Species*. Darwin used it later in his 1869 5<sup>th</sup> edition of his book.**
- ▶ For many, the **name of Herbert Spencer would be virtually synonymous with Social Darwinism**, a social theory that applies the law of the survival of the fittest to society





Darwin presumed that populations of individuals changed over time, and, in 1844, he developed the concept of the driving force for evolution. It wasn't until 1859 that he published his idea.

**“I have called this principle, by which each slight variation, if useful, is preserved, by the term Natural Selection.”**

—Charles Darwin from "The Origin of Species", 1859

## Darwin on human evolution in the *Origin of Species*

- ▶ "Light will be thrown on the origin of man and his history" (p. 488).
- ▶ This is not the only reference to changes within the human race in the *Origin of Species*, but it is the only absolutely unequivocal statement of Darwin's belief that his theory will account for the origins of mankind from a lower form.
- ▶ He was well aware that the extension of the theory to mankind would provoke controversy because it would threaten the traditional view that humans were on a higher plane than the animals.
- ▶ He hoped to minimize the resulting outcry by refusing to discuss human origins in detail but felt that he had to include at least this brief indication of his beliefs.

# Darwin's ideas about human evolution

## ▶ 1871: *Descent of Man*

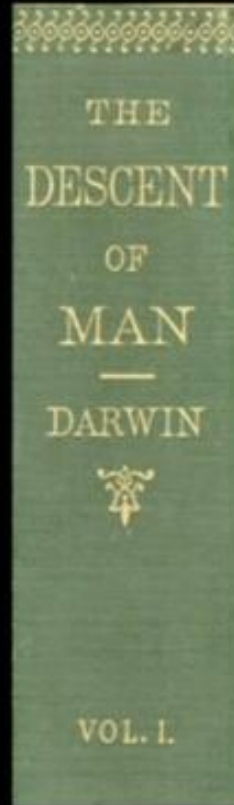
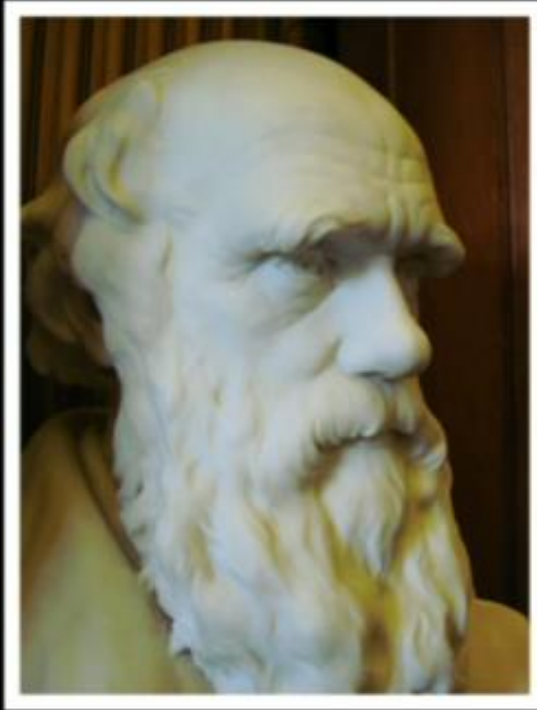
### ▶ Mostly about sexual selection; ignored fossil record

▶ *“In each great region of the world, the living mammals are closely related to the extinct species of the same region. It is therefore probable that Africa was formerly inhabited by extinct apes closely allied to the gorilla and the chimpanzee; and as these two species are now man’s nearest allies, it is somewhat more probable that our early progenitors lived on the African continent than elsewhere.”*

▶ So Darwin thought that the **most likely birthplace of man was Africa**. Humans and apes had probably shared a common ancestor there.

▶ Darwin **1871 warning about LCA** (p. 199): “But we must not fall into the **error** of supposing that the early progenitor of the whole Simian stock, including man, was identical with, or even closely resembled, any ape or monkey.”

# Darwin's important warning about the common ancestor



1871

Darwin 1871 (p. 199):  
“But we must not fall into the **error** of supposing that the early progenitor of the whole Simian stock, including man, was identical with, or even closely resembled, any ape or monkey.”



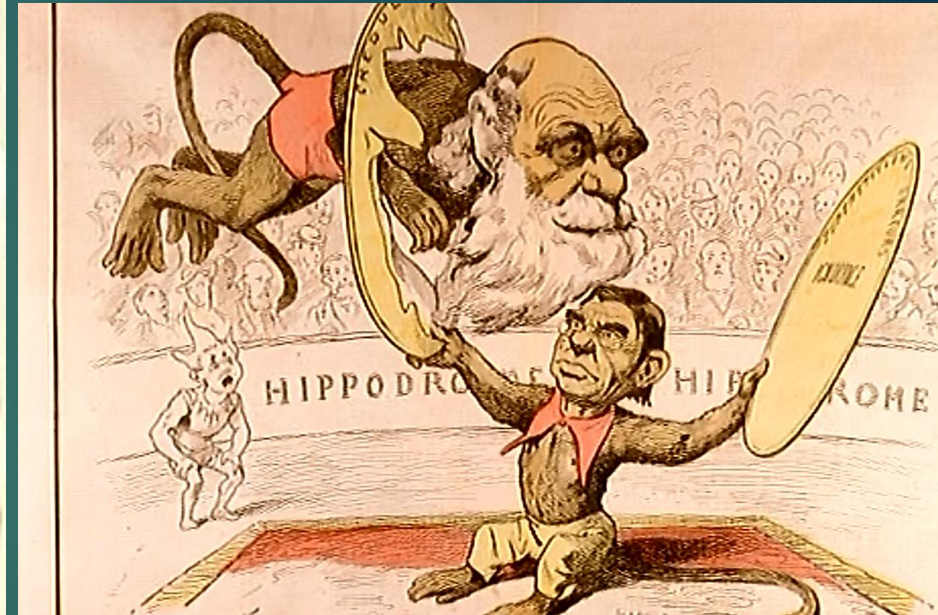
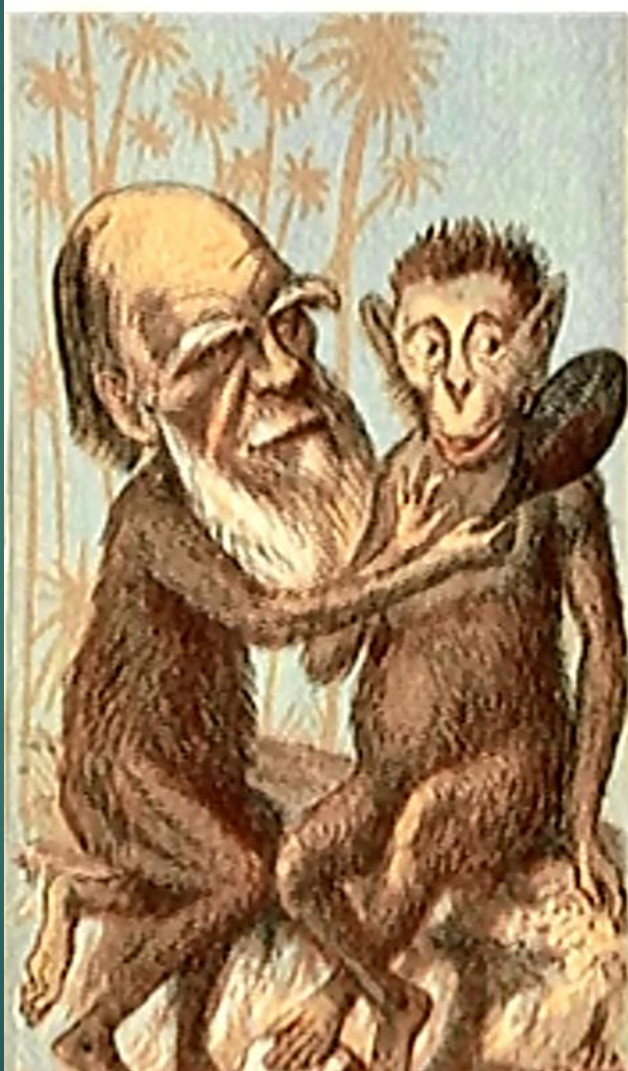
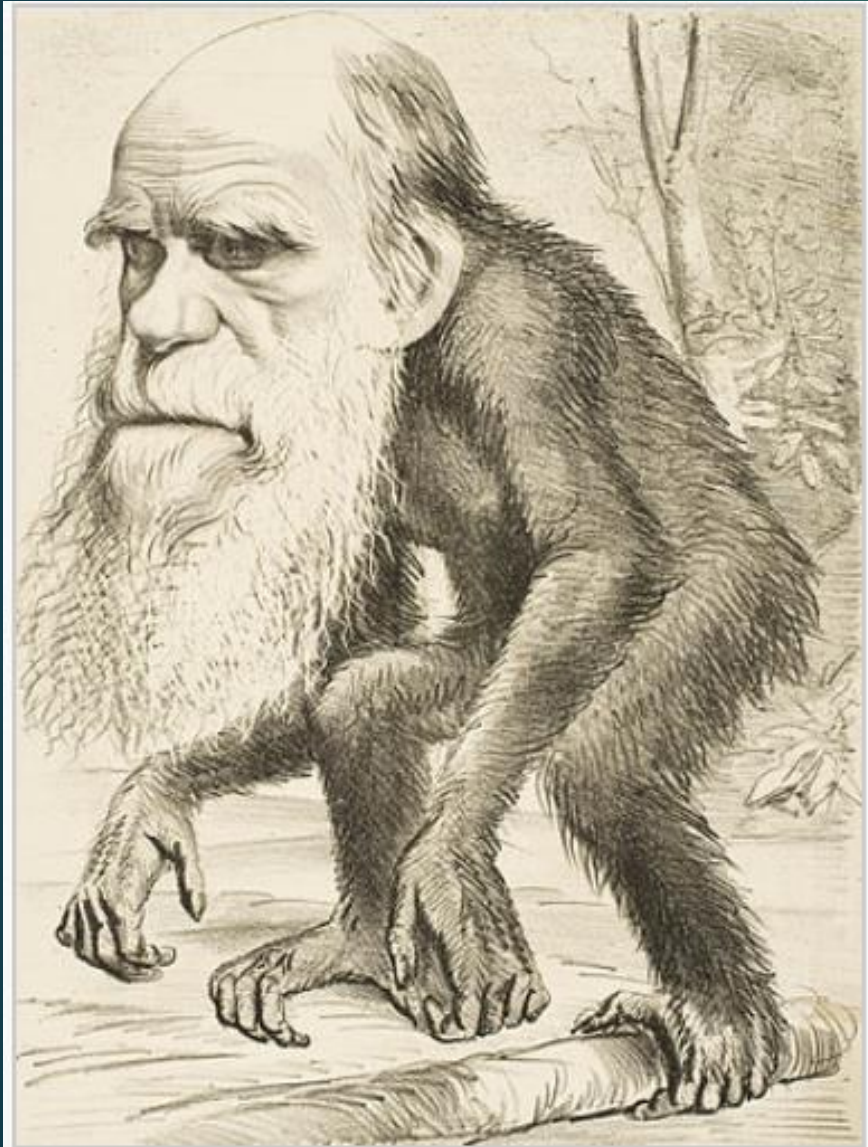
## Darwin's dilemma

Darwin was hesitant to publish his theories because of the backlash that previous authors had received.

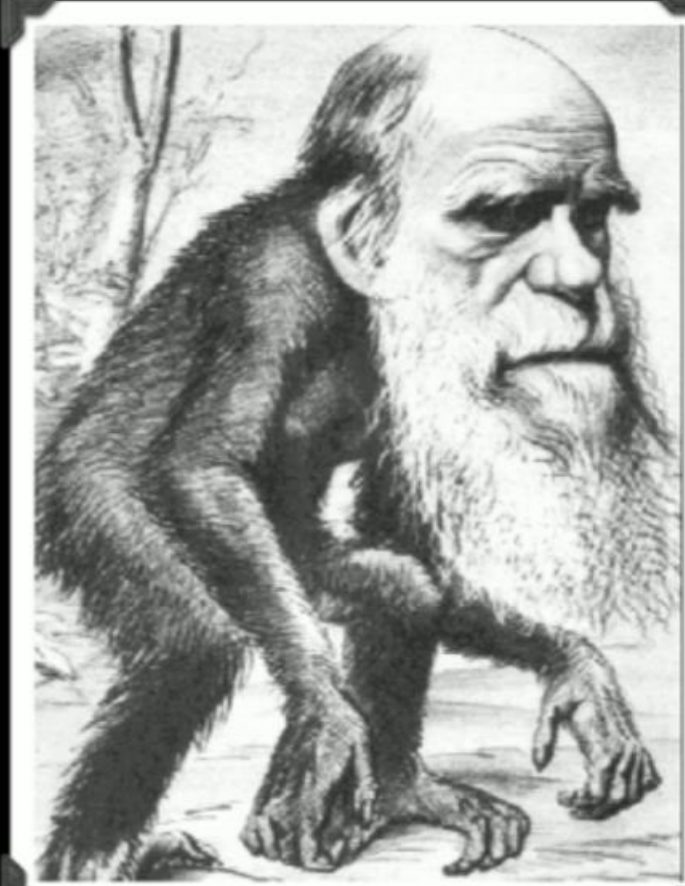
The idea that humans were not the center of evolution was revolutionary.

Adam Sedgwick responded to Robert Chamber's 1844 book, *Vestiges of the Natural History of Creation*, in which Chamber's hinted that organic creation was the result of natural laws, not God's intervention & that man descended from the apes: "If this book is true, religion is a lie, human law a mass of folly and a base injustice; & morality is moonshine."

# The Original Unfriendly Response to Darwin







***The Hornet, 1871***



**Scopes Trial 1925**

# Reaction to Darwin

- ▶ The idea that humans were related to African apes caused an **uproar in Victorian England**.
- ▶ Victorians believed in **Christian idea of special creation**, that humans were unique, separate from the rest of the animals.
- ▶ They were already accustomed to the idea of evolution, as progress planned by God (Great Chain of Being). They even were willing to accept the concept of common descent.
- ▶ “Descended from the apes!” exclaimed a **bishop’s wife** to her husband. To which he replied: “My dear, let us hope that it is not true, but if it is, let us pray that it will not become generally known.”



## A world without divine principle

- ▶ The problem was that Darwin's ideas implied that evolution was not God driven; it was governed solely by natural selection (response of species to its environment). Adaptation was the driving force. Humanity was just another species.
- ▶ Profound implications: a world without purpose or direction or goal; stripping humanity of its uniqueness; potentially threatened foundations of Christian belief.
- ▶ On one of his visits to the British Museum, Darwin was pointed out by a clergyman as “the most dangerous man in England.”

# A progressive tree of life preferred

- ▶ His model was based on linear development: a tree of life with trunk leading from “lower” organisms at the bottom to humans at the top; a modernized version of ancient Chain of Being
- ▶ Evolution was part of a purposeful process, directed toward a predetermined goal
- ▶ Darwin also had a preference for the way human abilities had developed: bipedal locomotion was key breakthrough – freed hands for toolmaking, which stimulated intelligence
- ▶ Other scientists thought it was brain size that was the crucial breakthrough

## Darwin Books online

Download *The Origin of Species*: <http://literature.org/authors/darwin-charles/the-origin-of-species/preface.html>

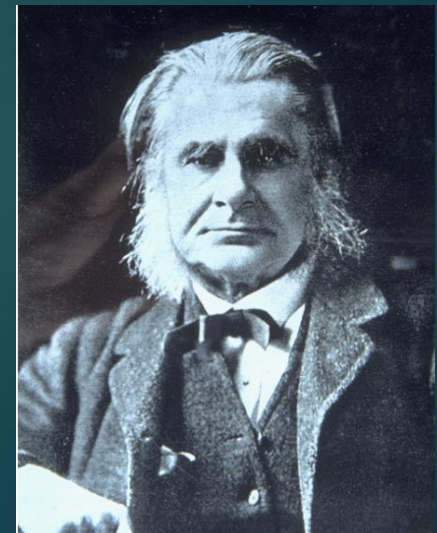
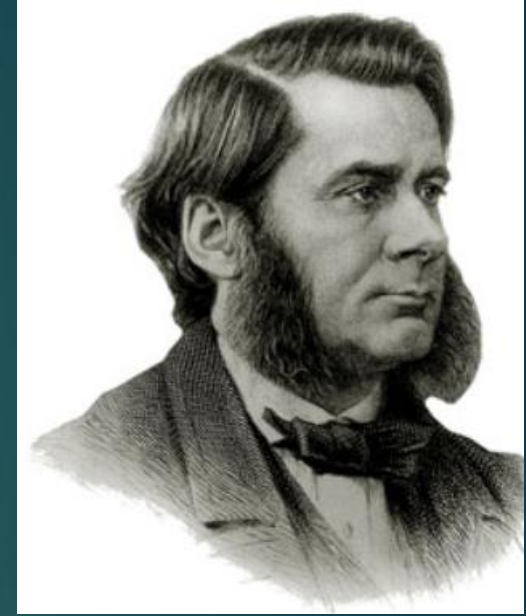
Download *The Descent of Man, and Selection in Relation to Sex*: [http://www.gutenberg.org/ebooks/2300?msg=welcome\\_stranger](http://www.gutenberg.org/ebooks/2300?msg=welcome_stranger)

Download *The Expression of the Emotions in Man and Animals*: <http://darwin-online.org.uk/content/frameset?pageseq=1&itemID=F1142&viewtype=text>

# Thomas Henry Huxley (1825-1895):

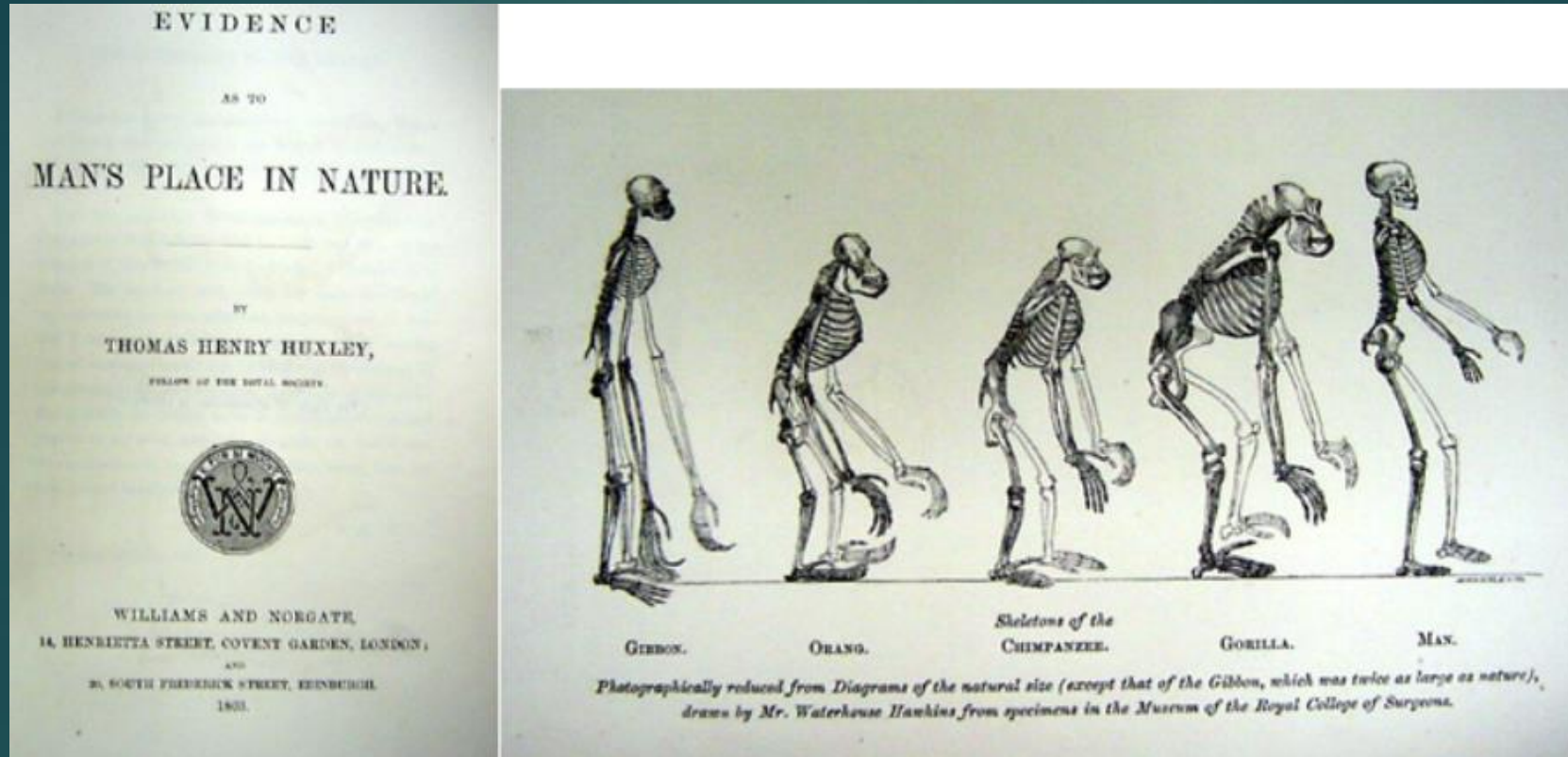
## Darwin's Bulldog

- ▶ English physician and comparative anatomist
- ▶ Darwin's Bulldog: major public supporter of theory of evolution; but not his poodle
- ▶ Thought **Neandertal** had some apelike features, but believed he was fully human
- ▶ Defined **large brain size as the defining human characteristic**; this set the standard for future British researchers (Keith's cerebral rubicon of 750 cc)





# 1863: Huxley's *Evidence as to Man's Place in Nature*



Huxley concluded that difference between modern humans & chimps and gorilla were less than differences between two African apes and Asian orangutan.

Darwin used this evidence in his 1871 *The Descent of Man* to suggest that African apes were morphologically closer to humans than to orangutans; therefore ancestors of modern humans were more likely to be found in Africa than in Asia

# Huxley v. Wilberforce: apocryphal story

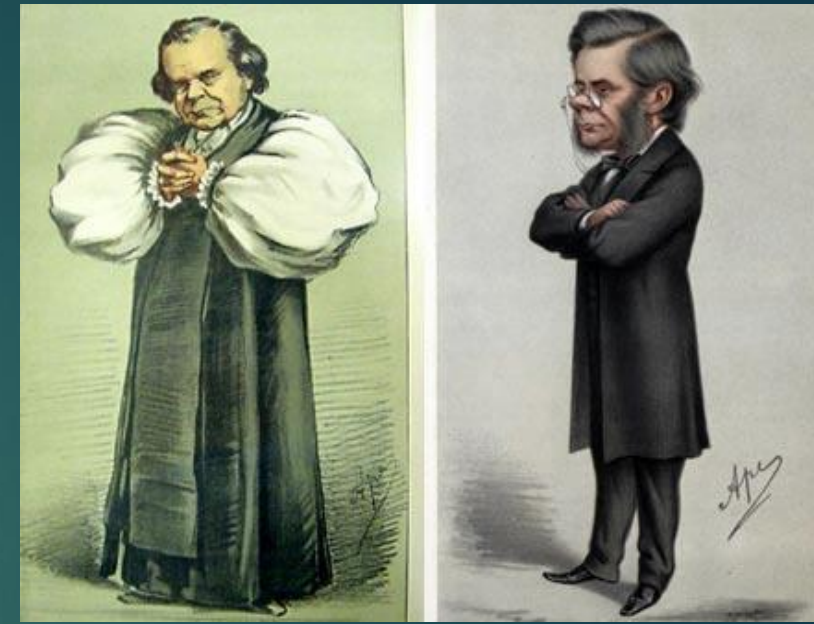


Bishop Wilberforce v. T. H. Huxley

- Darwin's idea of Evolution by Natural Selection was met with **huge controversy**.
- A **famous debate in 1860** pitted Bishop Wilberforce against Darwin's bulldog, **Thomas Henry Huxley**.
- Evolutionists got the better of the debate, but few were convinced by Darwin's idea of Natural Selection.

# Wilberforce v. Huxley

- ▶ 1860: Famous debate with Bishop Samuel Wilberforce:
- ▶ Admiral Fitzroy defended the bible.
- ▶ 1863: Huxley presents the first science-based explanation of the close relationship of modern humans with the African apes and discusses what little fossil evidence for human evolution was known at that time.



# Huxley vs Wilberforce in 1860

- ▶ The pivotal moment came at Oxford, in 1860, when Darwin's friend and champion **Thomas Henry Huxley engaged in a famous debate with Bishop Samuel Wilberforce**. Admiral Fitzroy defended the bible, stating "Listen to God, not to Man".
- ▶ The bishop capped his sardonic disputation of evolutionary theory by turning to his opponent and wryly asking, "Is it on your grandfather's or grandmother's side that you claim descent from the apes?"
- ▶ Huxley slowly rose and answered that "If...the question is put to me would I rather have a miserable ape for a grandfather or a man highly endowed by nature and possessed of great means and influence and yet who employs these faculties and that influence for the mere purpose of introducing ridicule into a grave scientific discussion I unhesitatingly affirm my preference for the ape."
- ▶ A woman in the audience fainted.



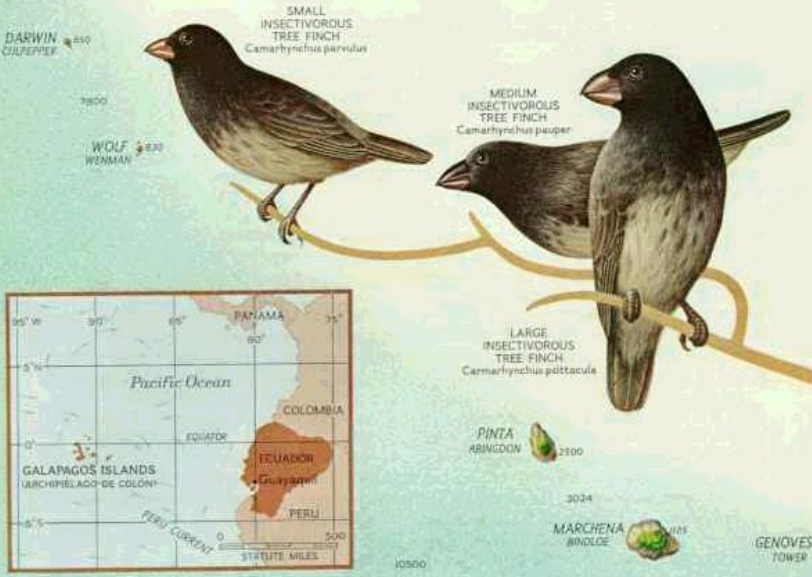
## Darwin's legacy

In Darwin's lifetime he would be recognized as one of the great masters of science.

By the 1870s almost all serious scientists in England had accepted evolution.

# Darwin's Postulates

- ▶ Infinite ability of populations to grow, but finite ability of environments to support growth
  - ▶ Malthus showed that the planet can not support uncontrolled growth, i.e. a large percentage of offspring will die and Darwin helps provide the answer as to who will die
- ▶ Within populations, organisms vary in ways that affect ability to survive and reproduce
- ▶ Variations are transmitted from parents to offspring
- ▶ Natural selection – evolution by variation and selective retention; because resources are finite & because of random variation, some individuals will be better than others at accessing those resources & will produce more surviving offspring in same species; advantage = increase in animal's “fitness”



Galapagos finches perch on their family tree. Thirteen distinct species of finches on the ocean-isolated Galapagos Islands prompted Charles Darwin's theory on the origin of species. Staff artist Ned Seidler groups them to show their relationships to each other and to a common, unknown ancestor. Birds appear two-thirds life-size.

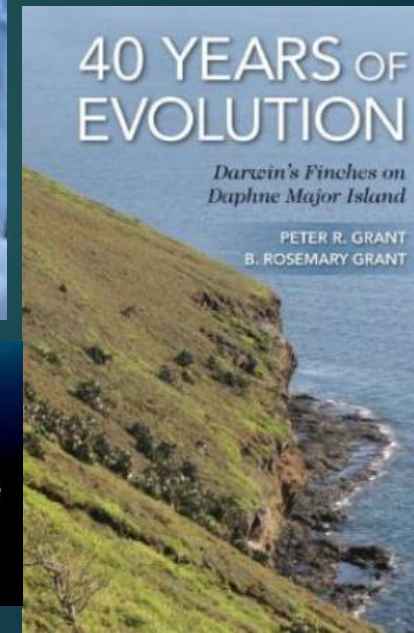
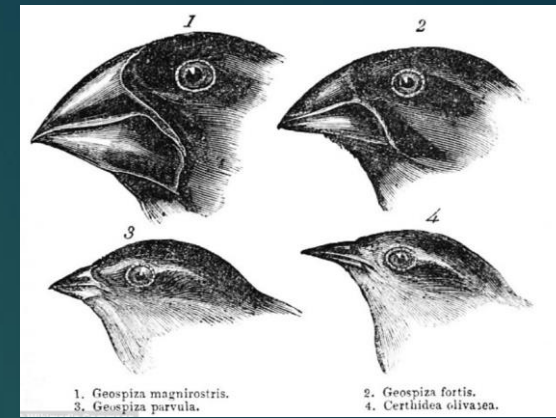


PAINTING BY ERIC ARMIT; NED SEIDLER  
RESEARCH BY LEO MONTGOMERY  
ILLUSTRATION AND DESIGN  
© NATIONAL GEOGRAPHIC SOCIETY



# Evolution in action: Peter & Rosemary Grant

- ▶ Darwin spent 5 weeks in the Galapagos;  
Grants, 45 years
- ▶ **Peter Raymond Grant and Barbara Rosemary Grant**, a married couple, are both British evolutionary biologists at Princeton University. They are noted for their work concerning Darwin's finches on the Galápagos Island named Daphne Major.
- ▶ The Grants have spent six months of the year each year since 1973 capturing, tagging, and taking blood samples of the finches on the island.
- ▶ The Grants' work: the **most important research program in evolutionary biology in history.**





# Individual Selection

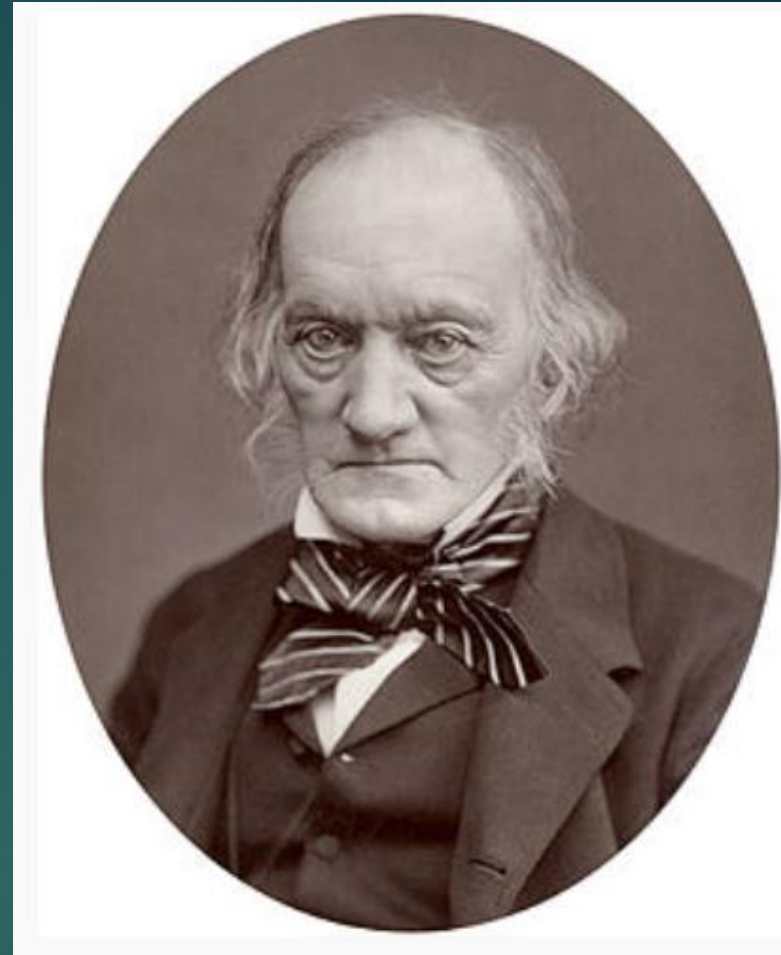
- ▶ Selection arises from competition among individuals, not among populations or species
- ▶ Example – individual reproductive success vs species' survival
- ▶ Selection may favor high individual fertility, even if population growth threatens survival of species

# Evolution of Evolutionary Theory

- ▶ Darwin could not explain how variation was maintained
  - ▶ Could not explain evolution beyond original range of variation
  - ▶ Darwin did not know: genetics, DNA
  - ▶ Assumed **blending inheritance (we know its particulate)**
- ▶ Acceptance of Darwinian mechanisms awaited rediscovery of Mendelian genetics
- ▶ Eventually inclusion of genetics evolutionary theory in the Modern Synthesis (1930-1950)
- ▶ Evo-Devo (1980-present): role of development in evolution

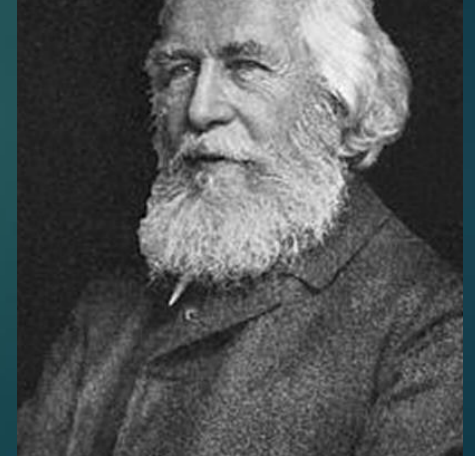
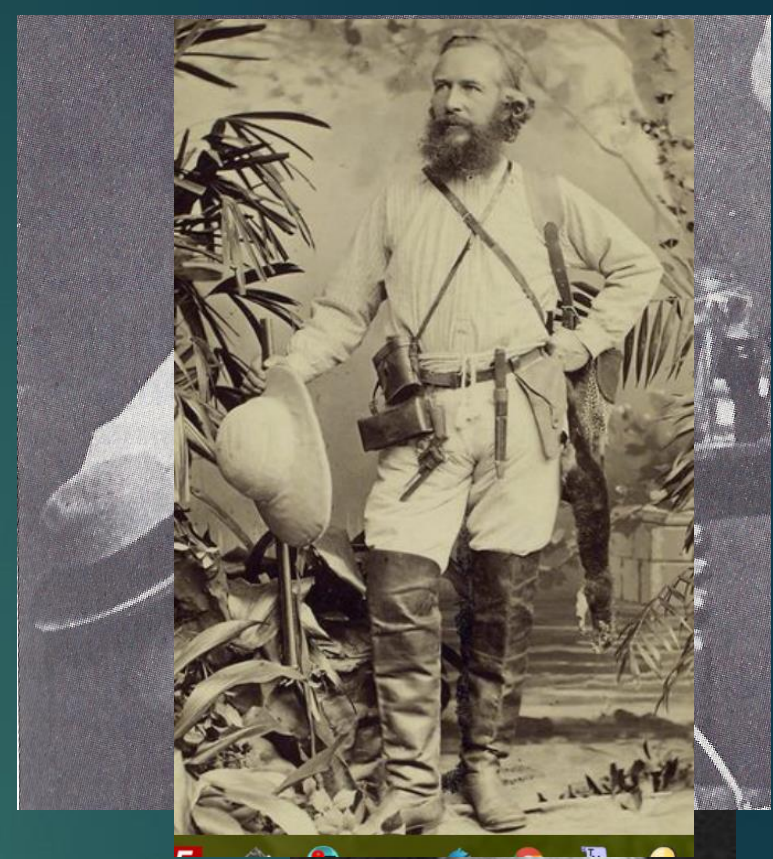
# Richard Owen (1804-1892): No Evolution!

- ▶ Prominent 19<sup>th</sup> century biologist
- ▶ Had worked on problem of species for long time.
- ▶ Outspoken opposition to Charles Darwin's theory of natural selection/evolution and archenemy of Thomas Huxley
- ▶ Darwin's use of morphology as an argument for common descent owes a lot to Owen's work
- ▶ Coined the word *Dinosauria*; Helped to found the British Museum



# Ernst Haeckel (1834-1919): Darwin is right, but look to Asia

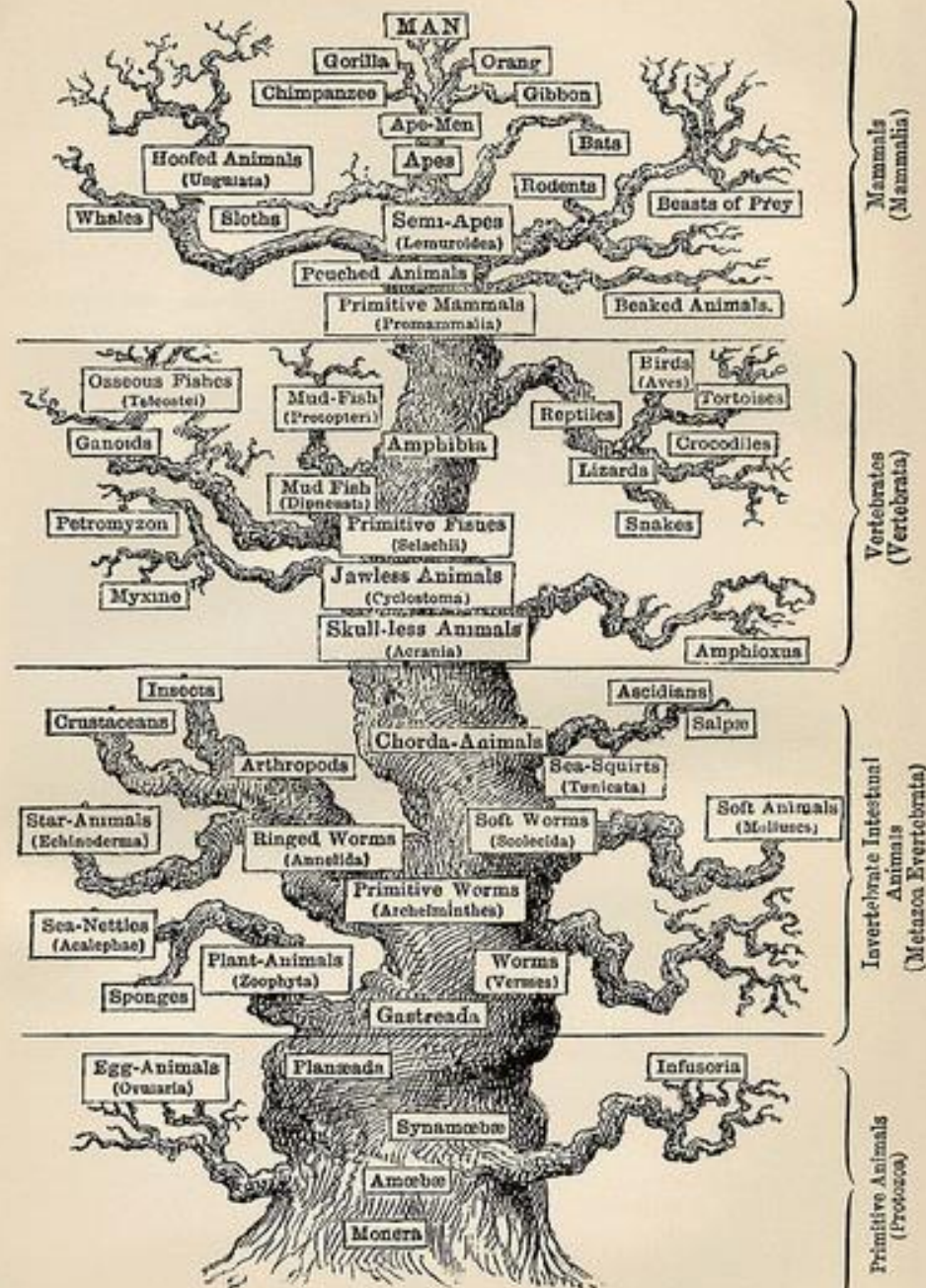
- ▶ German anatomist & zoologist
- ▶ Adversary of former professor Rudolf Virchow
- ▶ Founded German evolutionary biology
- ▶ Coined terms ecology, ontogeny & phylogeny
- ▶ “Ontogeny recapitulates phylogeny”: development of the embryo of every species (ontogeny) fully repeats the evolutionary development of that species (phylogeny)
- ▶ Major Darwin defender
- ▶ His “survival of fittest” ideas influenced later Nazi thought





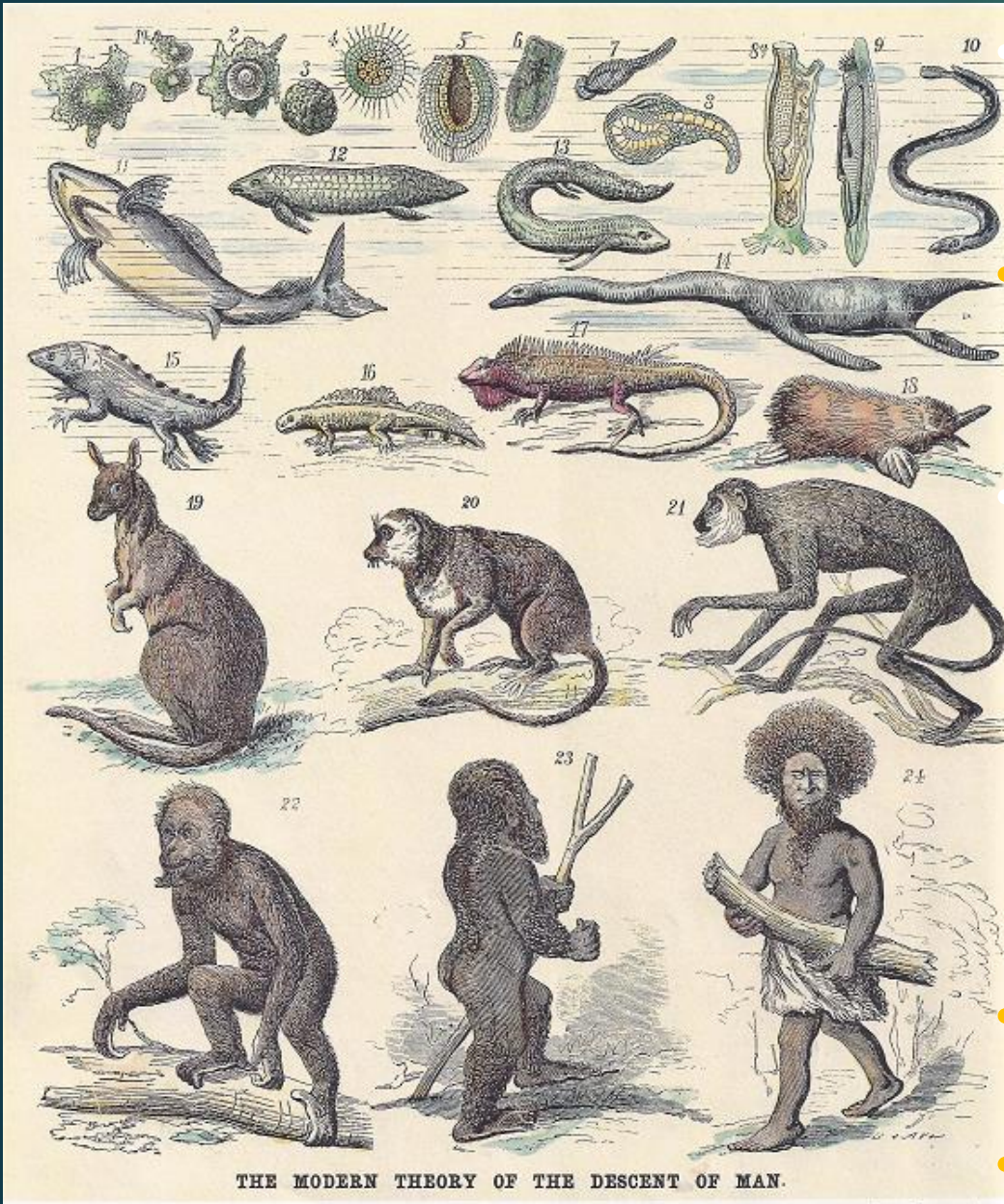
The tree of life depicted by Ernst Haeckel in *The Evolution of Man* (1879)

PEDIGREE OF MAN.





# 1867: Ernst Haeckel's ancestry of man



Proposed a human evolutionary sequence different from Darwin's.

Called Neanderthal "*Homo stupidus*" & note the platypus & kangaroo in our ancestry

His evolutionary tree shows a single lineage from apes to man, with an intermediary link, *Pithecanthropus alalus* ("apeman without speech") in Asia (which influenced Eugene Dubois); He thought speech capacity would take longer development.

Orangutans closer to man: Asia as origin of man

Gave rise to concept of missing link.

# Natürlichen Schöpfungsgeschichte, 1868

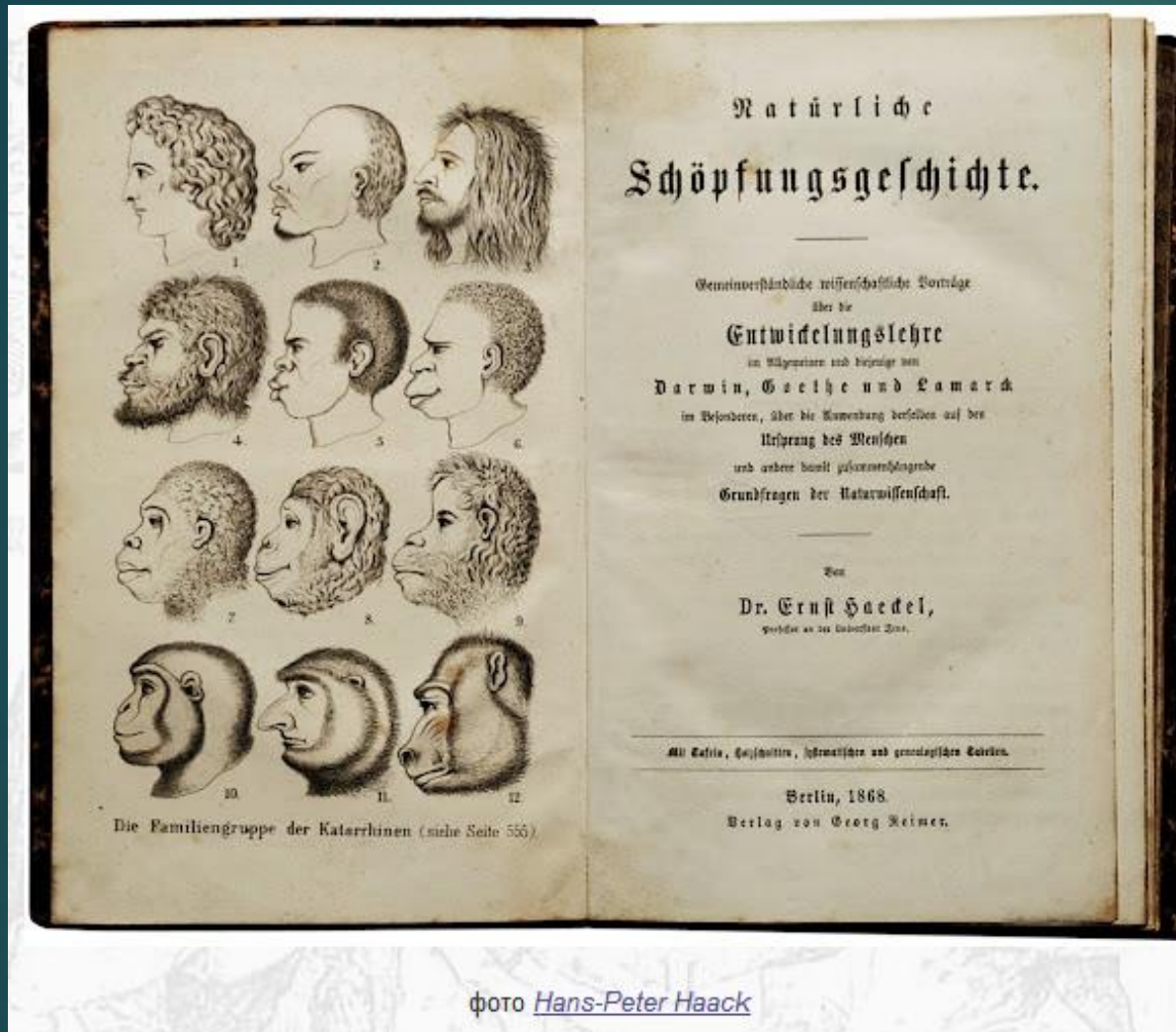


фото [Hans-Peter Haack](#)

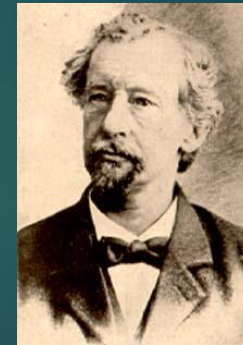
- 22 stages
- Haeckel argued that Asian apes – orangutans and gibbons – were more closely related to humans than African apes were.
- Made Asia a more likely birthplace

*The History of Creation, 1868*



# Gregor Mendel (1822-1884): A method for evolution: genes

- ▶ Czech Augustinian monk; failed his science exams
- ▶ Founder of genetics
- ▶ Experiments with breeding garden peas, 1856-1863
  
- ▶ 1865: Mendel delivered two long lectures that were published in 1866 as "Experiments in Plant Hybridization." This paper established what eventually became formalized as the Mendelian laws of inheritance of discrete traits. Darwin had it on his bookcase but with pages uncut.
  
- ▶ Fell into obscurity until rediscovered in 1900 by Hugo de Vries & Carl Correns


























# What Darwin did not know: Genetics

Mendel and his peas



- From 1856-63, he cultivated 29,000 pea plants to investigate how evolution worked i.e., how characteristics were passed on the generations.
- Concepts of inheritance then centered on idea of “blending”. His insight was to study transmission of traits that did not blend. He bred for traits that had 2 alternative forms (color, height).
- He figured out the basic principles of genetics. He showed that offspring received characteristics from both parents, but only the dominant characteristic trait was expressed.
- Mendel’s work only came to light in 1900, long after his death

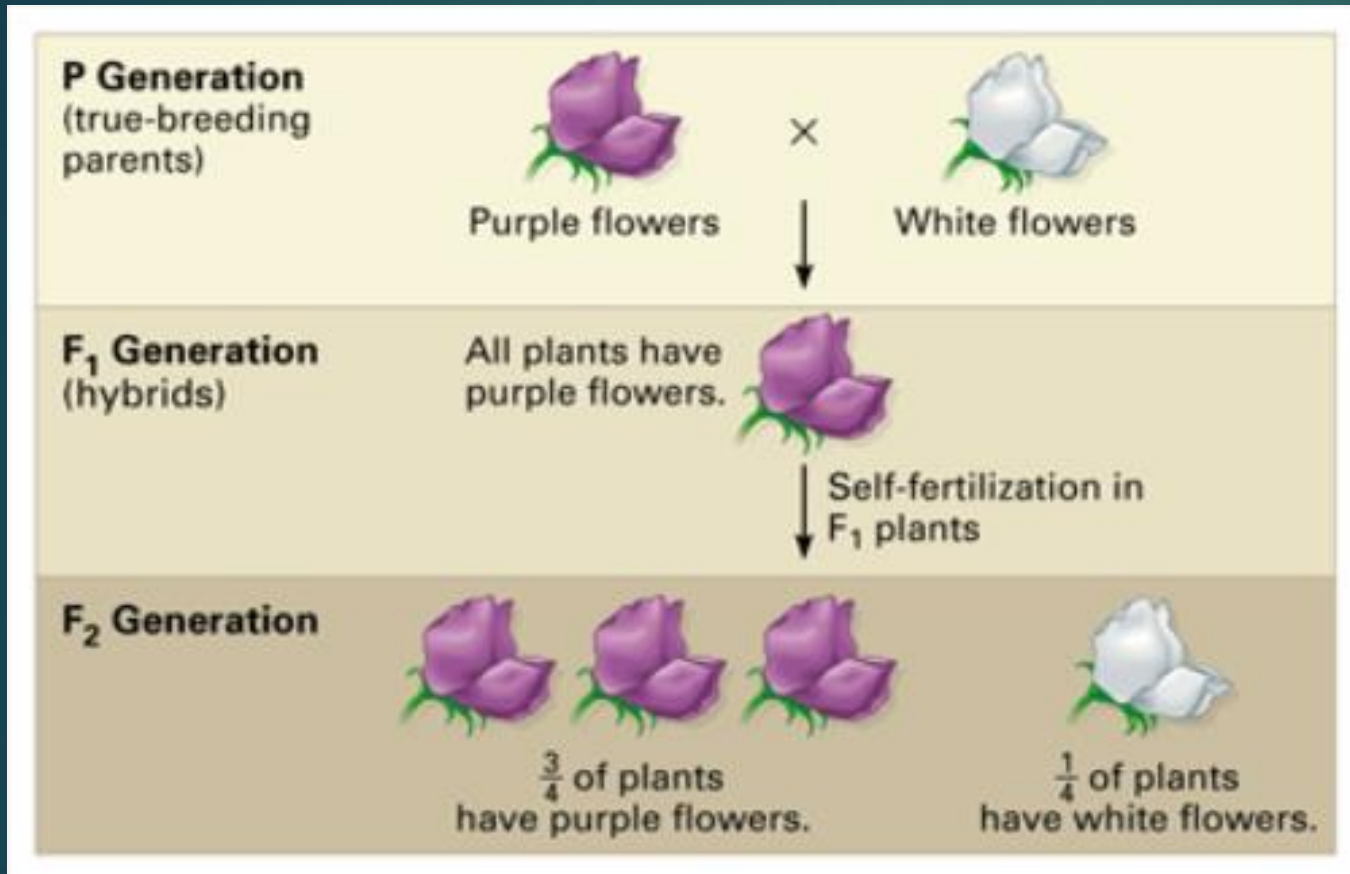
# Mendel's Peas

	Flower color	Flower position	Seed color	Seed shape	Pod shape	Pod color	Stem length
P	Purple 	Axial 	Yellow 	Round 	Inflated 	Green 	Tall 
	White 	Terminal 	Green 	Wrinkled 	Constricted 	Yellow 	Dwarf 
F <sub>1</sub>	Purple 	Axial 	Yellow 	Round 	Inflated 	Green 	Tall 



The pea characters that Mendel used. Shown are the characters in the parents (P) and if the offspring when different parents are cross-fertilized (F<sub>1</sub>). By counting the proportions of these characters in several generations of plants, he concluded that these features must derive from paired copies of what we now call genes. He was lucky – each trait was controlled by 1 gene.

# Mendel's Peas



An example of Mendel's experiments, in which he started by cross-fertilizing different parents (P) to produce the F<sub>1</sub> offspring, and then self-fertilized these (to form the F<sub>2</sub>) to find out how many plant types they produced. 3 to 1 ratio, if P is homozygous



# Concept of Species

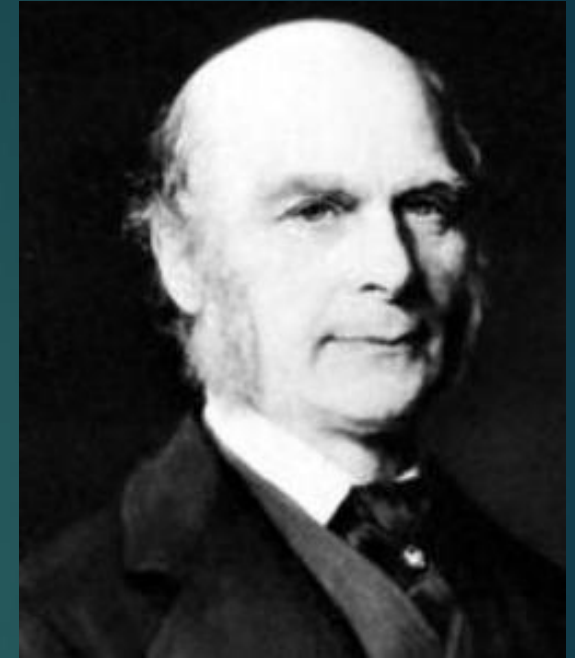
- ▶ 2 ideas in concept of species:
  - ▶ resemblance between individuals
  - ▶ and ability to reproduce
  - ▶ first is consequence of second
- ▶ Species are usually viewed as reproductive communities composed of individuals that resemble each other and who are able to interbreed among themselves while being unable to breed with other such communities
- ▶ It is because of their common genetic heritage that individuals composing a species look similar; but it is invariably on the second criteria of similarity that we recognize individuals as belonging to same species.



# Francis Galton (1822-1911):

## Human genetics

- ▶ Darwin's cousin
- ▶ Mathematician, racist, founder of study of human inheritance
- ▶ 1869: *Hereditary Genius*
- ▶ Founder of eugenics movement, fingerprinting, statistical regression, first weather maps
- ▶ Founded 1<sup>st</sup> genetics department (Univ. College London)



# Peter Wilhelm Lund (1801-1899): 2<sup>nd</sup> *H. sapiens* discovery

- ▶ Danish paleontologist, zoologist, archeologist
- ▶ 1842/1843: Excavations at Sumidouro Cave in Lagoa Santa, Brazil, discovering fossil *Homo sapiens*
- ▶ Not well publicized
- ▶ The first professional archaeological excavations in Lagoa Santa were carried out by Wesley Hurt and Oldemar Blasi in 1956
- ▶ Cranial morphology of early Americans from Lagoa Santa, Brazil: Implications for the settlement of the New World by Walter A. Neves and Mark Hubbe, 2005



1843: *Homo sapiens*, Sumidouro Cave in Lagoa Santa, Brazil



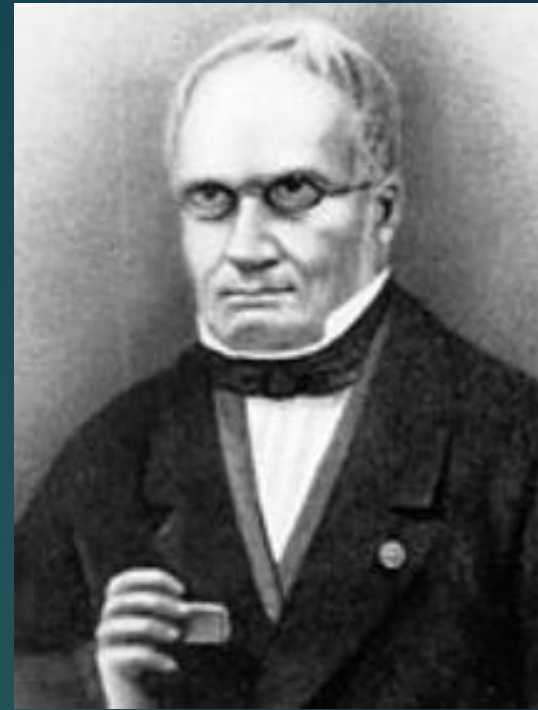
Two radiocarbon dates: (**9,720** ± 128 and 9,028 ± 120)

- ▶ Acervo Museu Arqueológico da Lapinha

# Edouard Lartet (1801-1871):

## Paleontology - Hunt for Paleolithic sites

- ▶ French solicitor and prehistorian
- ▶ Considered a founder of paleontology
- ▶ Discovered many important Upper Paleolithic sites (Le Moustier, La Madeleine)
- ▶ 1837: Discovery of jaw of first fossil monkey (*Pliopithecus*) at Sansan, France
- ▶ Classification system for sequence of hominid ages based on associated animals (i.e. Magdalenian)
- ▶ 1868: Edouard Lartet & English banker Henry Christy: excavated rock shelter at Les Eyzies de Tayac, of Dordogne region, which became “Capital of Prehistory”.





## Antiquarianism becomes archeology

- ▶ Exploration of limestone landscape of Dordogne region of western France
- ▶ In 1868, Edouard Lartet & English banker Henry Christy: excavated rock shelter at Les Eyzies de Tayac, of Dordogne region, which became "Capital of Prehistory".
- ▶ 1865-1875: Lartet and Christy's great work *Reliquiae Auitanicae* published.

# Louis Lartet (1840-1899): Discovery of *H. sapiens* in Europe

- ▶ Edouard Lartet's son
- ▶ French geologist and paleontologist.
- ▶ **1868**: During railroad construction, discovered Cro-Magnon 1 in the Cro-Magnon rock shelter at Les Eyzies, Dordogne, France : the partial skeletons of four fossil modern adults and one infant along with perforated shells, ivory, and worked reindeer antler.

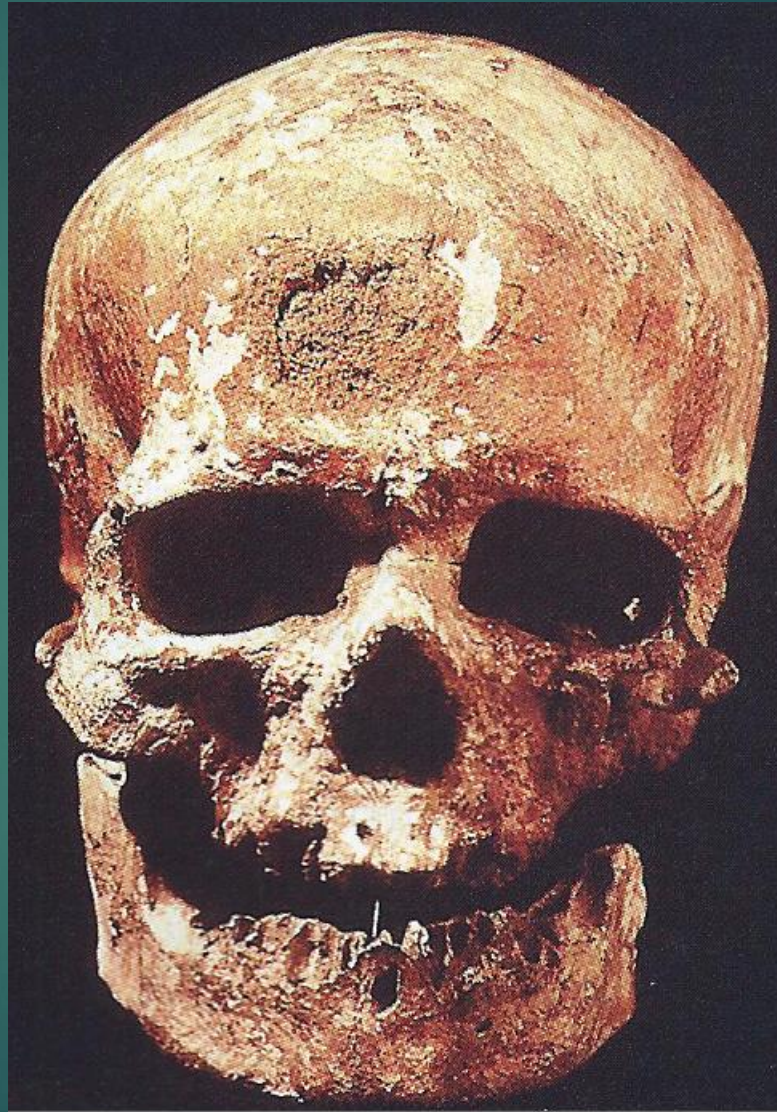


# First *Homo sapiens* fossils in Europe

- ▶ **March 1868**: the geologist **Louis Lartet**, financed by Henry Christy, discovered the **first five skeletons of Cro-Magnons**, the earliest known European examples of *Homo sapiens sapiens*, in the **Cro-Magnon rock shelter at Les Eyzies-de-Tayac**. These skeletons included a fetus, and the skulls found were remarkably modern-looking and much rounder than the earlier Neanderthal.
- ▶ **Rock shelter at Cro-Magnon**: Mr. Magnon kept his farm equipment below rock overhang
- ▶ **Cro-Magnon site gave name “Cro-Magnons” to MHs in Europe**
- ▶ **Cro-Magnon 1 was made the type specimen of a new species *Homo spelaeus* by Lapouge in 1899. Arthur Keith in 1912 placed it in *Homo sapiens*.**




# 1868, European *Homo sapiens*, Cro-Magnon 1, 30 Ka



*Homo sapiens*  
(Cro-Magnon I)  
Discoverer: Louis Lartet & Henry Christy  
Locality: Abri Cro-Magnon, Les Eyzies, France  
Date 1868  
Age: 30-32 K



Double edged Scraper on blade   
from Cro-Magnon - Collection **Louis Lartet** - Muséum de Toulouse

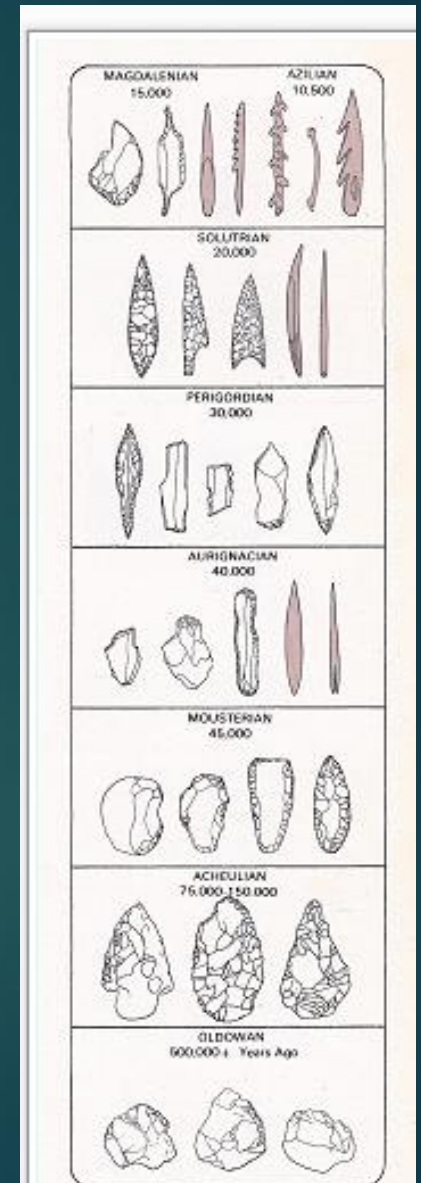


Shell adornment of Cro-Magnon -   
Collection **Louis Lartet** - Muséum de  
Toulouse



# Gabriel de Mortillet (1821-1898): European Paleolithic typology

- ▶ Based on stone tool types and locales
- ▶ Acheulean (Chellian) (200-1.8M) – hand axes
- ▶ Mousterian (~40-200 K) –
  - ▶ flakes from predetermined core
- ▶ Aurignacian (28-40 K)
  - ▶ (Chatelperronian in this period); engraved tools
- ▶ Gravettian (22-28 K)
- ▶ Solutrean (18-22 K) – laurel-leaf points
- ▶ Magdalenian (10-18 K) – bone and antler tools
- ▶ Robenhausen (10 K)



THE EVOLUTION OF TOOLS

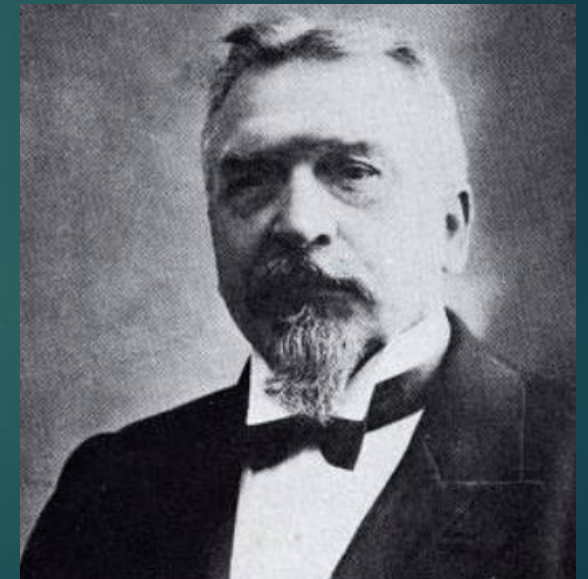
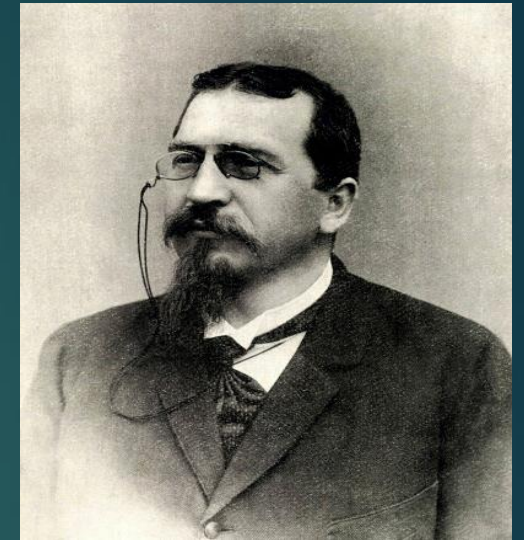
This column shows the seven major tool

*Le Préhistorique*, 1883

# Karel Jaroslav Maska:

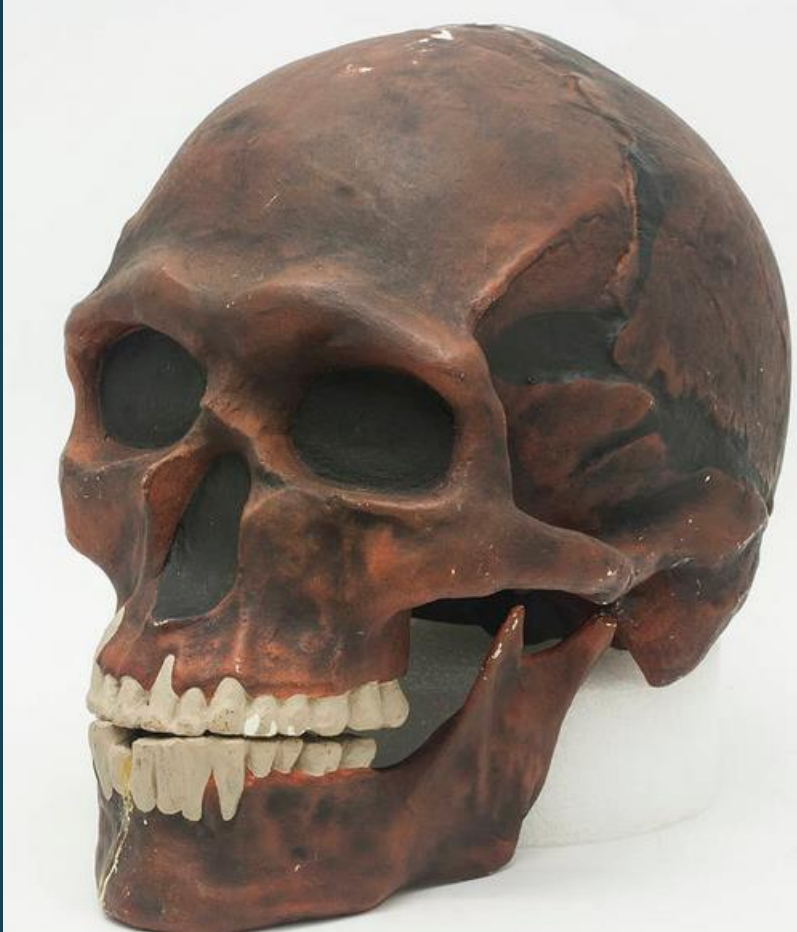
## *Homo Neanderthalensis & Sapiens* in Czech Republic

- ▶ Schoolteacher turned prehistorian
- ▶ 1880: Discovered Neandertal mandible of a 9-10 yo child at Sipka, (Moravia) Czech Republic
- ▶ Also Mousterian tools and traces of hearths
- ▶ 1894: modern human materials from Predmosti, Moravia
- ▶ Large Upper paleolithic mammoth-hunter encampment
- ▶ One of founding fathers of central European Paleolithic archeology





1894: *Homo sapiens*, Predmosti, Moravia, 26 Ka



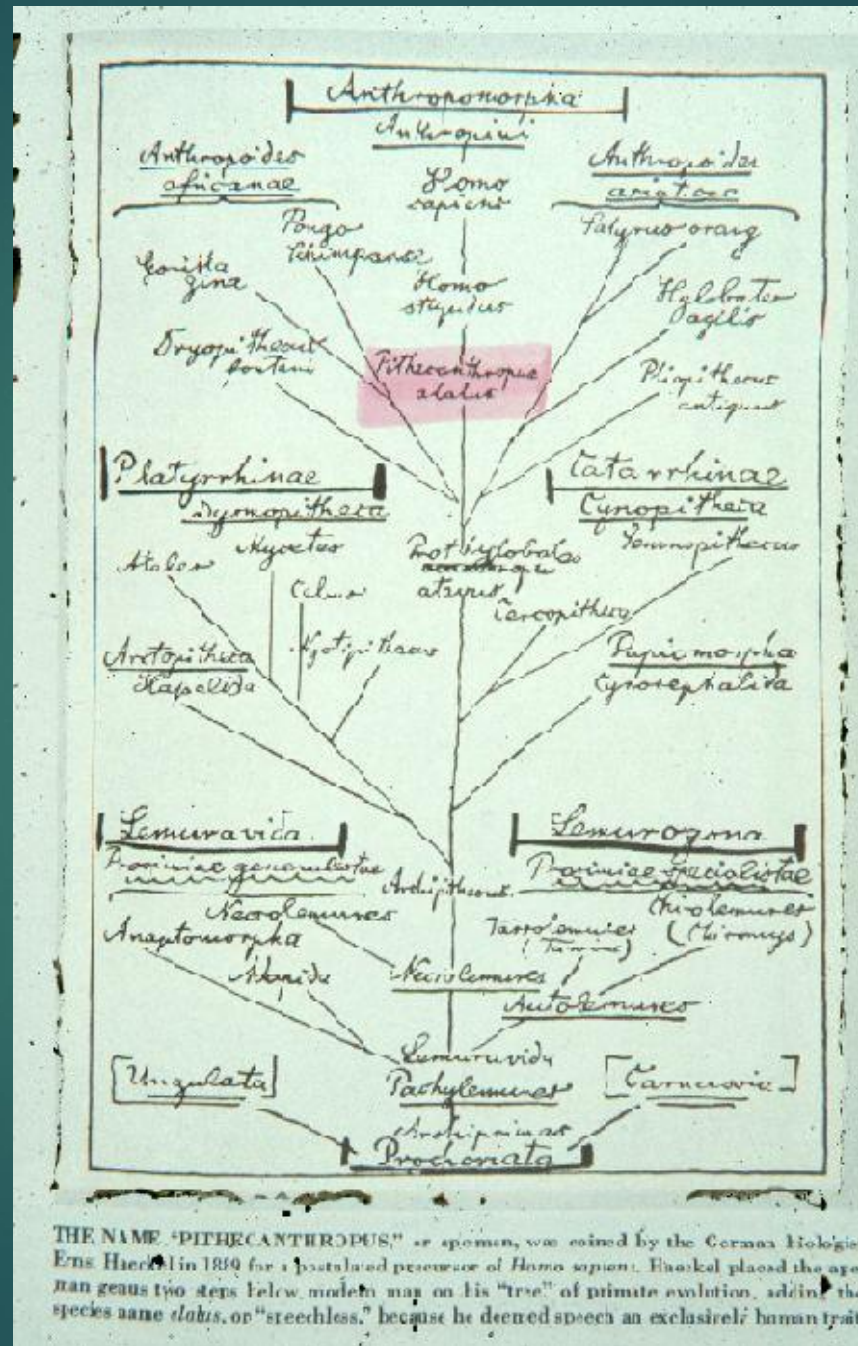
Skull 3; Cranial capacity = 1580 cc

# Ernst Haeckel's Tree:

*Homo sapiens*

*Homo stupidus*

*Pithecanthropus*



THE NAME "PITHECANTHROPUS," or "ape-man," was coined by the German Biologist Ernst Haeckel in 1871 for a postulated precursor of *Homo sapiens*. Haeckel placed the ape-man genus two steps below modern man on his "tree" of primate evolution, adding the species name *alatus*, or "speechless," because he deemed speech an exclusively human trait.



Java, during most of the Pleistocene, was continental Asia, not islands; later sea rise created archipelago



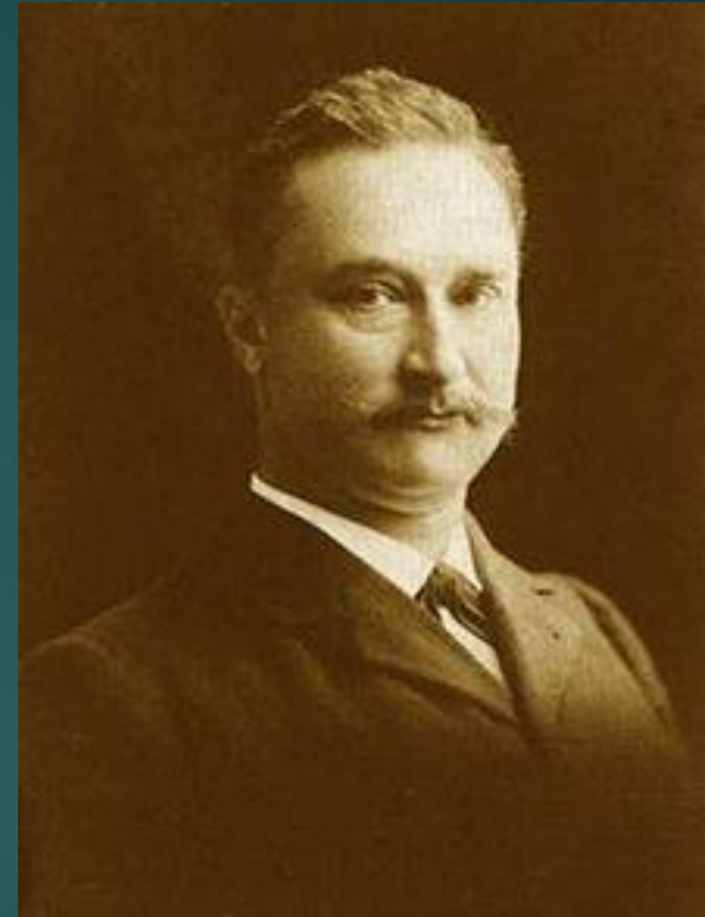
during ice age.

Java, during most of the Pleistocene, was continental Asia, not islands; later sea rise created archipelago

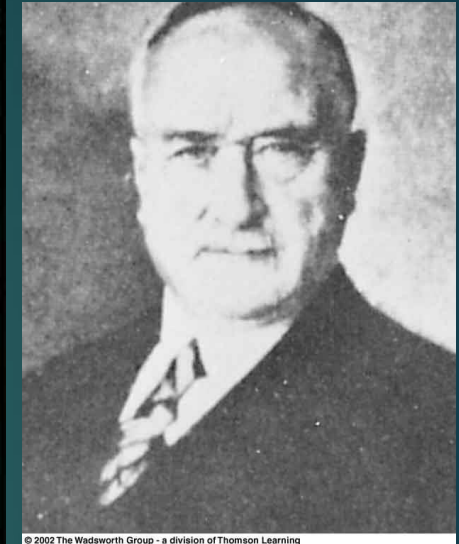
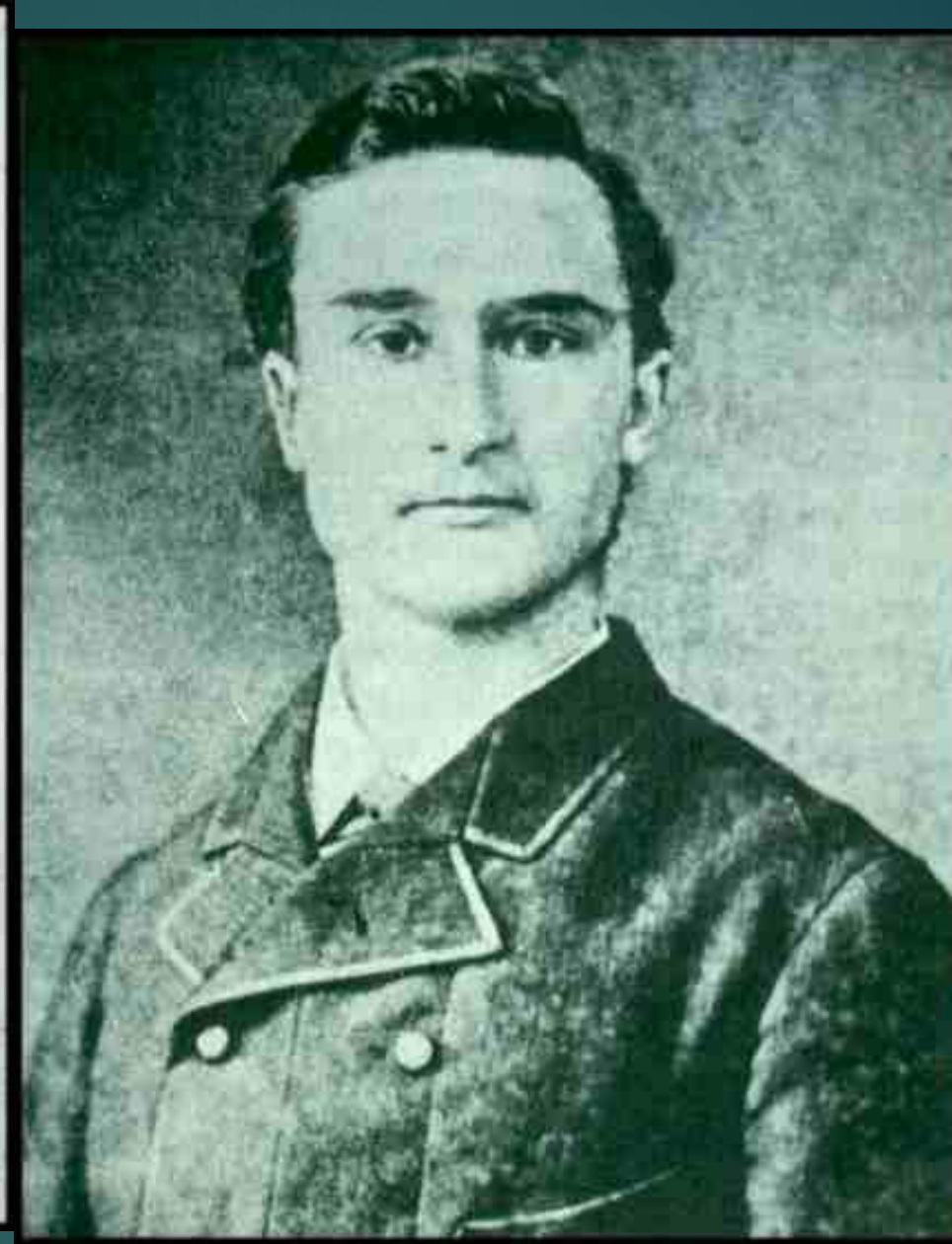


# Eugène Dubois (1858-1940): Search for “Missing Link” *Pithecanthropus erectus/Homo erectus* in Java

- ▶ Dutch anatomist & paleontologist
- ▶ Joined Medical Corps of Royal Dutch East Indies Army to get to Java
- ▶ 1891: First discovery of *Pithecanthropus erectus*, or Java Man at Trinil, Java—“a species in between humans and apes”, a tooth & skull cap in 1891 & femur in 1892
- ▶ 1894: Dubois makes the Trinil calotte the type specimen of *Pithecanthropus erectus*. Eventually reclassified as *Homo erectus*.
- ▶ Returned to Netherlands in 1895, buried fossils under his floorboards and did not show for 23 years; became withdrawn;; Henry Fairfield Osborn of AMNH set up international protest. He eventually showed them, but died embittered man.







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Eugene Dubois  
1858-1940

Lewis *et al*, 9<sup>th</sup>  
p. 230



## Naming: *Pithecanthropus erectus*

- ▶ The species was named by Eugène Dubois in 1894, after his 1891 find from Trinil, Java, in Indonesia (molar = Trinil 1, calotte = Trinil 2).
- ▶ Dubois was inspired by Ernst Haeckel's conviction that the origins of modern humans might lie in Southeast Asia. Dubois enlisted as an army surgeon in the Royal Dutch East Indies Army, and searched for fossils in Sumatra in 1888.
- ▶ He had little success in Sumatra; In 1891, with the help of 50 convicts, unearthed a thick mineralized hominin skull plate near the bank of the Solo River on the island of Java, Dutch East Indies (now Indonesia); near the village of Trinil. First a tooth, then a calotte. Then, a year later, a femur.
- ▶ Dubois made his find public a few years later, and was met by derision from the dominant British paleontological hierarchy.



Two white squares show where the femur (left) and the skullcap (right) were discovered.



1891: *Pithecanthropus erectus*, Java Man, 1-1.5 M, 940 cc, at Trinil, Java



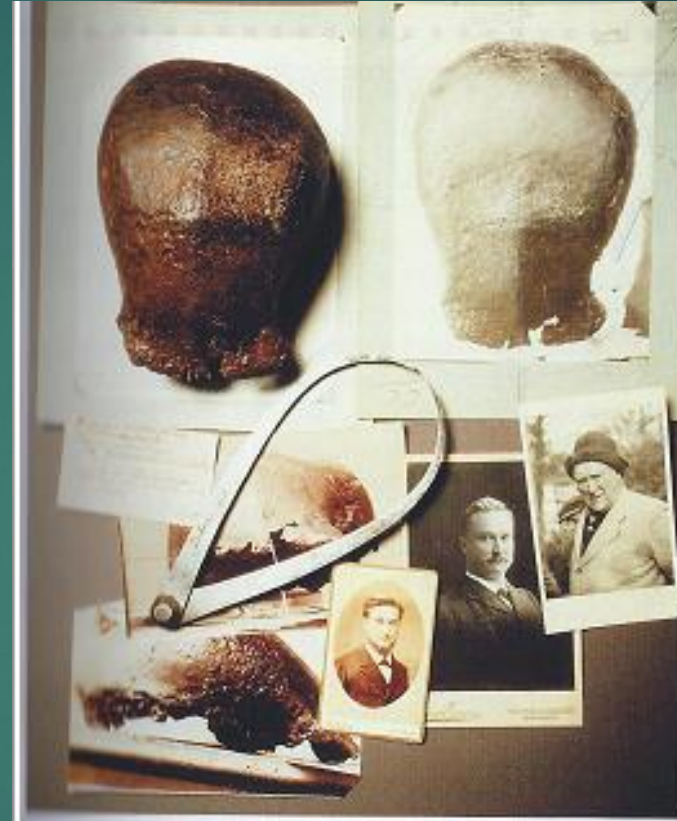
*Homo erectus*  
(Trinil 2, type)

Discoverer: Eugene Dubois

Locality: Trinil, Java, Indonesia

Date 1891

Age: 1.0 M



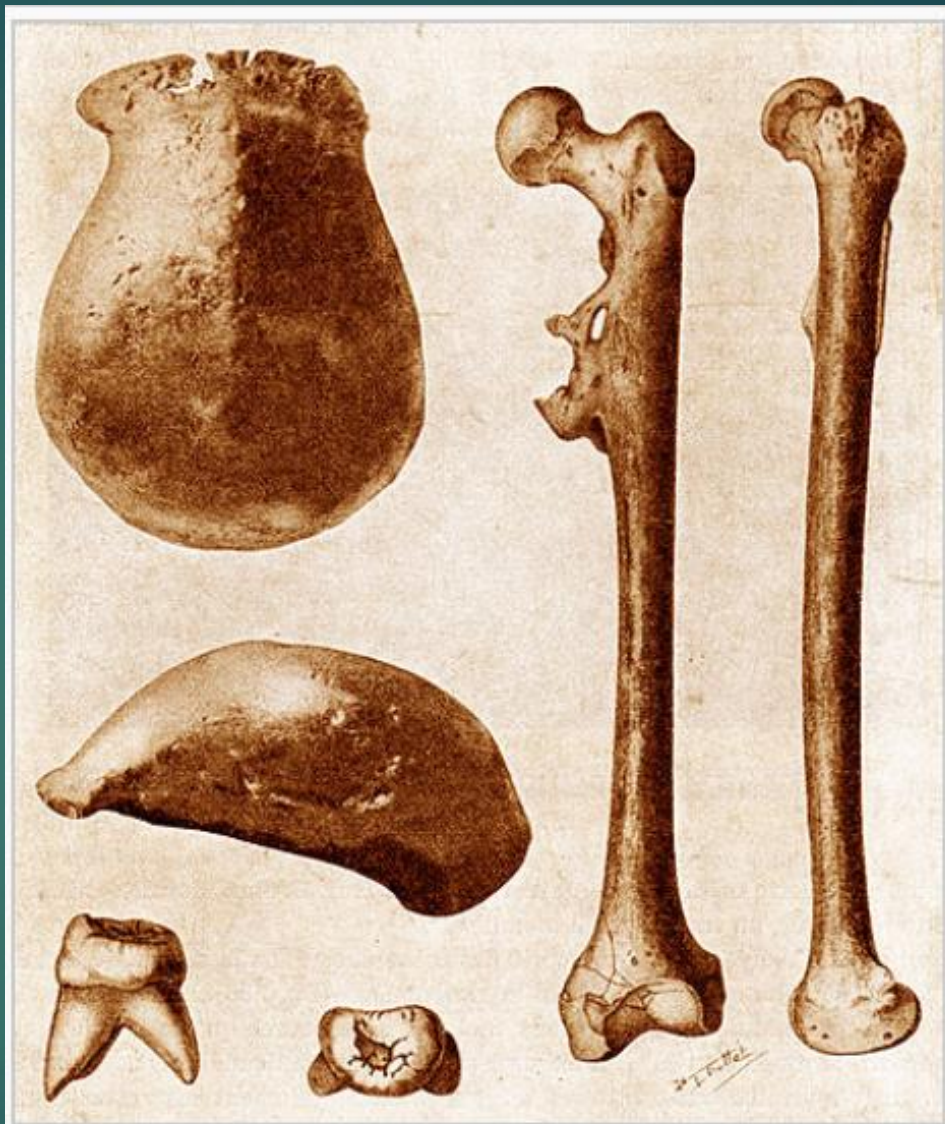
1892

First hominin fossil outside of Europe; first fossil of *Homo erectus*

Trinil 2: Calotte

Femur is younger than skull cap; has pathological projections

Trinil 1: Molar



Original fossils of *Pithecanthropus erectus* (now *Homo erectus*) found in Java in 1891.



# Eugene Dubois





## *Pithecanthropus (Homo erectus), Java Man 2*

- ▶ In homage to Haeckel, he described the species as *Pithecanthropus erectus* (from the Greek *πίθηκος* (*pithec*), "ape", and *ἄνθρωπος* (*anthropos*), "man"), based on a **calotte (skullcap)** and a **femur** like that of *H. sapiens* found from the **bank of the Solo River at Trinil, in East Java**. (This species is now regarded as *H. erectus*). The find became known as *Java Man*
- ▶ He believed that his findings were an extinct form of Homo sapiens.
- ▶ Dubois is often considered the first paleontologist.

# Dubois's 1899 imaginary reconstruction of Java Man, using son as model



Incorrect abducted/divergent toe

Ardi (4.4 Ma) had last abduction

Postcranially *H. erectus* was modern

# Eugene Dubois & *H. erectus*

- Eugene Dubois found first *H. erectus* fossils in Java.
  - Piece of lower jaw at Kedung Brubus in N. Java
  - Then near Trinil village, on banks of Solo River: 1891, teeth, femur, skull cap (calotte); he first thought it was an ape
  - 1894 published paper: *Pithecanthropus erectus*
  - Not all convinced calotte and femur are from same individual, or that calotte is as old (femur found in same level, but 10-15 meters away)
  - Believed it was ancestral to humans
- Findings:
  - Lacks large brain and the tall rounded brain case of modern humans
  - Brain volume only 60% of average modern human, 940 cc
  - Femur similar to modern human
  - First implication that bipedality preceded large brain



## 1891: *Pithecanthropus erectus*, Trinil 2: 1M-700K, 940 cc

- When this skull cap was discovered in 1891, it was the first early human fossil recognized outside Europe. It was called "Java Man" because it was found on the island of Java, Indonesia.
- This calotte, Trinil 2, is long, with a flat forehead and distinct browridges and a sagittal keel, though many of its features have been worn flat with age.
- Dubois named a new species, *Pithecanthropus erectus* after this specimen in 1894, but Ernst Mayr reassigned Trinil 2 to *Homo erectus* in the 1950s.



Nickname: Java Man

Site: Trinil, Java, Indonesia

Date of discovery: 1891

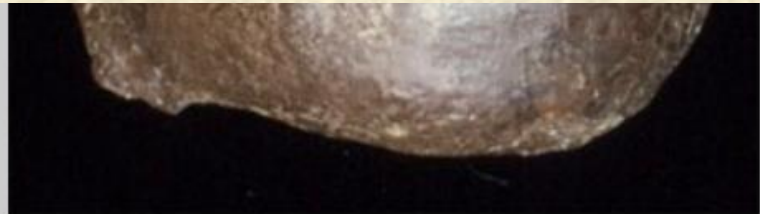
Discovered by: Eugene Dubois

Age: Between 1 million and 700,000 years old

# Eugene Dubois: controversies

- ▶ He believed Pithecanthropus was transitional between apes and humans
- ▶ Arthur Keith thought it was an earlier hominin; Virchow thought it was a gibbon; this angered Dubois
- ▶ Toured Europe with fossils from 1895 to 1900, then returned to Netherlands. After seeing other researchers reinterpreting his findings, circa 1900 he buried fossils under his floorboards.
- ▶ He continued to do research; he pioneered study of brain-to-body-size ratios (encephalization).
- ▶ He did not show his fossils again until 1923.
- ▶ He died an embittered man
- ▶ In a eulogy, Arthur Keith accurately described him as "... an idealist, his ideas being so firmly held that his mind tended to bend facts rather than alter his ideas to fit them."

# Trinil 2



**Trinil 2**

**Trinil 2**



# Java, *Homo erectus*: Variety of Names

Fig. 82 The Trinil calotte (*Pithecanthropus I*)

Left lateral view

Courtesy of Professor J. S. Weiner and Dr D. A. Hooijer

*Synonyms and other names* *Pithecanthropus erectus* (Dubois, 1894); *Pithecanthropus I* (von Koenigswald and Weidenreich, 1939); *Homo erectus javensis* (Weidenreich, 1940); *Homo erectus* (Mayr, 1950); *Homo erectus erectus* (Dobzhansky, 1944; Campbell, 1964)  
Java man

*Site* Trinil, approximately 20 miles north-west of Madiun, six miles west of Ngawi, Central Java, Indonesia.

*Found by* Eugene Dubois, 1891.

*Geology* Trinil lies at the foot of a volcano, Lawu, whose lavas and cinders have spilled over a wide area. Elevated Pleistocene 221

# Neandertal's antiquity

- ▶ Neandertal's antiquity was only firmly established with the eventual discovery of additional similar skeletons that, unlike the Neanderthal 1 skeleton, were found together with stone tools and with the bones of extinct animals.
- ▶ Once their status as fossil predecessors of modern humans was accepted, their relationship with modern humans, and particularly modern Europeans, began to be intensely debated.

# Gustav Schwalbe, MD (1844-1916)

- ▶ German anatomist and anthropologist
- ▶ Long monographs on both Java Man (which angered Dubois) and Neandertals
- ▶ Line of descent: morphological series from Pithecanthropus to Neandertals to MHs
- ▶ He considered the Neanderthal to be a direct ancestor of modern humans.
- ▶ He was important in getting Ns accepted as a distinct form of early man

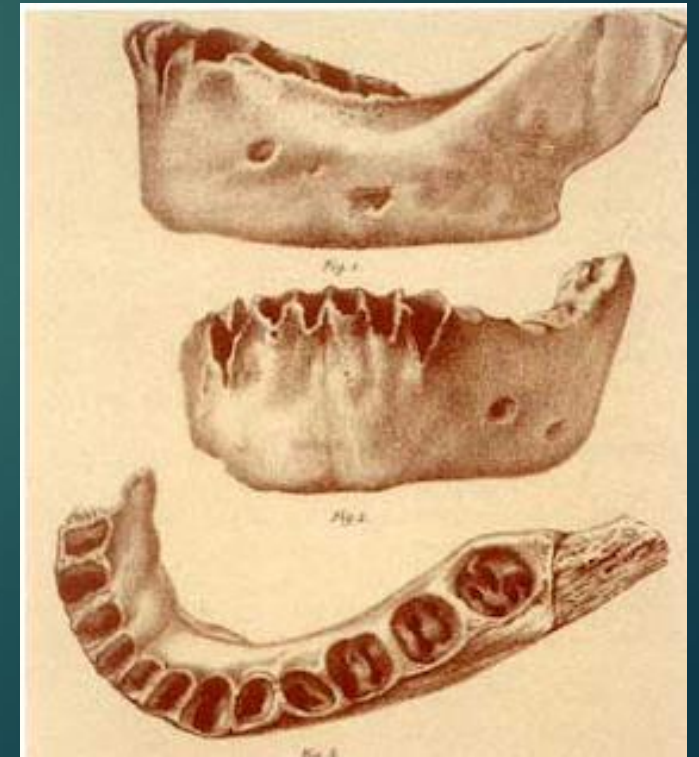
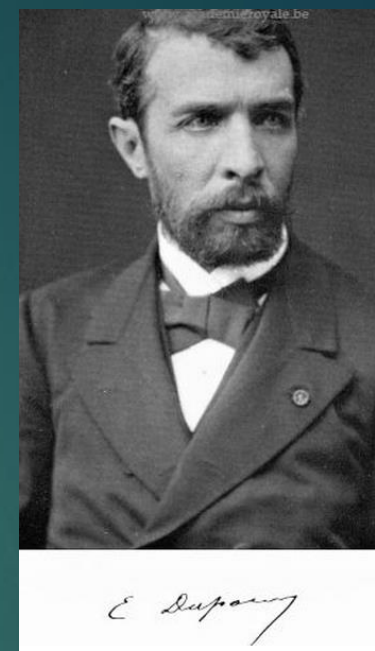


- *Studien über Pithecanthropus Erectus* (Study of Pithecanthropus Erectus), Leipzig, 1899
- *Der Neander Schädel* (The Neanderthal skull) ib. 1901
- *Vorgeschichte der Menschen* (Prehistory of humans) ib. 1903.



# Edouard Dupont (1841-1911): Neanderthal really is ancient

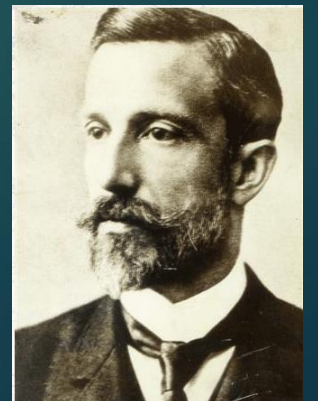
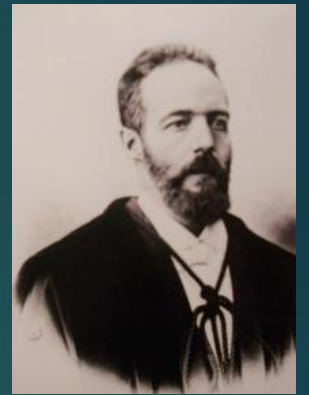
- ▶ Belgian geologist
- ▶ Director of the state *Musée d'Histoire Naturelle*, in Brussels.
- ▶ 1865: in Trou de la Naulette, Belgium, discovered a Neanderthal mandible (lower jaw), ulna (one of two forearm bones) and metacarpal (hand-bone) in association with bones of extinct animals
- ▶ Collected bones & stones at Goyet, Belgium in 1867; in 2004, discovery of a mandible tip that clearly belonged to a Neanderthal (& in 2018, best evidence of N cannibalism).
- ▶ First Neanderthal remains to be generally accepted as of truly great antiquity and as having different anatomy than modern humans.
- ▶ Authored *Man During the Stone Age*



# Marcel de Puydt, Max Lohest, & Julien Fraipont:

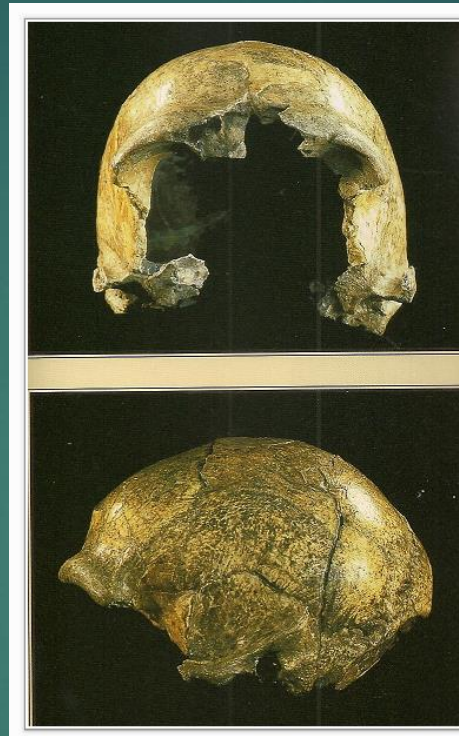
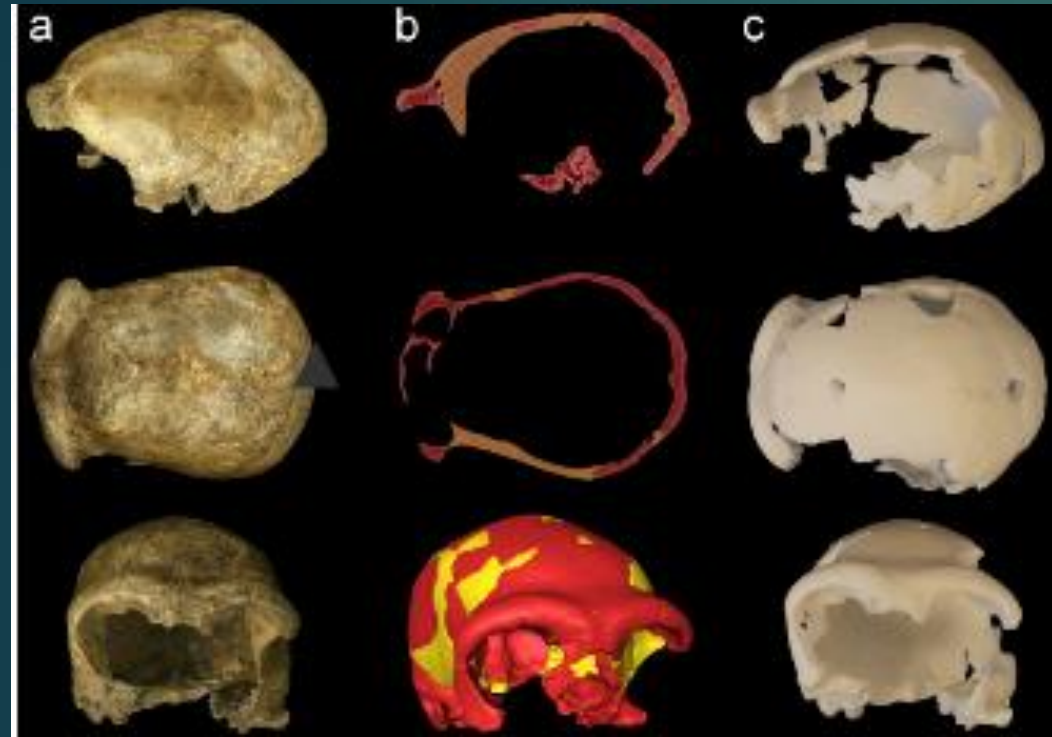
Spy Neandertal & Mousterian Tools

- ▶ Belgian lawyer & amateur archeologist; and a geologist
- ▶ 1886: Discoverers of 2 nearly complete Neandertal skeletons (male & female), in burial positions, at Spy d'Orneau, Belgium, found with Mousterian tools (knapped flints) (dated to older than 40 Ka)
- ▶ Found in undisturbed archeological context that for first time established their antiquity; all prior discoveries were incidental findings in cave mouth contexts
- ▶ 1888: Julien Fraipont, anatomist at Univ. of Liege, co-wrote monograph on it in the *American Anthropologist*

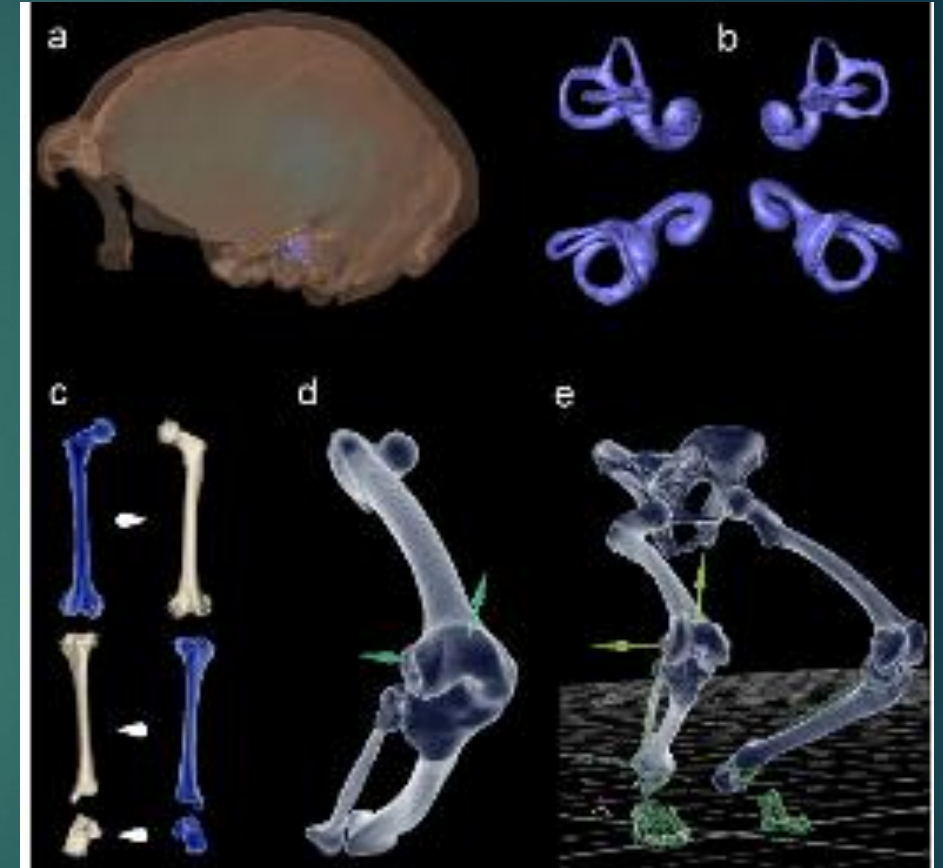




# 1886: Neandertal, Spy Belgium, > 40 Ka



[Spy 1]



[Spy 2, a complete skeleton found in a contracted position.]

Believed Ns crouched in walking

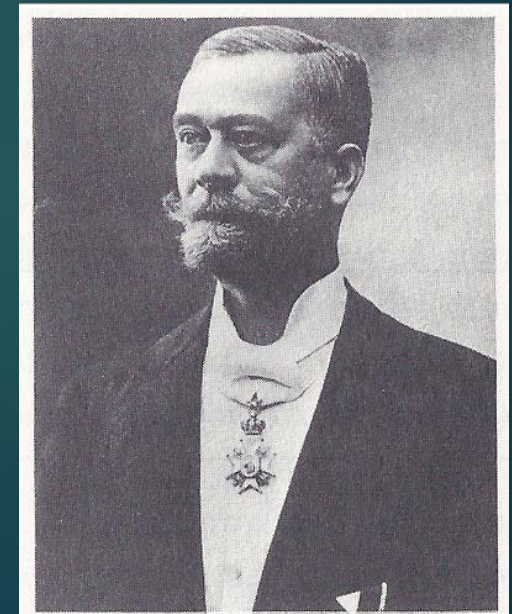


## 1899-1911: bonanza of N discoveries

- ▶ 1899-1905: Croatian cave of **Krapina** – partial N fossils
- ▶ 1908 - German site of **Ehringsdorf**
- ▶ 1908-1911: French cave sites of **La Chapelle-aux-Saints, Le Moustier, La Ferrassie, and Le Quina** – complete N skeletons
- ▶ **N archetype: “old man” of La Chapelle skeleton** as described by Marcellin Boule

Dragutin Gorjanović-Kramberger (1856-1936):  
Largest N fossil find of all + cannibalism in Neandertals

- ▶ Croatian paleontologist
- ▶ 1899: discovered the Neandertal fossils at Krapina, Croatia
- ▶ In 1906 published “On the diluvial man of Krapina”
- ▶ Gorjanović-Kramberger's research **helped prove the theory of evolution of the human species**, concluding that Neandertals were not modern humans
- ▶ Evidence of cannibalism (although later disputed)





# Krapina





# Dragutin Gorjanović-Kramberger 2

- ▶ The material from **Krapina** is the
  - ▶ largest population sample of Neanderthals ever found,
  - ▶ one of the largest fossil hominin samples ever found.
- ▶ There are more than 800 fossils, 25 individuals, ages of 16-24 years, dated to 130 Ka; representing a period of over 50K years
- ▶ Bones are gracile, highly fragmented;
  - ▶ signs of arthritis & healed fractures
  - ▶ cut marks due to cannibalism (based on the fragmentation and traces of burning), but theory is contested
  - ▶ use of eagle talons as necklaces

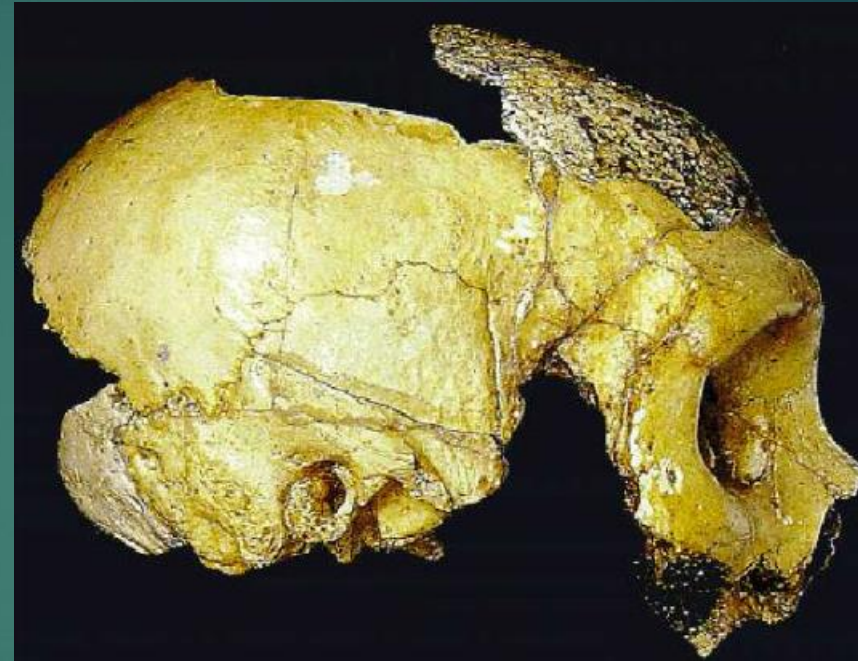


Eagle talons, 130 Ka

# 1899: 800 fossils of 25 Neandertals, Krapina, Croatia



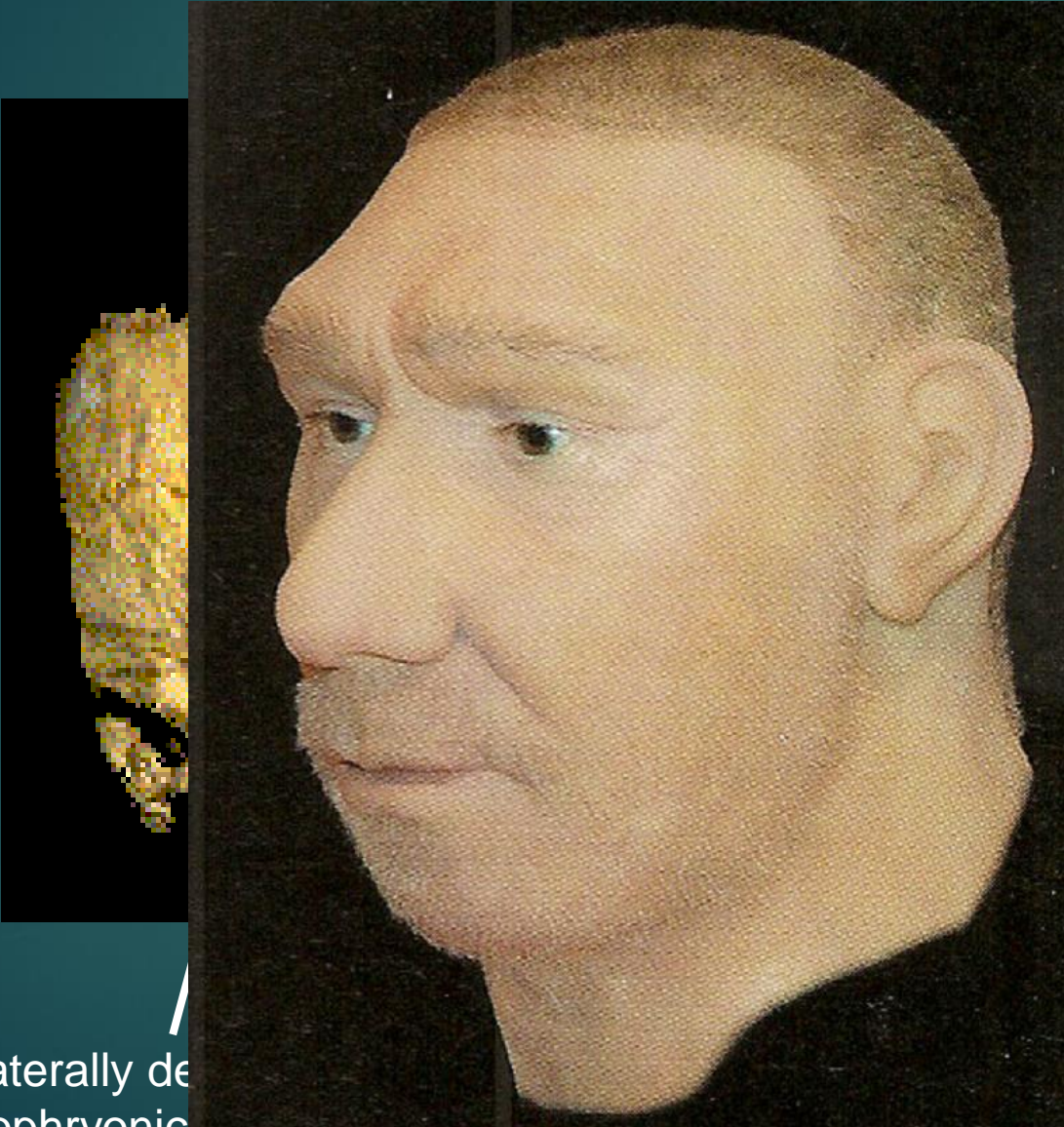
More than 800 fossils,  
25 individuals, ages of 16-24  
years, dated to 130 kyr; **over**  
**period of 50K; cannibalization**



*Homo neanderthalensis*  
(Karpina C)  
Discoverer: Karl Gorjanovic-Kramberger  
Locality: Krapina cave, Croatia  
Date: 1899  
Age: 130K



# Krapina Neandertals



Laterally de  
(ophryonic groove)

Protruding nasal shelf

- Artificial grooves on 14 teeth indicate **toothpick use**
- Also the most **extreme taurodonty** (vertically enlarged pulp chamber) of any human fossil





# How do you prove cannibalism in fossils

- ▶ **Evidence**: craniocervical fragmentation, diaphyseal (long bone) splitting, “cut-marks”, patterned preservation and breakage, burnt bone, and disassociation of the skeletons; latest = same pattern in hominin and associated faunal
- ▶ In addition to **Gran Dolina** (level TD6; Early Pleistocene) in Spain, which has produced the earliest undisputed evidence for cannibalism,
- ▶ At **Eastern European Neandertal site**
  - ▶ Krapina, Croatia
- ▶ at several **Western European Neandertal sites**
  - ▶ El Sidrón and Zafarraya in Spain,
  - ▶ Moula-Guercy and Les Pradelles in France
  - ▶ Goyet, Belgium

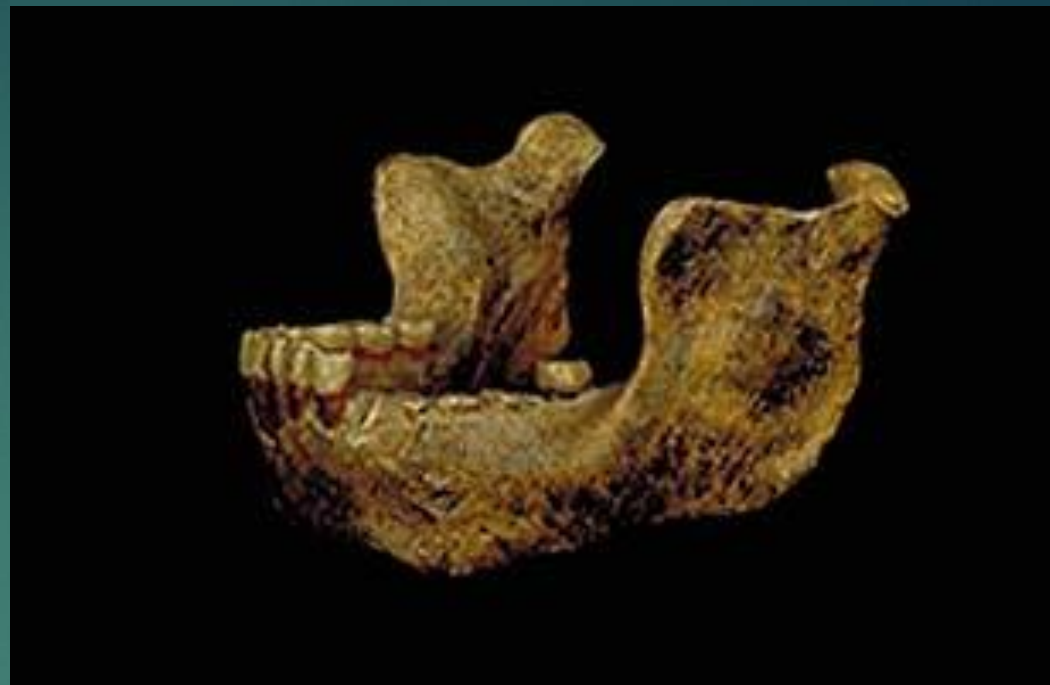
# Otto Schoetensack (1815-1912):

Discovery of *Homo heidelbergensis* at Mauer

- ▶ German industrialist and later professor of anthropology.
- ▶ 1907: at Mauer, south of Heidelberg, Germany, a site he directed; the worker Daniel Hartmann at quarry owned by Joseph Rosch, found the lower jaw of a hominin.
- ▶ Schoetensack later named it the type specimen of *Homo heidelbergensis*; 600 Ka
- ▶ Despite 5000 faunal bones found by 1962, jaw is only hominin find
- ▶ “*The lower jaw of the Homo heidelbergensis out of the sands of Mauer near Heidelberg*”, 1908



Species:	<i>Homo heidelbergensis</i>
Age:	Middle Pleistocene
Date of Discovery:	October 21, 1907
Location:	Mauer, Germany
Discovered by:	An anonymous workman



This **mandible** was found by a workman in the **Rösch sandpit just north of the village of Mauer near Heidelberg, Germany, in 1907**. The workman showed the find to the **anatomist O. Schoentensack**, who provided the initial description of the specimen. The mandible is complete with only the premolars and first two molars on the left side missing. The **molars were recovered separately**, although the premolars were lost.

Combination of primitive features (for example, high corpus thickness, very wide ramus, receding chin, and receding symphysis) and more recent human features, such as small dentition, small molars, particularly the canines and anterior teeth.

This lower mandible probably belonged to a **young adult female**. It was found close to a partial skull, giving scientists a direct comparison of two individuals.



# *Homo heidelbergensis*

- ▶ The mandible itself is large, and robustly built like that seen in *Homo erectus*, with broad ascending rami. The corpus of the mandible is deep and thicker than a modern human's. No chin.
- ▶ Schoentensack proposed the species name *Homo heidelbergensis* for the Mauer specimen. This assignment has been problematic over the years. The robust morphology of the jaw shows affinities to *Homo erectus* populations from the same time period, yet the **tooth morphology is decidedly more "modern"** in appearance.
- ▶ Most researchers agree that the Mauer mandible **is not *Homo erectus***. For a long time many scientists placed the mandible a rather confusing taxon: **"Archaic" *Homo sapiens***. Recently, members of this taxon have been separated at the species level and given a separate species name: ***Homo heidelbergensis***.
- ▶ There is **no way to absolutely date the Mauer specimen**. However, faunal correlation has placed the find within the Middle Pleistocene, circa **600 Ka**.



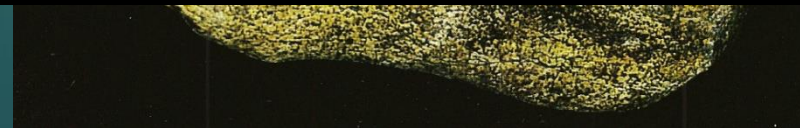
type specimen of *Homo heidelbergensis*

1907: *Homo heidelbergensis*,  
Mauer mandible, 610K; type specimen



Mauer

Very few other mandibles



Age 610 K

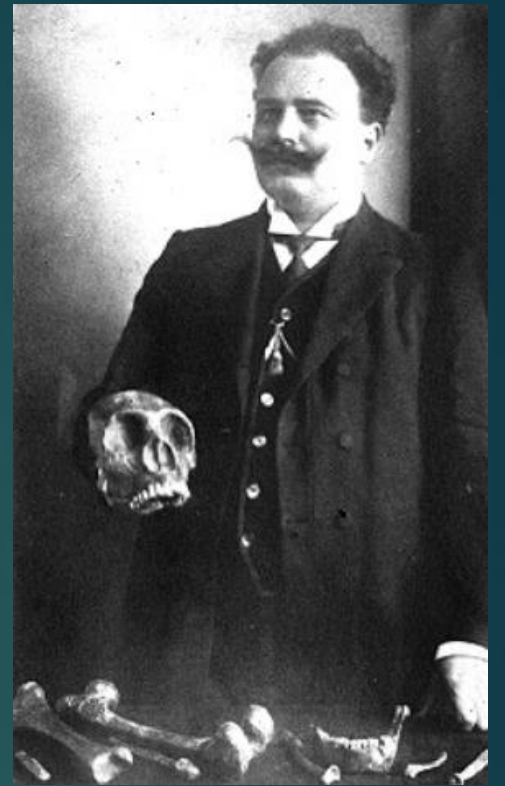


# *Homo heidelbergensis* Mauer ~600ka?



# Otto Hauser (1874-1932): Discoveries by **despised dealer**

- ▶ Swiss-German antiquities dealer
- ▶ **Detested by the French for his discoveries**
- ▶ 1908: Le Moustier rockshelter, southwest France: discovers a complete Neanderthal skeleton within a “burial” site (all but the skull later lost in World War II); type site for Mousterian lithic culture.
- ▶ 1909: discovery of a Cro-Magnon skeleton at Combe, Capelle; associated Chatelperronian industry



# Le Moustier



A Juvenile Neanderthal excavated in 1909.

<http://www.mnh.si.edu/anthro/humanorigins/ha/lemoust.htm>



1908: Le Moustier, Neanderthal cranium, 45K





# 1911: Hauser postcard ad

**FOUILLES DE O. HAUSER**  
**LES EYZIES**  
DORDOGNE (FRANCE)



**LAUGERIE HAUTE (Les Eyzies)**

**LAUGERIE HAUTE (LES EYZIES)**  
BUREAU DER AUSGRABUNGSLEITUNG  
Ausstellung prähistorischer Funde.  
· PLÄNE · PHOTOGRAPHIEN ·  
Wagen, Gute Zimmer, Angenehmer Aufenthalt,  
DUNKELKAMMER

Bureau de la Direction des Fouilles préhistoriques.  
ACHEULLÉEN, MOUSTÉRIEN AURIGNACIEN,  
SOLUTRÉEN, MAGDALENIEN.  
Exposition des objets préhistoriques. Plans, Photographies  
VOITURES, CHAMBRES, SEJOUR AGREABLE  
CHAMBRE NOIRE

**LAUGERIE HAUTE (LES EYZIES)**  
Prehistoric excavations. Manager's office.  
· EXHIBITION OF PREHISTORIC OBJETS ·  
· PLANS · PHOTOS ·  
Carriages, Rooms to let. Agreeable sojourn.  
· DARK ROOM ·



Pierre gaule effroyal, Aurignacien



Cerveau Neanderthal, Néaen



# Abbes Jean and Amedee Bouyssonie: French Priests get into the act

- ▶ French brothers and priests
- ▶ 1908: Excavated, with Bouffia Bonneval, the Neandertal skeleton, the 'Old Man', at La Chapelle-aux-Saints
- ▶ In 1908, Joseph Bonneval, a servant, discovered the skull by sinking a pick into it.
- ▶ Turned it over to **Marcellin Boule** for analysis



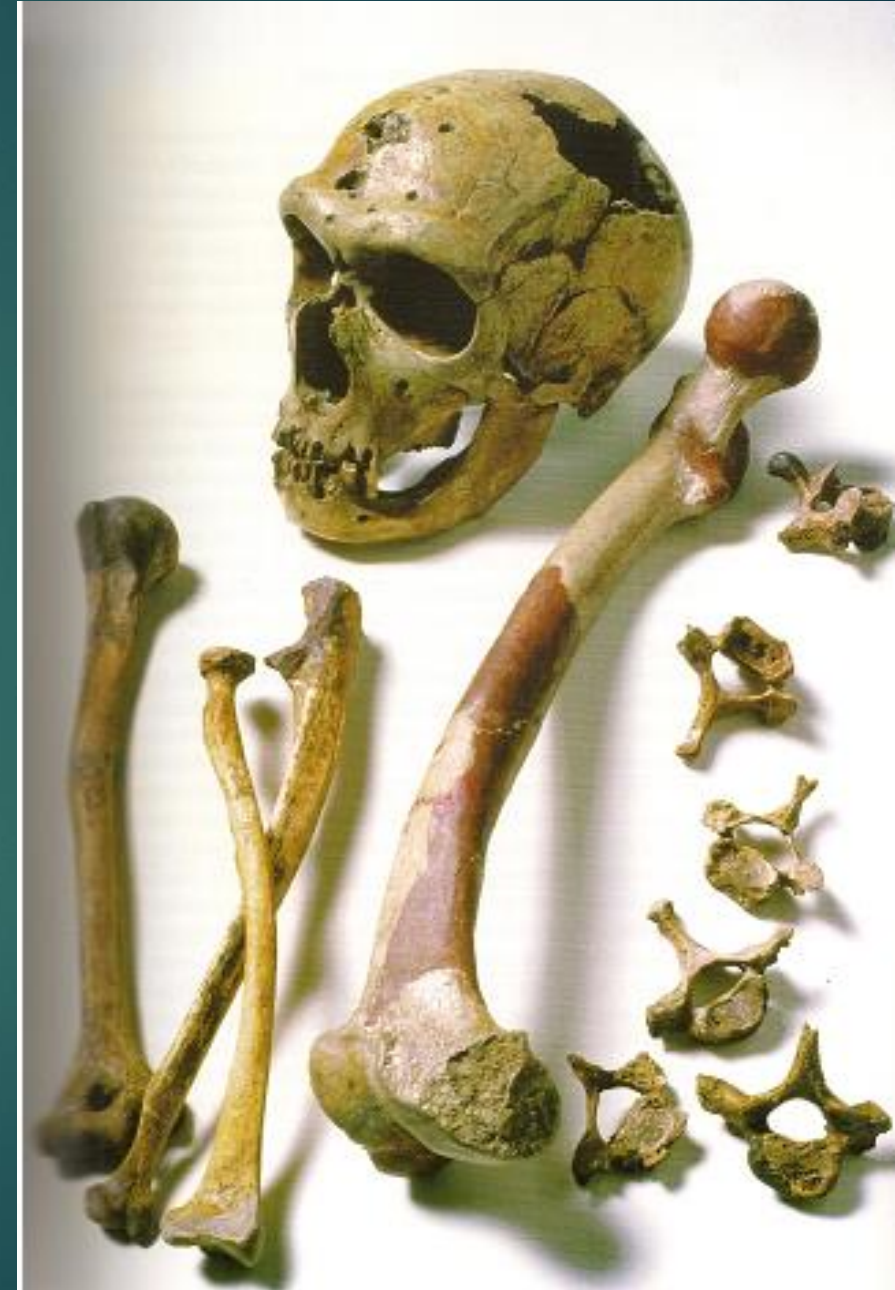


# 1908: Neandertal, La Chapelle-Aux-Saints, “Old Man”



*Homo neanderthalensis*  
(La Chapelle-Aux-Saints)  
Discoverer: Fathers Bouyssonie &  
Josef Bonneval  
Locality: Bouffia Bonneval,  
La Chapelle-Aux-Saints, France  
Age: 350K  
Date: 1908

Aged, pathological skeleton  
formed basis of pervasive negative  
view of Neandertal





La Chapelle aux Saints  
50,000

In 1908, Joseph Bonneval, a servant, discovered the skull by sinking a pick into it.

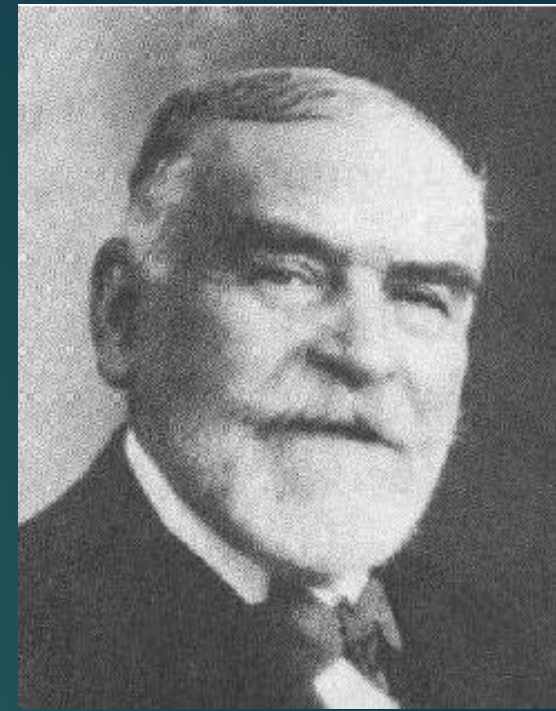
# N as own species

- ▶ The predominant view of N in the 1910s and 1920s was represented by scientists like Marcellin Boule and Sir Arthur Keith, who were among the most influential scholars of their day.
- ▶ They placed Neanderthals in their own species, *Homo neanderthalensis*, and rejected any ancestral role for them in the evolution of modern people, pointing out their “primitiveness” and presumed inferiority (e.g., Boule 1911–1913).



# Pierre Marcellin Boule (1861-1942): Neandertal as a slouchy, barbaric troglodyte

- ▶ Predominant French paleontologist of early 20<sup>th</sup> century
- ▶ One of founders of Paris's Institut de Paleontologie humaine
- ▶ 1911: Monograph of first complete Neandertal skeleton, from La Chapelle-aux-Saints (Correze, France)
- ▶ 1911-1913: Marcellin Boule's article in *Annales de Paléontologie* establishes paleoanthropology as a discipline.
- ▶ 1921: Rejected Piltdown fossil as chimp jaw & human skull



# Boule: N as brute

- ▶ His view of “Old Man” (& of Neanderthals) led to erroneous view that he was a stooped, arthritic, apish, brutish, & shuffling; more ape-like than human with "rudimentary intellectual abilities".
- ▶ He deduced that its head must have been slouched forward, its spine hunched, knees bent, its toe was divergent like an ape's, and it had an inferior brain.
- ▶ Then, having reassembled the Neanderthal this way, Boule insulted it. This “brutish” and “clumsy” posture, he wrote, clearly indicated a lack of morals and a lifestyle dominated by “functions of a purely vegetative or bestial kind.”
- ▶ Boule believed in “Presapiens” theory: modern humans already existed at the time of the Ns; Ns not ancestral; believed Pithecanthropus was giant gibbon

Original N conceptions: only species that is used as a paleontological insult – “You are a Neandertal”



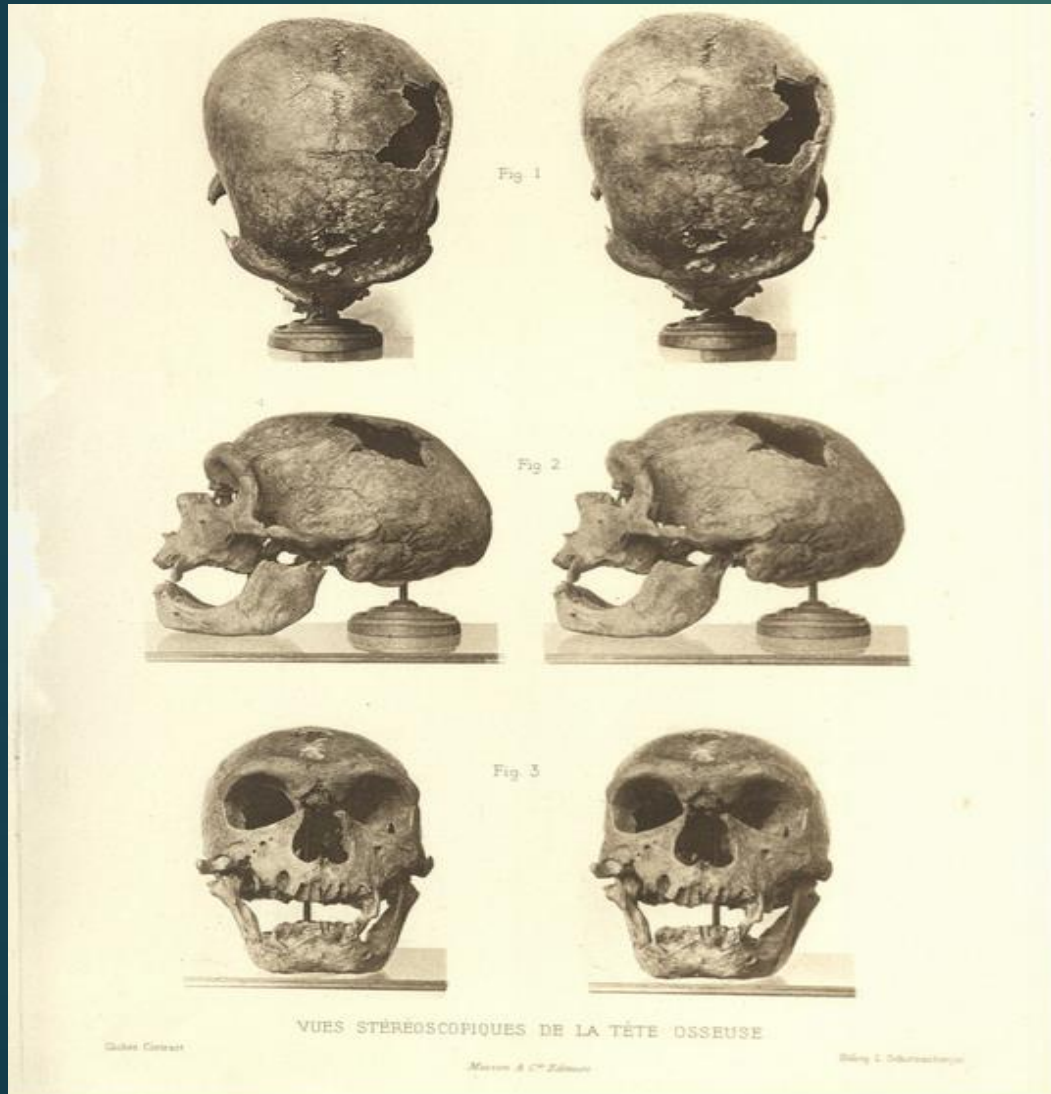
Old Man of La Chapelle-aux-Saint;  
an arthritic Neandertal;  
Boule's erroneous 1911 reconstruction



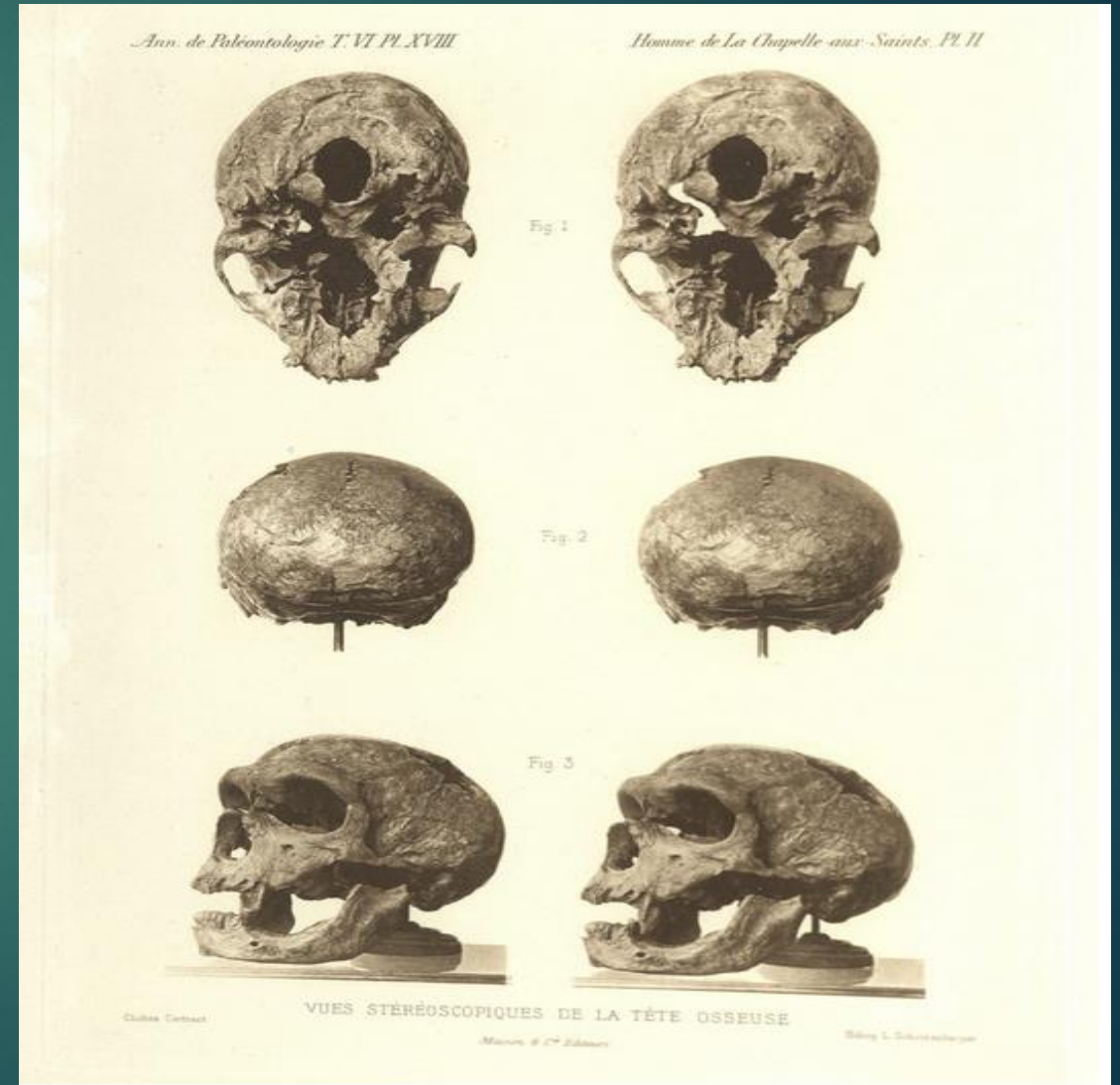
19<sup>th</sup> Century Neanderthal Portrayal,  
1909 by Frantisek Kupka



# Marcellin Boule's *L'Homme de La Chapelle* (1911): Used stereoscope images to create 3D images.

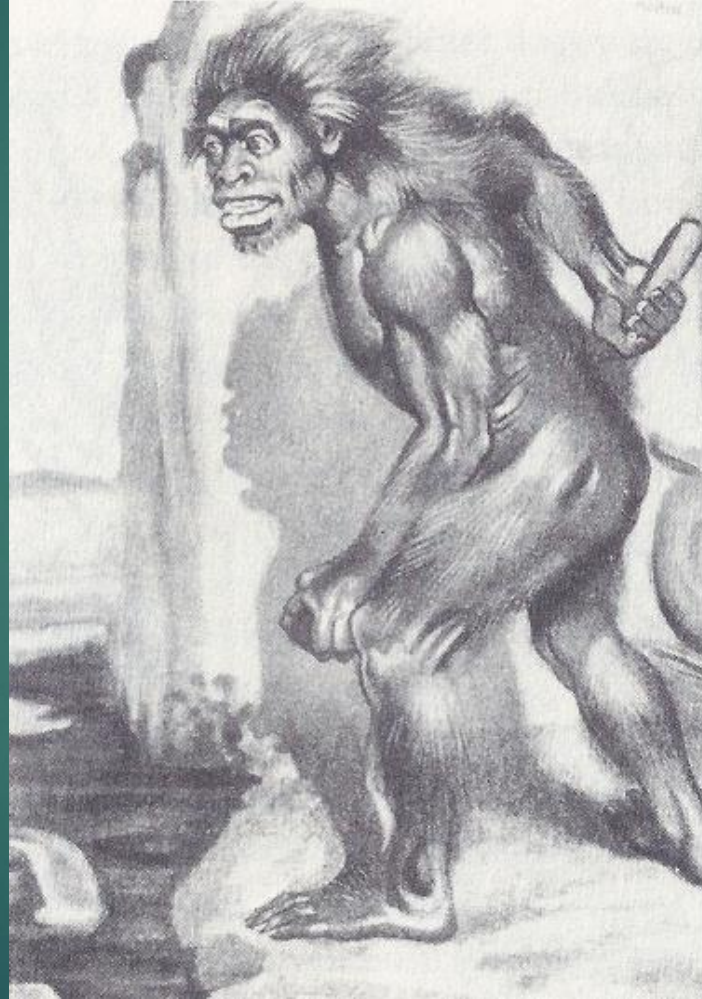


The first three stereographs from Boule's *L'Homme de La Chapelle* (1911) – Source: author's scan.



The last three stereographs from Boule's *L'Homme de La Chapelle* (1911) – Source: author's scan.

# 1909: Neandertal as Brute



Frantisek Kupka, 1909 bestial reconstruction, per Boule



# Negative depictions of Ns





# Neanderthals: Earlier Views



Until very recently, Neanderthals were most often depicted as brutish, dimwitted, “half man . . . half beast.”

# THE NEANDERTHAL MAN



He held them  
all in the grip of  
deadly terror  
nothing could  
keep him from  
this woman he  
claimed as  
his own!

CLASSIFIED BY  
ONTARIO BOARD OF CENSORS  
AS  
**ADULT ENTERTAINMENT**

STARRING  
ROBERT SHAYNE  
RICHARD CRANE  
DORIS MERRICK  
JOYCE TERRY  
Directed by E. A. DUPONT  
Written and Produced by  
AUBREY WISBERG and  
JACK POLLEXFEN  
A WARNER BROS. PRESENTATION  
DISTRIBUTED BY WARNER BROS. PICTURES  
RELEASED FROM WARNER ARTISTS

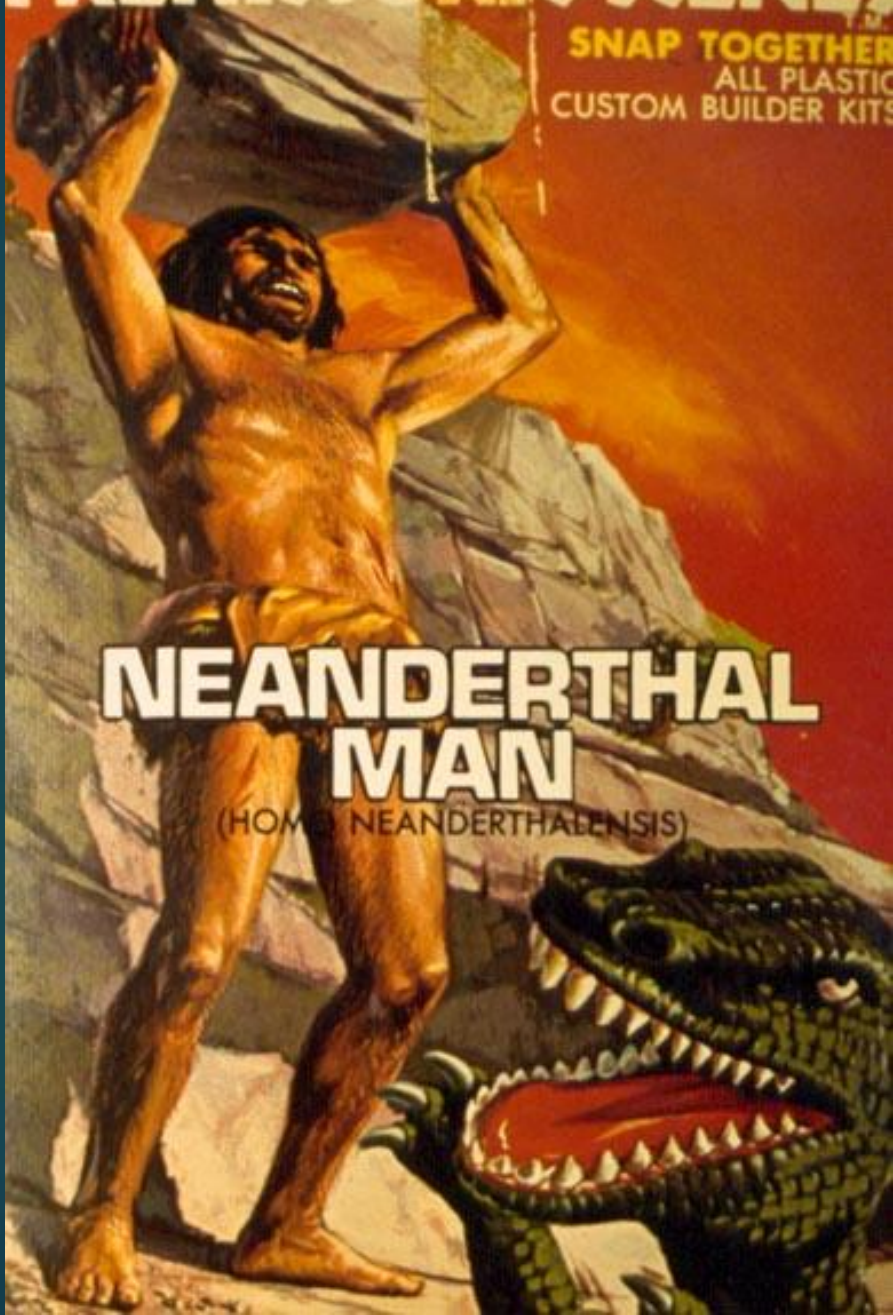
**HALF MAN... HALF BEAST...**

Neandertal as frat boy run amok.  
British behavior considered Neandertal.



**AURORA**  
**PREHISTORIC SCENES**

**SNAP TOGETHER**  
ALL PLASTIC  
CUSTOM BUILDER KITS



**NEANDERTHAL  
MAN**

(HOMO NEANDERTHALENSIS)

**NEANDERTHAL?**



**GET FAST RELIEF WITH**



**NEW!**  
**EVO-  
LOTION**

BEFORE

AFTER

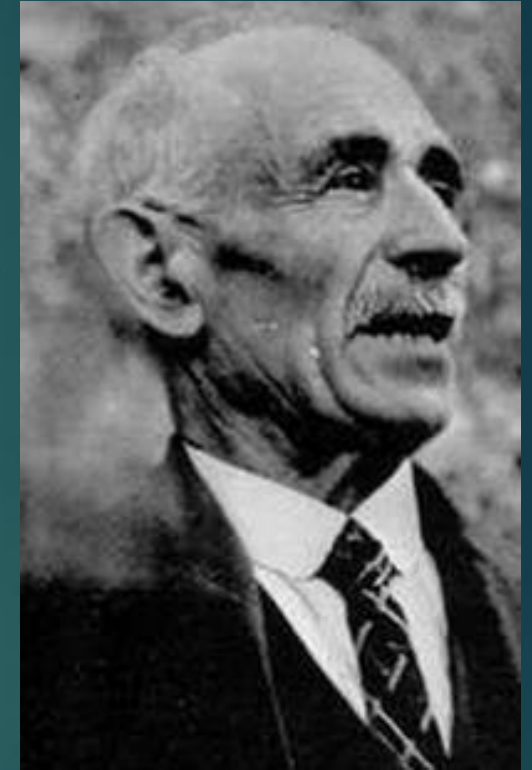
AVAILABLE IN TUBE, BOTTLE OR STONE JAR



Denis Peyrony (1869-1954):

## Discovery of most complete Neandertal skull at La Ferrassie

- ▶ School teacher and prehistorian
- ▶ 1909: With L. Capitan, discovered the largest and most complete Neandertal skull ever discovered, along with several other Neandertal fossils, in the rock shelter of La Ferrassie in southwestern France.
- ▶ Adult male and female Neanderthal skeletons, followed in later years by isolated bones of five children; first “family” burial; 8 in all
- ▶ Described by Jean-Louise Heim



1909, Discovery of most complete Neandertal skull at La Ferrassie, 50K



*Homo neanderthalensis*

(La Ferrassie 1)

Discoverer: Denis Peyrony & Louis Capitan

Locality: La Ferrassie, France

Age: 50K

Date: 1909

# Neanderthals and Sapiens

La Ferrassie 1



Cro-Magnon

At the same time in Europe



# Henri Martin:

Neandertal at different times at same site

- ▶ French archaeologist
- ▶ 1910: Discovered **two Neandertal skeletons with Mousterian scrapers** and other tools at La Quina Shelter, France
- ▶ 1905-1935: Excavated systematically by Dr. Henri Martin; first confirmed occurrence of Neandertal remains in multiple levels of an occupation site
- ▶ *Astragale humain du Moustérien moyen de La Quina. Ses affinités, Henri Martin, 1910*



# 1910: Neandertal, La Quina



# Charles Dawson (1864-1916): Piltdown Man Hoax

- ▶ English solicitor and antiquarian
- ▶ 1912: The pairing of a modern human cranium and a stained, broken orangutan jaw confirmed expectations of a human ancestor with a large, rounded braincase.
- ▶ Victim (or perpetrator?) of Piltdown Man hoax
- ▶ Negatively affected paleontology for 40 years





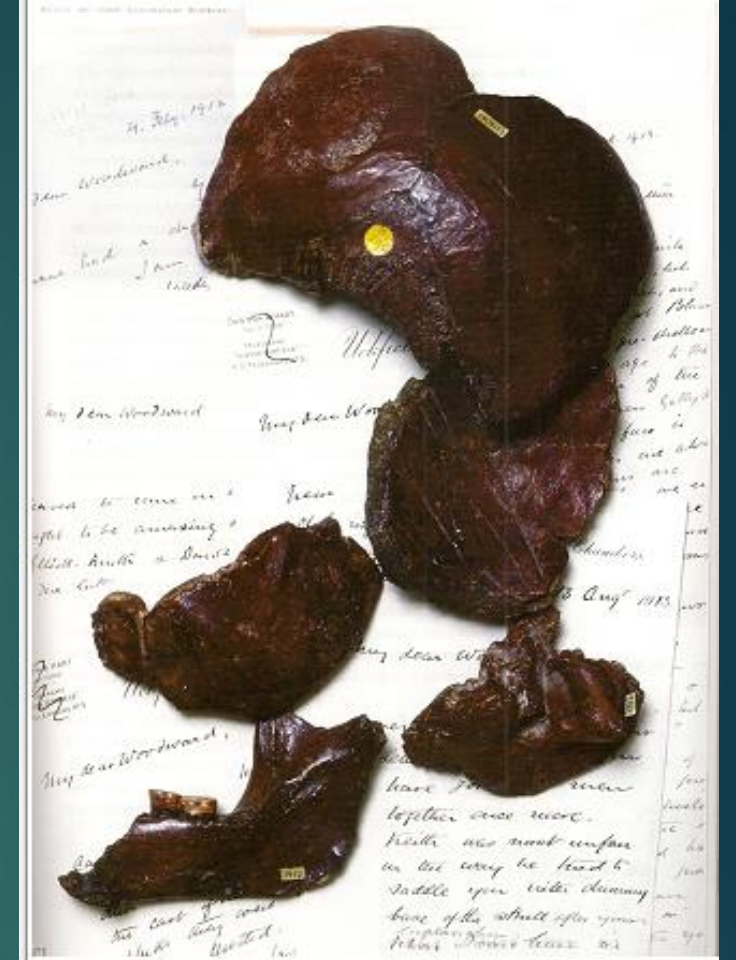
# Pitdown



Charles Dawson (seated) poses alongside Arthur Smith Woodward (R), Robert Kenwood Jr (L) and 'Chipper' the goose at the Pitdown pit in 1913 CREDIT: -/NATURAL HISTORY MUSEUM PICTURE LIBRARY



1912: *Eoanthropus dawsoni* ("Dawson's dawn-man"): a human skull & ape jawbone, in England



In 1908 workers digging in gravel pit at Piltdown, Sussex, handed fragments of a thick human skull to Charles Dawson; other pieces were also found. In 1912 Dawson gave iron-stained flints and "a portion of a human skull" to Arthur Smith Woodward. Woodward, as well as Pierre Teilhard de Chardin, worked at site, finding a apelike jaw and stone tools. Skull = 1070 cc; Woodward named it *Eoanthropus dawsoni*. In 1913, de Chardin found a lower apelike canine tooth. By 1915, Piltdown in Britain accepted as humanlike braincase & apelike jaw, ancestral to MHs. There were several reconstructions. Also a sculpted elephant bone, referenced as a cricket bat.



# Pitdown Committee: British Academic autocracy

France had Cro-Magnon,  
Germany had Neanderthal.  
Britain zero, until Pitdown.



The painting "The Pitdown Committee":

Back Row: F. O. Barlow, cast maker; Grafton Elliot Smith, anatomist; Charles Dawson, and Arthur Smith Woodward, zoologist.

Front Row. Dr A. S. Underwood, teeth expert; Arthur Keith, anatomist; W. P. Pycraft, zoologist; & Sir Ray Lankester, zoologist. Fr. Pierre Teilhard de Chardin is absent.

Estimated date of 500 Ka to 1 Ma.



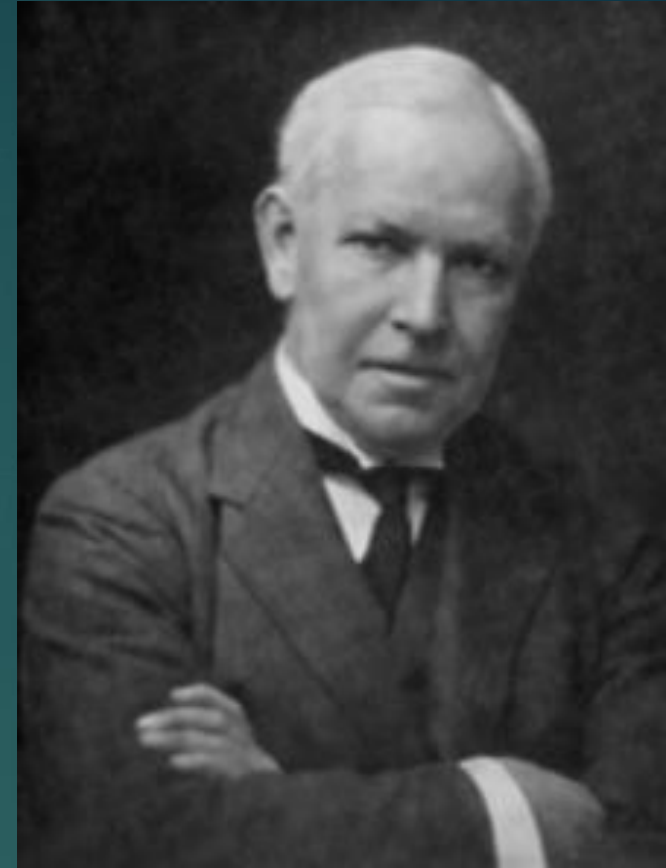
# Pittdown and Pre-sapiens theory

- ▶ Boule rejected Pittdown.
- ▶ But because of Pittdown, popularity of Pre-sapiens theory grew.
- ▶ **Pre-sapiens theory:** French paleoanthropologists of the time (& Henri Vallois in 1954) proposed the “pre-sapiens” theory, in which the line to modern-looking humans was said to have branched off before the appearance of the Neanderthals. A split occurred in human lineage in Pliocene: one branch led to rise of early appearance of modern humans, via Pittdown. Other branch led to Ns. Anthropologists believed that a non-Neandertal human ancestor should exist.
- ▶ Pittdown’s (& Galley Hill skeleton) very humanlike braincase from much earlier than the Neandertals made it seem that there were different types of humans coexisting throughout our evolution. Very modern-looking skulls at very early dates as evidence. (In the first half of the 20th century, no direct dating of specimens was possible).
- ▶ By early 1920’s, almost no paleoanthropologist supported Gustav Schwalbe’s theory that MHs stemmed from Ns. Except one.

# Sir Grafton Elliot Smith (1871-1937):

## Larger brain came first hypothesis

- ▶ Australian neuroanatomist and anthropologist, Univ. of Manchester
- ▶ The authority on primate brain during his life. Believed larger brain came first in human evolution
- ▶ Supported Piltdown; and M. Boule's interpretation of Neanderthal as brute; disliked Arthur Keith & Woodward
- ▶ Found lunate sulcus in human brain
- ▶ Supported M. Boule's contention that Neanderthal were unrelated to humans
- ▶ Teacher of Raymond Dart & Davidson Black
- ▶ Eventually supported Out of Africa theory



Sir Arthur Keith (1866-1955):  
Piltdown real & Taung Child is an ape

- ▶ Scottish anatomist & physical anthropologist
- ▶ One of foremost authorities on fossil humans in early 20<sup>th</sup> century Britain
- ▶ Believed in European origin of mankind
- ▶ “Authenticated” Piltdown man & *pithecanthropus erectus* for Dubois
- ▶ 1924: criticized Raymond Dart’s interpretation of Taung Child; believed he was an ape





# Arthur Keith

- ▶ **Pre-sapiens theory:** *H. erectus*, *H. neandertalensis* & *H. heidelbergensis* played little or no role in the evolution of modern humans.
- ▶ Defined the cerebral Rubicon test: 750 cc.
  - ▶ Small brains were apes; larger brains were human.
  - ▶ Test passed by Pithecanthropus; australopiths failed.
  - ▶ Rubicon would become one of the ongoing major fights in paleontology.
  - ▶ What made you human: for Keith it was brain size, for Leakey, tools, today it's bipedality.
- ▶ Involved in disproven Galley Hills skeleton; identified Gibraltar 1 as Neandertal

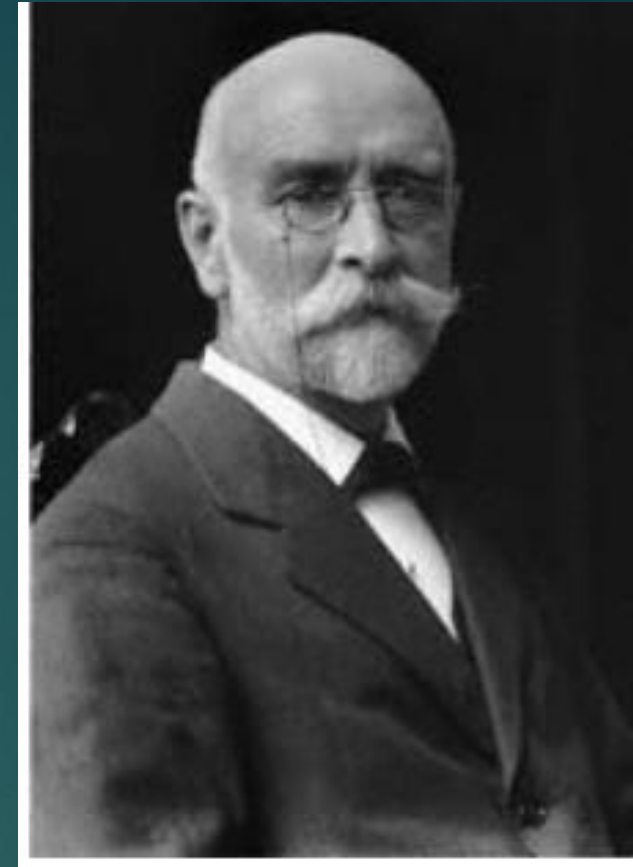
## 1888: Galley Hill Man



- British anatomist Arthur Keith (1866-1955) whose work profoundly affected investigations into the evolution of man. He is seen with **bones from the Galley Hill skeleton found in 1888** in gravel pits in the east of London.
- The deposits were ancient, but the anatomy of the bones was considered recent.
- **In 1910 Keith re-evaluated the bones** confirming their affinity with Homo sapiens, but **considered the bones to be as ancient as the deposits**.
- This supported his evolutionary view of the antiquity of modern man and that Java and Neanderthal man were not ancestors, but 'degenerate cousins'.
- In 1949, using fluorine tests, the bones were shown to be of recent origin,

## Sir Arthur Smith Woodward (1864-1944): *Eoanthropus dawsoni* & *Homo rhodesiensis*

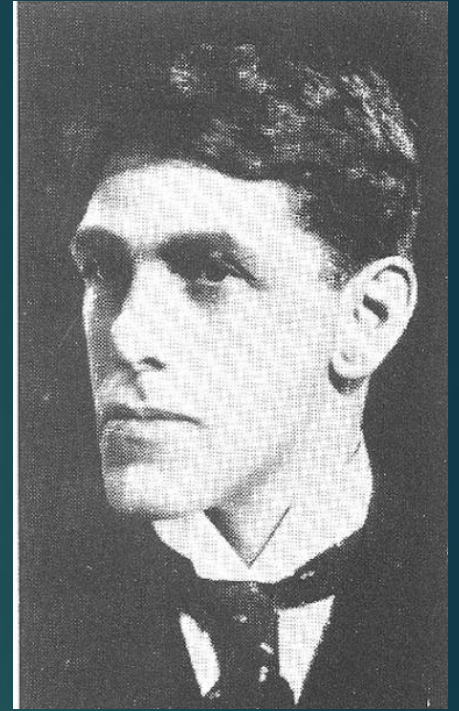
- ▶ British paleontologist and greatest fossil ichthyologist
- ▶ Keeper of geology at British Museum (Natural History)
- ▶ 1912: Charles Dawson gave Piltdown skullcap to him and helped find the jaw. Visited Piltdown for 20 years
- ▶ Named Piltdown skull as *Eoanthropus dawsoni* (Dawson's Dawn man); wrote *The Earliest Englishman*
- ▶ 1921: Swiss miner Tom Zwiglaar's skull discovery at Broken Hill (now Kabwe, Zambia) sent to Woodward; called it *Homo rhodesiensis* (now *Homo heidelbergensis*)





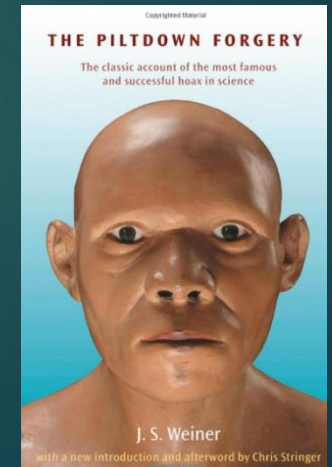
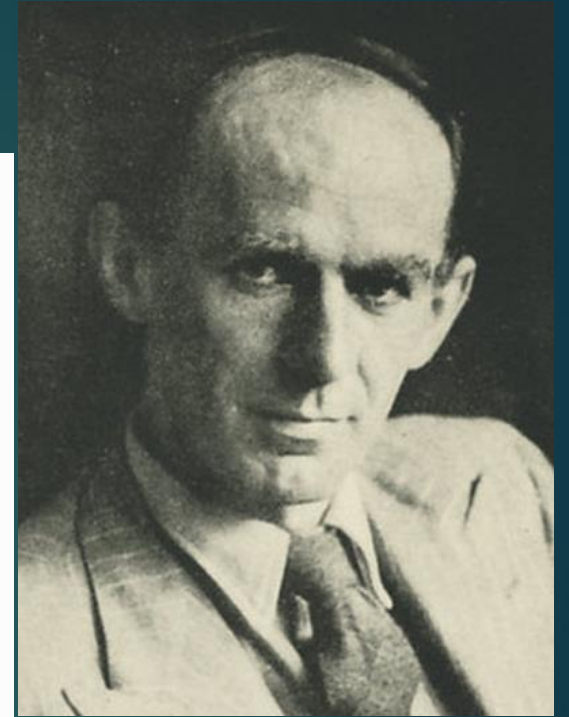
## Martin Alistair Campbell Hinton (1883 –1961)

- ▶ Volunteer then staff; Curator of Zoology at British Museum
- ▶ Often cited as a suspect in Piltdown forgery
- ▶ 1970: A trunk belonging to Hinton left in storage at the Natural History Museum and contained animal bones and teeth carved and stained in a manner similar to the Piltdown finds, and raising questions about Hinton's involvement in the deception.
- ▶ Disliked Woodward & was jokester



# Kenneth Page Oakley (1911-1981): Piltdown was a hoax

- ▶ British geologist
- ▶ British Museum
- ▶ Known for his fossils by fluorine date actual fossil sediments.
- ▶ 1953: Instrumental Piltdown Man
- ▶ Piltdown: less than 1% of human brain capacity  
orangutan jaw





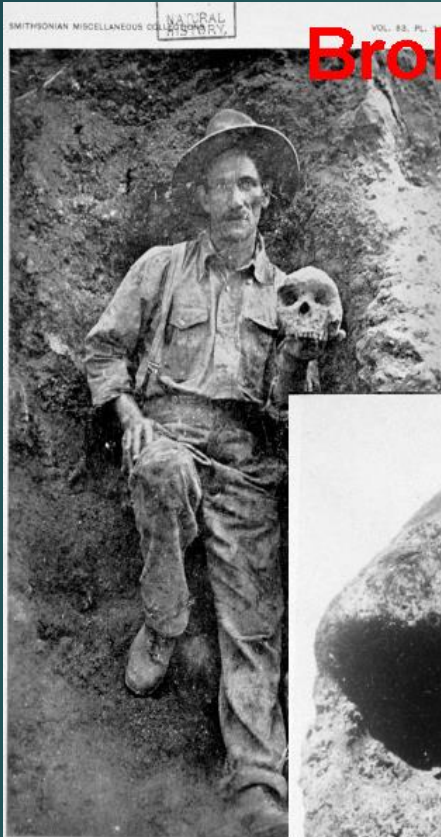
# Pittdown Hoax: Fossils and the media

- ▶ Each piece had been stained red to look as if they were from the same skull while the teeth had been flattened with a metal file, and putty used to embed them, and the "cricket bat" was carved with a knife
- ▶ More than **30 individuals have been accused of being Pittdown hoaxers: Charles Dawson** was almost certainly involved (a number of his other finds turned out to be hoaxes). By age 45 he'd written or co-authored more than 50 scientific articles, but no recognition. Dreamed of being elected a fellow of the Royal Society. He was always present at findings.
- ▶ **Other candidates** include Arthur Conan Doyle (played golf at Pittdown, disliked scientists), Pierre Teilhard de Chardin (a practical joker from nearby seminary), Arthur Smith Woodward, Arthur Keith, and Martin Hinton
- ▶ **Importance of Pittdown:** Despite it's being a hoax and impeding progress in paleoanthropology, **it was Pittdown that brought the human fossil record into the public eye and established the pattern of media sensationalism of human fossil discoveries.**

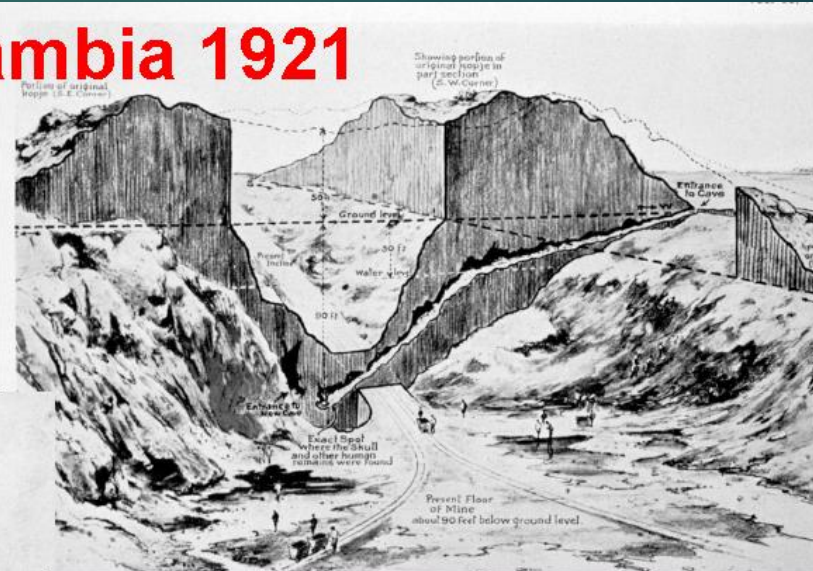


# The first African Hominin

## Broken Hill, Zambia 1921



Mr. Zwigelaar, the discoverer of the Rhodesian skull, sh  
(Photograph given Hellička by Mr. Zw

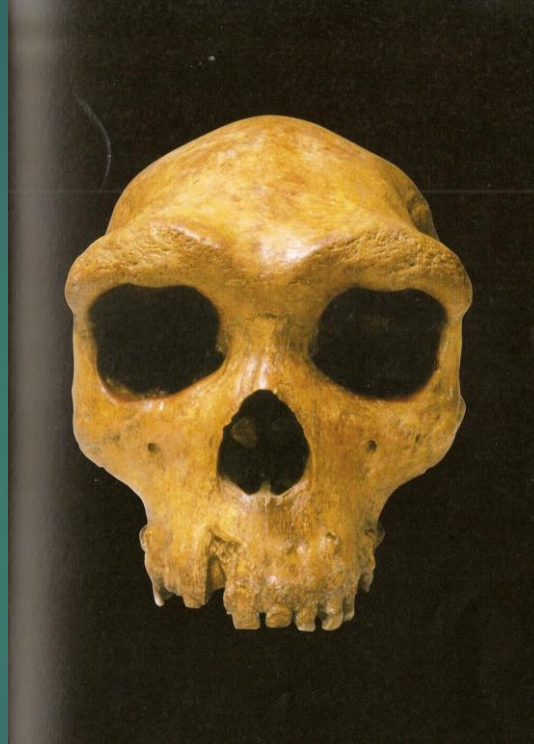


# 1921: Rhodesian Man (*Homo heidelbergensis*) - Broken Hill, Kabwe, Zambia

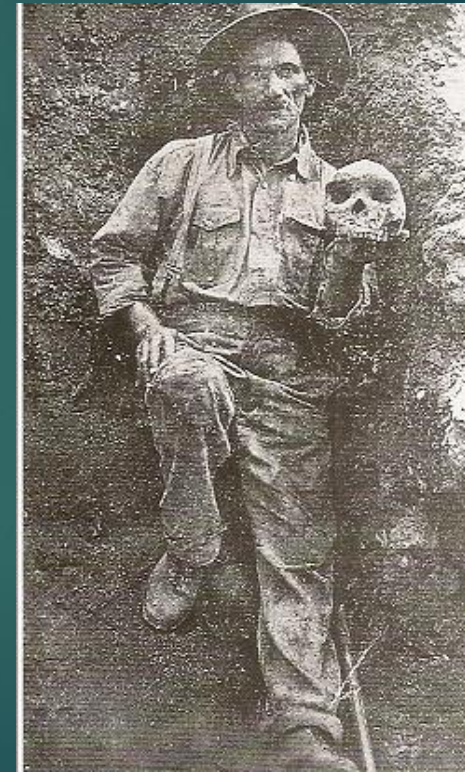
- ▶ The first hominin fossil discovered outside Europe



10 cavities, left ear wound



*Homo heidelbergensis*  
(Broken Hill 1)  
Discoverer: Tom Zwigelaar  
Locality: Kabwe, Zambia  
Date 1921  
Age: 300K



Tom Zwigelaar



## Broken Hill: 1280 cc



Heavy browridges (supraorbital torus), slightly keeled & constricted frontal bone, short parietals that show little bossing, acutely flexed occiput with prominent occipital torus, lateral expansion of the mastoid & supramastoid regions, and extensive paranasal sinus development; severe dental decay; several pathological lesions in left temporal bone

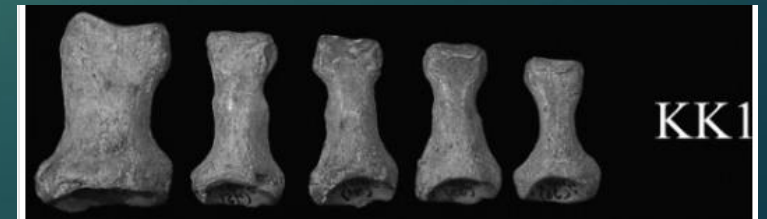
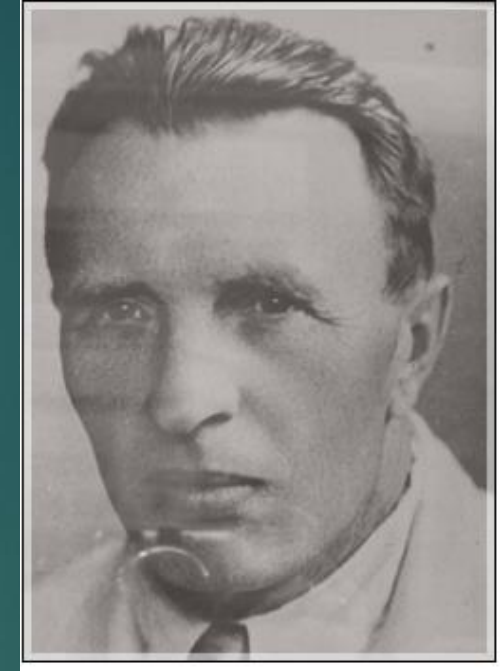
**Cranial volume = 1280 cc**

Femoral fragments lack *erectus* elongated femoral neck, but have thickened cortical bone on lateral side; tibia has modern rounded anterior crest and posteromedial/lateral angles; otherwise modern postcranially



# Gleb Anatol'evich Bonch-Osmolovskii (1890-1943): Neandertals in Russia

- ▶ Soviet anthropologist and archaeologist.
- ▶ 1924: in the Kiik-Koba cave (Crimea), Bonch-Osmolovskii discovered the first Neanderthal fossil in the USSR.
- ▶ Two skeletons, a child and an adult
- ▶ Imprisoned in the Gulag for involvement in "nationalist fascist organization."





Box in which **Taung child** fossils reside: The Taung skull is in a repository at the University of Witwatersrand.

Dean Falk has called it "**the most important anthropological fossil of the twentieth century.**"

## Raymond Dart (1893-1988):

Taung Child: Bipedalism, not a large brain, came first

- ▶ Australian South African anatomist
- ▶ Professor of anatomy at Univ. of Witwatersrand, Johannesburg, S. Africa
- ▶ 1924: Taung child's cranium is the first African early hominin
- ▶ Changed course of human paleontology with this discovery of the first *Australopithecus africanus*, the Taung child, an erect walking hominin
- ▶ Interpretation of this fossil as human ancestor largely rejected by the British scholars for 30 years (Arthur Keith, Grafton Elliot Smith, & Arthur Smith Woodward) due to belief in Piltdown.
- ▶ 1945: Makapansgat: bones & use of "fire", *A. prometheus*
- ▶ Dart later developed erroneous Osteodontokeratic (bone, tooth, horn) culture theory of use of antlers as weapons: "murderers & flesh hunters", "killer ape"; highly criticized theory



# Raymond Dart



# Taung child

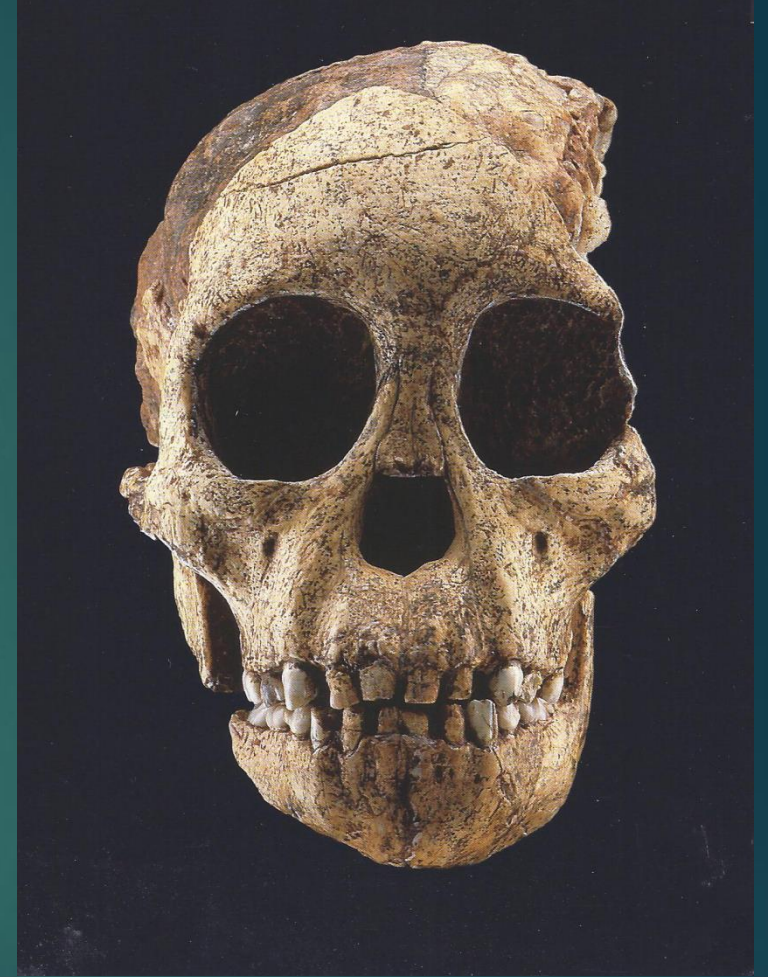
- ▶ Small cave exposed during mining at Buxton Limeworks at Taung, S. Africa
- ▶ Delivered in box on wedding day of friend; Used his wife's sharpened darning needles, spent 6 months to expose face from rock
- ▶ Based on small canines, backward placement of lunate sulcus, and location of foramen magnum (bipedal), published article in *Nature* in 1925, "*Australopithecus africanus: The Ape-Man of South Africa*"
- ▶ Only initial support was from Robert Broom
- ▶ Music Hall jokes: "Who was that girl I saw you with last night; is she from Taung?"
- ▶ Went to Europe in 1931: Wife Dora left Taung fossil in back of taxi cab (for 2 days; police thought they had a murder case). Returned to Dart.
- ▶ 1947: Arthur Keith conceded "Professor Dart was right, and I was wrong."; called it Dartian, not hominid



1924: *First Australopithecus africanus*, Taung Child,  
2.8 Ma; 3.3 years old, bipedal  
440 cc, First brain endocast to be discovered



*Australopithecus africanus* (Taung Child; type)  
Discoverer: M. de Bruyn, Robert Dart  
Date: 1924  
Locality: Taung, S. Africa  
Age 2.8 M



**Killed by eagle:** puncture marks at  
bottom of orbits & presence of  
eggshells & small animal remains  
at site



# Robert Ardrey (1908-1980): Screenwriter & anthropology writer

▶ American  
academic

▶ Met Raym  
phase

▶ Wrote Afr  
(1966), The  
Hypothes  
in paleoar

▶ Proponen  
theory. The work of anthropologist Raymond Dart, ethologist  
Konrad Lorenz, and writer Robert Ardrey thought that our  
species had been born from a violent, “blood bespattered”  
past



# Dorothy Garrod (1892-1968): **Levant Ns** **First Neandertal outside Europe, Tabun I**

- ▶ British archaeologist; Fellow at Newham College; first woman professor at Cambridge University
- ▶ **\*\*1925: excavated a Neandertal child's skull at Devil's Tower Cave, Gibraltar.**
- ▶ **\*\* 1928-1934: Leader of British School of Archaeology's excavations at Mt. Carmel caves, Palestine (Israel), in the caves of Tabun, El Wad, Es Skhul, Shuqba and Kebara; **Tabun was first Neanderthal burial found in Middle East.****
- ▶ **1932: Skeleton of female Neandertal, Tabun I, excavated at Tabun Cave, Palestine, the first confirmed discovery of Neandertals outside Europe.**
- ▶ 'Mount Carmel Man' in 1930





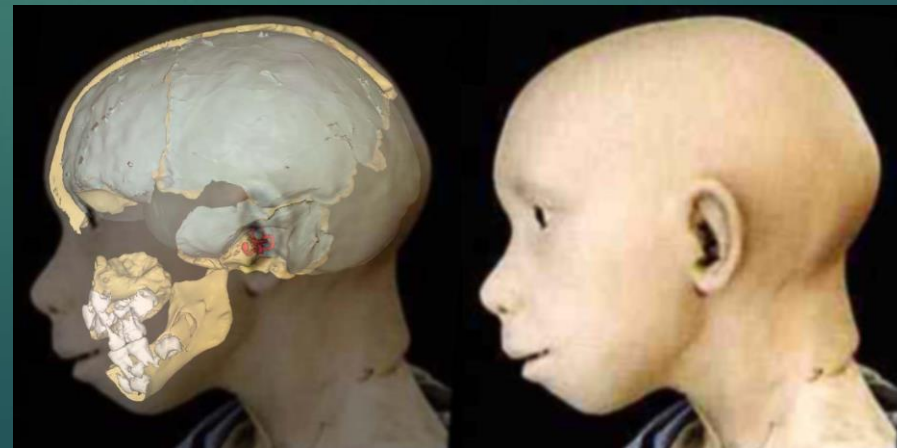
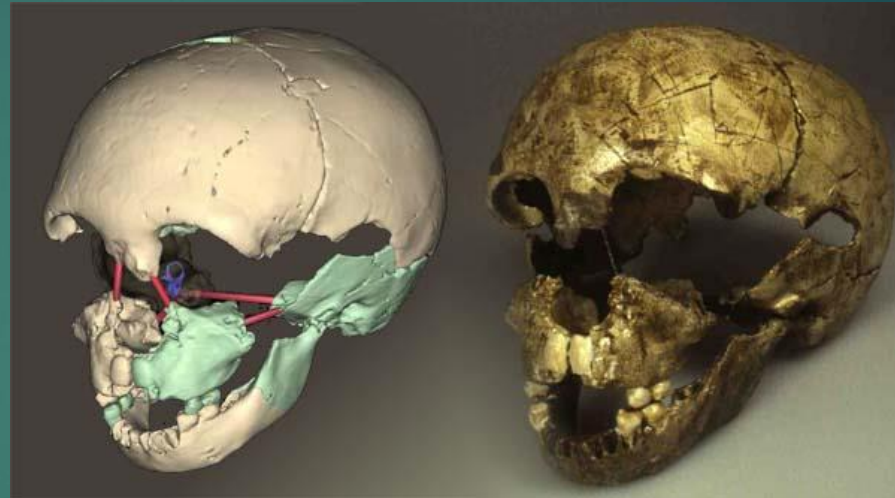
# 1925: Neandertal child, Devil's Tower, Gibraltar; Gibraltar 2 skull



**Teeth** show developmental disorders consistent with **seasonal starvation**. Gibraltar Ns among the last of their species; the **Iberian Peninsula** acted as a “refuge” for the retreating Neanderthal populations and Gibraltar community as having been the last, existing until around 24 Ka; **10 sites**; **mild climate** for over 125,000 years; **same hearth in Gorham's Cave** used for over 8,000 years

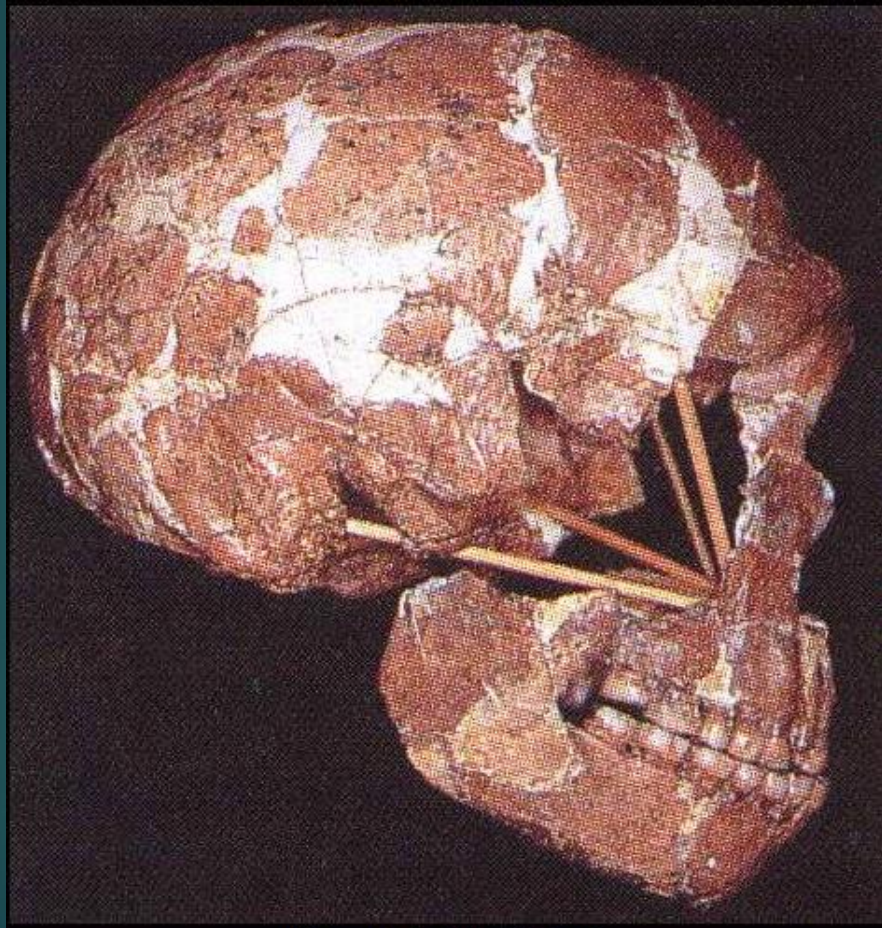


## Famous Gibraltar Child reconstruction: A Neandertal Child

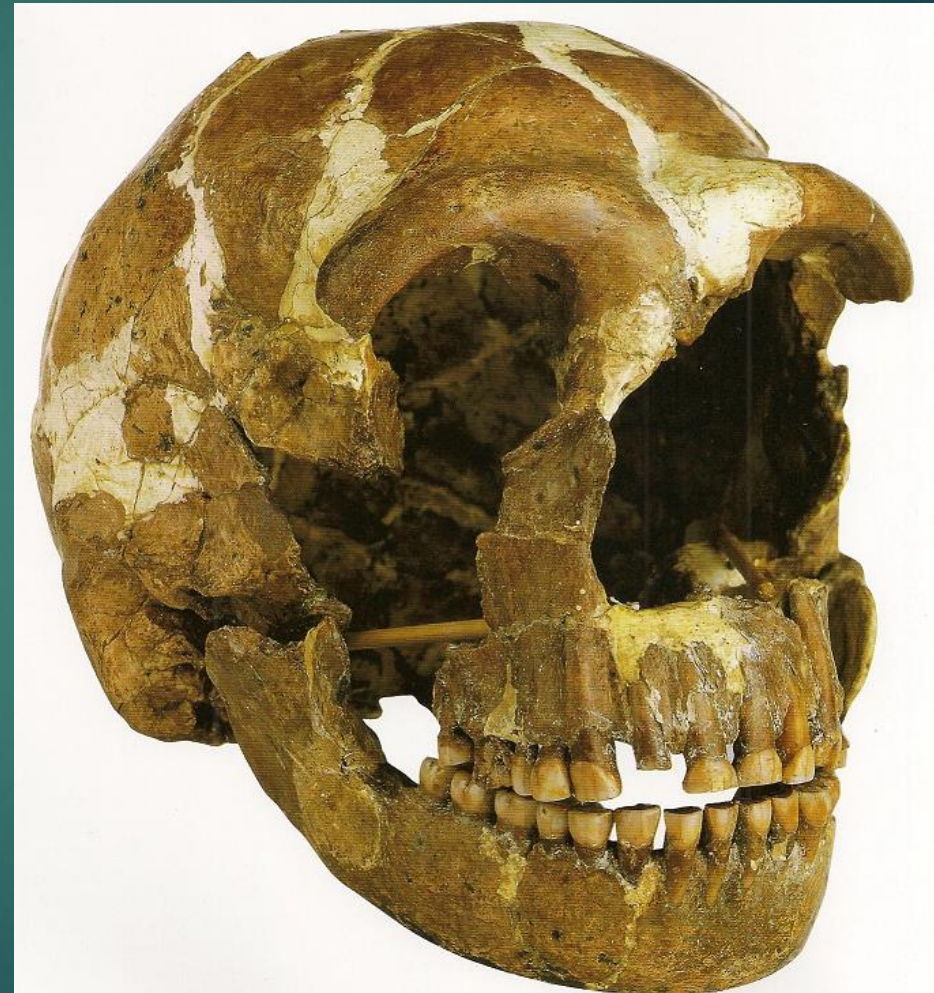




1932: Neandertal, Tabun I, Mount Carmel, Palestine;  
the first confirmed discovery of Neandertals outside Europe.



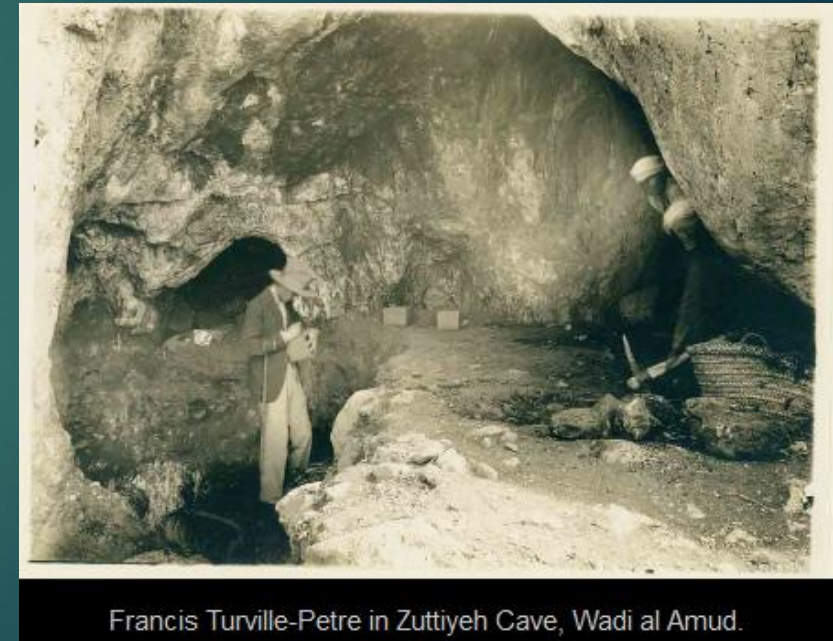
Photograph by Milford Wolpoff.





# Francis Turville-Petre (1901 - 1941): Neandertal in Palestine: Galilee Man

- ▶ Openly gay English anthropologist
- ▶ 1925: discovered in the Zuttiyeh Cave near Sea of Galilee, the partial frontal cranial remains of a Neanderthal individual, named the 'Galilee Skull' or 'Galilee Man'; first ancient fossilized hominin found in Western Asia.
- ▶ He later worked with Dorothy Garrod in her excavations at Kebara Cave on Mount Carmel.
- ▶ Was a close friend of Christopher Isherwood and W. H. Auden



Francis Turville-Petre in Zuttiyeh Cave, Wadi al Amud.



# 1925: Neandertal, Galilee Man

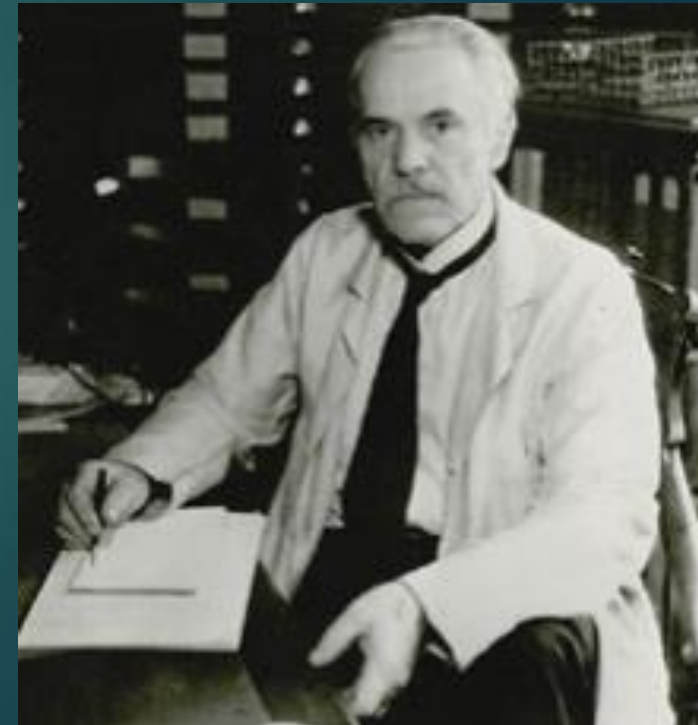
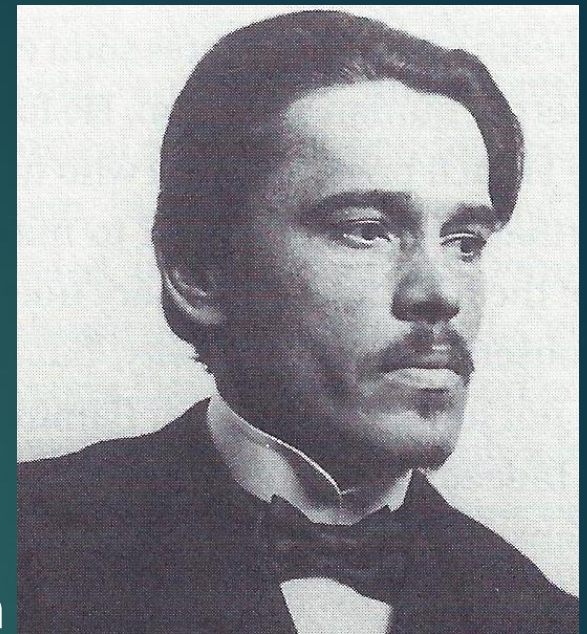


Dated at > 250 Ka; probably *H. heidelbergensis* as regional variant

# Ales Hrdlicka (1869-1943):

## American anthropology; Siberian Land Bridge

- ▶ Bohemian born American physician and physical anthropologist, Smithsonian/NMNH; Conducted massive anthropometric studies
- ▶ Research & theory of movement into the New World via land bridge from Siberia; challenged evidence for early fossil humans in the Americas
- ▶ Questioned Piltdown skull & Taung child (ape) & *Ramapithecus* as hominid
- ▶ 1912: tried, but not allowed, to see Dubois's fossils
- ▶ 1927: believed Neandertals were ancestors of modern humans and that Europe was origin place of humanity



## China

- Geological Survey of China 1917
- J. Gunnar Anderson
- dragon bones
- *Sinanthropus pekinensis*





# Zhoukoudian

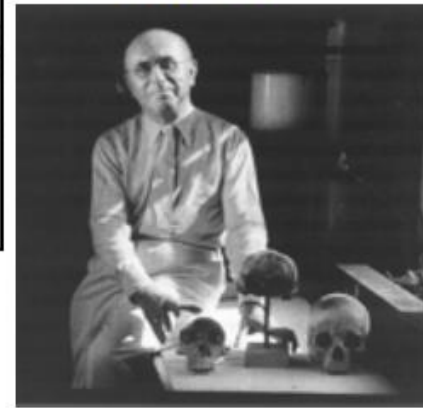
## Zhoukoudian



**Davidson Black**



**Franz Weidenreich**



**Pei Wenzhong, 1929**

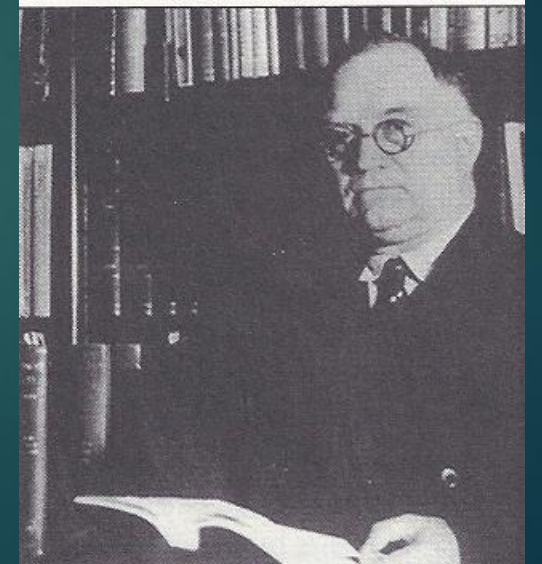
## Zhoukoudian

### ■ 1941 – Camp Holcomb



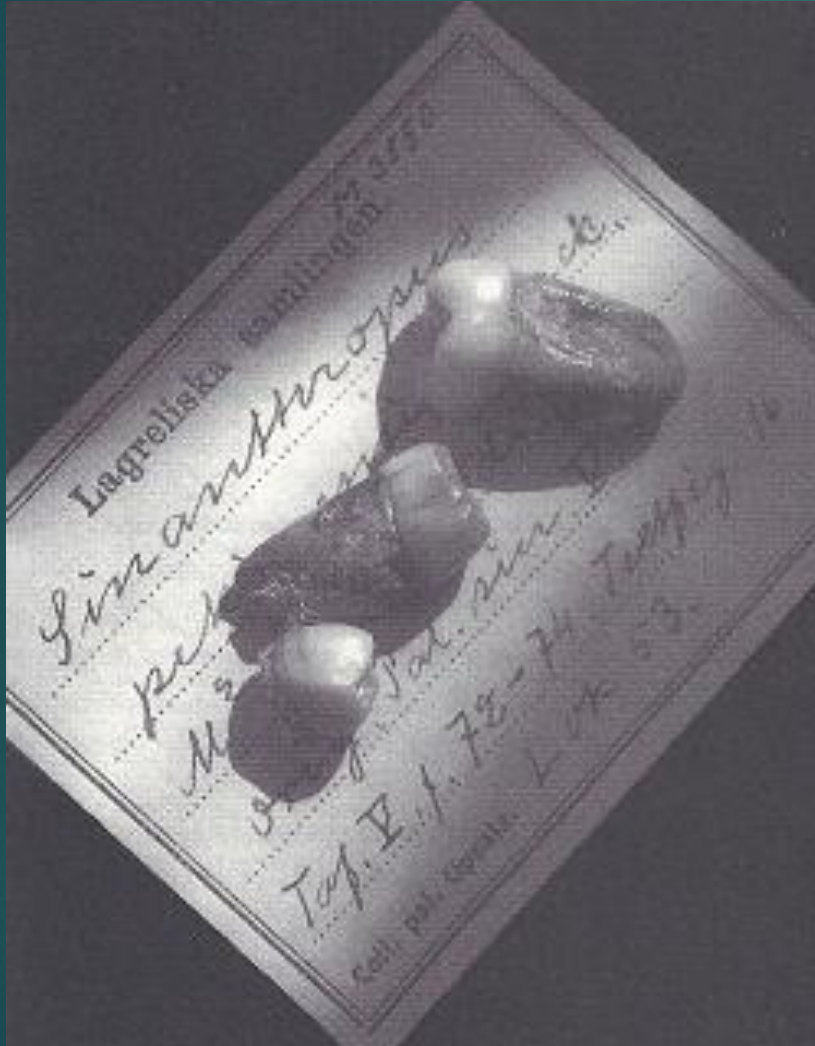
# Johan Gunnar Andersson (1874-1960)

- ▶ Swedish Geologist
- ▶ Associated with the beginnings of Chinese archaeology between 1914-1926
- ▶ Confirmed fossil bones near Choukoutien (Zhoukoudian), China, in 1918
- ▶ Helped create excavation at Dragon Bone Hill at Longgushan, China





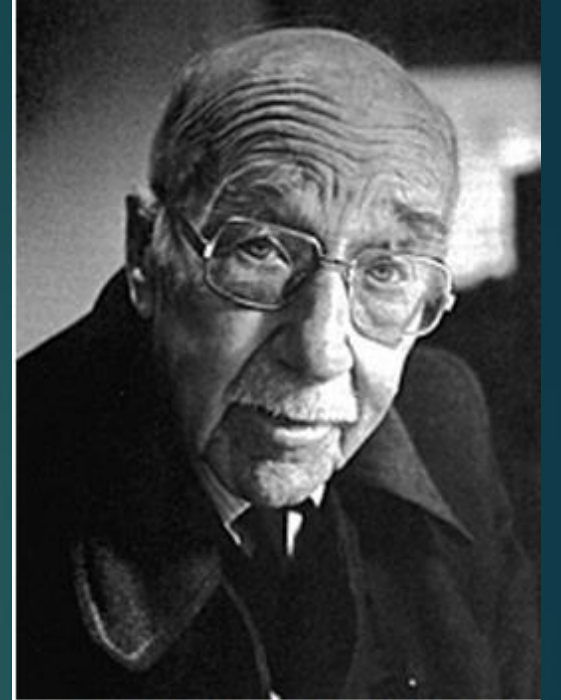
1921: 1<sup>st</sup> 2 molars, *Homo erectus*, Peking Man, Dragon Bone Hill at Zhoukoudian, China, from apothecary shop



The Chinese, historically, believed that fossilized teeth (*longgu*) were dragon's teeth and were routinely sold in apothecary shops to be ground up for medicinal purposes (seizures in children, etc.)

# Otto A. Zdansky (1894 - 1988): Discovery of Peking Man

- ▶ Austrian paleontologist
- ▶ Worked in China, where he, as an **assistant to Johan Gunnar Andersson**
- ▶ **\*\* 1921: Discovered two fossil teeth of the Peking Man, *Homo sinanthropus*, at the Dragon Bone Hill at Zhoukoudian**
- ▶ **Did not disclose it until 1926 when he published it in *Nature* after an analysis by Davidson Black.**



Professor Otto Zdansky. Foto Clas Thor 1984. Reproducerad med tillstånd.

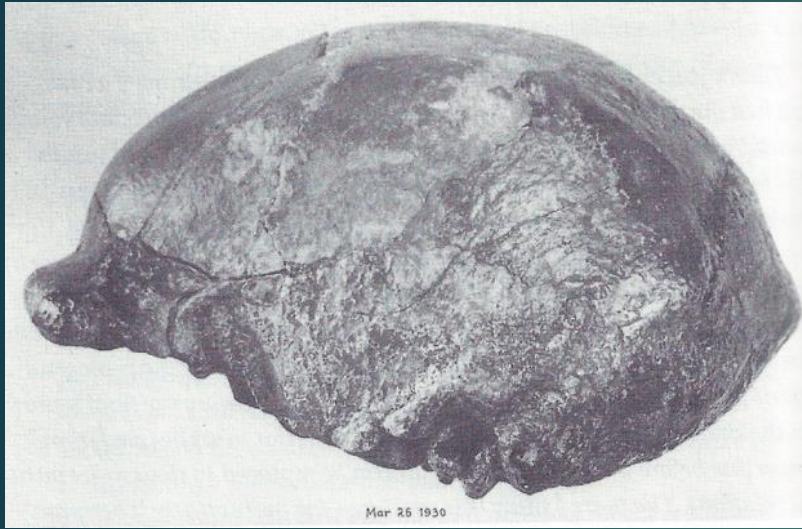
# Davidson Black (1884-1934): *Sinanthropus pekinensis*

- ▶ Canadian physician and anatomist
- ▶ **\*\* 1927: described 2 molars, and later a molar & a skull, and named it *Sinanthropus pekinensis* (now *Homo erectus pekinensis*) or the “Peking Man” at Choukoutien (Zhoukoudian) Cave; 300K (molar found by Dr. Birger Bohlin; skull by Wenzhong Pei)**
- ▶ **Founder & 1<sup>st</sup> director of Cenozoic Research Laboratory (Geological Survey of China) at Peking Union Medical College**
- ▶ **\*\* Black's theory of an Asian origination wrong, Black's work greatly advanced our knowledge of the development of human beings in Asia.**





1928: *Sinanthropus pekinensis*: Zhoukoudian Cave, China  
(now *Homo erectus pekinensis*), Peking Man, 680-780 Ka, 850-1100 CC



Mar 26 1930

*Homo erectus*  
(Peking Man)

Discoverer: W. C. Pei

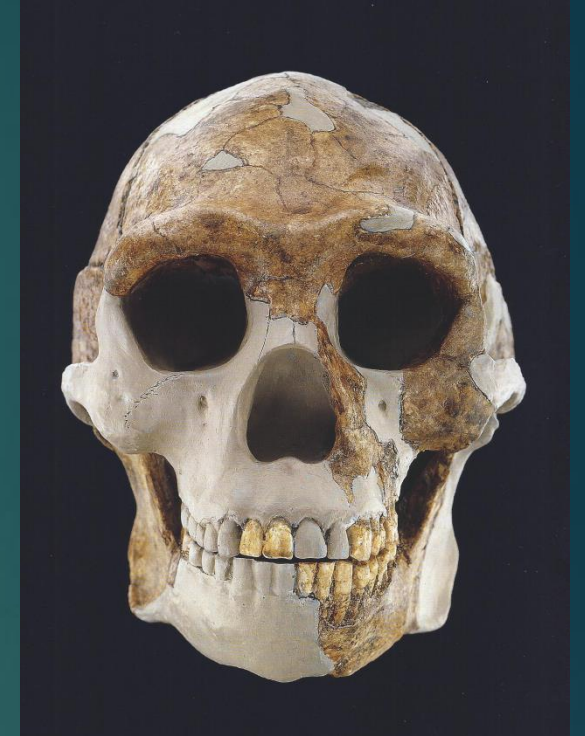
Date: 1928-1937

Locality: Zhoukoudian Cave, China

Age 300-600 K



*Homo erectus*,  
original cast of Peking Man



*Homo erectus*, reconstruction

Zhoukoudian produced some 17,000 stone artefacts , 200 human fossils, fossils of 50 *H. erectus* individuals, including 6 nearly complete skullcaps

# Davidson Black: Zhoukoudian, China - Peking Man

- ▶ Canadian anatomist **Davidson Black's** (1921): initial description of a **lower molar**, which was dubbed ***Sinanthropus pekinensis***; most of the early and spectacular discoveries of this taxon took place at **Zhoukoudian in China in 1929**.
- ▶ German anatomist **Franz Weidenreich** provided much of the **detailed description of this material** in several monographs published in the journal *Palaeontologica Sinica* (Series D).
- ▶ **\*\* Nearly all of the original specimens were lost during World War II**; however, authentic Weidenreichian casts do exist at the American Museum of Natural History in New York and at the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing, and are considered to be reliable evidence.

# Zhoukoudian, China

- ▶ Franz Weidenreich, who replaced Black in China after the latter's death in 1933, argued that *Sinanthropus* was also a transitional fossil between apes and humans, and was in fact so similar to Java's *Pithecanthropus* that they should both belong to the same group. Dubois rejected these interpretations.
- ▶ Based on Weidenreich's work and on his suggestion that *Pithecanthropus* and *Sinanthropus* interbred, German biologist Ernst Mayr reclassified them both as being part of the same species: *Homo erectus*.
- ▶ He proposed this conclusion in a paper he presented at the Cold Spring Harbor Symposium in 1950. A "revolution in taxonomy", his "single-species" approach to human evolution was quickly accepted. And later rejected by paleontologists.



# Zhouhoudian: 500-700 KA, 850-1100 CC

## ▶ 15 Localities



Peking Man Site (Locality 1)



Locality 3



Locality 4



Locality 5



Locality 12



Locality 15



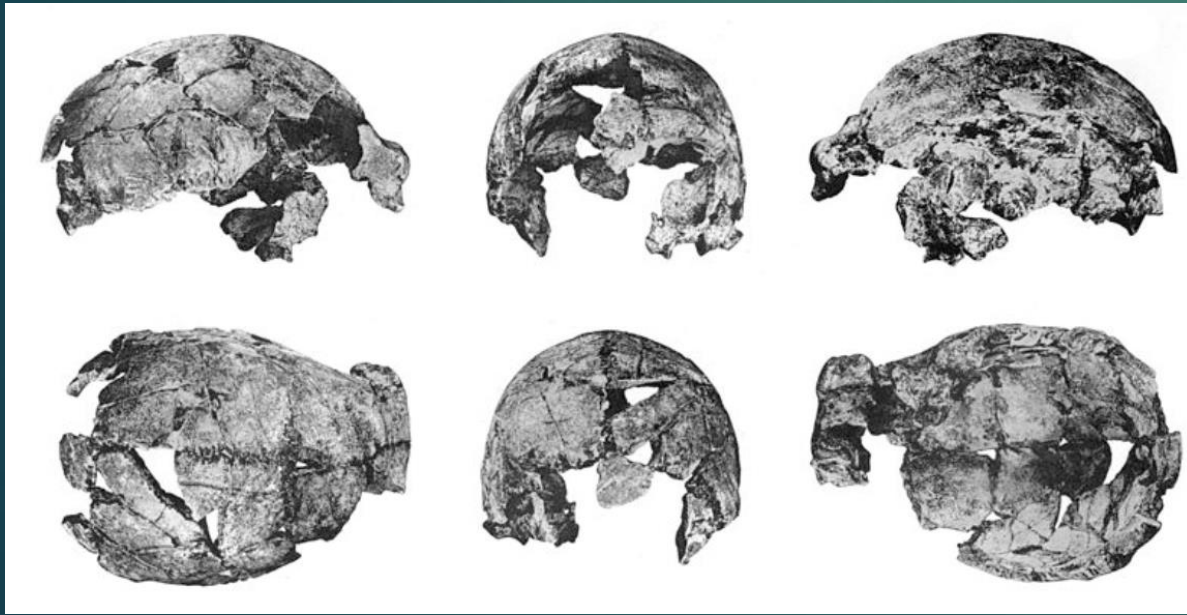
Site of skull find in 1966



A reconstruction of Peking Man

## Locality 1: 500-300K

- ▶ Between 1929 and 1937, 15 partial crania, 11 mandibles, many teeth, some skeletal bones and large numbers of stone tools were discovered in the Lower Cave at Locality 1. The original fossils disappeared in 1941, but excellent casts and descriptions remain.



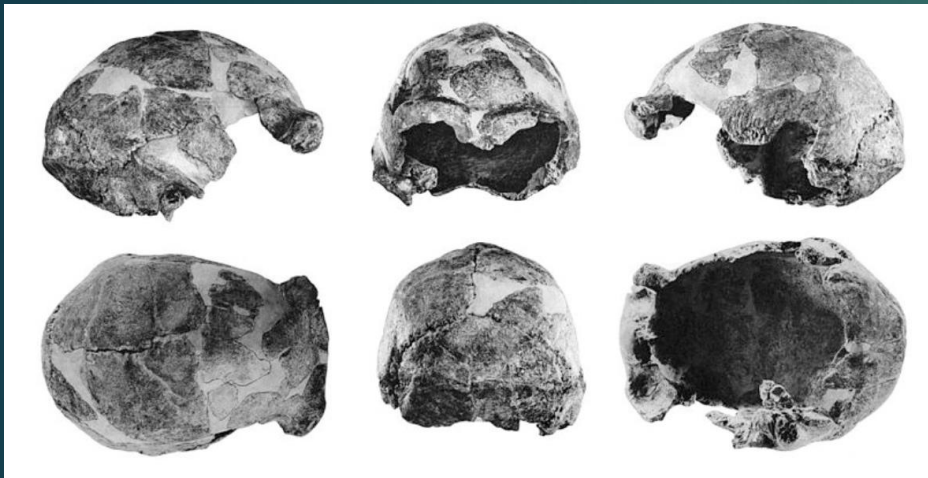
Skull II: 1030 CC



Skull III: 915 CC



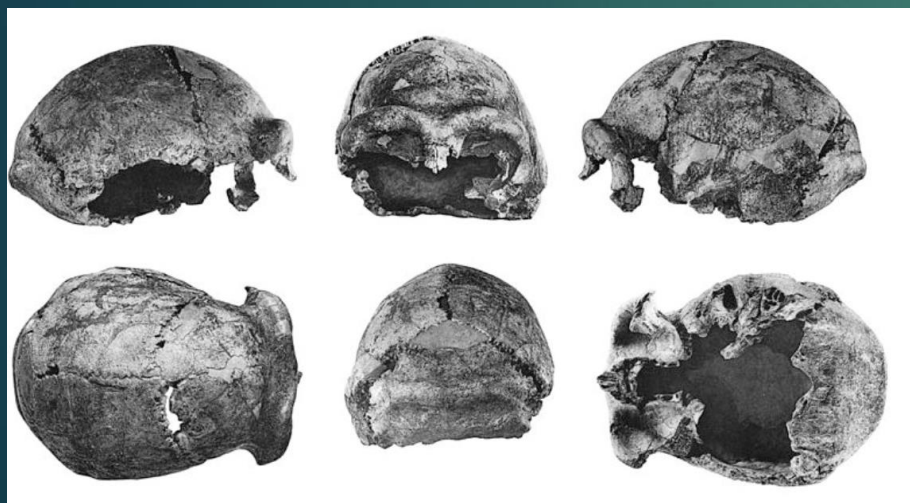
# Locality 1



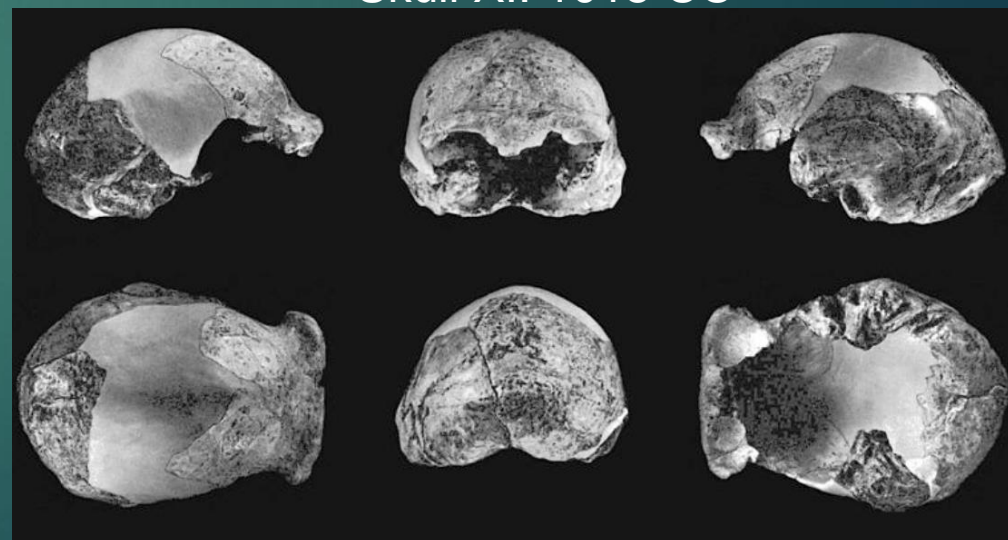
Skull X: 1225 CC



Skull XI: 1015 CC



Skull XII: 1030 CC



Skull V: 1140 CC

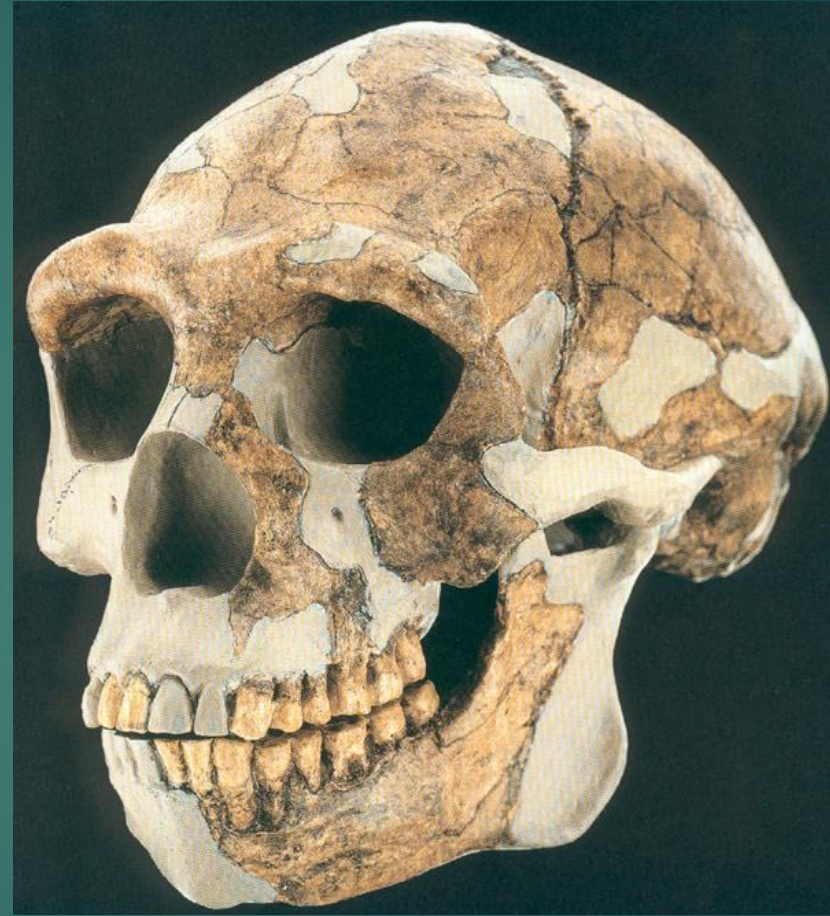


# Peking man and reconstructed endocasts: less asymmetry

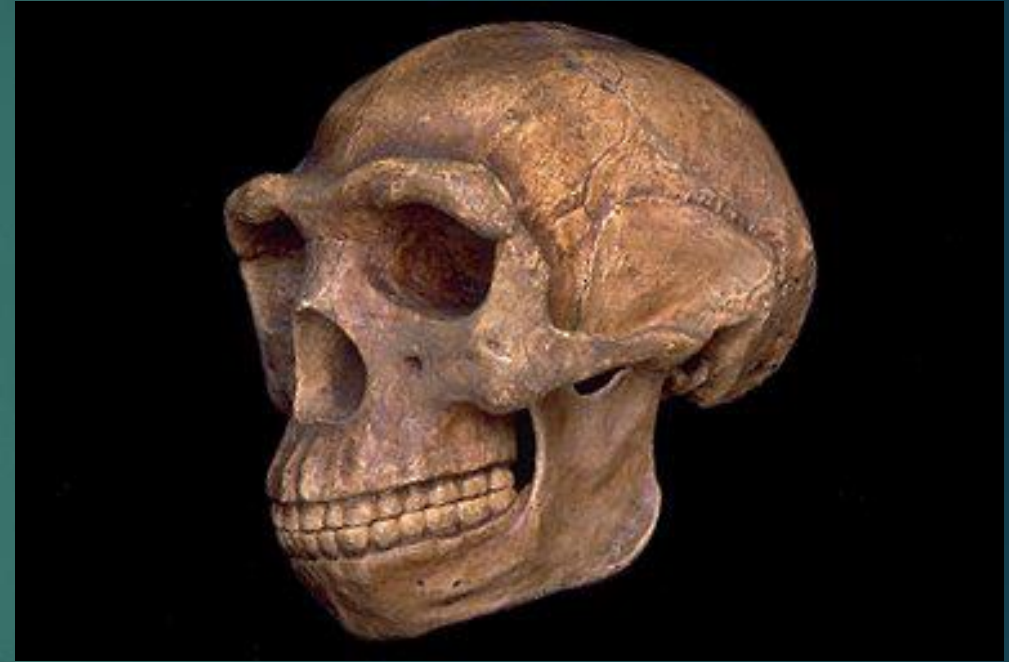


Zhoukoudian: .5-.7 M, 850-1100 CC

Peking Man



# Peking Man reconstructions: 680-780 Ka, 850-1100 CC





# Zhoukoudian 1929: Chinese *H. erectus* gang (founders of Chinese paleontology)



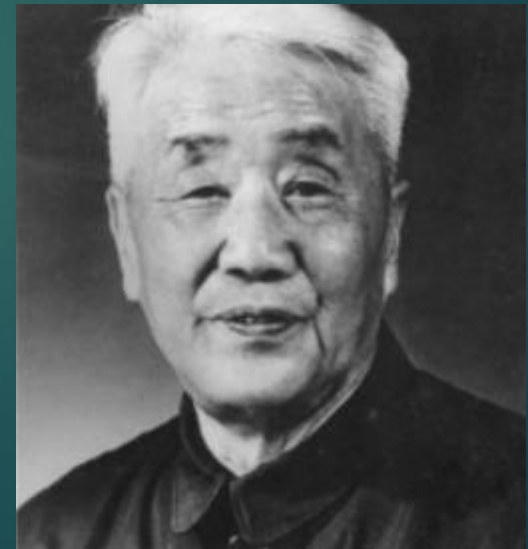
Wenzhong Pei, x, x, Zhongjian Yang,  
Birger Bohlin, Davidson Black, Teilhard  
de Chardin, George Barbour



Zhoukoudian: 5 skulls,  
15 partial skull pieces,  
14 lower jaws, 152 teeth

# Wenzhong Pei (1904-1982): Chinese paleoanthropology

- ▶ Chinese paleoanthropologist
- ▶ A founding figure of Chinese anthropology.
- ▶ Director of Cenozoic Research Laboratory
- ▶ \*\* 1927: Pei found the first skull of *Sinanthropus pekinensis* (now *Homo erectus*)
- ▶ Field director of excavations at Zhoukoudian



# Zhongjian Yang (1897-1979): Zhoukoudian excavation leader

- ▶ Also known as C.C. (Chung Chien) Young
- ▶ One of China's foremost paleontologists. Founded China's Institute of Vertebrate Paleontology and Paleoanthropology in Beijing
- ▶ \*\* He has been called the 'Father of Chinese vertebrate paleontology'.
- ▶ \*\* 1928: worked for the Cenozoic Research Laboratory of the Geological Survey of China and took charge of the excavation at Zhoukoudian

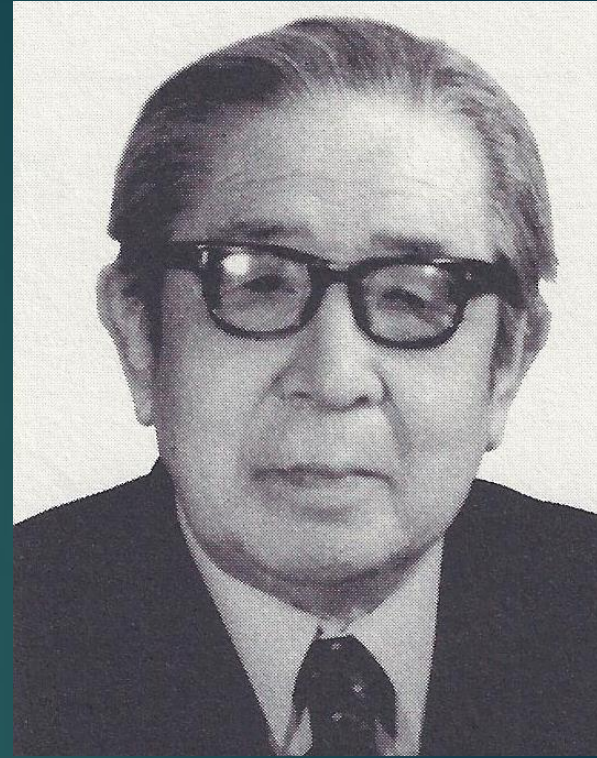




## Jia Lanpo (1908-2001):

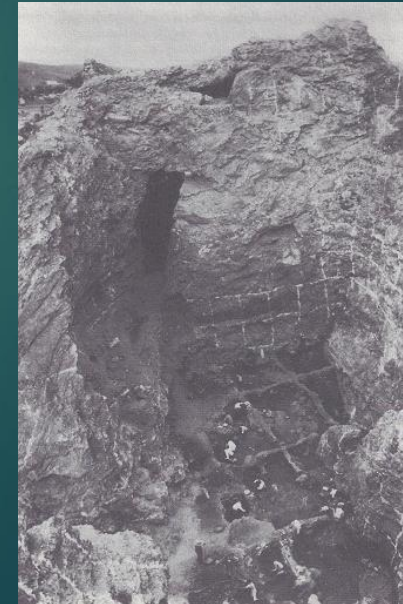
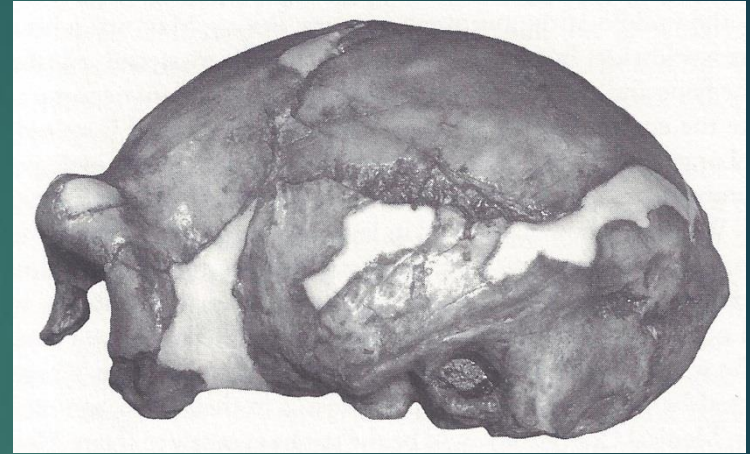
Discoverer of *Homo erectus* skulls at Zhoukoudian

- ▶ Chinese paleoanthropologist
- ▶ One of the founders of Chinese anthropology
- ▶ 1931: joined the excavations at Zhoukoudian; he worked with many of the most renowned figures in paleoanthropology of his era, including Pierre Teilhard de Chardin, Henri Breuil, Davidson Black, Franz Weidenreich and Pei Wenzhong whom he replaced as the field director of the Zhoukoudian excavations in 1935
- ▶ \*\* 1936: Discoverer of *Homo erectus* Skulls X, XI, XII at Zhoukoudian
- ▶ \*\* Saved Zhoukoudian excavation data during WWII





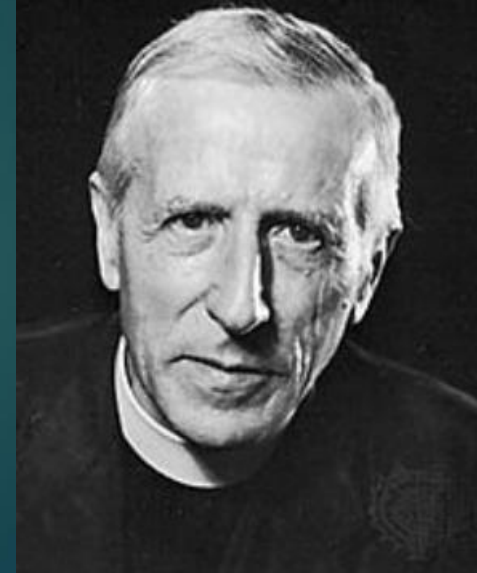
1936: *Homo erectus*, Skull XII, Zhoukoudian  
Chief excavator Jia Lanpo



Excavating *Homo erectus* skull XII at Dragon Bone Hill

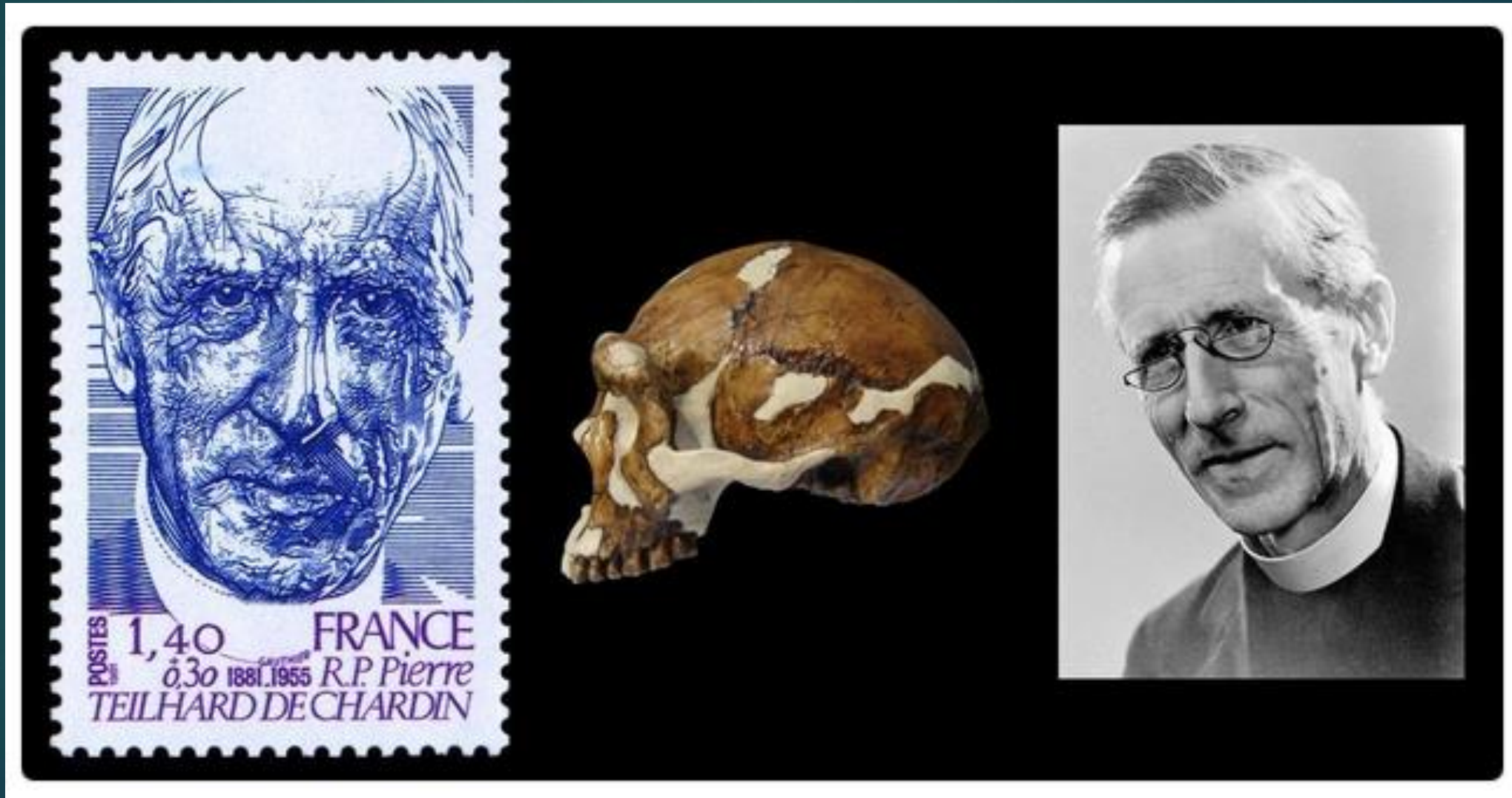
# Pierre Teilhard de Chardin (1881–1955): Piltdown, Gobi, Zhoukoudian, Orthogenesis

- ▶ French Jesuit priest, paleontologist, theologian
- ▶ Studied paleontology with Marcellin Boule
- ▶ 1913: found Piltdown canine tooth while a seminarian
- ▶ Advisor to Geological Survey of China (1<sup>st</sup> geological map of China), Paleontological expeditions in Gobi (with Roy Chapman Andrews) and at Zhoukoudian (Choukoutien), China
- ▶ Worked with Davidson Black on H. erectus. Directed excavations after Black's death, until Franz Weidenreich arrived; as a geologist, dated the findings
- ▶ Wrote *Divine Milieu & The Phenomenon of Man*
- ▶ A leading proponent of orthogenesis, the idea that evolution occurs in a directional, goal driven way
- ▶ “Remain true to yourself, but move ever upward toward greater consciousness and greater love! At the summit you will find yourselves united with all those who, from every direction, have made the same ascent. For everything that rises must converge.”





Stamp of Pierre Teilhard de Chardin, a Jesuit paleontologist who took part in the discovery of Peking Man in China



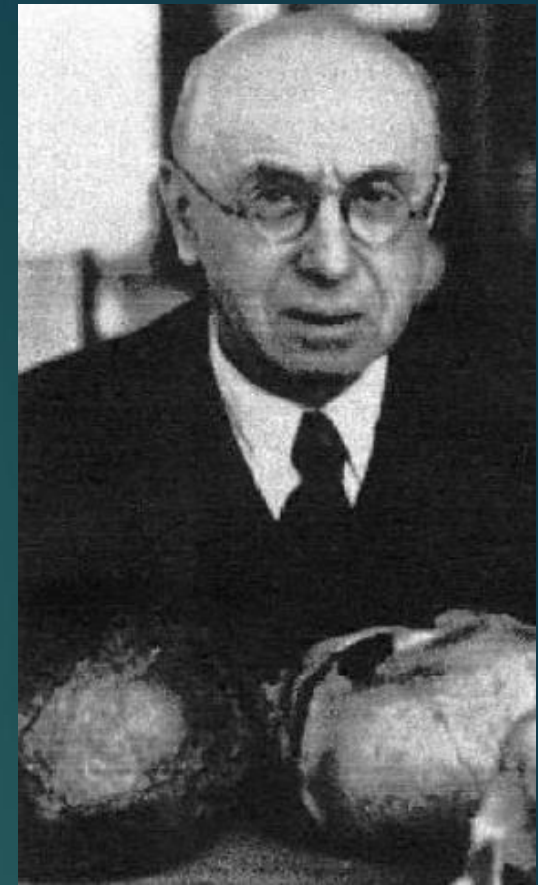
1991 Stamp depicting the bust of Peking Man on display at Zhoukoudian #China





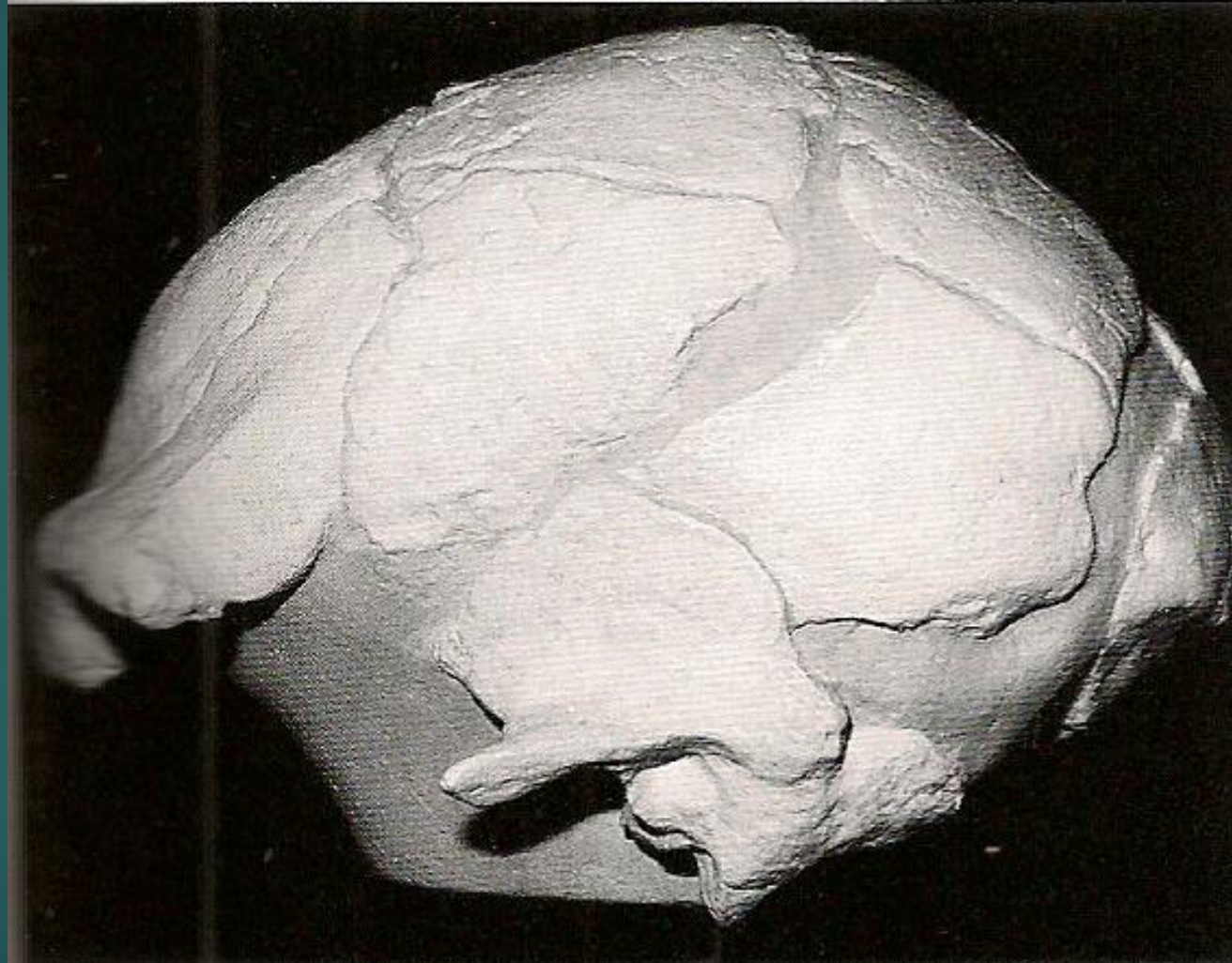
# Franz Weidenreich (1873–1948): Oldest Neandertal & *Homo erectus* in China

- ▶ German anatomist and anthropologist
- ▶ 1925: at Ehringsdorf, Germany, discovered the remains of both an adult and adolescent Neandertal in the Fischer and Kämpfe quarries: was the oldest occurrence of Neandertals associated with Mousterian culture (150–120K)
- ▶ Wrote the monograph on *Sinanthropus* fossils at Zhoukoudian, China
- ▶ Controversial claims of fire, hunting, and cannibalism.
- ▶ 1940: Established the name *Homo erectus* (he transferred both *Sinanthropus pekinensis* & the Javanese *Pithecanthropus erectus* to this new name).
- ▶ Succeeded Davidson Black as head of Cenozoic Research Laboratory & collaborated with Teilhard de Chardin at Zhoukoudian.





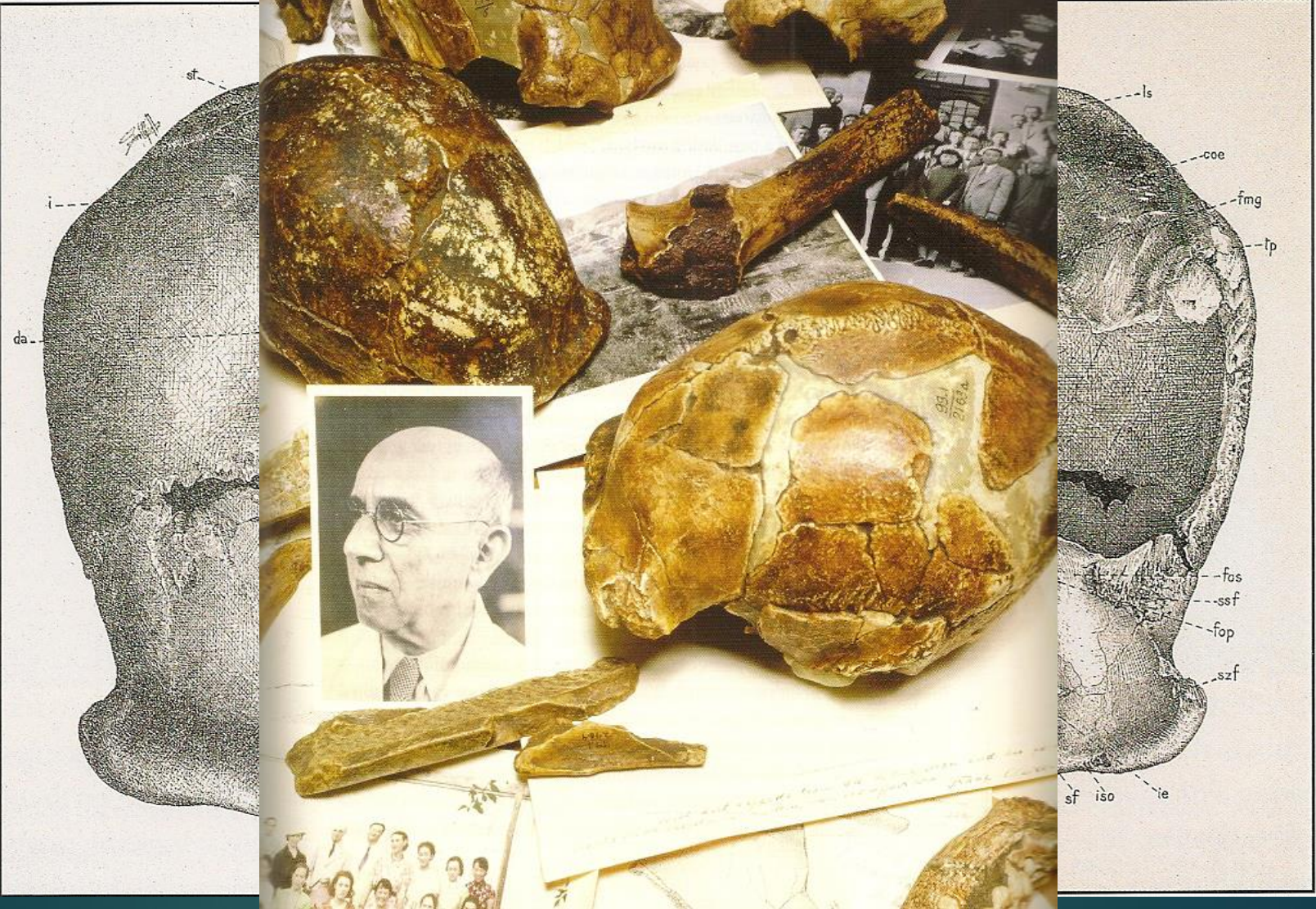
1925: Ehringsdorf Neandertal skull, 150K





1943: Franz Weidenreder  
*Erectus*; all Zhoukoudian

no





# Ridiculed Paleontologists (von Koenigswald & Weidenreich):

“any place where the dead are disturbed”



Franz Weidenreich, who in the 1930s studied the fossils of *Homo erectus* unearthed in China, is caricatured along with Ralph von Koenigswald (wielding the shovel), who found fossils of *H. erectus* in Java. The fanciful setting is, according to the artist, "any place where the dead are disturbed."

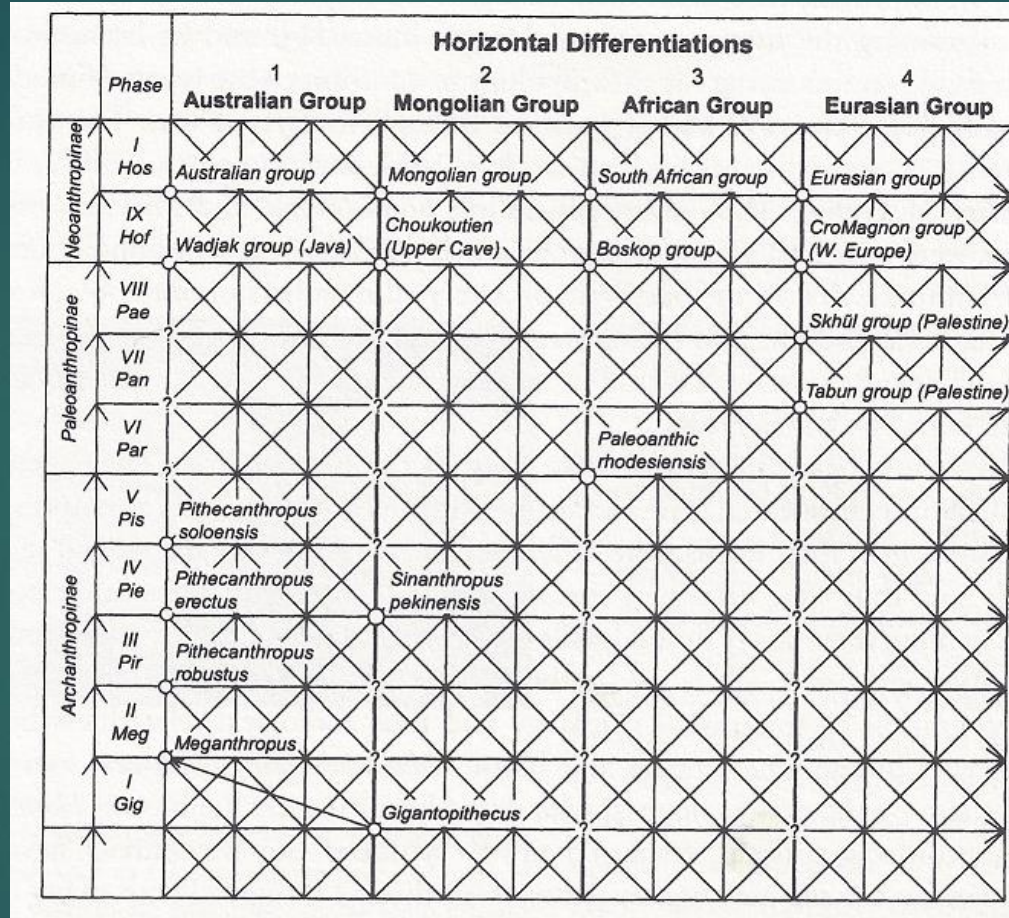


# Franz Weidenreich 2:

## Rescue of *H. erectus* casts & Regional Continuity theory

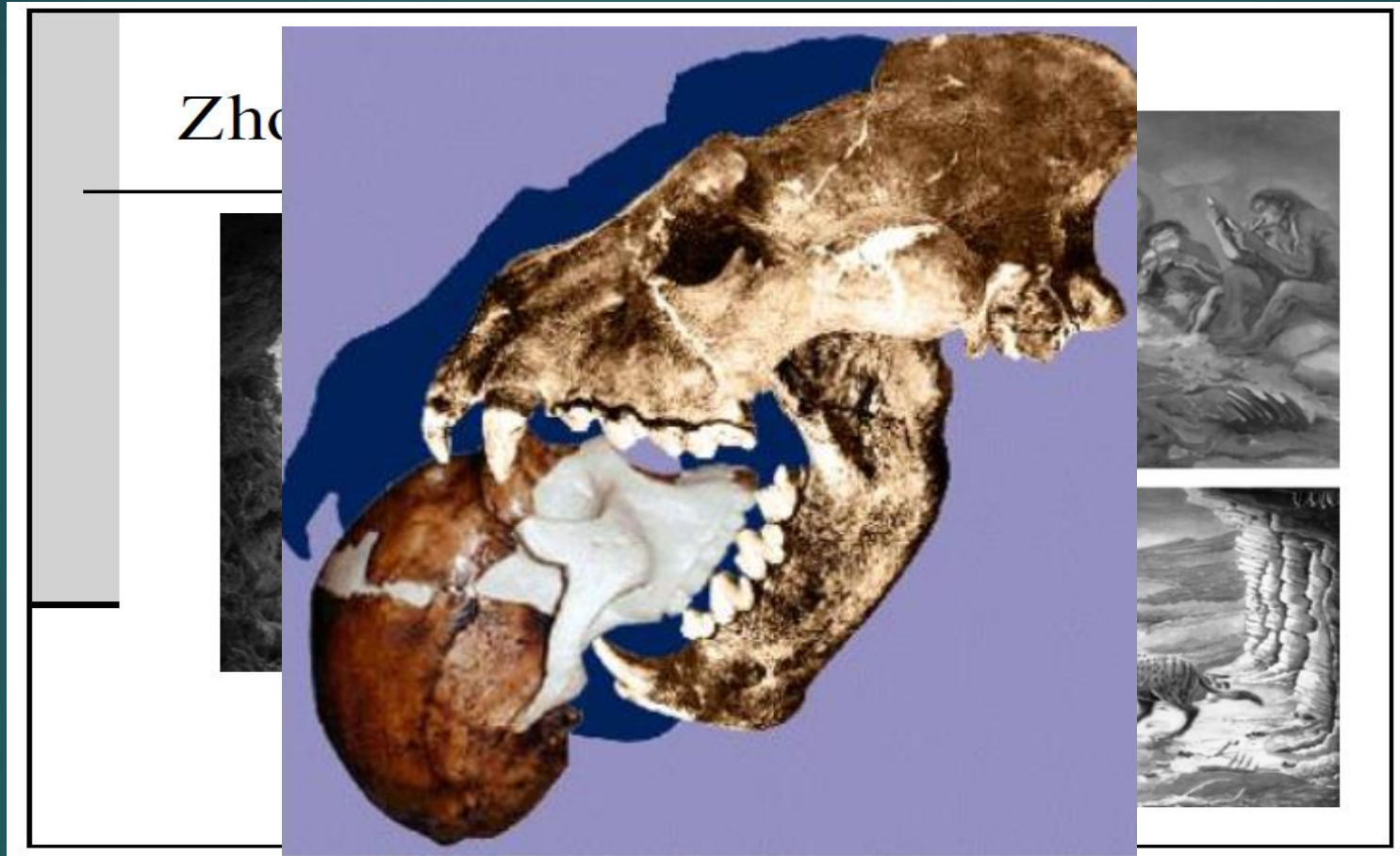
- ▶ \*\* 1941: When he moved to AMNH, he took casts, notes & photos of all Zhoukoudian fossil discoveries.
- ▶ \*\* 1945: He considered Peking Man as a human ancestor and specifically an ancestor of the Chinese people. He created the regional continuity hypothesis (multiregionalism): Weidenreich's theory states that human races have evolved independently in the Old World from *Homo erectus* to *Homo sapiens*, while at the same time there was gene flow between the various populations.
- ▶ Believed in orthogenesis (evolutionary directionality – “mankind as their goal”). Human “races” evolved from deep roots (Australian Aborigines from Java Man; Chinese from Peking man)
- ▶ At beginning of WWII, US marines were supposed to take fossils to SS President Harrison to go to US. All original fossils disappeared in China in 1941. Multitude of theories about vanishing.
- ▶ The authentic Weidenreichian casts housed at the American Museum of Natural History in New York and at the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing, and are considered to be reliable evidence.

# First Multiregional Theory



- ▶ **Weidenreich's 1945 theory:** Population networks connected by gene exchange; early idea of population genetics in human evolution. Used later as counter to Out of Africa theory of human origins.

# Zhoukoudian: Not a shelter, “food refuse” of giant hyenas



Hyena Den

Only skulls found; absence of faces & postcranial bones was a mystery; skulls were marked by nicks, pits, and cuts; ? of cannibalism per Weidenreich; Pei Wenzhong = hyena den; rather than being the dominant hunters in the area, *Homo erectus* were often prey for the large carnivores per Noel Boaz & Russell Ciochon in 2004; prey to extinct hyena species *Pachycrocuta brevirostris*; damage consistent with way hyenas attack skulls



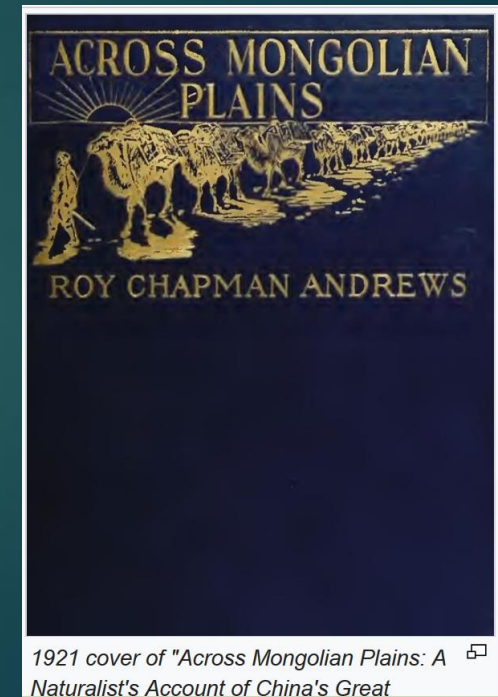
# Peking Man skulls - reconstructions



Disappeared in WWII

# Roy Chapman Andrews (1884-1960): real Indiana Jones

- ▶ American explorer, adventurer and naturalist who became the **director of the American Museum of Natural History**
- ▶ Lead a series of expeditions through **China (Gobi Desert and Mongolia)**. **Out of Asia** theory of humanity's origins. **From 1922 to 1928, "Central Asiatic Expeditions"** to search for the earliest human remains in Asia. Found none.
- ▶ The expeditions made fossil **dinosaur and mammal** discoveries and found the first-known **fossil dinosaur eggs**
- ▶ His popular writings about his adventures made him famous.



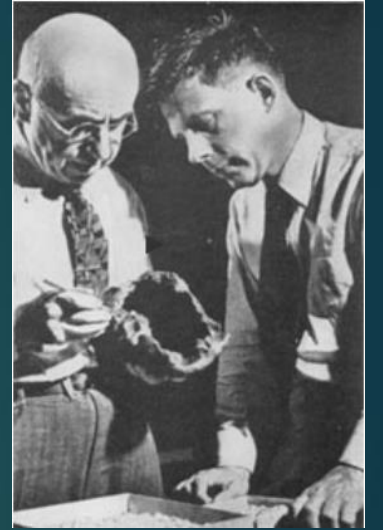
## W. F. F. Oppenoorth: *Homo (Javanthropus) soloensis* in Ngandong, Java

- ▶ Dutch paleontologist
- ▶ **1931-1933**: Geological Survey of the Netherlands Indies unearthed 14 *Homo erectus* fossils from a single excavation site on Java (Excavation I Ngandong).
- ▶ **1931**: Solo River terrace, Ngandong, Java: discovers several skulls interpreted as “tropical Neanderthals”, naming them *Homo (Javanthropus) soloensis*; now assigned to *H. erectus*
- ▶ GHR von Koenigswald worked under him.



# Gustav Heinrich Ralph von Koenigswald (1902–1982): *Homo erectus* at Ngandong & Sangiran

- ▶ German paleontologist
- ▶ **1931**: Systematic search for fossils in Java & research on *Pithecanthropus/H. erectus* at Ngandong & Sangiran in 1930s under W.F.F. Oppenoorth
- ▶ Discovered the *Homo erectus* fossils at Sangiran
- ▶ **1937**: Sangiran: first find in one site of successive deposits with several evolutionary phases of *Homo erectus*
- ▶ Claimed that India as the original home of the Hominidae.



1931: *Homo (Javanthropus) soloensis* at Ngandong, 750 cc,  
143 Ka



Ngandong 11



Ngandong 11



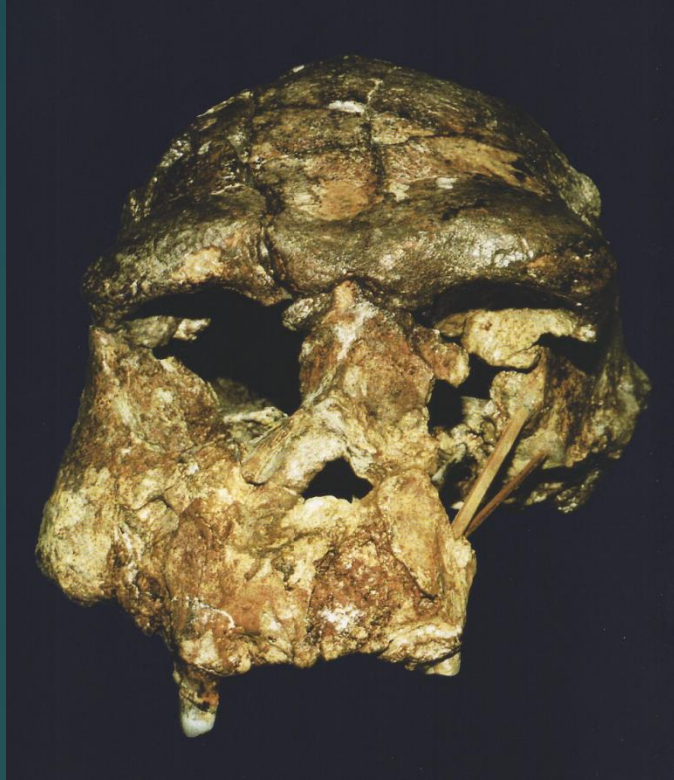
Ngandong 9



Ngandong 6

- Between September 1931 and November 1933 the Dutch Geological Survey conducted excavations in the upper terrace (20 meter terrace) of the Solo River near Ngandong, Java: cranial vaults of 11 hominins
- Initially assigned to a new species, *Homo soloensis*, by Oppenoorth (1932), the Ngandong crania are now widely accepted as belonging to *H. erectus*, sharing a suit of anatomical features with the crania from the other Javan sites of Sangiran and Sambungmachan

# 1937: *Homo erectus*, Sangiran 17



Indonesian characteristics of flat forehead & cheeks; projecting face, & flat braincase on sides and broad at base



*Homo erectus*  
(Sangiran 17)

Discoverer: Mr. Towikromo

Date: 1969

Locality: Sangiran, Java, Indonesia

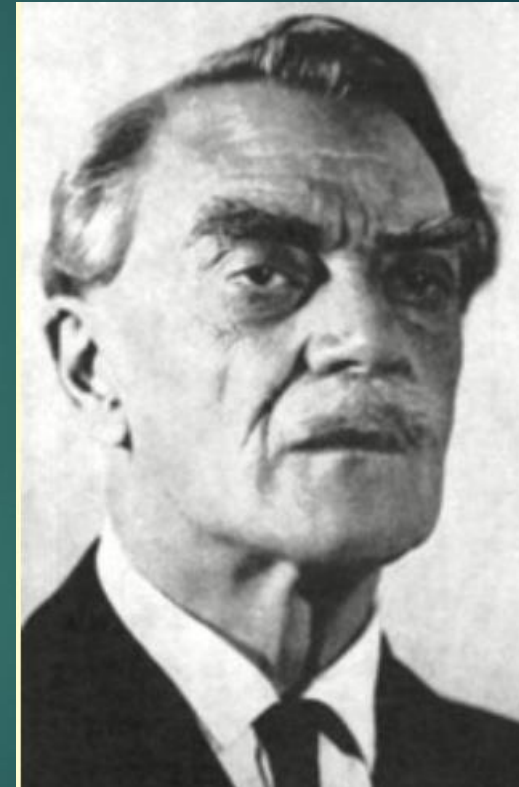
Age 800 K



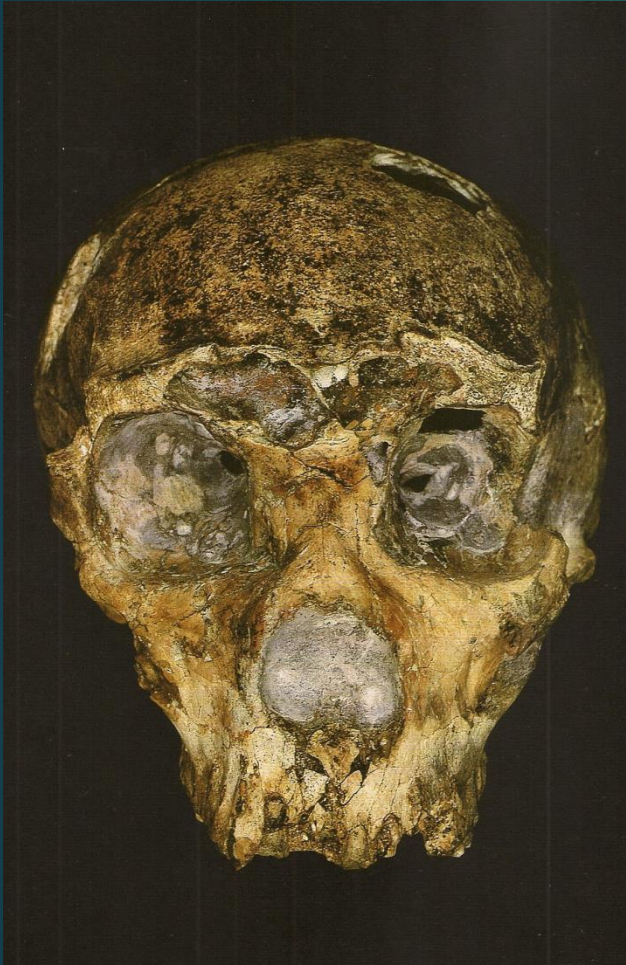
# Sergio Sergi (1878-1972):

## Italian Neandertals

- ▶ Father of modern human paleoanthrology in Italy
- ▶ **1929:** Studied the Saccopastore neanderthal, found by Mario Grazioli: partial Neandertal craniums at Saccopastore quarry at Rome, Italy; 80-120K
- ▶ Collaborated with Alberto Blanc on the Monte Circeo Neanderthal cranium



# 1929: *Homo Neandertalensis*, Saccopastore, Italy



Similar to N of Krapina, Croatia;  
Early N – less thick boned

*Homo neanderthalensis*

(Saccopastore 1)

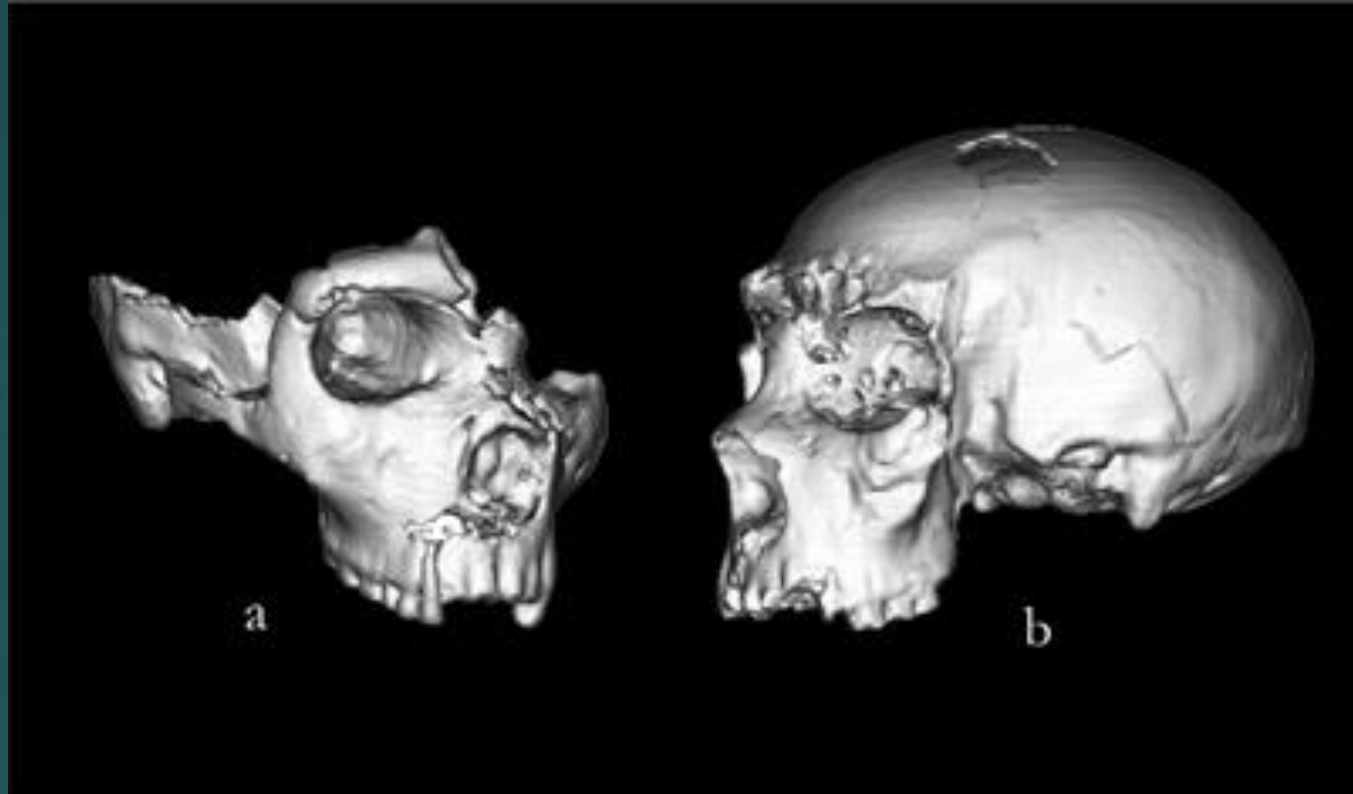
Discoverer: Mario Grazioli

Locality: Saccopastore quarry, Rome, Italy

Date: 1929

Age: 120K

# Saccopastore, Italy



En bombe  
Protruding midface  
Prominent nose  
Sloping molars  
No canine fossa

Sacc.2

ECV 1300cc

Sacc.1

ECV 1200cc



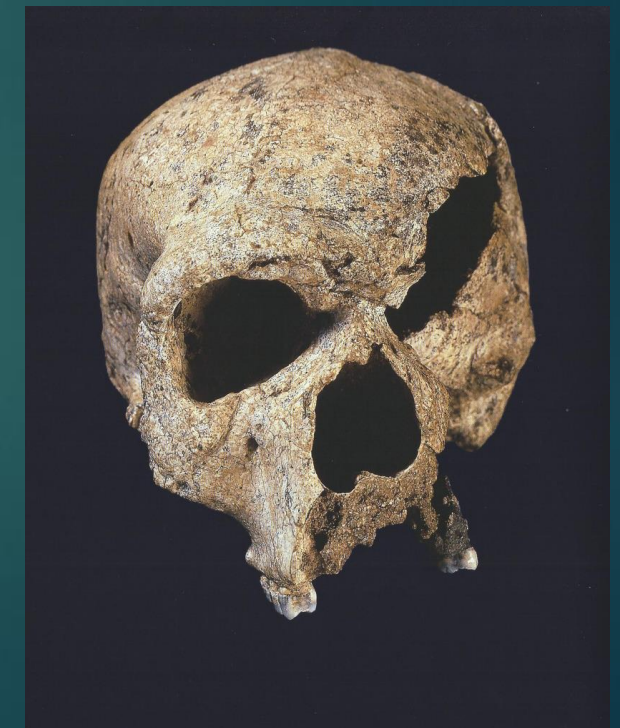
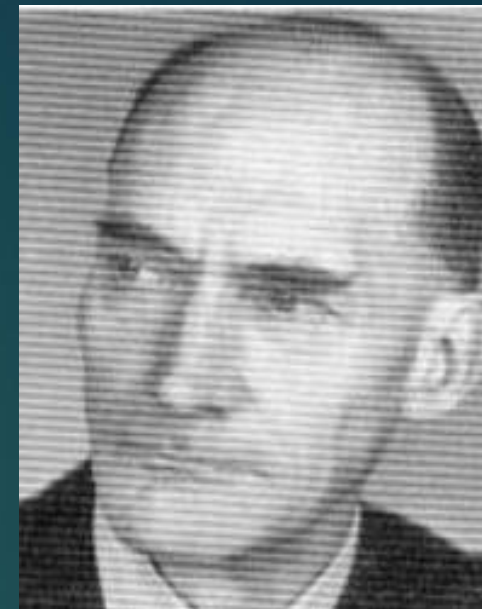
**Fritz Berckhemer** (1890-?):

*Homo heidelbergensis*, Steinheim skull, Neandertal evolved in Europe

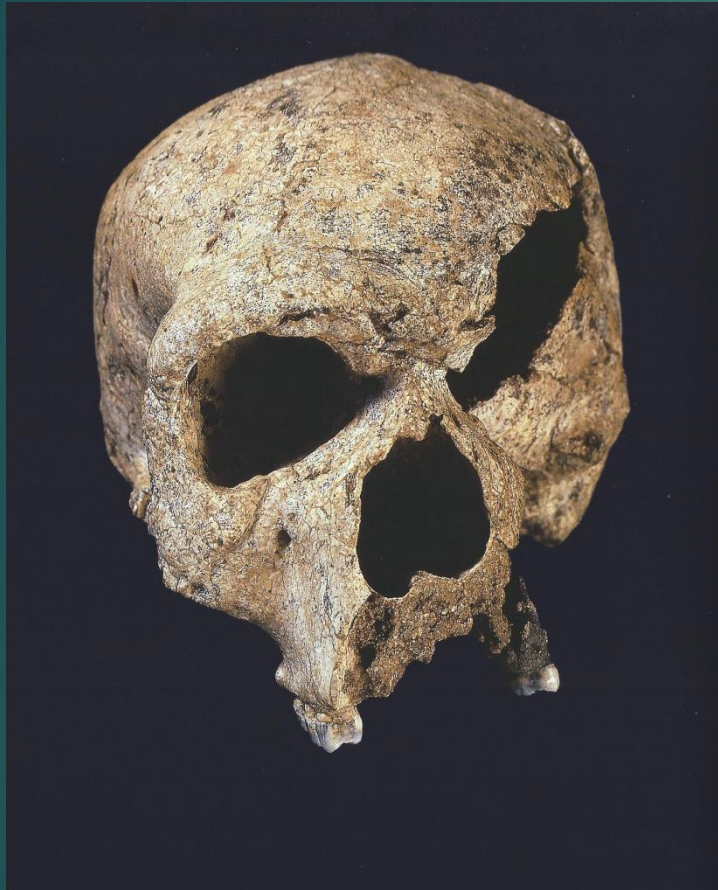
- ▶ **1933: Steinheim skull** discovered by Karl Sigrist, Jr., owner of gravel pit near Steinheim an der Murr, Germany. Given to Fritz Berckhemer, a paleontologist.

- ▶ **\*\* 1933: The Steinheim skull is a fossilized skull of an archaic *Homo sapiens* or *Homo heidelbergensis*. No archaeology from site; 250-350K**

- ▶ This skull is considered to be an example of European *Homo heidelbergensis* fossils that were showing early Neanderthal-like features by about 300,000 years ago, suggesting that Neanderthals evolved in Europe from this species.



# 1933: *Homo heidelbergensis*, Steinheim skull, 250 Ka



*Homo heidelbergensis*  
(Steinheim)

Discoverer: Karl Sgrist, Jr.

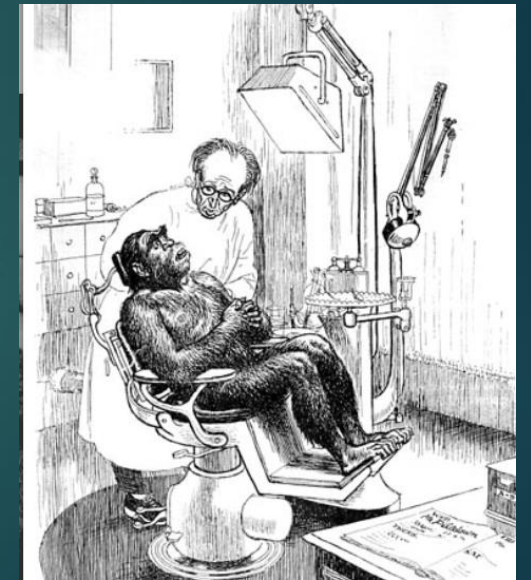
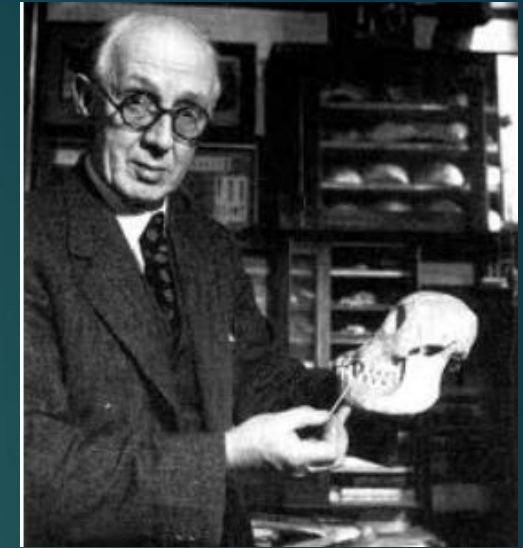
Date: 1933

Locality: Sgrist gravel pit, Steinheim Germany

Age: 250 K

# Alvin T. Marston (1889-1971): *Homo heidelbergensis* at Swanscombe

- ▶ English dentist
- ▶ 1935: Found the Swanscombe occipital and left parietal skullbones and 26 Acheulian tools in the Barnfield Pit, Kent; (right parietal of the skull found in 1955)
- ▶ Got Oakley to use fluorine dating on it: 300K; and to test Piltdown specimens
- ▶ Seriously questioned association of Piltdown fossils; believed Piltdown jaw and canine belonged to a fossil ape, but did not think it was a forgery



This may hurt, but I am afraid I'll have to remove the whole jaw! (Punch)



1935: *Homo heidelbergensis*, Swanscombe



Oldest human remains in Europe directly associated  
with Acheulian tools (300K)

## Alexei Pavlovich Okladnikov (1908-1981): Teshik-Tash Neandertal child

- ▶ Soviet archaeologist and ethnographer
- ▶ \*\* 1938: Discoverer of Teshik-Tash Neandertal child
- ▶ \*\* At the time, the farthest known easterly occurrence of Neanderthal male child at Bajsuntau, Uzbekistan



# 1938: Teshik-Tash Neandertal child, Bajsuntau, Uzbekistan



*Homo neanderthalensis*  
(Teshik-Tash)

Discoverer: Alexei Okladnikov

Locality: Teshik-Tash, Uzbekistan

Date: 1938

Age: 70K



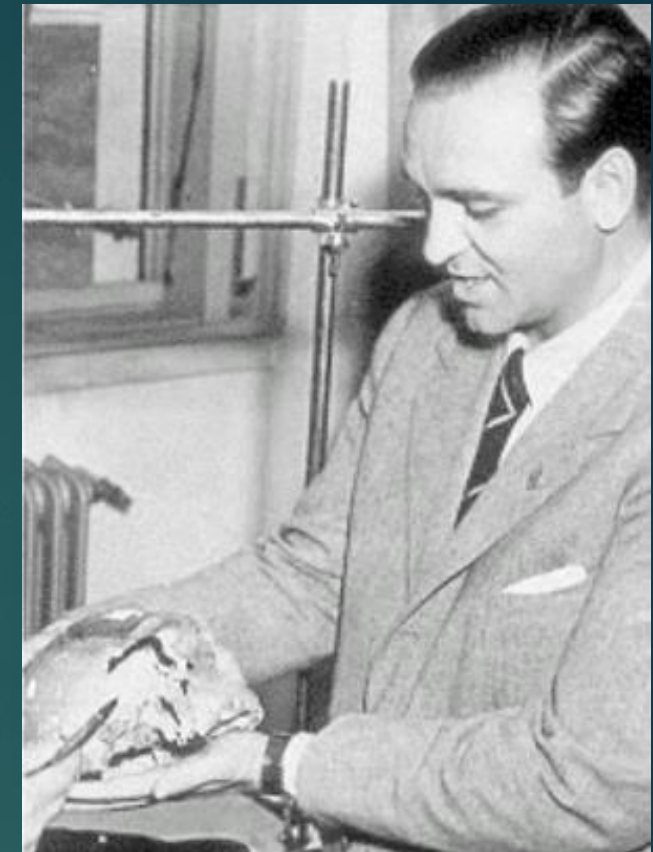
# Neandertal: The iconic other

- ▶ The first non MH hominid discovered.
- ▶ Originally seen as different from MHs, the outsider, the other, the contrast.
- ▶ Now viewed as having variability and a huge range; but a 10<sup>th</sup> of population of Africa; always a small population



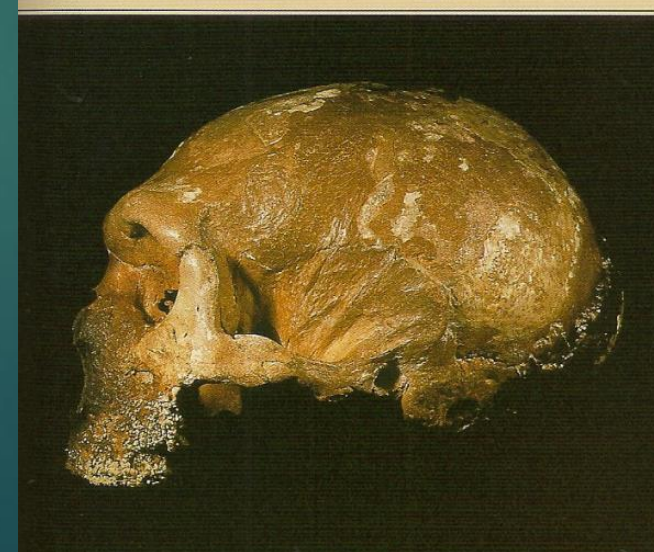
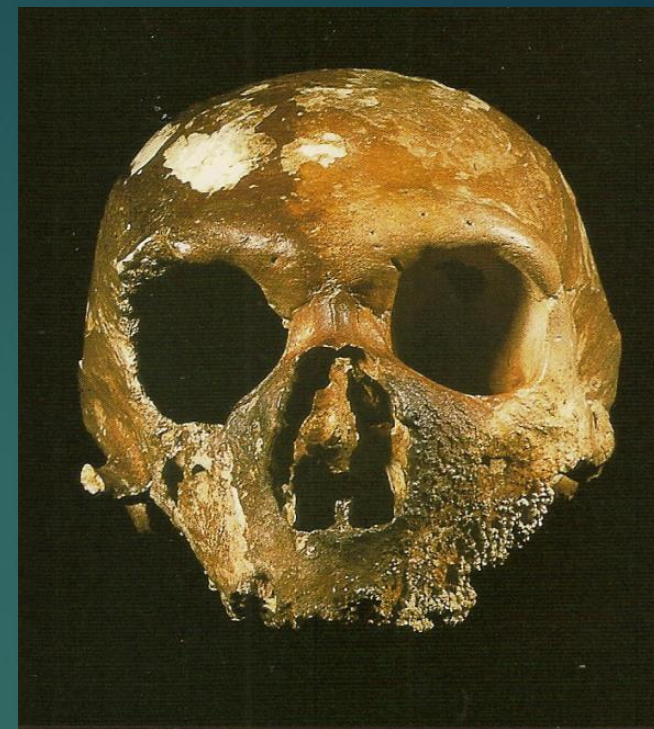
# Alberto Carlo Blanc (1906-1960): Italian Neandertal; Religious?

- ▶ Italian paleoanthropologist
- ▶ 1935: He and H. Brenne discover a second set of remains with both archaic and semi-modern features at Saccopastore.
- ▶ 1939: Discovers the Neandertal cranium from Grotta Guattari at Monte Circeo
- ▶ Found within a stone circle (Mousterian ritual?); this helped foster a growing belief in Neanderthal ritual behavior, including ceremonial cannibalism.
- ▶ Believed Neandertals had religious beliefs





1939: Neandertal cranium  
from Grotta Guattari at Monte Circeo





## G. Edward Lewis (1908-):

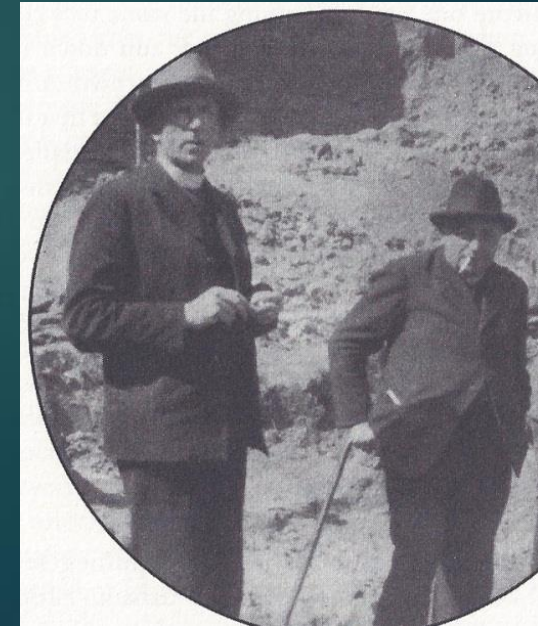
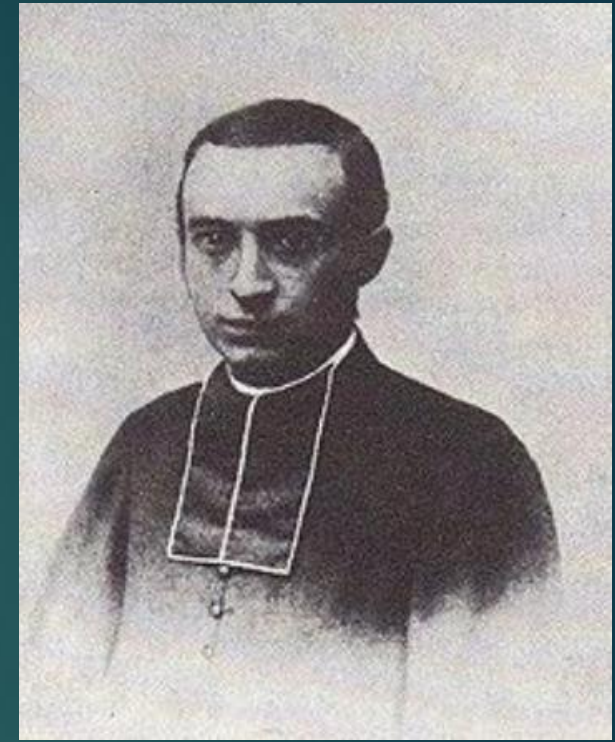
*Ramapithecus: hominid or Orangutan ancestor*

- ▶ American geologist
- ▶ 1934: Discovered a hominoid lower jaw at Haritalyanger, Siwalkik Hills, India
- ▶ Described it as type specimen of *Ramapithecus*.
- ▶ Believed that *Ramapithecus* was early hominid; supported by Elywn Simons in 1960s.
- ▶ In 1980s, evidence that *Ramapithecus* was closely related to 12 Ma *Sivapithecus*, a Miocene ancestor of orangutan.



# Father Henri Breuil (1877-1961): Paleolithic cave art

- ▶ French Catholic priest, archaeologist, anthropologist, ethnologist and geologist
- ▶ \*\* Published many books and monographs, introducing the caves of Lascaux and Altamira to the general public
- ▶ 1935: Breuil visited the Peking Man excavations at Zhoukoudian, China and confirmed the presence of stone tools at the site. Proposed extensive bone tool use (disproved), and influenced controlled excavation & mapping.
- ▶ \*\* Authority on North African and European Stone Age art





# Caves of Lascaux and Altamira



*The Hall of Bulls*  
c. 17,000 BC  
Lascaux, France

*Altamira Bison*  
c. 15,000 BC  
Altamira, Spain

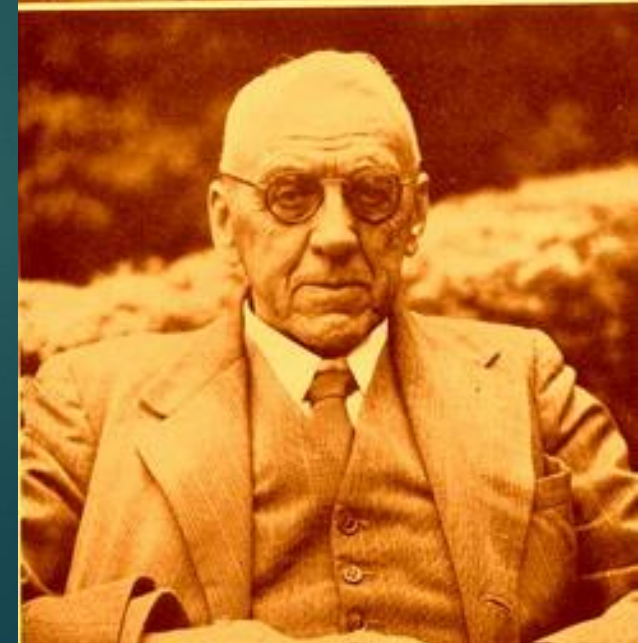




# Robert Broom (1866-1951):

Sterkfontein: *Australopithecus africanus*

- ▶ Scottish South African paleontologist
- ▶ Abrasive, MD with honors in midwifery, womanizer, with reputation for stealing & selling fossils; expert in mammalian fossils; hunted fossils in a suit then in nude
- ▶ First Supporter of Dart's interpretation of Taung Child
- ▶ 1936: excavation at Sterkfontein, discovered an endocranial cast (found by G. W. Barlow, lime works foreman); named *Australopithecus transvaalensis* (then *Plesianthropus transvaalensis*; then *A. africanus*)
- ▶ First postcranial remains of *Australopithecus africanus*



Brain endocasts & cranium of *A. africanus*, Sterkfontein, S. Africa;  
brains less than 500 cc





# Gert Terblanche discovers first *P. robustus*

- ▶ **1938:** A partial cranium and mandible of *Paranthropus robustus* was discovered by a local schoolboy, Gert Terblanche, at Kromdraai (70 km south west of Pretoria) in South Africa.
- ▶ **5 chocolate bars for *P. robustus***
- ▶ **1938:** It was described as a new genus and species by Robert Broom of the Transvaal Museum. Broom made **TM 1517**  
the type specimen of *Paranthropus robustus*





# 1938: *Paranthropus robustus*, Swartkrans; 1<sup>st</sup> robust australopithecine discovered



*Paranthropus robustus*  
(TM 1517)

Discoverer: Gert Terblanche

Date: 1938

Locality: Kromdraai, S. Africa

Age 2 M

1948: *Paranthropus robustus*, SK 48, Dated from 1.8-1.0 Ma in South Africa



# Robert Broom: *Swartkrans* & *Paranthropus robustus*

- ▶ 1947: With John T. Robinson, most complete skull of *Plesianthropus transvaalensis* (*Australopithecus africanus*) STS 5, Mrs. Ples
- ▶ 1948: first *Paranthropus robustus* at Swartkrans
- ▶ Despite lack of enthusiasm by British academics, with Dart, Broome changed human evolution theory by showing australopithecines were among the earliest hominids
- ▶ South African fossils: None associated with stone tools (we don't know about wood, which does not preserve) or many postcranial remains.
- ▶ Published 450 articles



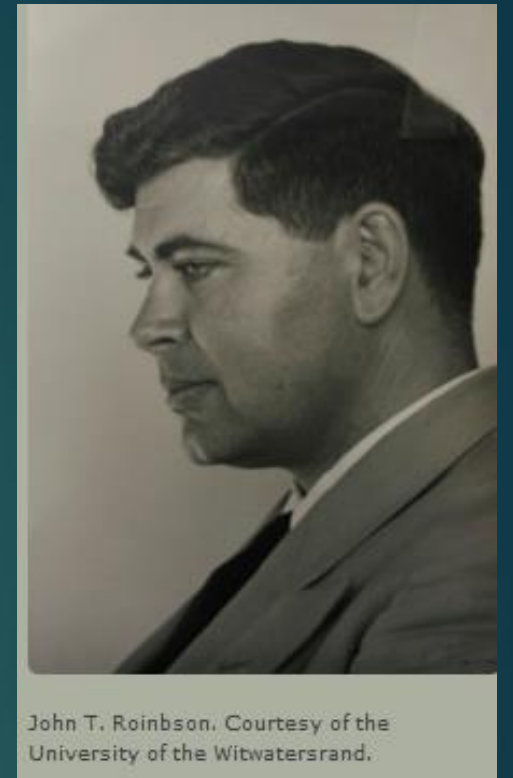
## Mrs. Ples



- **Mrs. Ples** was discovered by Robert Broom and John T. Robinson on April 18, 1947.
- Because of Broom's use of dynamite and pickaxe while excavating, Mrs. Ples's skull was blown into two pieces and some fragments are missing. Nonetheless, Mrs./Mr. Ples is one of the most perfect pre-human skulls ever found.
- The nickname "**Mrs. Ples**" was coined by Broom's young co-workers. It derives from the scientific designation *Plesianthropus transvaalensis* (near-man from the Transvaal), that Broom initially gave the skull
- **Mrs. Ples is actually Mr. Ples. An adolescent, so Ms. Ples?**
- In 2004, Mrs. Ples was **voted 95th** in the *Great South Africans Top 100* list.

# John Talbot Robinson (1923 – 2001): Mrs. Ples & *Homo ergaster*

- ▶ South African hominid paleontologist
- ▶ Professor at University of the Witwatersrand, and the University of Wisconsin–Madison
- ▶ \*\* Excavations, with Robert Broom, at the caves of Sterkfontein, Kromdraai and Swartkrans.
- ▶ \*\* 1947: His most famous discovery (with Robert Broom) was the nearly complete fossil skull of an *Australopithecus africanus*, known as Mrs. Ples.
- ▶ \*\* 1949: First discovered a mandible of a new hominid in South Africa; he named the species *Telanthropus capensis*, now recognized as a member of *Homo ergaster*.





## Hard to drill South African breccia



Broome's use of dynamite to break up breccia was not conducive to precise stratigraphic dating by relative faunal association; Robinson used jack hammers.



1949: SK15, *Telanthropus capensis* (now *Homo ergaster*)

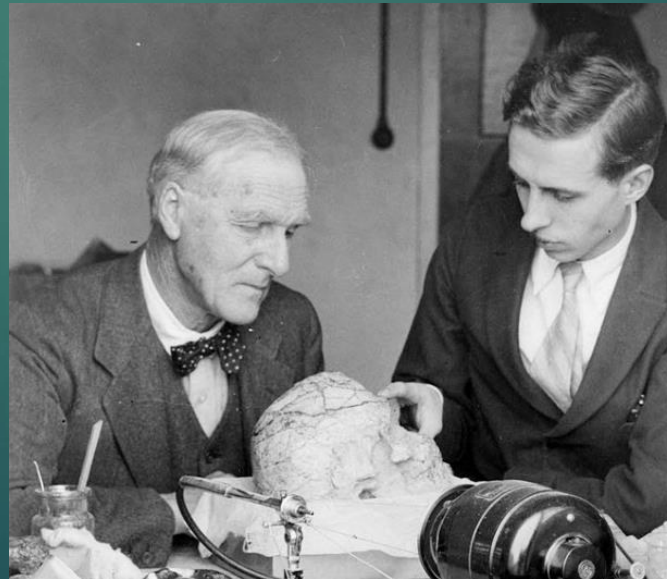
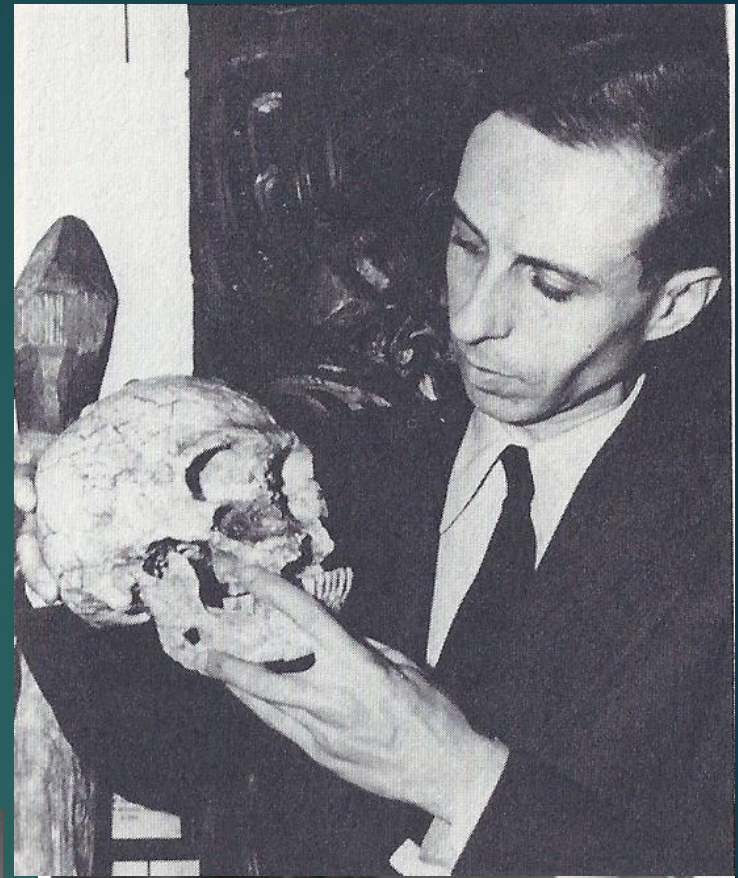


# Sterkfontein: First Evidence for Bipedality

- ▶ STS5, Mrs. Ples, *A. africanus*
- ▶ STS14: 1<sup>st</sup> partial pelvis from *A. africanus*
- ▶ 1<sup>st</sup> valgus angle of knee evidence

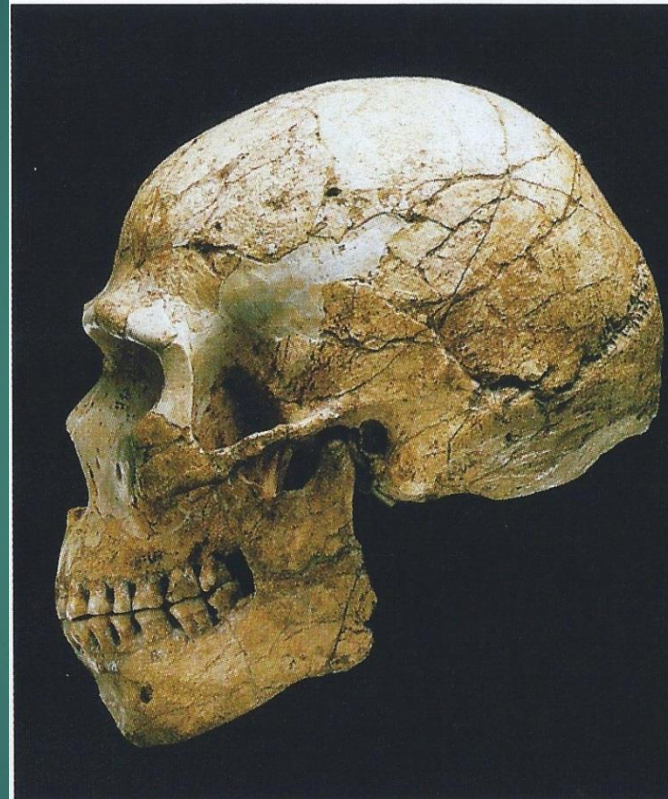
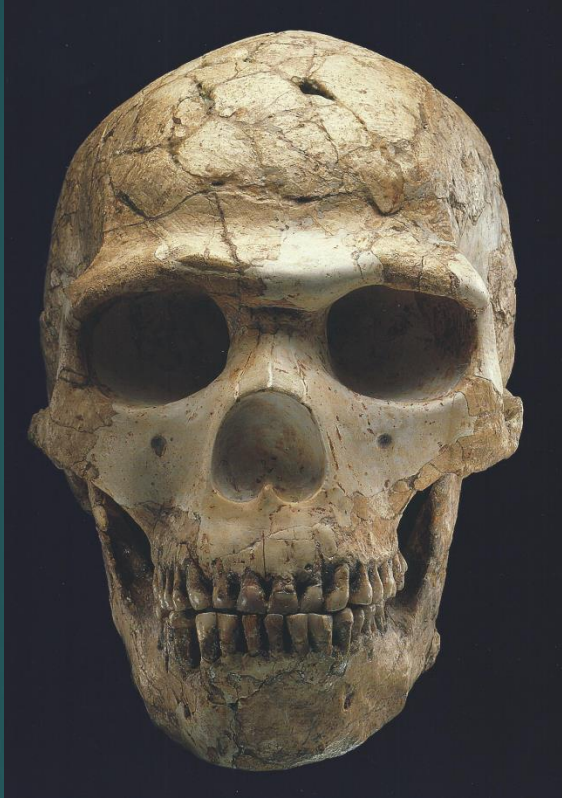
**Theodore D. McCown** (1908-1969):  
Excavation at Skhul, transitional skulls

- ▶ American anthropologist; **Univ. of Calif. Berkeley**
- ▶ Study of the **Neanderthal skeletons from the Skhul and Tabun caves of Mt. Carmel in Israel**
- ▶ Publication of his work in 1939 with the British anatomist Sir Arthur Keith, *The Stone Age of Mount Carmel*





## ~1925: *Homo Sapiens*, Skhul V



*Homo sapiens*  
(Skhul V)

Discoverers:  
Theodore McCown  
& Hallam Movius  
Jr.

Locality: Skhul cave  
Mount Carmel,  
Israel

Date: 1932

Age: 90K

Skhul/Qafzeh *H. sapiens* possess brow ridges, no chin, and a projecting facial profile, similar to the Neandertals.

## Rene Neuville:

### Excavation at Jebel Qafzeh

- ▶ French archeologist and consul in Jerusalem in the 1930s
- ▶ 1934: First excavated Jebel Qafzeh, near Nazareth, and found anatomically modern human remains, 92K
- ▶ Remains of 5 individuals in the Mousterian levels
- ▶ Similar in anatomy to the individuals from Skhul (not published until 1951).



## Growing Problem with evolution

- ▶ Charles Darwin's 1859 book *On the Origin of Species* was successful in convincing most biologists that evolution had occurred, but was less successful in convincing them that natural selection was its primary mechanism.
- ▶ In the 19th and early 20th centuries, variations of Lamarckism (inheritance of acquired characteristics), orthogenesis (progressive evolution), saltationism (evolution by jumps) and mutationism (evolution driven by mutations) were discussed as alternatives.
- ▶ Discovery of Mendel's genetics in early 1900s
- ▶ 1930: *The Genetical Theory of Natural Selection*, by R. A. Fisher showed how Mendelian genetics was consistent with the idea of evolution driven by natural selection



## Evolutionary Synthesis (1930-1950): added genes to natural selection

- ▶ Computational geneticists: J.B.S. Haldane, R. A. Fisher, Sewall Wright
- ▶ 3 seminal books: Integration of Darwin's natural selection and Mendel's genetics
  - ▶ 1937: geneticist Theodosius Dobzhansky (gene): *Genetics & the Origin of Species*
  - ▶ 1942: ornithologist Ernst Mayr (species): *Systematics & the Origin of Species*
  - ▶ 1944: paleontologist George Gaylord Simpson (origin of higher taxa): *Tempo & Mode in Evolution*

# Evolutionary Synthesis: continuity and change

## ▶ Basic Principles

- ▶ 1 – Evolution was gradual, long term process – accumulation of small genetic mutations & recombinations, resulting in large phenotypic effects
- ▶ 2 – Generation to generation change was controlled by natural selection; environmental factors promoting adaptation via differential reproductive success or failure; as environments changed, populations would change to improve adaptive fitness
- ▶ 3 – Same process of gradual accretion of genetic change explains origin of species and variation

## ▶ Central thesis: integration of natural selection & gene frequencies

- ▶ modification of gene frequencies by natural selection
- ▶ emphasis on species change via reproductive isolation and gradualist continuities
- ▶ Evolution as opportunistic, non-goal oriented process
- ▶ By the 1950s, natural selection acting on genetic variation was virtually the only acceptable mechanism of evolutionary change

# Evolutionary Synthesis: continuity and change

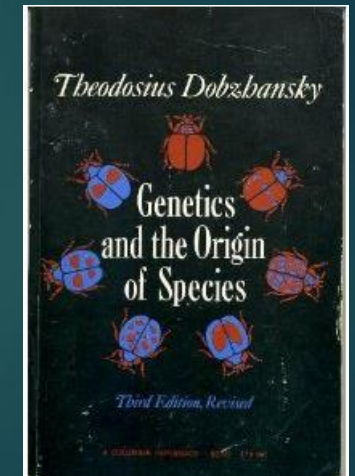
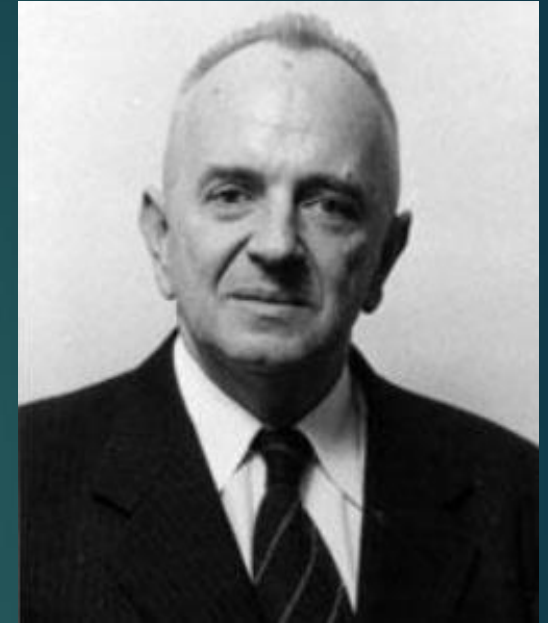
- ▶ Central thesis: integration of natural selection & gene frequencies
  - ▶ modification of gene frequencies by natural selection
  - ▶ emphasis on species change via reproductive isolation and gradualist continuities
  - ▶ Evolution as opportunistic, non-goal oriented process
- ▶ By the 1950s, natural selection acting on genetic variation was virtually the only acceptable mechanism of evolutionary change



# Theodosius Dobzhansky (1900-1975):

Evolutionary synthesis: One hominid species

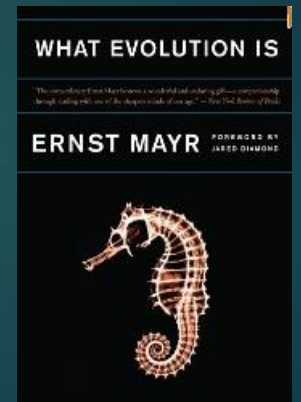
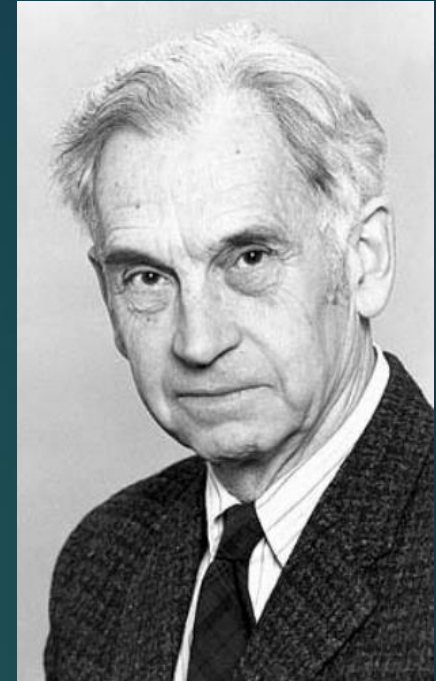
- ▶ Fruit fly geneticist
- ▶ Architect of new evolutionary synthesis
- ▶ There has only been only one hominid species at any one time; rejected phylogenetic tree/bush model
- ▶ Note that he never handled a fossil bone; Weidenreich was his neighbor (multiregionalist)
- ▶ Essay "Nothing in Biology Makes Sense Except in the Light of Evolution".



# Ernst Mayr (1904-2005):

## Biological speciation & hominid single species

- ▶ **Bird taxonomist** and highly influential evolutionary theorist; Harvard University
- ▶ 1942: *Systematics and the Origin of Species*: Brought together **natural history & genetic theory** to form the new **evolutionary synthesis**
- ▶ Concept of “biological speciation”: **ability to breed together & isolation**
- ▶ **Problem**: 29 generic names and over 100 specific names proposed for ancient human species
- ▶ Single species theory: Hominid lineage of australopithecines to Homo erectus to Homo sapiens; **hominids did not speciate because they occupied all the ecological niches**
- ▶ Influenced multiregional model (Brace, Wolpoff)
- ▶ Clearly a **lumper**



# George Gaylord Simpson (1902-1984): Genetics in evolutionary synthesis

- ▶ American vertebrate paleontologist
- ▶ American Museum of Natural History, New York
- ▶ Genetic foundation of evolutionary synthesis
- ▶ How fossil record could be interpreted in terms of natural selection and evolutionary trends: origin of higher taxa





# Evolutionary Synthesis (1930-1950): Effect on paleontology

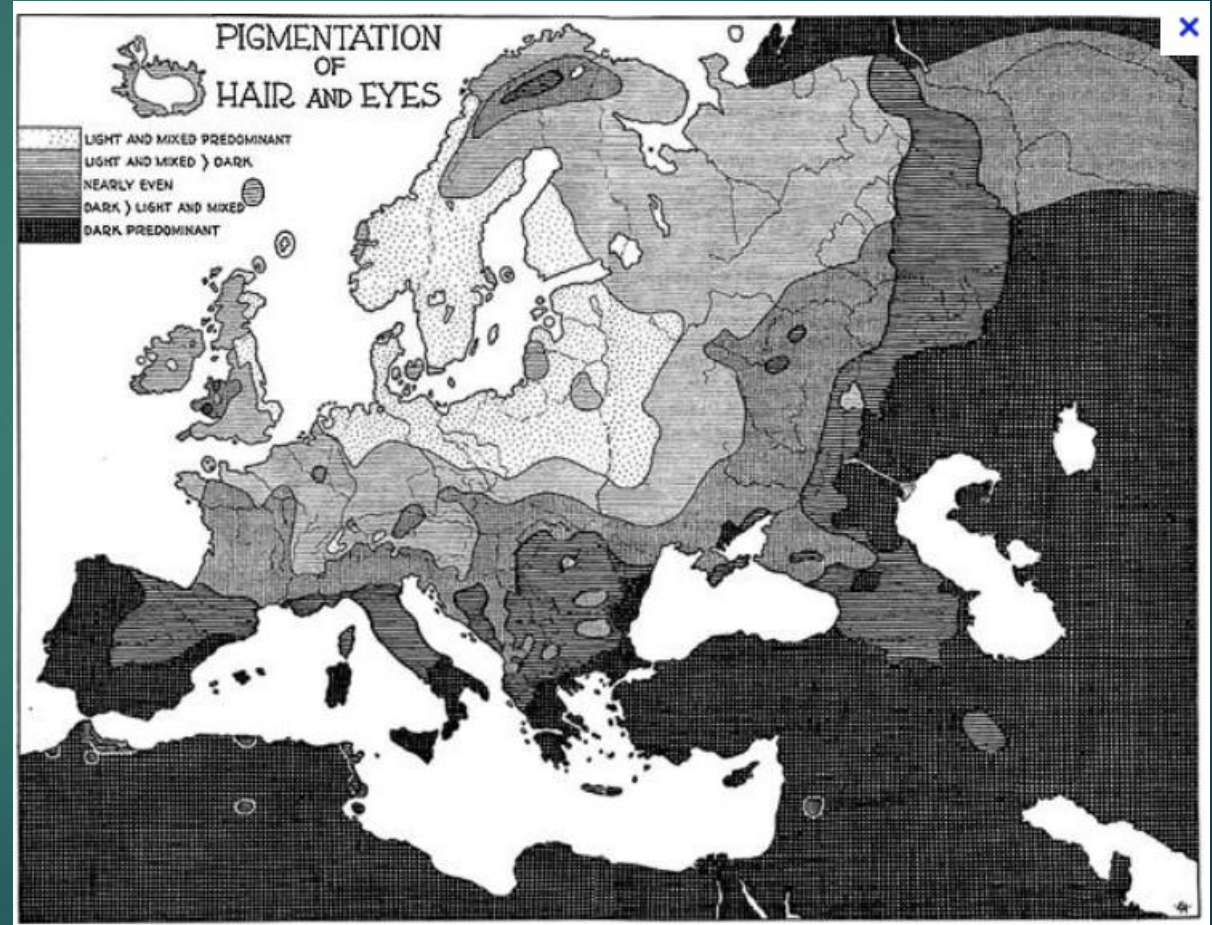
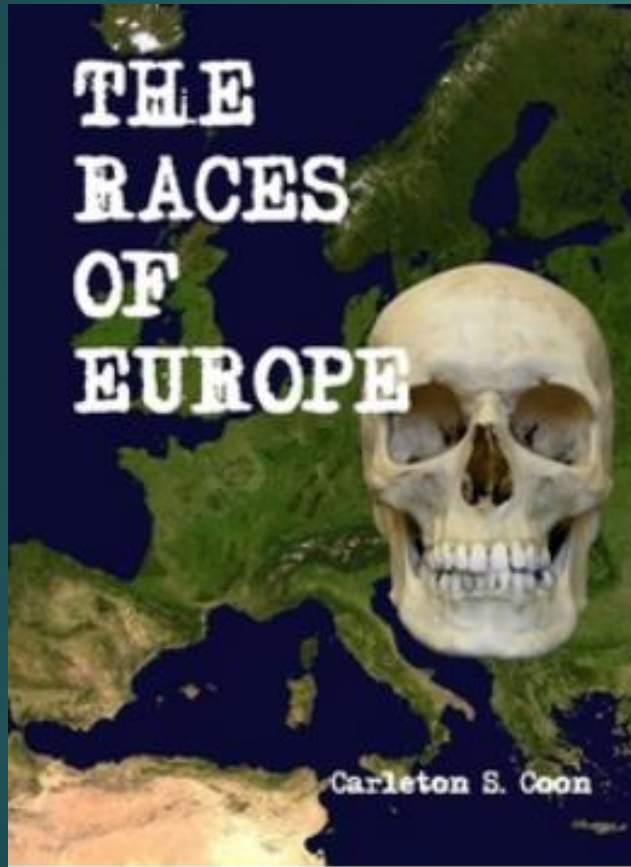
- ▶ **Effect on paleontology:** Single linear model = only one Hominid Species (later the multiregional/continuity model)
- ▶ Limit the number of species; emphasis on lumping, not splitting; focus on ancestors & descendants, not diversity
- ▶ **Dobzhansky:** There has only been only one hominid species at any one time; rejected phylogenetic tree/bush model
- ▶ **Mayr: Single species theory:** Hominid lineage of australopithecines to Homo erectus to Homo sapiens; hominids did not speciate because they occupied all the ecological niches
- ▶ See Ian Tattersall for major counter argument.

## Later Evolution theories:

### Survival of the most genetically adaptable

- ▶ “Survival of the species” (group selection arguments) no longer acceptable. Such explanations were largely replaced by a gene-centered view of evolution.
- ▶ This viewpoint would be summarized and popularized in the influential 1976 book *The Selfish Gene* by Richard Dawkins
- ▶ Theory of punctuated equilibrium: Niles Eldredge and Stephen Jay Gould proposed that there was a pattern of fossil species that remained largely unchanged for long periods (what they termed *stasis*), interspersed with relatively brief periods of rapid change during speciation.

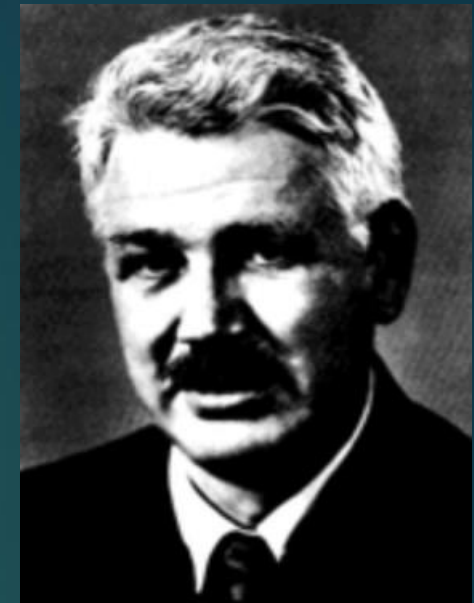
# Rise of academic theories of Evolution and racial origins: Races of Europe, 1939 – Charlton Coon





# Carlton Stevens Coon (1904-1981): Racial differences & Continuity theory

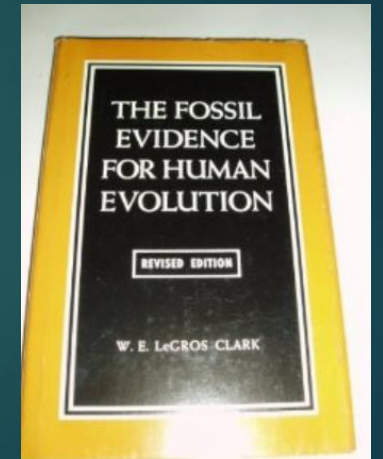
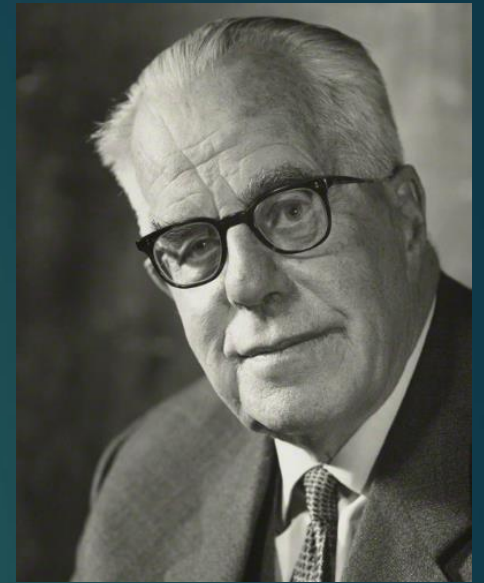
- ▶ American physical anthropologist
- ▶ Expert on racial differences: and *The Races of Europe* (1939), *The Origin of Races* (1962), *The Story of Man* (1954),
- ▶ Human races had been separate since Homo erectus & had evolved toward Homo sapiens in parallel: he reintroduces the multi-continuity hypothesis but without genetic exchange between geographically separated populations.
- ▶ Theory of 5 races: some races reached the Homo sapiens stage in evolution before others, resulting in the higher degree of civilization among some races.
- ▶ Castigated as a racist in 1960s for his modified version of Franz Weidenreich's multi-regional theory



## Sir Wilfred Edward Le Gros Clark (1896-1971):

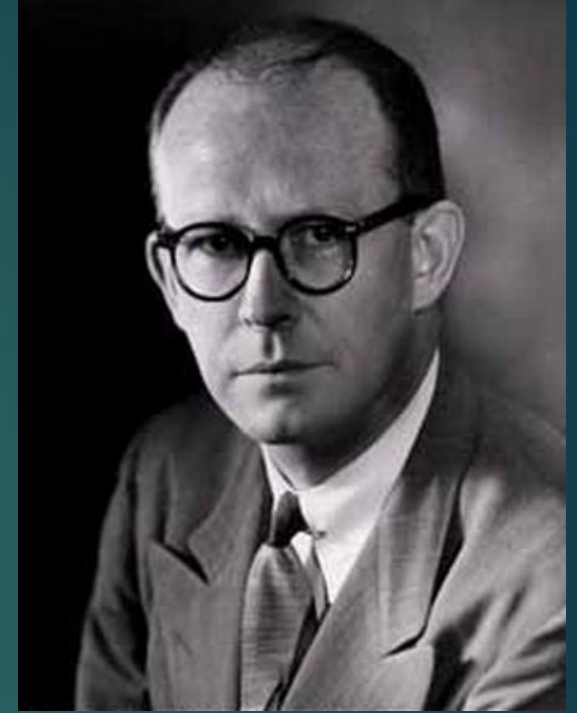
Primatology, Taung Child, Piltdown discredited

- ▶ British anatomist; professor at Oxford; replaced Arthur Keith
- ▶ Dubbed the first primatologist
- ▶ \*\*1947: spoke out in favor of Raymond Dart's assessment of Taung skull
- ▶ 1950: First morphological comparison of ape vs. australopithecine vs. human skulls
- ▶ \*\*Helped K. Oakley & J. Weiner to expose Piltdown hoax in 1953
- ▶ While he never found any human fossils, he had **major scholarly influence on primate evolution and human origins via his 4 books**



# Willard Frank Libby (1908-1980): Radiocarbon dating

- ▶ American chemist
- ▶ 1947: developed the radiocarbon dating method; received Nobel Prize in 1960
- ▶ Revolutionary impact on archeology for material less than 50K
- ▶ Originally needed to destroy large sample to accurately date, so usually done on associated organic materials (charcoal), so you don't destroy fossil; improvements lead to smaller samples





# Ernest A. Hooton (1887-1954): Neandertal differences & racial classification

- ▶ **\*\* First American professor of physical anthropologist**
- ▶ Professor, Harvard University
- ▶ Influential teacher of a generation of physical anthropologists
- ▶ **\*\*1946**: described differences between “classic Neanderthals” (more robust) from Western Europe and those with more modern appearance from central Europe (lighter boned at Krapina) or the Near East.
- ▶ Known for his work on racial classification
- ▶ **Mildly racist; but maintained no correlation between race & IQ**

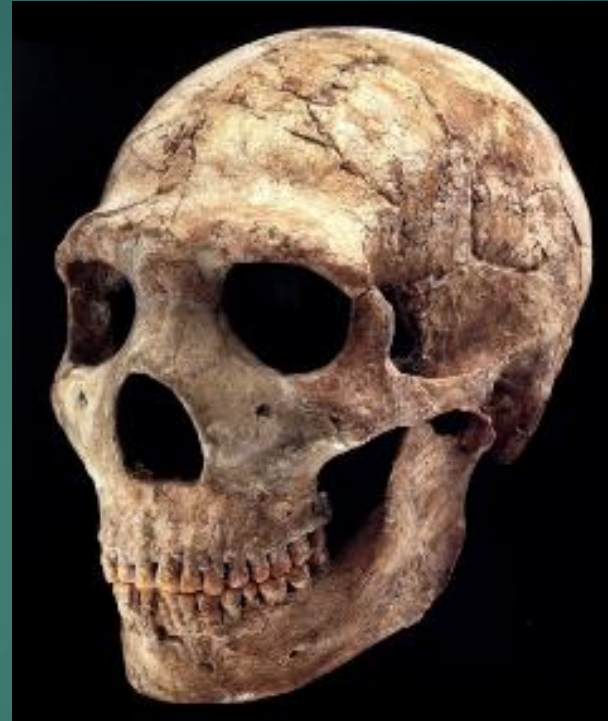


# Classic Western vs. Levantine Neandertals

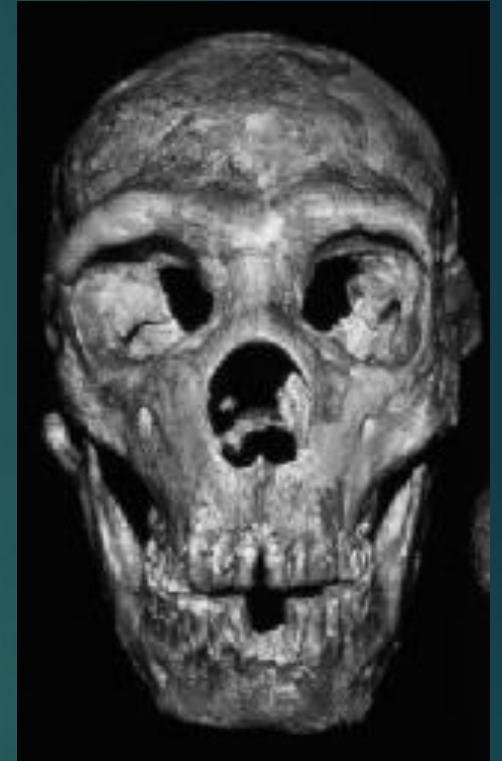
## Classic Neanderthals



La Ferrassie, France: considered typical of "Classic" Neanderthals – also among largest in Europe



Amud 1:  
Tallest (1.8 m) & largest  
hominin brain (1740cc)  
Date: 53 K



Shanidar 1

Levantine Ns were younger;  
Younger also than MHs in area

## 1948: Potassium-Argon Dating:

Decay of radioactive potassium-40 to radioactive argon-40 in minerals and rocks; K has a half life of 1.23 By



Especially used with volcanic rocks, which do not contain argon; can date layer above & below fossil, Fossil bearing sedimentary deposits between the tuffs & lava flows. In 1961, used to date Zinj to a then astonishing age of 1.75 Ma

Range: 20 K to 4.5 billion years



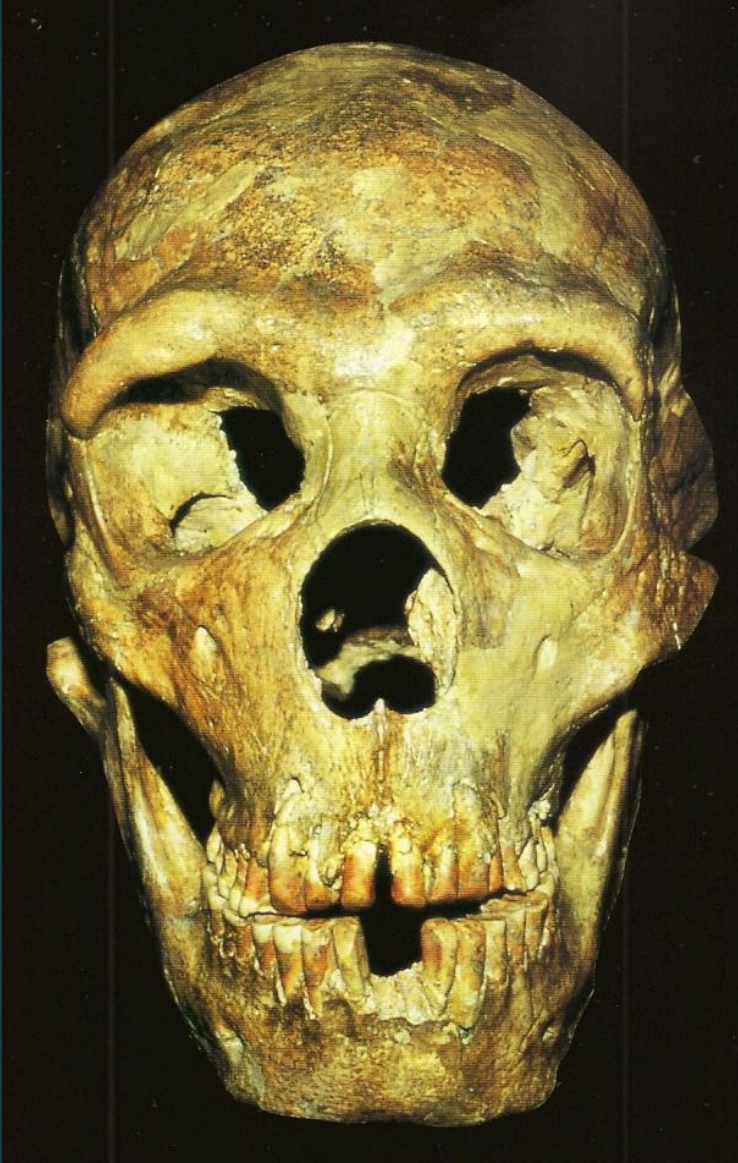
# Ralph Solecki (1917-): Neandertals the Flower People



- ▶ American archeologist, Columbia Univ.
- ▶ 1957-1961: Excavated at Shanidar, Iraq
- ▶ *“Shanidar, the First Flower People”*
- ▶ First adult Neandertal skeletons in Iraq, 80K.
- ▶ The excavated area produced nine skeletons (labeled Shanidar I – IX).
- ▶ Developed theory that Neandertals had religious beliefs: funeral ceremonies, burying their dead with flowers (although the flowers are now thought to be a modern contaminant; Persian Jird), and that they took care of injured individuals
- ▶ Jean Auel used his ideas in writing her Clan of the Cave Bear series.



# Shanidar 1: adult male, 40-50 years, old & injured



- Eye socket crushed-blinded in that eye
- Had suffered substantial injuries to arms, legs, & head, which had partially healed, suggesting he had been cared for by others

Left arm amputated above the elbow



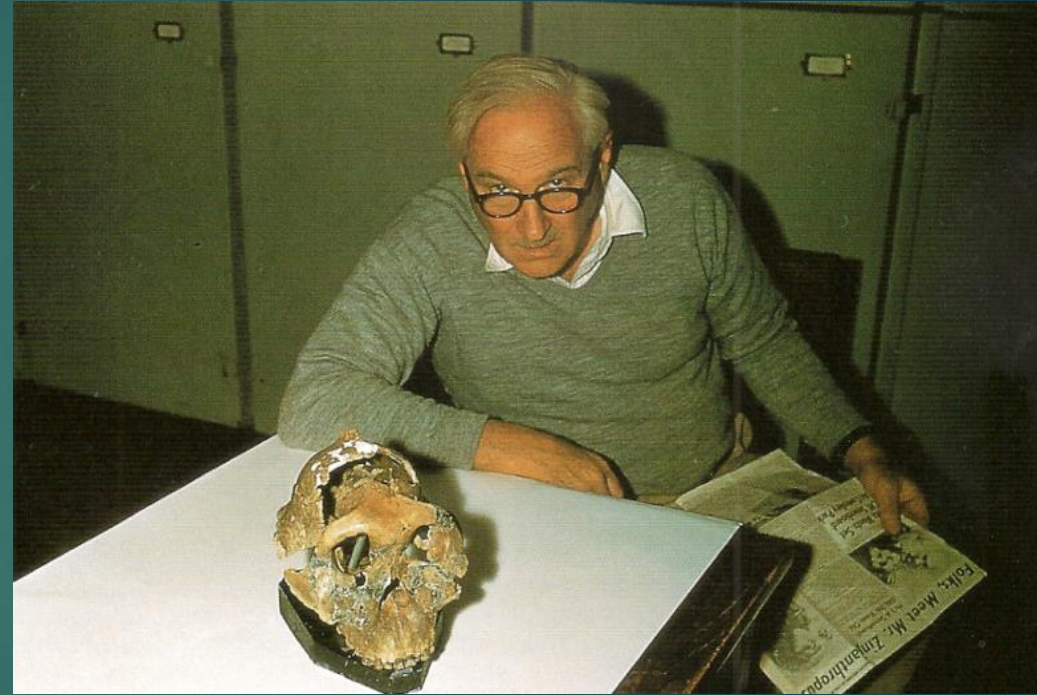
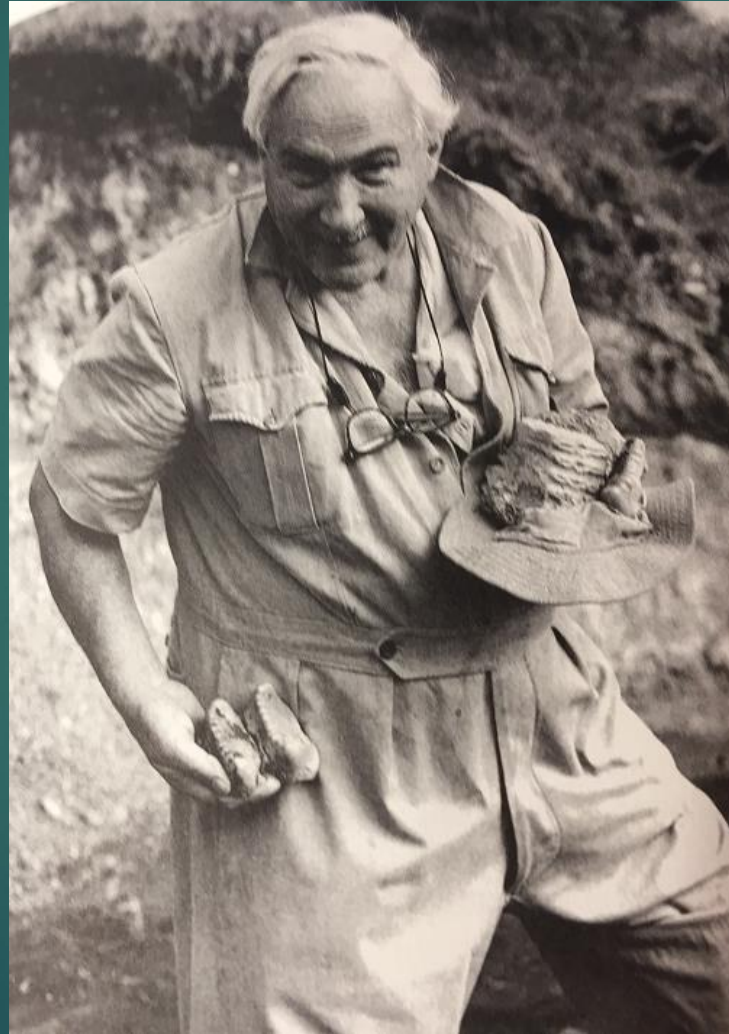
Shanidar 1 = He was **inspiration for Creb**, the disabled shaman in Jean M. Auel's novel *The Clan of the Cave Bear* (1980)



# Louis Leakey: Discoverer of *Zinj* & *Homo habilis* *First International Superstar in Paleoanthropology*



1920, fully initiated  
Kikuyu Tribe member





# 1959 - *Paranthropus boisei*:

Most famous Olduvai Gorge fossil; “Zinj”



1959: Zinj, OH5



*Australopithecus/Paranthropus boisei*

(OH 5, type)

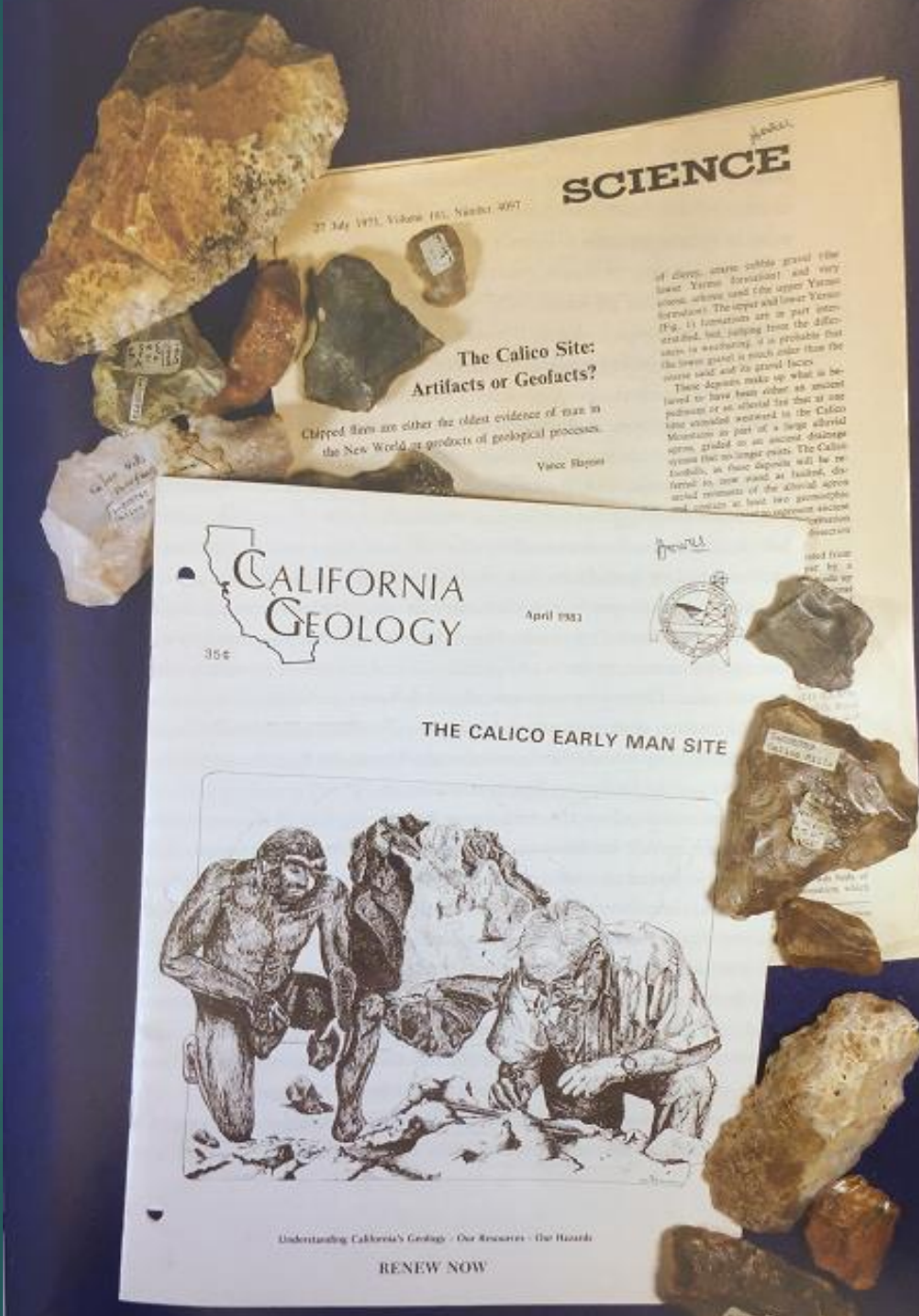
Discoverer: **Mary Leakey**

Locality: Olduvai Gorge, Tanzania

Age: 1.8 M

Date 1959

Calico Man tools  
...not real.



# Louis Seymour Bazett Leakey (1903-1972):

## First Superstar in Paleoanthropology

- ▶ Pioneer East African paleontologist; replaced Robert Broom
- ▶ One of the most renowned paleoanthropologists of all time; always controversial
- ▶ 1943-1947: handaxes at Olorgesailie, Kenya, 400K
- ▶ 1959: son **Jonathan Leakey** found & **Mary Leakey** unearthed the first robust *Zinjanthropus boisei* (OH5) at Olduvai Gorge, Tanzania; first claimed as human ancestor; Later, reclassified as *Australopithecus*, then *Paranthropus*.
- ▶ 1960: with **Mary**, discovered the skull and hand of *Homo habilis*, (OH 7) 1.75 Ma. Published with Phillip Tobias & John Napier
- ▶ Controversial involvement with **Calico Hills, CA** search for early man (not hominid artifacts)



# Louis Leakey biography

- ▶ Born in 1903 in Kenya to missionary parents. He was initiated into the Kikuyu ethnic group (later the Mau Mau), becoming fluent in Kikuyu. In 1926 he received a double first in anthropology and archeology at Cambridge. He suffered a head injury during a rugby match, which doctors diagnosed as post-traumatic epilepsy. He discovered the Acheulean site of Kariandusi, which he excavated in 1928. In 1928 he married Frida Avern. Mentored by Arthur Keith, Louis received his PhD in 1930.
- ▶ After butterfly collector almost fell into the gorge in 1911, Hans Reck explored Olduvai in 1913 looking for flint tools. In November 1931 Louis led an expedition to Olduvai, including Hans Reck, whom he allowed to enter the gorge first. Louis did find Acheulean tools within the first 24 hours, costing Reck ten pounds on the bet. Tools were basalt & quartzite.

Louis Leakey in 1932; thought they were 600 Ky old;  
used iron stakes in concrete to mark areas of discovery;  
while gone, fisherman pounded them into fish hooks



Kanam jaw and  
Kanjera skull  
fragments

## Louis Leakey 2

- ▶ He asked Frida for divorce 1 month after birth of 2<sup>nd</sup> child, having become involved with 20 yo illustrator Mary Nicol.
- ▶ Scandal followed. An ethics investigation, then questions raised as to his archeological work in Africa. Everyone turned vs him. He and Mary returned to Olduvai. Then returned to England for several years of poverty. In January 1937 the Leakeys travelled to Kenya. He was a Kenyan intelligence officer during WWII.
- ▶ In 1947 Louis conducted the first Pan-African Congress of Prehistory at Nairobi. Sixty scientists from 26 countries attended, delivering papers and visiting the Leakey sites. The conference restored Louis to the scientific fold. Mary and he then headed the famous expeditions of 1948 and beyond at Rusinga Island in Lake Victoria, where Mary discovered the most complete Proconsul fossil up to that time.

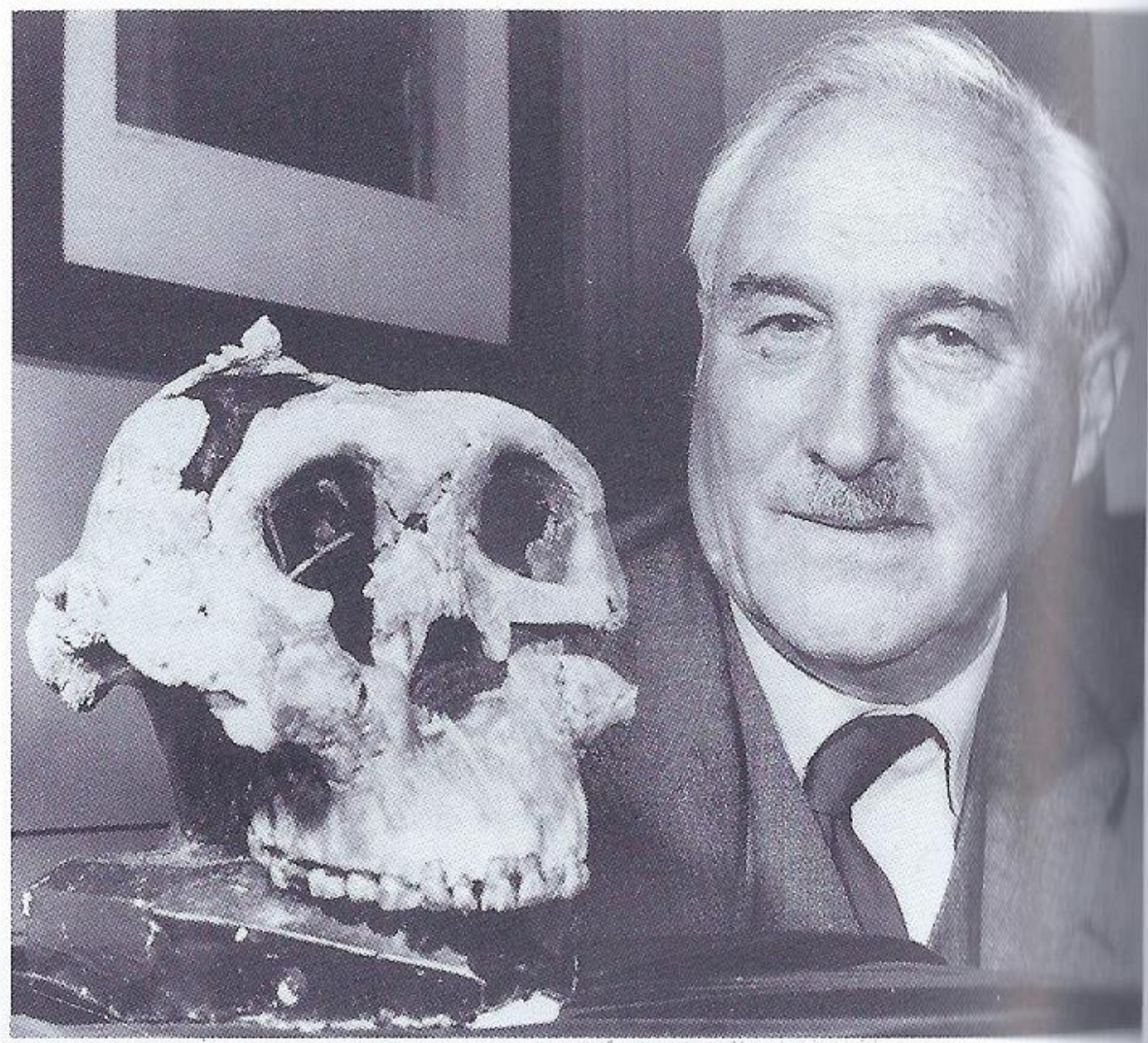
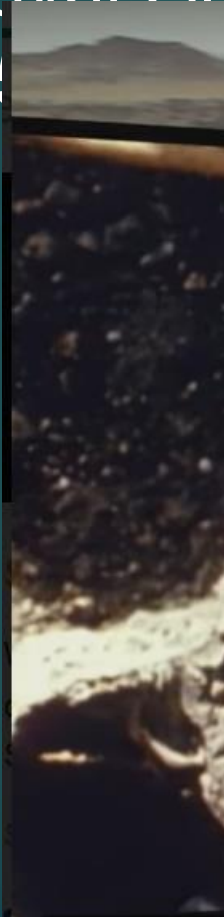


# Louis Leakey and the Mau Maus

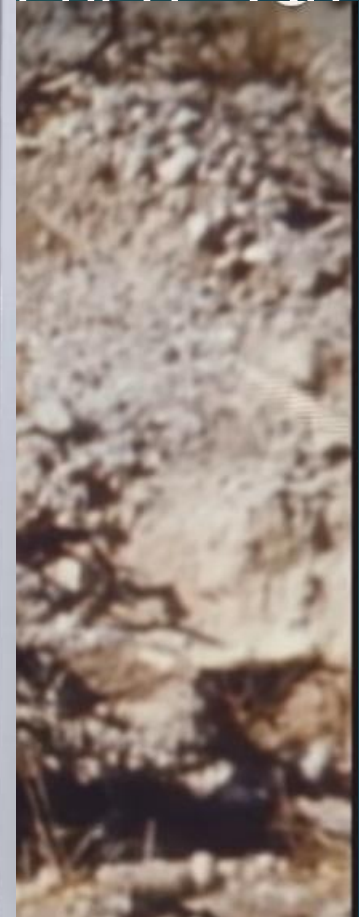
- ▶ During the 1950s, Kenya was racked by an anti-colonial rebellion by the Mau Maus, a secret underground anti-British group.
- ▶ In response to the Mau Mau rebellion, the British colonial government created a network of detention camps across the country that imprisoned a significant proportion of the native population.
- ▶ Because he spoke fluent Kikuyu, Leakey acted as a translator for the British. Warned the British, translated at the trial of Jomo Kenyatta (who became president at Kenya's independence in 1964), carried a gun and put under protective custody, attempted to help resolve conflict, etc. Complex issues.
- ▶ 1954 book: Defeating the Mau Mau

# Louis Leakey 3

- ▶ For 30 years toolmaker. Believed that man was at Olduvai Gorge on July 17, 1960



...s but not the  
ensive research  
ened. On July





# Louis Leakey 4

- ▶ While Louis was sick in camp, Mary discovered the fossilized skull OH 5 at FLK site, *Paranthropus boisei*, famously identified as "*Zinjanthropus*" or "Zinj." Le Gros Clark retorted casually "Shades of Piltdown." Dated at 1.7 Ma. In 1960, the Leakeys discovered OH 7, *Homo habilis*, the toolmaker. Two separate species, at 1.8 Ma. Swung paleontology to Africa.
- ▶ In 1960, Louis appointed Mary director of excavation at Olduvai. She brought in a staff of Kamba assistants, including Kamoya Kimeu, who later discovered many of eastern Africa's most famous fossils. At Olduvai, Mary set up Camp 5 and began work with her own staff and associates.
- ▶ In 1961 Louis got a salary as well as a grant from the National Geographic Society and turned over the acting directorship of Coryndon Museum (Nat. Museum of Kenya) to a subordinate. He created the Centre for Prehistory and Paleontology on the same grounds, moved his collections to it, and appointed himself director.



Louis Series



## Louis Leakey 4

- ▶ In 1962 Louis was visiting Olduvai when Ndibo Mbuika discovered the first tooth of *Homo habilis* at MNK. Louis and Mary thought it was female and named her Cinderella, or Cindy. Phillip Tobias identified Jonny's Child and Raymond Dart came up with the name *Homo habilis* at Louis' request, which Tobias translated as "handyman."
- ▶ In 1963, Leakey obtained funds from the National Geographic Society and commenced archaeological excavations at Calico Hills, CA. He claimed stone tools were 100 Ka; ultimately proven to be natural stone breakage. In her autobiography, Mary Leakey wrote that because of Louis's involvement with the Calico Hills site she had lost academic respect for him and that the Calico excavation project was "catastrophic to his professional career and was largely responsible for the parting of our ways"



# The Trimates - Leakey's Angels: Go study apes!



Jane Goodall



Dian Fossey



Birute Galdikas



# Louis Leakey 5

- ▶ One of Louis's greatest legacies stems from his role in fostering field research of primates in their natural habitats, which he understood as key to unraveling the mysteries of human evolution. He personally chose three female researchers, Jane Goodall (chimps), Dian Fossey (gorillas), and Birute Galdikas (orangutans), calling them The Trimates.
- ▶ During his final years Louis became famous as a lecturer in the United Kingdom and United States
- ▶ In 1968, Louis refused an honorary doctorate from the University of Witwatersrand in Johannesburg, primarily because of apartheid in South Africa. Mary accepted one, and thereafter led separate professional lives. He and Dian Fossey had a brief romance. Louis assisted with the founding of The Leakey Foundation, to ensure the legacy of his life's work in the study of human origins.
- ▶ On 1 October 1972, Louis had a heart attack in Jane Goodall's apartment in London and died that day.

# Leakey bibliography

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- ▶ *Adam's Ancestors: The Evolution of Man and His Culture, 1934*
- ▶ *The Stone Age races of Kenya, 1935*
- ▶ *Stone Age Africa: an Outline of Prehistory in Africa, 1936*
- ▶ *White African: an Early Autobiography, 1937*
- ▶ *Olduvai Gorge: A Report on the Evolution of the Hand-Axe Culture in Beds I-IV, 1951*
- ▶ *Mau Mau and the Kikuyu, 1952*
- ▶ *Olduvai Gorge: A Preliminary Report on the Geology and Fauna, 1951–61, 1965*
- ▶ *Unveiling Man's Origins, 1969*
- ▶ *Olduvai Gorge, 1965–1967, 1970*
- ▶ *By the Evidence: Memoirs, 1932–1951, 1974*

# Leakey biographies

- ▶ *Disclosing the Past* – Mary D. Leakey, 1984
- ▶ *Olduvai Gorge: My Search for Early Man* - Mary Leakey
- ▶ *One Life - Richard E Leakey* by Richard Leakey, 1984
- ▶ *Excavations at Njoro River Cave* (with Louis Leakey), 1950
- ▶ *Olduvai Gorge: Excavations in Beds I and II, 1960–1963*, 1971
- ▶ *Olduvai Gorge: My Search for Early Man*, 1979
- ▶ *Africa's Vanishing Art: The Rock Paintings of Tanzania*, 1983
  
- ▶ *The Leakeys: A Biography* by Mary Bowman-Kruhm
- ▶ *Ancestral Passions The Leakey Family and the Quest for Humankind's Beginnings* by Virginia Morell
- ▶ *Mary Leakey: In Search of Human Beginnings* by Deborah Heiligman
- ▶ *Origins Reconsidered: In Search of What Makes Us Human* by Richard E. Leakey & Roger Lewin



# *Paranthropus boisei*:

Most famous Olduvai Gorge fossil; “Zinj”



1959: Zinj, OH5



*Australopithecus/Paranthropus boisei*  
(OH 5, type)

Discoverer: Mary Leakey

Locality: Olduvai Gorge, Tanzania

Age: 1.8 M

Date 1959





# Paranthropus boisei, Sexual dimorphism



OH 5, male



KNM-ER 732, female



*Homo habilis*. Olduvai Gorge (642cc):  
4 specimens: Jonny's Child, Twiggy, Cindy, George



“Jonny's Child”, *H. habilis*, OH 7, 1.7 M, type



“Twiggy”, *Homo habilis*, OH 24, 1.8 M, pancaked flat



“Cindy”, *H. habilis*, OH 13, 1.6 M, ~ 650 cc.;  
Mandible & teeth, bits of maxilla, cranial fragment.



“George”, *Homo habilis*, OH 16, 1.7 M  
Aprox 640 cc. Teeth & skull fragments.

# *Homo habilis*



*Homo habilis*,  
(OH 7 type)

Discoverer: Jonathan Leakey

Locality: Olduvai Gorge, Tanzania

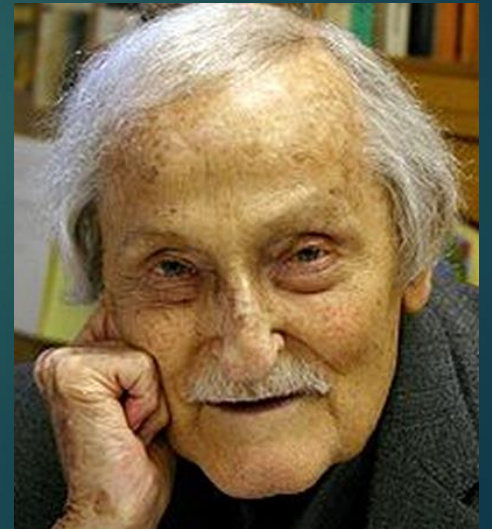
Age: 1.75 M

Date 1960

# Phillip Vallentine Tobias (1925-2012):

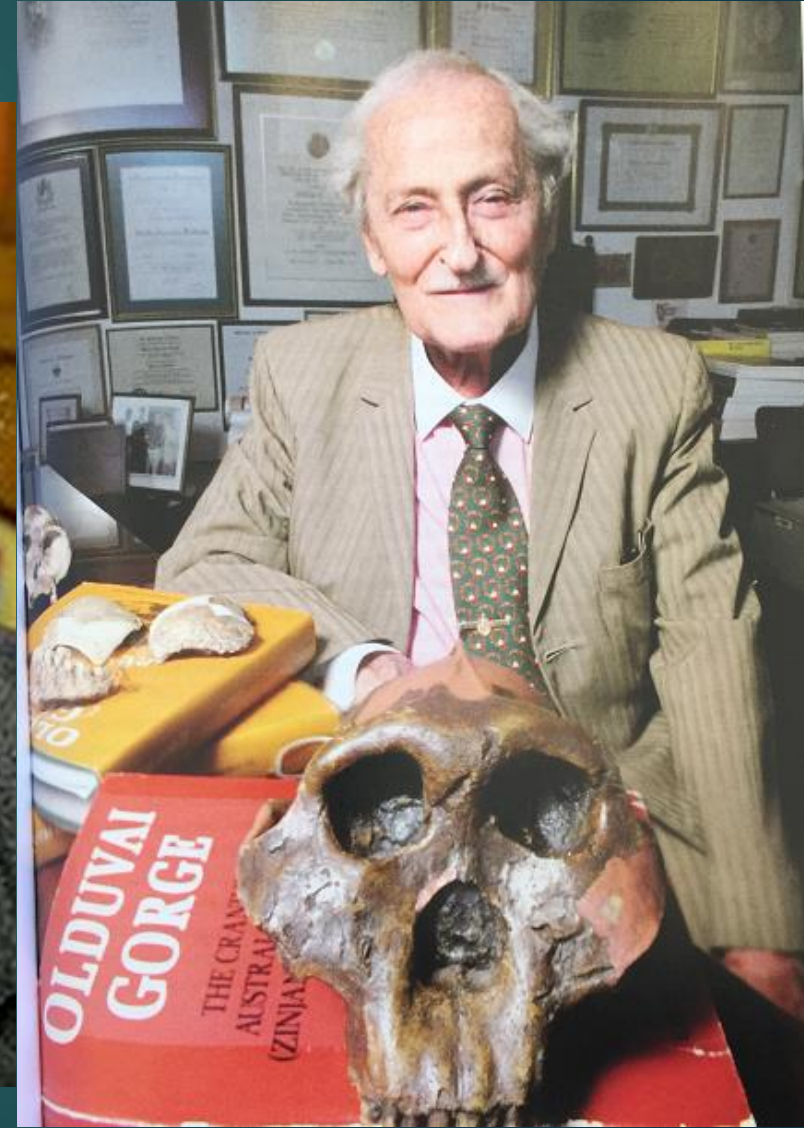
## Described & Named *Homo habilis*

- ▶ South African paleoanthropologist & Professor Emeritus at the University of the Witwatersrand in Johannesburg; Student & successor of Raymond Dart.
- ▶ Tobias has excavated at the Sterkfontein caves and worked at almost all other major sites in Southern Africa since 1945.
- ▶ 1964: Collaborating with Louis Leakey, Tobias identified, described and named the new species *Homo habilis*.
- ▶ At the Sterkfontein site: the largest single sample of *Australopithecus africanus* as well as the first known example of *Homo habilis* from Southern Africa
- ▶ Published over 600 journal articles and authored or co-authored 33 books
- ▶ Anti-apartheid activist



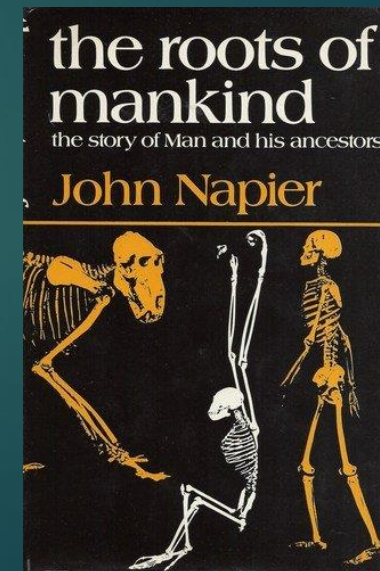


# Phillip Vallentine Tobias (1925-2012):



# John Russell Napier (1917-1987): *Homo habilis*

- ▶ British anatomist
- ▶ Primate evolutionary biology
- ▶ Studied *Proconsul africanus*
- ▶ With Philip Tobias & Louis Leakey, named *Homo habilis* as a species
- ▶ 3 influential books, incl. *The Roots of Mankind*, 1971





# Mary Leakey (1913-1996):

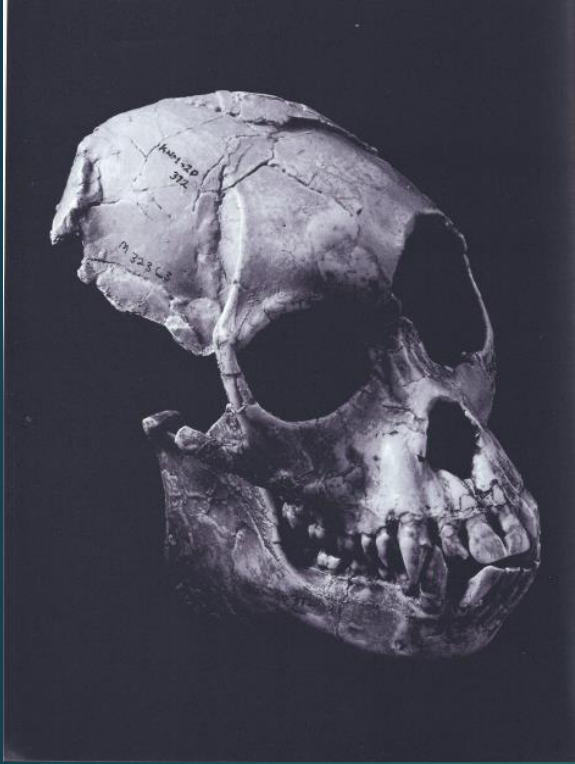
Discoverer of Proconsul, Zinj, & Laetoli footprints

- ▶ Mary Douglas Nicol; British archaeologist and anthropologist
- ▶ As famous as her husband Louis.
- ▶ 1948: discovered the first *Proconsul africanus* on Rusinga Island, Lake Victoria; 18MY
- ▶ 1959: discovered the robust *Zinjanthropus* skull at Olduvai Gorge.
- ▶ **Classification system of Oldowan tools.**
- ▶ 1960: became director of excavations at Olduvai.
- ▶ 1978: discovered, with Tim White, Laetoli footprints, dated 3.7 million years ago; clearly bipedal.





# Mary Leakey



1948: *Proconsul africanus*

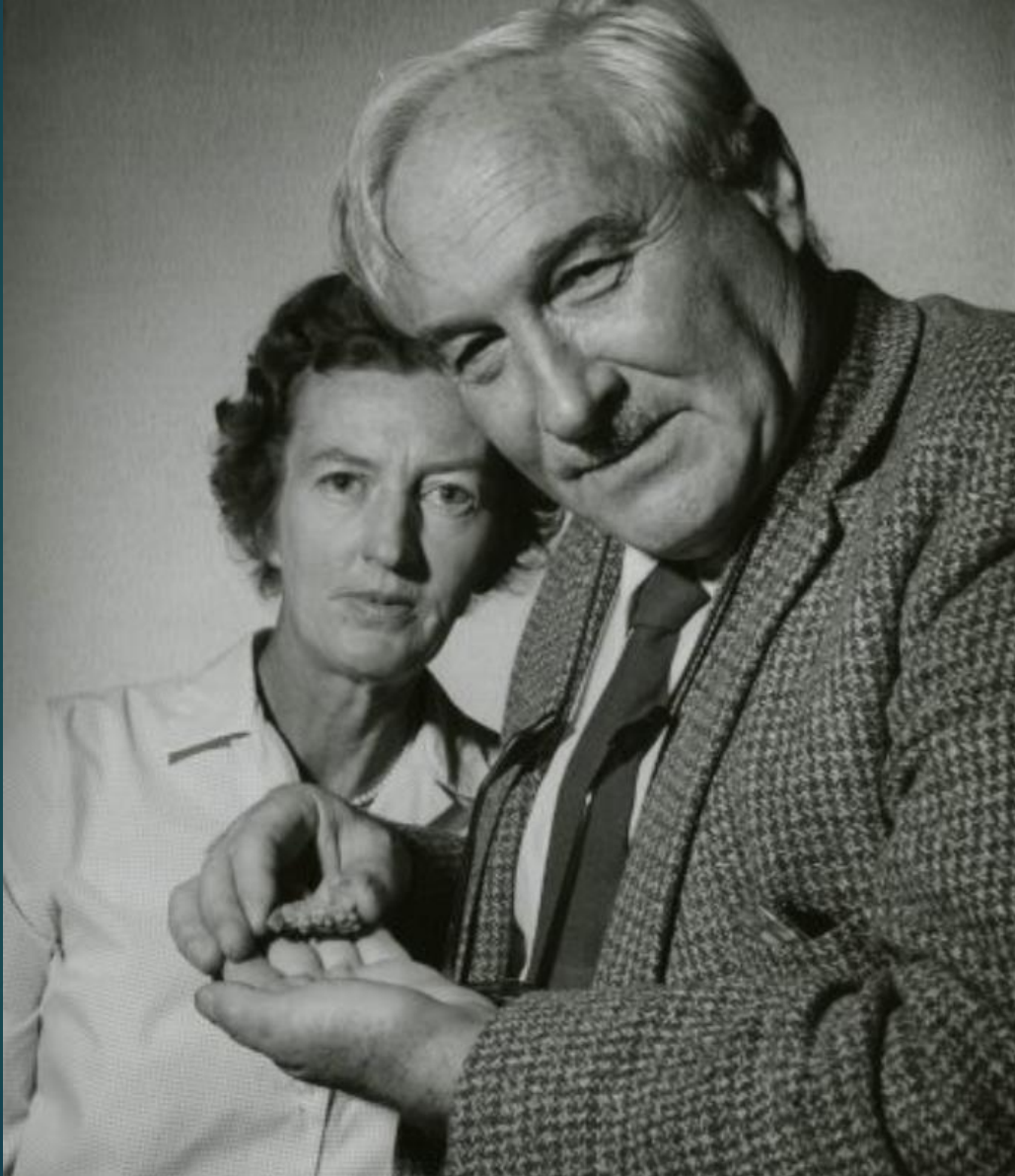


1959: Paranthropus Boisei



1978: Laetoli *A. afarensis* footprints

# Mary Douglas Nichol Leakey: Woman behind the man



- Artist, paleontologist
- Not accepted at Oxford
- 4 honorary doctorates
- 24 research grants
- 5 books
- Multiple manuscripts
- Discoverer of
  - Zinj,
  - Laetoli footprints,
  - stone technology

She accepted honorary doctorate from Univ. of Witwatersrand; Louis refused his because of apartheid; separated after this



# Mary series





# Mary Leakey biography

- ▶ During her career, Leakey discovered fifteen new species of animal. She also brought about the naming of a new genus.
- ▶ In 1972, after the death of her husband, Leakey became director of excavations at Olduvai. She maintained the Leakey family tradition of paleoanthropology by training her son, Richard, in the field.
- ▶ Mary was a 3rd great-granddaughter of antiquarian John Frere
- ▶ Mary and Louis Leakey had three sons: Jonathan, born in 1940, Richard in 1944, and Philip in 1949.
- ▶ While her husband was alive, they published many joint findings. However, her contributions were often credited to her husband

## Mary Leakey 2

- ▶ Throughout the 1930s-50s, Mary and Louis Leakey worked at Later Stone Age, Neolithic, and Iron Age archaeological sites in central Kenya, such as Hyrax Hill and Njoro River Cave. In October 1948, Mary discovered a *Proconsul africanus* skull on Rusinga Island. Mary Leakey also recorded and published the Kondoa Irangi Rock Paintings in central Tanzania.
- ▶ The Leakeys' most famous research, however, was at Olduvai Gorge in the Serengeti plains of northern Tanzania. The site yielded many stone tools, from Oldowan choppers to multi-purpose hand axes. The earliest tools they dug up were likely made by *Homo habilis* and can be dated to over two million years ago.

# Mary Leakey 3

- ▶ On the morning of 17 July 1959, Louis felt ill at Olduvai and stayed at camp while Mary went out to the field. At some point she noticed a piece of bone that "seemed to be part of a skull" with a "hominid" look". After dusting the topsoil away, she found "two large teeth set in the curve of a jaw", and she drove back to camp exclaiming "I've got him!" Active excavation began the following day and a partial cranium was unearthed within a few weeks, though it had to be reconstructed from fragments scattered in the scree. After examining the cranium, Louis Leakey concluded it was of a species ancestral to humans, the australopithecines. He eventually dubbed the find *Zinjanthropus boisei*, "East Africa man"—*Zinj* is an ancient Arabic word for the East African coast. The name was later revised to *Paranthropus boisei*
- ▶ After her husband died in 1972, Mary Leakey continued their work at Olduvai and Laetoli. It was at the Laetoli site that she discovered hominin fossils that were more than 3.75 million years old.



# Mary Leakey 4

- ▶ From 1976 to 1981 Leakey and her staff uncovered the Laetoli hominin footprint trail which had been tracked through a layer of volcanic ash some 3.6 million years ago. The subsequent years were filled with research at Olduvai and Laetoli, follow-up work to discoveries, and preparing publications.
- ▶ Throughout her career, Leakey discovered 15 new species of animals, and one new genus.
- ▶ She received honorary doctorates from Univ. of Witwatersrand, Yale, Michigan Univ., and Oxford

# Mary Leakey's books

- ▶ *Excavations at Njoro River Cave* (with Louis Leakey), 1950
- ▶ *Olduvai Gorge: Excavations in Beds I and II, 1960–1963*, 1971
- ▶ *Olduvai Gorge: My Search for Early Man*, 1979
- ▶ *Africa's Vanishing Art: The Rock Paintings of Tanzania*, 1983
- ▶ *Disclosing the Past*, 1984

# Importance of Elephant Dung

- ▶ 1976, when paleoanthropologist Andrew Hill and a colleague were tossing elephant dung at each other in Laetoli, a hominid archeological site in Tanzania. As Hill dived out of the way, he stumbled on what turned out to be some fossilized animal footprints.
- ▶ In 1977, large elephant tracks were found by **Mary Leakey's** son **Philip** and a co-worker, **Peter Jones**, and alongside them some tracks that looked suspiciously like human footprints
- ▶ This was the origin of one of the wonders of prehistoric finds: a trail of hominid footprints about 3.6 million years old.



# Laetoli Footprints



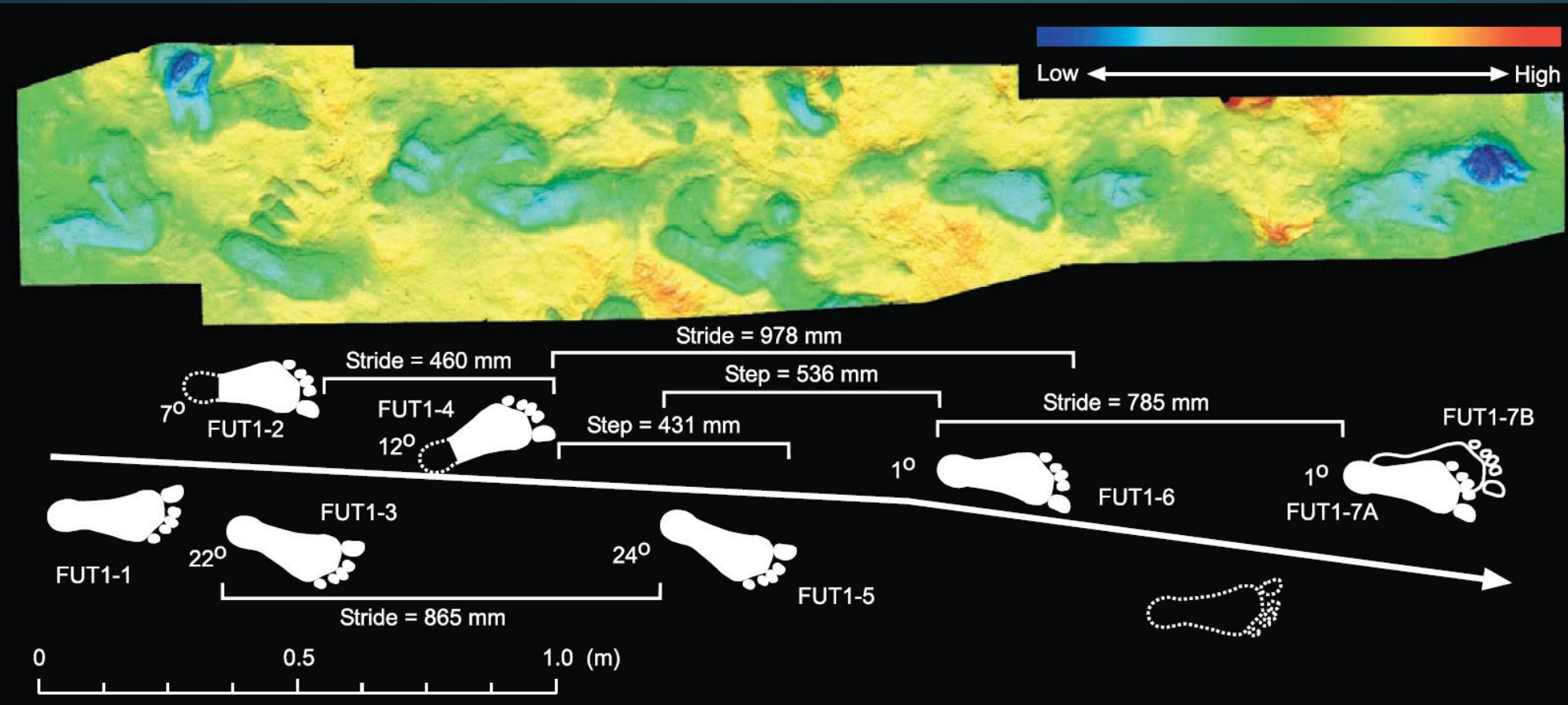
# Laetoli footprints continued: Charles Musiba

- ▶ U C Denver, Anthropology
- ▶ Co-founder of the Tanzania Field School in Anthropology
- ▶ Evolution of upright posture and bipedal gait in humans
- ▶ Laetoli, Tanzania since 1996
- ▶ Laetoli footprints: 4 individuals not 2, walking in each others tracks





# Ileret, Kenya, Footprints: 1.5 M



- ▶ These are the **oldest known evidence of an essentially modern human-like foot anatomy** and differ from the Laetoli footprints left by australopithecines 3.6 million years ago.
- ▶ The size and shape suggest that they were **made by *Homo ergaster***, which also makes them the **oldest surviving footprints made by a human species**.



# Happisburgh Footprints



- ▶ Happisburgh Footprints: 850-950K, 5 people; Norfolk, England; oldest outside Africa; *Homo antecessor*

# Dates of earliest historical discoveries 1

- ▶ **1823** – *H. sapiens*, skeleton, “Red Lady”, Wales
- ▶ **1829** – *H. neanderthalensis*, cranium, **Engis**, Belgium
- ▶ 1843 – *H. sapiens*, skeleton, Brazil
- ▶ **1848** – *H. neanderthalensis*, cranium, **Gibraltar**
- ▶ **1856** – *H. neanderthalensis*, skeleton, **Feldhofer**, Germany
- ▶ 1865 – *H. neanderthalensis*, mandible, Trou de la Naulette, Belgium
- ▶ **1868** – *H. sapiens*, skeleton, **Cro-Magnon**, France
- ▶ 1880 – *H. neanderthalensis*, mandible, Sipka, Czech Republic
- ▶ 1886 – *H. neanderthalensis*, skeletons, Spy, Belgium
- ▶ **1891** – *Pitcanthropus erectus* (*H. erectus*), cranium, **Java**, Indonesia
- ▶ **1899** – *H. neanderthalensis*, 25 skeletons, **Krapina**, Croatia

## Dates of earliest historical discoveries 2

- ▶ 1907 – *H. heidelbergensis*, mandible, **Mauer**, Germany
- ▶ 1908 – *H. neanderthalensis*, skeleton, **Le Moustier**, France
- ▶ 1908 - *H. neanderthalensis*, skeleton, **La Chapelle-aux-Saints**, France
- ▶ 1909 - *H. neanderthalensis*, skeleton, **La Ferrassie**, France
- ▶ 1910 - *H. neanderthalensis*, skeleton, Le Quina, France
- ▶ 1912 – “*Eoanthropus dawsoni*“, Piltdown, England [hoax]
- ▶ 1921 – *Homo rhodesiensis* (*Homo heidelbergensis*), skull, **Broken Hill/Kawbe**, Zambia
- ▶ 1924 – *Homo neanderthalensis*, Kiik-Koba, Crimea
- ▶ 1924 – *Australopithecus africanus*, **Taung**, South Africa
- ▶ 1925 – *Homo neanderthalensis*, craniums, **Ehringsdorf**, Germany
- ▶ 1925 – *Homo neanderthalensis*, child cranium, Gibraltar



## Dates of earliest historical discoveries 3

- ▶ 1925 – *Homo neanderthalensis*, skull, Galilee, Israel
- ▶ 1925 – *Homo neanderthalensis*, skull, **Skhul**, Israel
- ▶ 1927 – *Homo sinanthropus* (*Homo erectus*), molars & skull, **Zhoukoudian**, China
- ▶ 1929 – *Homo neanderthalensis*, skull, Saccopastore, Italy
- ▶ 1931 – *Homo soloensis* (*Homo erectus*), skulls, **Ngandong**, Java, Indonesia
- ▶ 1932 - *Homo neanderthalensis*, skull, **Tabun**, Israel
- ▶ 1933 – *Homo heidelbergensis*, skull, **Steinheim**, Germany
- ▶ 1934 – *Homo sapiens*, skull, **Qafzeh**, Israel
- ▶ 1935 – *Homo heidelbergensis*, skull, **Swanscombe**, England

## Dates of earliest historical discoveries 4

- ▶ 1936 – *Australopithecus africanus*, endocasts, **Sterkfontein**, South Africa
- ▶ 1937 – *Homo erectus*, skull, **Sangiran** Java, Indonesia
- ▶ 1938 – *Homo neanderthalensis*, child skull, **Teshik-Tash**, Russia
- ▶ 1938 – *Paranthropus robustus*, skull, **Kromdraai**, South Africa
- ▶ 1939 – *Homo neanderthalensis*, skull, Grotto Guattari, Italy
- ▶ 1947 - *Australopithecus africanus*, skull (Mrs. Ples), **Sterkfontein**, South Africa
- ▶ 1948 – *Paranthropus robustus*, complete skull, **Swartkrans**, South Africa
- ▶ 1949 - *Telanthropus capensis* (*Homo ergaster*), skull, **Swartkrans**, South Africa
- ▶ 1957 – *Homo neanderthalensis*, skulls, **Shanidar**, Iraq
- ▶ 1959 – *Zinjanthropus boisei* (*Paranthropus boisei*), skull, **Olduvai Gorge**, Tanzania
- ▶ 1960 - *Homo habilis*, mandible, skull, **Olduvai Gorge**, Tanzania