Diversity and Human Evolution

Part II

**Homo neanderthalensis**

- Neanderthal 1
  - Photograph by Rheinisches Landesmuseum Bonn

- La Chapelle-aux-Saints
  - Photographs by John Reader

- Mount Circeo
  - Photograph by Ministry of Culture, Italy

**Homo neanderthalensis**

- An occipital bun
- A suprainiac fossa
- Position of the mastoid crest located behind the external auditory meatus
- Position of the juxtamastoid crest located behind the mastoid crest, and often larger than the mastoid process
- Position of the mastoid process
- The supraorbital torus
- The supratoral sulcus
- A receding frontal
- Presence of lambdoidal flattening
Inner Ear Morphology

- Another trait that is being looked at currently as a way of distinguishing Neanderthals in the inner ear morphology
- Researchers are trying to determine if the Neanderthals had a unique inner ear morphology that can be used
- When comparing the values of S/I, humans generally have a value close to 1, chimpanzees have values greater than 1, and Neanderthals have values less than 1

Features of Anatomically Modern Homo sapiens

Homo sapiens
Omo 1 and 2
Now thought to be 190 kya (2005)

CroMagnon 1
30 – 32 kya

Qafzeh IX
90 – 100 kya
Late Pleistocene Happenings

- The warm peak of the last interglacial (ca. 120,000 - 125,000 years ago) suspiciously coincides with the consensus date estimate of several genetic studies for the origin of modern *Homo sapiens*
  - The last refinements on language and improvements in technology may have occurred and been a substantial cultural advantage in this time of extreme climatic change
  - The final expansion of childhood to allow the perfecting of language skills may have accompanied this change

Recent Climates

- Genetic Origin of *Homo sapiens*
- Oxygen Isotope Measure ($\delta^18O$)
- Toba explosion and cooling

Roughly 70,000 years ago, the population of Modern Humans plummeted to only 2,000 to 10,000 individuals, greatly reducing the genetic variation to be found in a relatively young species

Toba eruption of 73,000 years ago produced at least 2,800 km$^3$ of ash

Toba spewed out enough magma to fill 25% of all the currently existing lakes in the world

Pinatubo Eruption of 1991 produced 4 km$^3$ of ash

Toba eruption of 73,000 years ago produced at least 2,800 km$^3$ of ash
A team of U.S. and German researchers has extracted mitochondrial DNA from Neandertal bone showing that the Neandertal DNA sequence falls outside the normal variation of modern humans.

These results indicate that Neandertals did not contribute mitochondrial DNA to modern humans.

Current models hold that Neandertals became extinct only 30,000 years ago and co-existed with modern humans in Europe.

- The team, however, found that Neandertals and modern humans diverged genetically 500,000 to 600,000 years ago.
- Suggests that though they may have lived at the same time, Neandertals did not contribute genetic material to modern humans.
Neandertal DNA, 3

- Since 1991, an interdisciplinary project has focused on the Neandertal-type specimen found in 1856 near Dusseldorf, Germany
  - A sample was removed for DNA analysis
- The researchers compared the Neandertal sequence with 2,051 human sequences and 59 common chimpanzee sequences (out-group for comparison)

Neandertal DNA, 4

- Researchers looked at the Neandertal sequence with respect to 994 human mitochondrial DNA lineages
  - Africans, Europeans, Asians, Native Americans, Australians and Pacific Islanders
- Results were that the number of base pair differences between the Neandertal sequence and these groups was 27 or 28 for all groups

Neandertal DNA, 5

- Neandertals inhabited the same geographic region as contemporary Europeans
- The differences between the Neandertal sequence and modern Europeans is no closer than for other contemporary human populations

Neandertal DNA, 6

- Phylogenetic tree reconstruction shows the Neandertal sequence branching before the divergence of the modern human mitochondrial DNA lineages, but after the split from chimpanzees
  - The phylogenetic tree shows the first three branches of humans are African
  - Only the fourth branch has non-African sequences
  - The branching pattern indicates that the ancestor of the mitochondrial DNA gene pool of contemporary humans lived in Africa

### Table 1. Sample of Ancient mtDNAs from European Early Modern Humans Needed to Exclude Various Levels of Neandertal Admixture in the Ancient Gene Pool

<table>
<thead>
<tr>
<th>Original Neandertal Admixture</th>
<th>Number* Needed to Exclude the Admixture at p &lt; 0.5</th>
<th>Number** Needed to Exclude the Admixture at p &lt; 0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>76%</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>50%</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>45%</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>25%</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>10%</td>
<td>29</td>
<td>44</td>
</tr>
<tr>
<td>5%</td>
<td>59</td>
<td>60</td>
</tr>
<tr>
<td>1%</td>
<td>299</td>
<td>459</td>
</tr>
</tbody>
</table>

*The number of ancient mtDNA sequences that would have to be recovered and be similar to those of modern humans (and not similar to Neandertal mtDNA).

**Rounded up to the nearest whole number. 7 have been sequenced to date.
Neanderthal-Modern hybridization zone
1600 generations = 40 kya

Expected Neanderthal Lineages in modern European populations under different admixture scenarios

Average % in box

10%
91%
99%
62%

Average Admixture Rate per Deme

New Phylogeny + Flores

Homo neanderthalensis
24 kya
Homo floresiensis
12 kya

Solo 6 from Ngandong, Indonesia Possibly as recent as 23 kya

Comparison of brain size