

A Recipe for Disaster: Rise of the Hominids  
(plus condensed version of remaining course material)

Reminder:  
Earth Sciences 083F Final  
Exam  
Saturday, December 9, 2006  
9:00 am  
Room: TC 348

Last day we ended with the division of  
prosimians into two main groups:

◆The adapids, from which  
lemurs and related forms  
arose



◆The omomyids, from which the  
anthropoids arose (new world  
monkeys, old world monkeys,  
and homonoid forms)



Emergence of Anthropoid Group From Omomyids

◆By the Oligocene (38-23  
million years ago), anthropoids  
dominated over lemurs and  
relatives.

◆The beginnings of the  
anthropoid group are traced to  
generalized forms such as the  
parapithecids (e.g.,  
*Aegyptopithecus*).



Branching Within the Anthropoids  
Old World Monkeys and Homonoids (Ape-Like Forms)

◆Dryopithecines (e.g.  
*Proconsul*) thought to be  
the common ancestor of  
stem group of Old World  
Monkeys and Ape-Human  
Line

◆*Proconsul*'s teeth have  
similarities with modern  
apes, but below the neck  
the skeleton is more  
monkey-like.



### Branching of Apes and Hominids (Human Line)

From Dryopithecines  
(or similar group)

...apes took one road  
(e.g. *Afropithecus*, *Kenyapithecus*, *Gigantopithecus*,  
modern apes)

...hominids took another  
(oldest hominid: *Sahelanthropus tchadensis* ?)

### Among the most unique ancient apes was *Gigantopithecus*

- *Gigantopithecus* is the largest primate that ever lived, some standing over 10 feet tall and weighing 1,200 pounds.
- Since it died out around 400,000 years ago, it coexisted with *Homo erectus*.
- Some people believe it is still alive as the yeti and bigfoot.



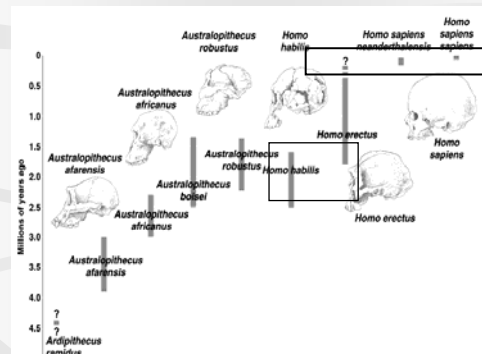
### Misconceptions:

1) Our ancestors were apes

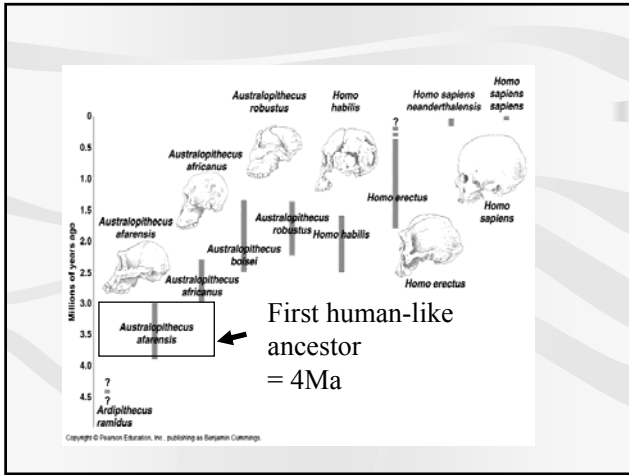
Contrary to popular belief, evolutionists do not claim we evolved directly from apes. More likely, we evolved from a common ancestor. In other words we are related to apes, but did not necessarily evolve from them.

2) Hominid evolution progressed along a single linear track directly from primitive ancestor to modern form.

Most evolutionists acknowledge assert that hominids evolved several branches (more like a bush than a stick) and that some of these branches overlapped in time and space.



Hominid evolution:  
General pattern through time  
(note coexistence of forms during some time periods)



**morphological trends**

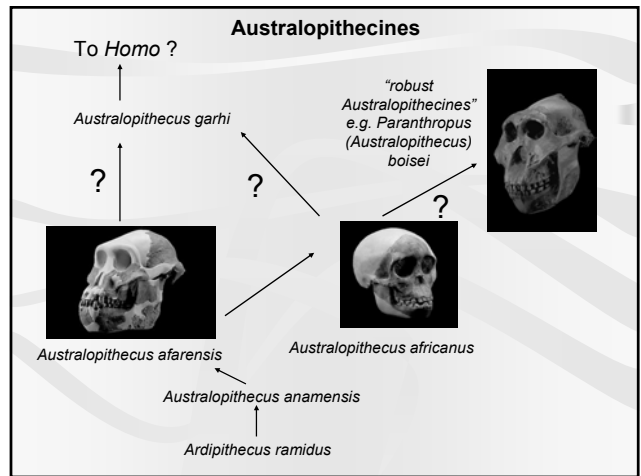
Ape-like ancestors to Australopithecines:

- Pelvis becomes shorter and flatter, pelvic canal expands
- Legs longer, arms shorter
- Digits shorter and straighter
- Foramen magnum (attachment area at base of skull) becomes directed downward

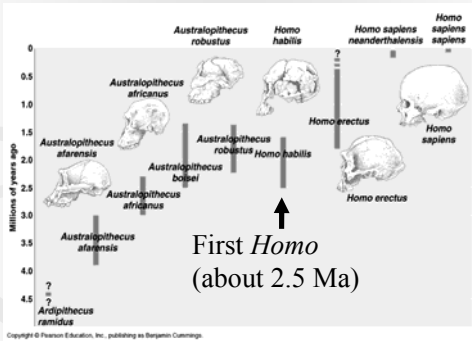
**Bipedal Locomotion**

Footprints of *Australopithecus* in volcanic ash (about 4 million years ago)

Male + Female (with child ?)



## Appearance of genus *Homo*



## *Australopithecus* to *Homo*:

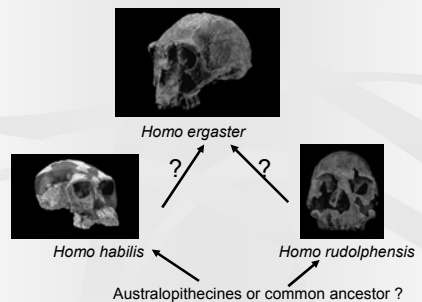
- Body size increases
- Change from largely herbivorous to omnivorous diet
- Bony facial ridges progressively reduced
- Upper and lower jaws protrude less
- Tooth number reduced
- Tooth morphology changes: sharper molars
- Cranial capacity increases
- Habitat changes from woodland to savanna
- Tool use
- Discovery and increased use of fire
- Development of language
- Development of prolonged parental care

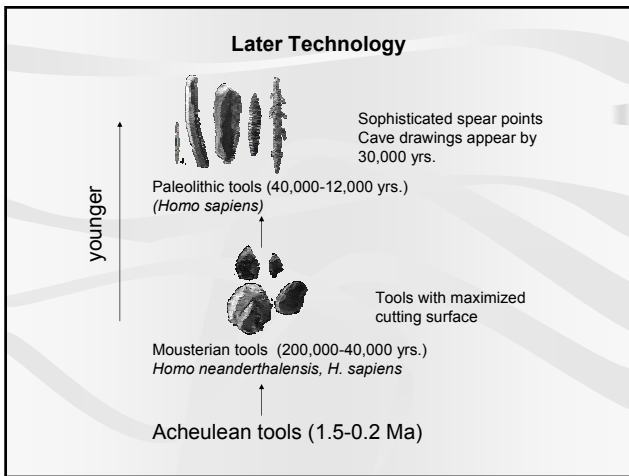
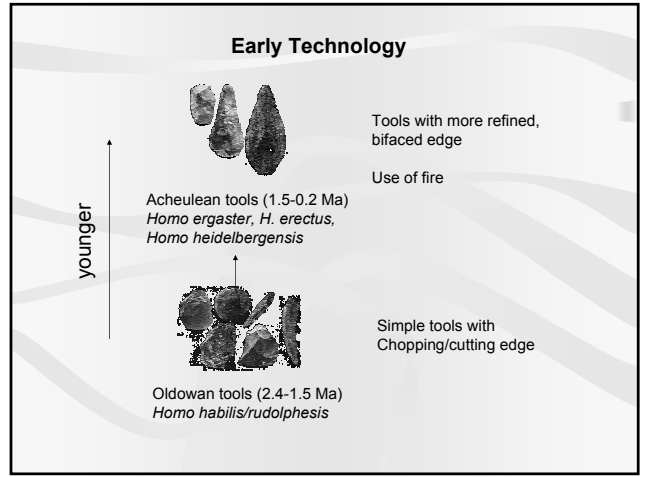
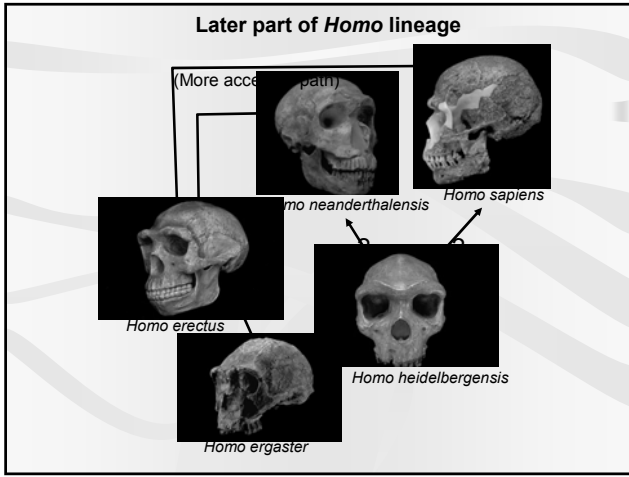


## Also, an overall increase in brain size



## Early part of *Homo* lineage





### Development of *Homo sapiens sapiens*

There are currently two main models to explain the development and distribution of modern *Homo sapiens sapiens*:

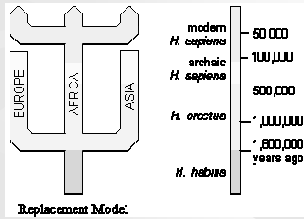
1. The Replacement Model
2. The Regional Continuity Model

## Replacement Model (also known as "Out of Africa Model" and "Noah's Ark" Model)

Proposed by Christopher Stringer and Peter Andrews

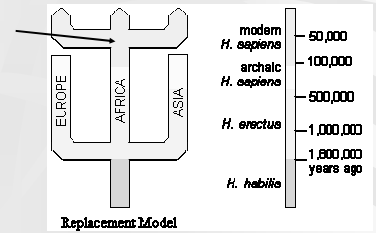
This model envisages modern humans evolving from archaic *Homo sapiens* 200,000-100,000 years ago only in Africa.

It is thought that modern *Homo sapiens* migrated from Africa into the rest of the Old World replacing all of the Neandertals and other late archaic *Homo sapiens*.

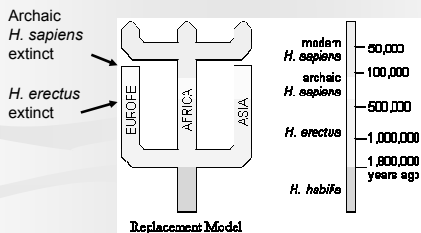


## Replacement Model, cont'd

If this interpretation is correct, all modern people share a relatively modern African ancestry.



## Replacement Model, cont'd

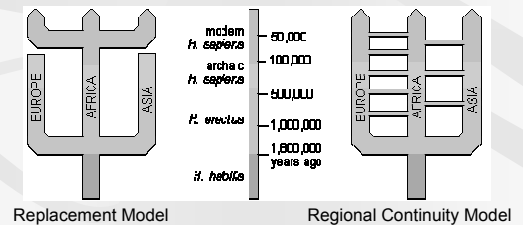


According to this model, the regional anatomical (e.g. racial) differences that we see among humans today are recent developments—evolving only in the last 50,000-40,000 years.

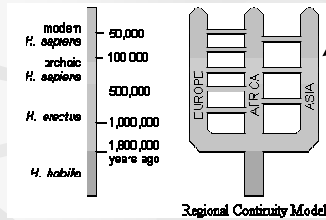
If so, all other lines of humans that had descended from *Homo erectus* presumably went extinct.

## Regional Continuity Model (also called Multiregional Model)

The regional continuity model proposed by Milford Wolpoff (University of Michigan) envisages modern humans evolving more or less simultaneously in all major regions of the Old World from local, scattered, archaic *Homo sapiens* populations.



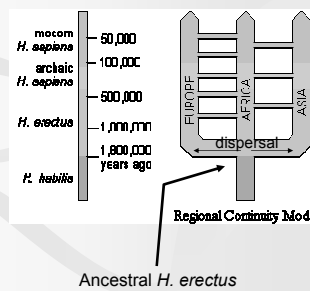
### Regional Continuity Model, cont'd



For example, modern Chinese are seen as having evolved from Chinese archaic *Homo sapiens* and ultimately from Chinese *Homo erectus*.

This would mean that the East Asians and some other peoples in the Old World have an origin of great antiquity.

### Regional Continuity Model, cont'd



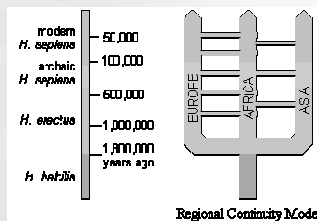
Advocates of the regional continuity model believe that the ultimate common ancestor of all modern people was an early *Homo erectus* (or *Homo heidelbergensis*) that arose in Africa, but which rapidly dispersed to other regions.

It is further suggested that there was sufficient gene flow among European, African, and Asian populations (via intercontinental interchange) to prevent long-term reproductive isolation and the subsequent evolution of distinct regional species.

### Regional Continuity Model, cont'd

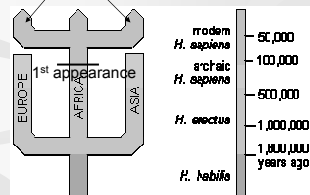
It is argued that intermittent contact between people of these distant areas would have kept the human line a single species at any one time.

However, the model also accommodates periods of some isolation which would have produced differing racial varieties, or subspecies, of humans.



### Which Model Makes More Sense ?

Later appearance in Europe and Asia



#### Fossil Evidence In Favour of Replacement Model:

The oldest known modern *H. sapiens* remains come from Africa and adjacent areas of southwest Asia

Elsewhere in the Asia and Europe, modern *H. sapiens* appears about 50,000 years later

Unless modern *Homo sapiens* remains 100,000 years or older are found in Europe or East Asia, the replacement model best explains available data

### Genetic Evidence In Favour of Replacement Model:

Geneticists argue that the geographic area where modern humans have resided the longest should have the greatest amount of genetic diversity.

This is based on the premise that the rate of mutation is more or less constant everywhere (so long-lived populations would show greater diversity from mutations)

Through comparisons of mitochondrial DNA sequences from people in different modern populations, it was concluded that Africa has the greatest genetic diversity and therefore must be the homeland of all modern humans

Assuming a specific rate of mutation, the common ancestor of all modern humans was a woman who lived 200,000 years ago (mitochondrial Eve)

### Fossil Evidence in Favour of Regional Continuity Model

Proponents of the Regional Continuity Model is claim that there has been some continuity of some anatomical features from archaic *Homo sapiens* to modern humans in Europe and Asia. These include:

1. A heavier brow in Europeans, relative to other populations (brow shape similar to that seen in Neandertals).
2. Facial characteristics in Oriental people can be seen in Asian archaic *Homo sapiens* dating to 200,000 years ago
3. East Asian commonly have shovel-shaped incisors (similar to *Homo erectus*) while Africans and Europeans rarely do

It would seem that there is a direct local linkage between Asian *Homo erectus* and modern Asians and that there are sufficient differences between them among other populations to suggest a multiregional origin.

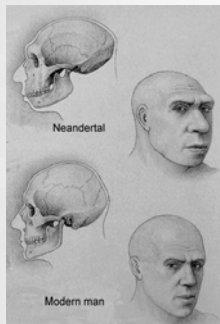
### Morphological differences: *Homo neanderthalensis* vs. *Homo sapiens*

Another dilemma: how closely are Neandertals related to us (subspecies of *H. sapiens*) or separate species ?

Extinction of Neandertals:

If subspecies of *H. sapiens*, could have interbred with other subspecies (in which case all of us could contain a little Neanderthal).

Or Neanderthals belong to a separate species that went extinct due to competition with *H. sapiens sapiens* ?



Neandertals have gotten a bad rap

Neandertals show a surprisingly sophisticated level of intelligence.

Neandertals apparently had some respect for members of their groups (burial sites include evidence of flowers being buried alongside the deceased).

There is evidence of long-term care for injured individuals (injuries sufficiently severe to have normally been fatal).



Humeri from opposite arms of same male

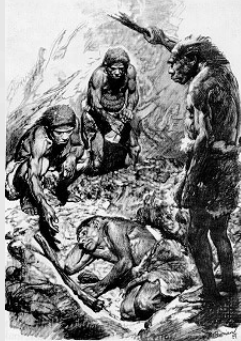


## Were Neandertals religious ?

There is some evidence that Neandertals practiced burial rituals.

Evidence includes the position of the remains (e.g. with head cradled in hand), presence of flower pollen in the grave, and animal remains (which some think was food for the individual in his/her journey to the afterlife).

However, these interpretations have been doubted by a number of researchers.



## More surprises continue to surface: The “Hobbit People”

On Flores, an island of Indonesia, scientists have recently found skeletons of a diminutive species of human that grew no larger than a three-year-old modern child (about 1 metre high)

The species is appropriately named *Homo floresiensis*



## Who were they and where did they come from ?

*Homo floresiensis* is believed to be a long-term, isolated descendant of large-bodied Javanese *H. erectus*, though it could be a recent divergence.

Once on Flores, the ancient humans could have assumed a "dwarfed" form in response to ecological pressures of the island (e.g. limited food resources).

They used stone tools and coexisted on the island with dwarf elephants, giant rodents, and Komodo dragons.



*H. floresiensis*   *H. sapiens*

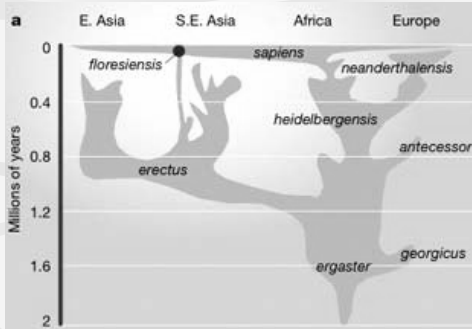


It is estimated that *H. floresiensis* lived on Flores between 95,000 years ago until at least 13,000.

This means that their time range overlapped with mainland *Homo sapiens*.



### Implications of the new discovery



The discovery of this new species has thrown yet another complication into the current understanding of human evolution.

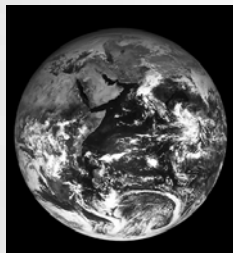
So What Happens From Here ?

### How Will We Go and When ?

Since microbes began pumping oxygen into Earth's atmosphere in the Archaean, humans are the only other group of organisms that has so profoundly affected the Earth's conditions.

Scientists are becoming increasingly concerned that our consumption of resources and disregard for the consequences of this consumption will bring an end to the age of humans.

Others suggest that humans might be wiped out in a more spectacular way, by natural events over which we have no control.



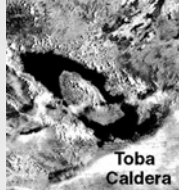
### Events we have minimal control over:

To cause a serious affect on human civilization, the impactor would have to be 1.5 km or more in diameter. It has been estimated that impacts by objects of this size occur once in a million years (note that the impactor that produced Chicxulub hit Earth 65 million years ago, but the size of that one was about 10.0 km in diameter).



Supervolcano – Every 50,000 years or so, a volcanic eruption capable of injecting enough ash and sulphur dioxide into the atmosphere to cause a dramatic effect on global climate for a few years.

74,000 years ago, Toba (in Indonesia), erupted enough ash and cooling gases into the atmosphere to dramatically cool Earth's atmosphere. Freezing conditions existed in the tropics for about 5-6 years. Humans teetered at the edge of extinction, and barely made it through.



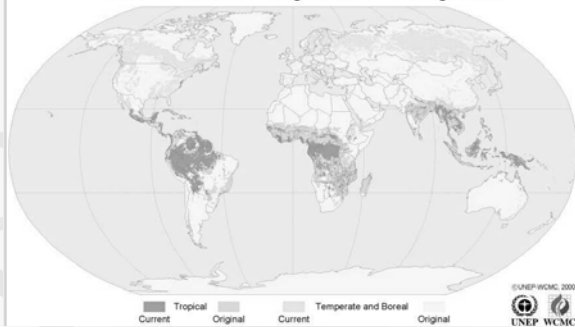
Toba Caldera

A bacterial or viral pandemic – Within the last century humans have witnessed four major flu epidemics, plus HIV and Sars.



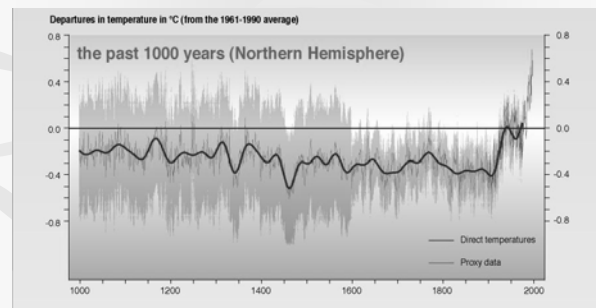
### Events We Have Some Control Over:

#### Global Distribution of Original and Remaining Forests



Habitat destruction (forest cover used as a measure here) – destruction of habitat means lower biotic diversity, and in the case of forests, decreased consumption of atmospheric carbon dioxide

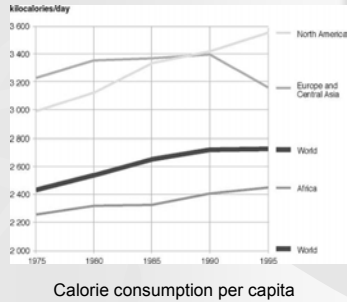
Climate change – This is obviously the biggest, but most complex concern. Average global temperatures have been climbing since at least the mid-1800s with an accelerated increase from 1960 onward.



Overpopulation and competition for resources - humans have a very high demand for food and energy.

The human carrying capacity is still up for debate.

But...the biggest potential problem lies in the inequality in resource use.



### Resource Supply and Demand

Current estimates for the total amount of conventionally recoverable oil on the planet is around 2 trillion barrels.

We have consumed almost 1 trillion of this - so roughly half the oil is gone.

The rest will last another 40 years at current consumption rates.

But demands for oil will not stay at current rates.

It continues to rise steadily



Can the unthinkable happen due to competition for resources ?



...when somebody gets desperate enough to send a message ?

What would survive the next mass extinction ?

Depends on how it happens

- as an extreme example, consider nuclear war

Almost undoubtedly:

Rodents



Insects



But all bets are off for anything else.

So...we've got a closed system

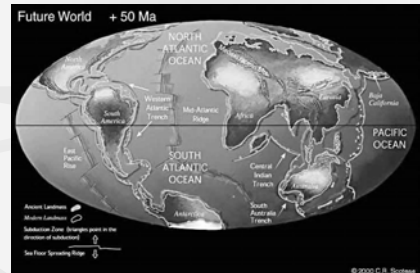
...made of interacting components (the geosphere, biosphere, atmosphere, hydrosphere).

So...we can bring the course together and say:

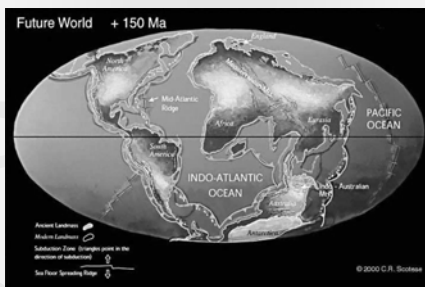
1. We're stuck with what we've got (unless we master colonization of other planets), so we'd better take care of it.
2. Do we face the same selective pressures as other animals ?
  - Competition for resources
  - Competition of "exotic" populations with indigenous populations
  - Changing environmental conditions
  - Thinning out of populations by disease
  - The dangers of overspecialization and overpopulation
  - Reduction of variability within our species

The world will go on – with or without us  
(let's look again at plate tectonics)

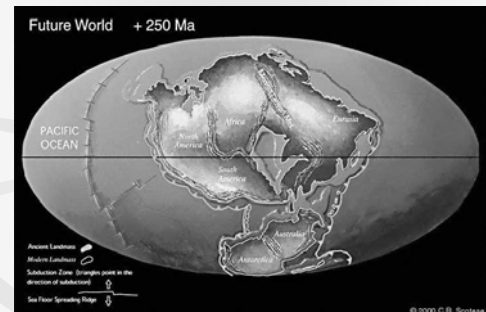
50 million years in the future



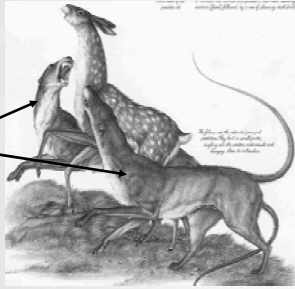
150 million years in the future



250 million years in the future



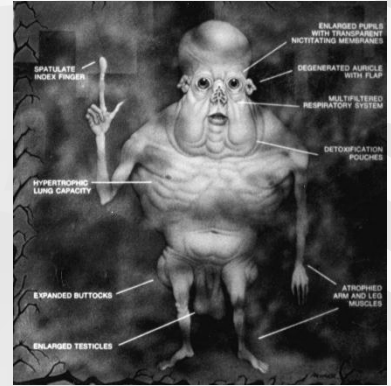
And whoever survives will lead the next revolution in Earth's biological history



The future of humans ?

And if we are smart enough to avoid killing ourselves off, will natural selection still hold for humans ?

If it does, maybe this will be what your great, great, great, great, great grandchild will look like.



Natural history repeats itself

We have much to gain, and nothing to lose in learning from the past.

What are we gonna do about it ?

***END OF LECTURE***

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