Early Human Evolution

- Overview and Chronology
- What makes us human?
- Ardipithecus and early Australopithecus
- Robust and gracile australopithcines
- Oldowan tools

Overview

- First hominins appeared late in the Miocene, but most hominin fossils date to Pliocene and Pleistocene epochs
- Hominid
  - Family that includes apes and humans (both current and fossil)
- Hominin
  - Tribe that includes humans and early ancestors

Chronology of Hominid Evolution

- If we compare Earth's history to a 24-hour day (1 second = 50k yrs)
  - Earliest fossils deposited at 5:45 a.m.
  - First vertebrates appeared at 9:02 p.m.
  - Earliest mammals, at 10:45 p.m.
  - Earliest primates, at 11:43 p.m.
  - Earliest hominins, at 11:57 p.m.
  - Homo sapiens arrived 36 seconds before midnight

Overview of Species

- Ardipithecus (6 million years)
- Australopithecus (4 million years)
- A. Africanus and A. Robustus
- By 2 million years ago two distinct hominin groups
  - Homo and A. boisei

Epochs of the Cenozoic Era

<table>
<thead>
<tr>
<th>Epoch</th>
<th>Duration</th>
<th>Notable Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miocene</td>
<td>23.7-5.3 Ma</td>
<td>Transition from dinosaurs to mammals</td>
</tr>
<tr>
<td>Pliocene</td>
<td>5.3-2.6 Ma</td>
<td>Earliest hominins appeared</td>
</tr>
<tr>
<td>Pleistocene</td>
<td>2.6-0 Ma</td>
<td>Earliest Homo sapiens appeared</td>
</tr>
</tbody>
</table>

Hominins emerged in late Miocene, but most fossils are from Pliocene and Pleistocene epochs.

Table 8.1 Dates and Geographic Distribution of Major Hominoid, Hominid, and Hominin Fossil Groups

<table>
<thead>
<tr>
<th>Hominid Group</th>
<th>Fossil Site</th>
<th>Date (Ma)</th>
<th>Geographic Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ardipithecus</td>
<td>East Africa</td>
<td>4.4</td>
<td>East Africa</td>
</tr>
<tr>
<td>Australopithecus</td>
<td>South Africa</td>
<td>4.0</td>
<td>South Africa</td>
</tr>
<tr>
<td>H. ergaster</td>
<td>East Africa</td>
<td>2.8-2.7</td>
<td>East Africa</td>
</tr>
<tr>
<td>H. sapiens</td>
<td>Africa, Europe</td>
<td>0.05-0.03</td>
<td>Worldwide</td>
</tr>
<tr>
<td>Homo erectus</td>
<td>Europe</td>
<td>2.0</td>
<td>Europe</td>
</tr>
<tr>
<td>Homo neanderthalensis</td>
<td>Europe</td>
<td>2.7-0.3</td>
<td>Europe</td>
</tr>
<tr>
<td>Homo florescens</td>
<td>Asia, Europe</td>
<td>0.07</td>
<td>Asia, Europe</td>
</tr>
<tr>
<td>Homo florescens</td>
<td>Africa</td>
<td>0.05</td>
<td>Africa</td>
</tr>
</tbody>
</table>

Early hominin sites
Chronology of Hominin Evolution

- Most important epochs for study of hominin evolution
  - Pliocene (5-2mya)
  - Pleistocene (2mya-10kya)
  - Recent (10kya-present)
- *Australopithecus* was main hominin genus until end of Pliocene
- Genus *Homo* evolved from *Australopithecus* by start of Pleistocene

What Makes Us Human?

- A number of traits differentiate hominins from their ancestors
  - Bipedalism
  - Trend toward large brain size
  - Longer period of childhood dependency
  - Trend toward complexity in tool use
  - Trend toward smaller back teeth

Bipedalism

- Hominins have bipedal locomotion – they walk on two legs
- A number of adaptive scenarios have been developed to account for the evolution of bipedalism:
  - Sentinel hypothesis
  - Home base hypothesis
  - Solar radiation hypothesis
  - Efficient gait hypothesis

“East Side Story”

- Adaptive story by Yves Coppens that accounts for:
  - Divergence of hominins from apes
  - Evolution of bipedalism
- Late Miocene saw climate change and shrinking of forest habitat; common ancestor split in two populations:
  - One population stayed in forest – led to modern chimps
  - Second population moved out into the savannah grassland – led to bipedal hominins

Figure 8.1 Phylogenetic Tree for African Apes, Hominids, and Hominins

The presumed divergence date for ancestral chimps and hominins was between 6 and 8 m.y.a. Branching in later hominin evolution is also shown. For more exact dates, see the text and Table 8.1.

Figure 8.3 Comparison of *Homo sapiens* and *Pan troglodytes* (the Common Chimp).

(a) Skeleton of chimpanzee in bipedal position; (b) skeleton of modern human; (c) chimpanzee and human “bisected” and drawn to the same trunk length for comparison of limb proportions. The contrast in leg length is largely responsible for the proportional difference between humans and apes.
Figure 8.4 A Comparison of Human and Chimpanzee Pelvises

The human pelvis has been modified to meet the demands of upright bipedalism. The blades, (ilia, singular, ilium) of the human pelvis are shorter and broader than those of the ape. The sacrum, which anchors the side bones, is wider. The australopithene pelvis is far more similar to that of Homo than to that of the chimpanze, as we would expect in an upright biped.

Brain Size

- Earliest hominins had brains not much bigger than modern apes
- Later hominins had progressively larger brains
- Early hominins
  - Primitive brains
  - Derived postcrania

Brain Size: Fossil Hominids: Cranial Capacity vs. Time

Childhood Dependency

- Hominins have longer period of childhood dependency for body and brain growth
- May have been a byproduct of evolution of bipedalism
  - Bipedal pelvis requires baby with small head

Tool Use

- Capacity for tool use and culture is a primitive trait shared by humans and some other hominoids
- Trend toward more complex tools in hominins
  - Earliest stone tools 2.5 mya

Dental Changes

- Early hominins have primitive large back teeth and thick enamel
  - Later hominins do not
- Canines reduced from hominoid ancestors
- One later hominin had extremely large teeth, but this was a unique adaptation not shared hominins ancestral to modern humans

Figure 8.5 A Comparison of the Skull and Dentition (Upper Jaw) of Homo and the Chimpanzees
Ardipithecus

- Lived during late Miocene, between 5.8 and 5.5 million years ago
- Eventually evolved into *australopithecines*
  - Distinction between *australopithecines* and later hominins made on genus level
  - *Kadaabba* finds consisted of 11 specimens that were apelike in size, anatomy, and habitat

Kenyanthropus

- Complicating picture is discovery, which Maeve Leakey named *Kenyanthropus playtops*
  - Shows at least two hominin lineages existed as far back as 3.5 million years ago
  - *Kenyanthropus* has flattened face and small molars
  - Lucy may not be a direct human ancestor

Australopithecus Species

- *A. anamensis* (4.2 to 3.9 m.y.a.)
- *A. afarensis* (3.8? to 3.0 m.y.a.)
- *A. africanus* (3.0? to 2.0? m.y.a.)
- *A. garhi* (2.5 m.y.a.)
- *A. robustus* (2.0? to 1.0? m.y.a.)
- *A. boisei* (2.6? to 1.2 m.y.a.)

Discovery of Taung Baby

- First australopithecine discovered by Raymond Dart in 1925
- Specimen was a juvenile referred to as the "Taung Baby"
- Developed the "Killer Ape" theory
  - Found *osteodontokeratic* tools
  - Claimed they were for early warfare
Australopithecus anamensis

- Fossils reported first by Leakey and Walker date to 4.2 – 3.9 m.y.a.
  - Molars have thick enamel and apelike canines are large
  - Weighed about 110 pounds (50 kg)
  - Bipedal
  - May be ancestral to A. afarensis

Australopithecus afarensis

- A. afarensis lived between 3.8 and 3.0 m.y.a.
  - Similar in many ways to chimps and gorillas
  - Indicates common ancestry with African apes must be recent
  - Very small brain case
  - Below neck, unquestionably human
  - Striding bipedalism

Table 8.2 Facts about the Australopithecines Compared with Chimps and Homo

<table>
<thead>
<tr>
<th>Species</th>
<th>Date Range</th>
<th>Known Characteristics</th>
<th>Important Sites</th>
<th>Body Weight (male)</th>
<th>Body Size (male)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australopithecus</td>
<td>1.2 - 1.0</td>
<td>Homo sapiens</td>
<td>A-Lake Turkana</td>
<td>112 ± 60 kg</td>
<td>1.55 m</td>
</tr>
<tr>
<td>Homo sapiens</td>
<td>Modern</td>
<td>150,000 years</td>
<td>East Africa</td>
<td>70 - 90 kg</td>
<td>1.8 m</td>
</tr>
</tbody>
</table>

A. afarensis and the Laetoli Footprints
Gracile & Robust Australopithecines I

- Two groups of South African australopithecines (3 – 1 m.y.a.)
  - Gracile smaller and lighter
  - Some argue graciles lived before robust (3 – 2 m.y.a.)
  - Others contend graciles and robusts overlapped
  - Others view them as opposite ends of a continuum

Gracile & Robust Australopithecines II

- Trend toward enlarged back teeth, chewing muscles, and facial buttressing, already noticeable in A. afarensis, continues in South African australopithecines
  - Might have hunted small and slow-moving game
  - Diet mainly vegetarian

Gracile & Robust Australopithecines III

- Contrasts with Homo in that front teeth are less marked
  - In Robust australopithecines, chewing muscles strong enough to produce sagittal crest
  - Brain size increased only slightly between A. afarensis (430 cm³), A. Africanus (490 cm³), and A. robustus (540 cm³)
  - Robusts probably did not use tools to large extent

The Australopithecines and Early Homo

- Ancestors of Homo split off and became reproductively isolated from later australopithecines between 3 and 2 m.y.a.
  - Homo erectus had larger brain and re-proportioned skull
    - Hunted and gathered, made sophisticated tools, and eventually displaced its sole surviving cousin species, A. boisei
    - Johanson and White propose that A. afarensis effectively produced two populations
Hominin Phylogeny

Australopithecines and Early Homo

- 1985 discovery of the black skull (dated 2.6 m.y.a.), apparently an early A. robustus, made for more possible models of the divergence between Homo and Australopithecus
- Surprising mixture of australopithecine features, particularly given its relatively early date

The “Black Skull”

Oldowan Tools

- Oldest tools from Olduvai are widely used between 1.5 and 2 m.y.a.
  - Stone tools consist of cores and flakes
    - Core-piece of rock from which flakes are removed
    - Chopper-tool made by flaking the edge of such a core on one side
  - Oldowan pebble tools represent world’s oldest formally recognized stone tools

A. Garhi and Early Stone Tools

- In 1999, a new hominid species, A. garhi, found in Ethiopia associated with stone tools and the remains of butchered animals
  - Added new species to human family tree
    - Demonstrated the thigh bone elongated one million years before the forearm shortened to create current human proportions
    - Showed early stone tools designed at getting meat and marrow from big game

Hominin Phylogeny