G03: The longest march of all
The human diaspora

WC 4112

In the year 525, the monk Dionysius Exiguus [1]invented the system of calibrating time he called Anno Domini and which we usually abbreviate to "AD". He wanted a system which would allow him to calculate when Easter should properly fall, but for us it is much more important than merely establishing when we can have a long week-end. Dionysius Exiguus gave us a perspective on time, a way we can conceptualise our human past. And so these days, we can imagine the last couple of thousand years, punctuating time with historical events we have learned about from school teachers, books we have read, and perhaps most importantly these days, from the telly.

Hence, when I say that it was the Venerable Bede, in his *Ecclesiastical History of the English People*[2], who introduced not only the term Anno Domini but also *Before Christ* (BC) to Britain, you have some idea that it was long before Queen Victoria, the Crusades and even the Norman Conquest. Unfortunately, Bede did not introduce a "year 0" which has caused arguments ever since. Furthermore, some of us even know a little about the world as it was when another Englishman, Alcuin, introduced the notion of AD to the court of Charlemagne where it was established as the European standard method of dating[3].

However, most of us are out of our depth when we talk, as we are doing here, in tens of thousands or even millions of years. As far as we can conceptualize such time frames, despite the numbers attached, we might just as well say "Once upon a time…." and leave it at that! Only geologists and climatologists (and I suppose, paleontologists) are accustomed to talking about such long stretches of time. They use a different calendar, one which places us in the **Holocene epoch** of the **Quaternary Period** of the **Cenozoic era,** which is fine if you need to know you are talking about the last 12,000 years. Most of the events we will be talking about in this course took place either in this, the Holocene or in the preceding epoch, the **Pleistocene** which dates from 1 MYA to 10 KYA. Those two epochs cover the known history of *Homo sapiens*, although we have to go back to the epoch before that, to the **Pliocene,** which stretched from 5.3 MYA to 1.8 MYA,

[1] The illustration is from Wikipedia and is in the public domain.
[2] *Ecclesiastical History* was finished in 731.
[3] It was not until 1422 that Portugal, the last European country to do so, adopted the *Anno Domini* era as standard.

when we consider the evolution of others in the genus *Homo* such as *H. erectus* and *H. neanderthalensis*.

Another group of scientists who need to think in long time spans are, of course, archeologists. They talk — or more commonly write —about episodes in the history of Man as "Old Stone Age" and "Middle Stone Age", "Neolithic" and so on. The term "Paleolithic or Old Stone Age was first used by the great British archaeologist John Lubbock.[4] in 1865. By this, he meant that time in our history when stone tools were made by chipping or "knapping". He also proposed "Neolithic" as an era when stone tools were made by grinding and polishing. However, these have been adapted by later archaeologists so that *Palaeolithic* means the period when humans lived entirely by hunting and gathering, and *Neolithic*, when we invented agriculture, pottery and the domestication of animals. To add to the confusion, other archaeologists roughly equate *Palaeolithic* with *Pleistocene* and *Neolithic* with the early part of the *Holocene.*

The Great Migrations

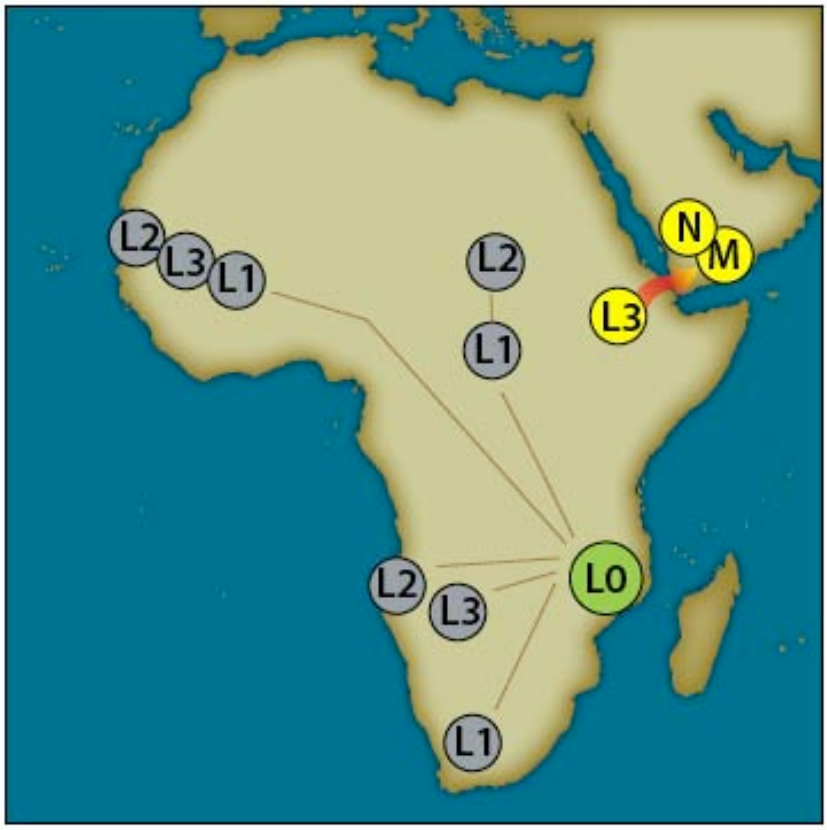
Within Africa

As I said in the *#02 Set in Stone*, AMH are first found in Africa ~130 KYA and for reasons not yet fully understood, spread out from Africa to the rest of the world ~ 50-85 KYA. I also mentioned that there were other theories but this so-called "Out of Africa" theory is the one most commonly accepted at this stage in paleoanthropology and its sister disciplines, including genetic genealogy.

However, quite clearly we — the genus *Homo*, albeit in our earliest incarnations — spent a long time within our natal continent. Although probably originating in Eastern Central Africa, these early people appear to have moved — or been moved — from this homeland. mtDNA sequences for modern Africans indicate that the

[4] He used these terms in his very influential book, *Pre-historic Times, as Illustrated by Ancient Remains, and the Manners and Customs of Modern Savages*. He succeeded to a baronetcy in 1865 and was created 1st Baron Avebury in 1900.

KhoiSan ('Bushmen') of Southern Africa and the West pygmies of Central Africa are the closest living descendants from these original humans. Their Haplogroups are designated mtHg **L0** and mtHg **L1**. All later groups, separated from these people by one or more mutations are also labeled with a letter and number combination. It is by identifying these Haplogroups, locating them geographically and calculating the time when the mutation/s occurred that we are able to track our remotest ancestors around the world.



The African expansion of Homo sapiens and second emergence into Asia

These people survived through some difficult times. While scientists are not sure about the reasons our remote ancestors moved around in Africa during this earlier part of their existence, one thing is sure, that they were subject to some extremes of climate change and part if not all their motivation for moving, was to follow their food supply. They were foragers, hunters and gatherers and so, for example, when drought came and many of the plants and animals they relied upon for food either died out or, in the case of some game animals, moved to greener pastures, the humans followed their food. This was a pattern human beings have followed ever since and constitutes the basis for what we call "migrations". These weren't journeys in our sense of the word on which you set out to get from Place A to Place B….. Rather they were the gradual movement of people, following the game, avoiding the consequences of climate change, catastrophes and territorial disputes.

Over time and as populations expanded, further mutations produced a much greater diversity, but — as recent research by Behar et al.[5] has shown — these early humans in Africa seem to have split, genetically, into two major branches on the human tree. On the one hand there are those of whom the Khoisan are the oldest example and represent mtHg L0 . On the other side of the genetic divide are mtHaplogroups L1 through L6. Of these latter, mutations on L3 are of particular

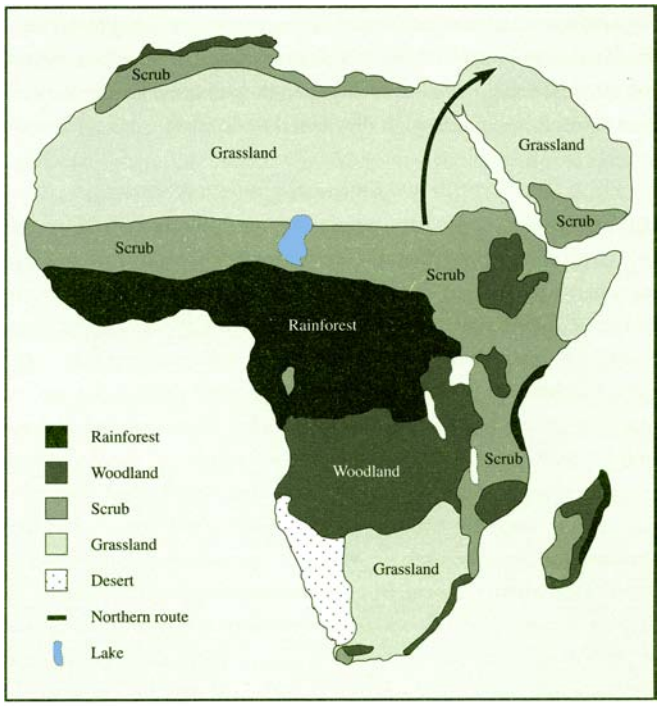
[5] Behar et al., The Dawn of Human Matrilineal Diversity, *The American Journal of Human Genetics* (2008), doi:10.1016/j.ajhg.2008.04.002

interest to us, because these are more commonly known as mtHaplogroups M and N and are the haplogroups to which our remote ancestors belonged who walked out of Africa and peopled the rest of the world.

Just why only two such haplogroups were represented by these early emigrants is something of a puzzle. Behar and his team suggest that early populations in Africa were very small and remained in isolation from each other for extremely long periods of time during which a phenomenon we will discuss later called "*genetic drift*", reduced the number of variants. The result was that in a small community isolated in north-eastern Africa all but two Haplogroups — M and N — had disappeared by the time these people, our ancestors, set out on what proved to be the longest journey of them all.

The first exodus and the Toba bottleneck

While no one seems able to give a certain date for it, some time between 130,000 and 100,000 years ago the first *Homo sapiens* moved out of Africa for the first time. Of course they were not the first of the genus *Homo* to do so, because both *H. erectus* and *H. neanderthalensis* had done so long before, but they were the first *Homo sapiens* to leave Africa. They appear to have crossed at the northern end of the Red Sea, from what is now Egypt and the "Gaza Strip". At that time, that part of the world was much wetter and greener, providing a "window of opportunity" during which there were green corridors through what — both before and after this window — was impassable desert[6].

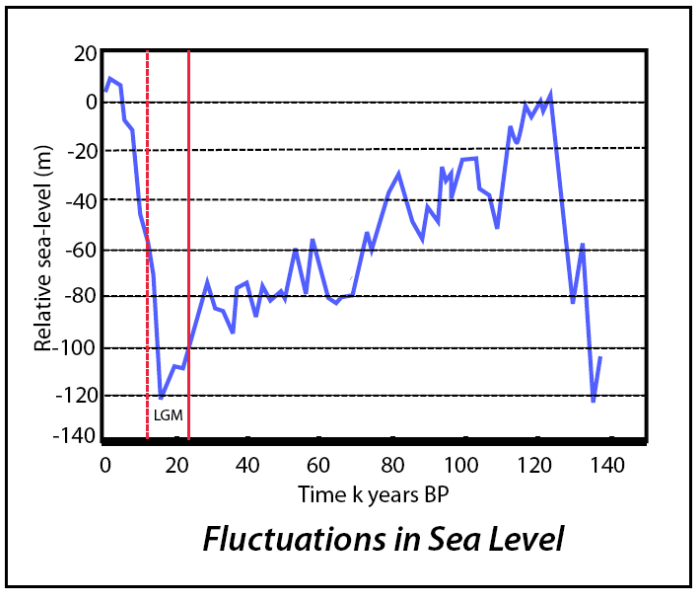


Northern Route Out of Africa ~ 100KYA

Once in the Middle East — the old term, *the Levant* is useful here to designate the region — they drove out their cousins, the Neanderthals, occupying their territories and even occupying the caves the older species had once called "home".

[6]See Science Daily, August 30, 2007: *Migration of Early Humans From Africa Aided By Wet Weather* and Science Daily, October 15, 2008: *New Evidence Provides An Alternative Route 'Out Of Africa' For Early Humans.* This last announces the discovery of ancient rivers other than the Nile which were flowing at that time.

Their sojourn in Eurasia, however, was cut short by the worst volcanic catastrophe known in the last 28 million years, the eruption of the Gunung Toba in northern Sumatra. The most precise date we have for this is 73 ± 4,000 years ago. If, like me, you have seen the devastation caused by the Mt St Helen's eruption in WA state in the USA or if you remember the tv footage of the Mt. Pinatubo eruption in the Philippines, then you know how destructive volcanic eruptions can be. Mt St Helen's spewed out 1 cubic kilometre of what is called "Dense Rock Equivalent", Pinatubo sent 4 cu. km DRE into the atmosphere… and if you remember the details of the famous Krakatoa eruption in Indonesia, then you might be surprised to know its contribution to the atmosphere was 21 cu km of DRE. BUT, Toba threw up 2,800 cu km of DRE, that is, it was more than 130 times the size of Krakatoa. Ash from the eruption is estimated to have covered at least 4 million square kilometres (that is, about half the size of the continent of Australia), and to have reached as far as Central Asia and the Middle East.



Global changes in sea levels during the Last Glacial Episode[7]. Note the drop between ~70 and ~60 KYA.

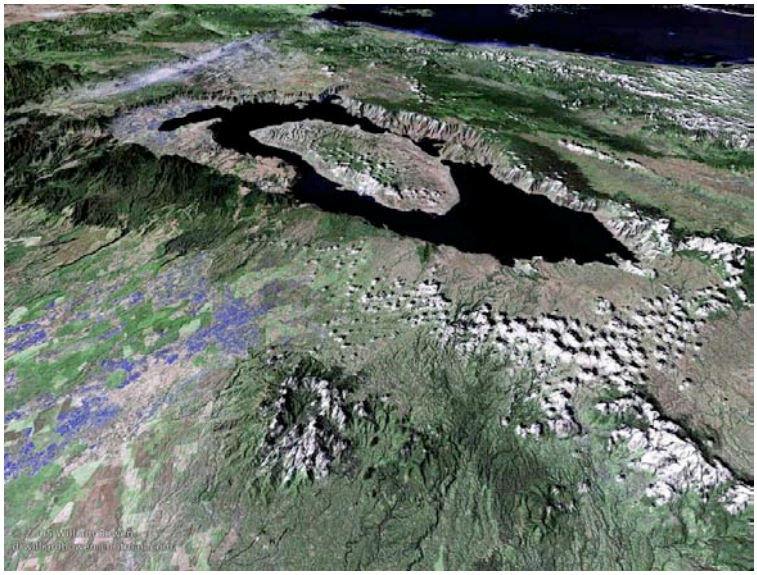
Although the eruption itself probably lasted only for a couple of weeks, the after-effects were felt for millennia. The cloud of ash and dust thrown into the atmosphere by the YTT created a volcanic winter which lasted for the next 6 years and a glacial maximum for a further 1000 years. During this time, the average global temperature dropped by 3 to 3.5 degrees Celsius while sea levels were lower than they had been since the Eermian Glacial Maximum some 60,000 years earlier[8]. Whether it was caused by the YTT as some scientists suggest or was rather part of the Earth's cyclic climate patterns, the Lower Pleniglacial as it is known was a very cold, dry low point in the Earth's climate. Some argue that the lower sea levels might have significantly aided the passage of humans across the Red Sea.

But it was not only on the ground that the ash had a devastating effect: the fine particles of ash would have blocked a lot of the sunlight as it passed through the Earth's atmosphere causing both the sea and the earth to cool. That doesn't sound

[7] Reproduced from **Coupé, C.** and **Hombert**, **JM**: *The Great Migration: from Africa to Australia*, August 2001 at http://www.andaman.org/BOOK/chapter56/text56.htm.
[8] See *Geological Oceanographers Investigate Possible Link Between Last Ice Age And Volcanic Eruptions In Indonesia* (2004) http://www.sciencedaily.com/releases/2004/01/040127081754.htm

much, but a drop of $1–3^oC$ can make the difference between a temperate and a Siberian climate!

The amount of light transmitted after the Toba eruption and during the ensuing 6 years of volcanic winter[9] ranged between "dim-sun" (about a 25% reduction of the visible light) to "overcast" (10% reduction). This is especially significant since just a 10% reduction in the noon value for a sunny summer day cuts photosynthesis by up to 85%,[10] and as all gardeners know, plant growth also drops off with decreasing temperatures. In short, even if people escaped being buried alive by the falling ash or dying from inhaling its caustic dust, plants must have died or been in ultra-short supply and along with the plants, went the animals so that without food — and of course, fresh, uncontaminated water — all but a small handful of our remote ancestors eventually perished.



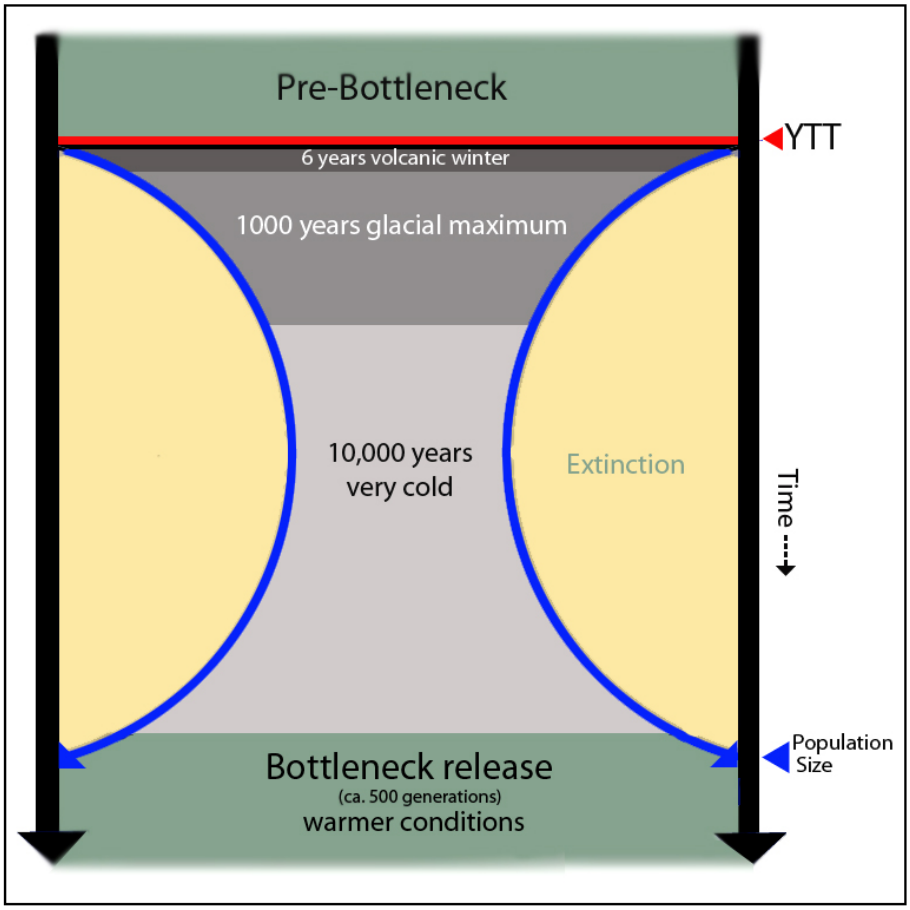
A 'virtual photograph" of Lake Toba and Samosir Island as it is today by Prof. Dr. William Bowen [11]

Some researchers argue that the volcanic winter and its affects upon resources in Africa actually prompted the exodus into Eurasia and so the "Out of Africa" must have started after the YTT ~74 KYA. Others, the proponents of the ~85 KYA date for the exodus, look instead to the effects of the YTT upon *Homo sapiens* outside Africa. Irrespective of however many people were left alive in East Africa, it is clear from the archaeological record that *Homo sapiens* was wiped out entirely in the Levant. After some years, the original inhabitants whom they had dispossessed, the Neanderthals, returned. This is shown by fossilised remains in many of the caves in Israel which show earlier occupation by *H. neanderthalensis*, then by *H. sapiens*, and then by *neanderthalensis* again until a much, much later incursion by *H. sapiens* eventually drove them west and finally, to extinction. The message of the re-occupation of the Levant after Toba was that they, with their stocky bodies and long noses (to warm up the air they breathed) were much better cold-adapted than we were.

[9] Although, as the diagram on the following page shows, the after-effects lasted for thousands of years.
[10] van Keulen et al., 1975 cited by Weber, G.: *Toba Volcano*, http://www.andaman.org/BOOK/originals/Weber-Toba/textr.htm
[11] *http://geogdata.csun.edu/world_atlas/index.html*, reproduced in *Toba Volcano*, http://www.andaman.org/BOOK/originals/Weber-Toba/ch1_intro/text1.htm

Closer to Sumatra, most of life must have been extinguished, as in Pompeii, by the blanket of ash which fell upon the land: in Malaysia to the North, the ash blanket has been shown to have been 9 m thick while further away, in much of India, between 3 and 6 m deep.[12] Surprisingly, there was little or no devastation east of Sumatra because prevailing winds carried the ash plume to the west. This was crucial — as we will see later — for the human migrations to South-east Asia and Australia.

Such a drastic reduction in population would have produced what geneticists call a ***bottleneck***. *A* species generally develops over a long period of time during which it accumulates genetic variations in a given population. If, as is suggested, during the aftermath of the YTT a large part of the human population was wiped out, there would have been a significant loss of genetic diversity. The fewer people who survived the catastrophe, the smaller the remaining diversity would have been.



Genetic bottleneck
(using Toba eruption ~74kya aka YTT as example)

The actual exodus out from Africa itself must have constituted a genetic bottle-neck if we recall that, although there were already several mtHaplogroups extant in Africa, only 2 mtHaplogroups, M and N are known to have made the exit. They were descended from mtHg L3. The small number here suggests that either the actual population in Africa was quite small and/or that the number of women crossing into Eurasia was also very limited. Some people argue that the Toba aftermath must have reduced the African population, others

[12] Scrivenor J.B. 1931; Acharya, S.A. and Basu P.K., 1993 respectively cited in Weber, G.: *Toba Volcano*, http://www.andaman.org/BOOK/originals/Weber-Toba/textr.htm

that climate change one way or another had seriously affected local populations. Whatever it was, given that the period preceding the YTT was a warm and humid one and probably conducive to a population expansion, the low genetic diversity points to a sudden and drastic reduction in numbers.

There have been varying estimates as to how many females actually came through the bottleneck: at the lower end was the 1993 suggestion by Harpending et al [13] of a total of women of childbearing age between 40 and 600, while at the high end, Ambrose [14], in 1998, raised the ante to 10,000 women of child-bearing age, which means that — as one commentator said — "……we are talking about the entire human race numbering no more than the population of one small country town today."

The human diaspora

Although the first exodus ended in the extinction of the first emigrants, the second was entirely successful, resulting as it did in the billions of humans now living in the rest of the world. Because the experts cannot agree on the date this diaspora began, we cannot be sure whether it started *before* or *after* the Toba eruption. Some argue that the eruption and consequent volcanic winter possibly precipitated the climate change in Africa which prompted the exit. Others, including Oppenheimer[15], argue that the eruption happened after the emigrants had left Africa and some were already sufficiently far from the "kill zone" to survive and continue populating the Earth. The date chosen by Oppenheimer of around 85 KYA conveniently encompasses most of the archaeological and other known facts and is the one we will live with during this course.

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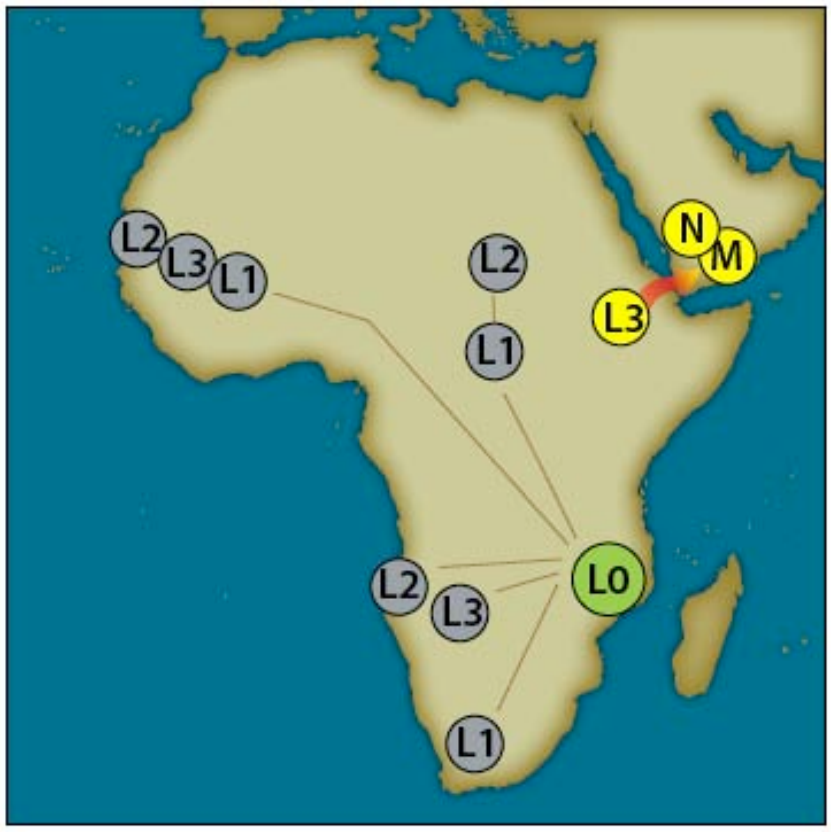
[13] **Harpending H.C. Sherry S.T., Rogers A.I.,** and **Stoneking M.** (1993). "The genetic structure of ancient human populations." *Current Anthropology* 34:483-496 reference in http://www.andaman.org/BOOK/originals/Weber-Toba/ch1_intro/text1.htm

[14] **Ambrose S.H**. (1998). "Late Pleistocene human population bottlenecks, volcanic winter, and differentiation of modern humans." *Journal of Human Evolution* 34:623-651. See also "Ancient Volcanic Winter Tied to Rapid Genetic Divergence in Humans", *Science Daily* report at *http://www.sciencedaily.com/releases/1998/09/980908074159.htm*

[15] Op. cit.



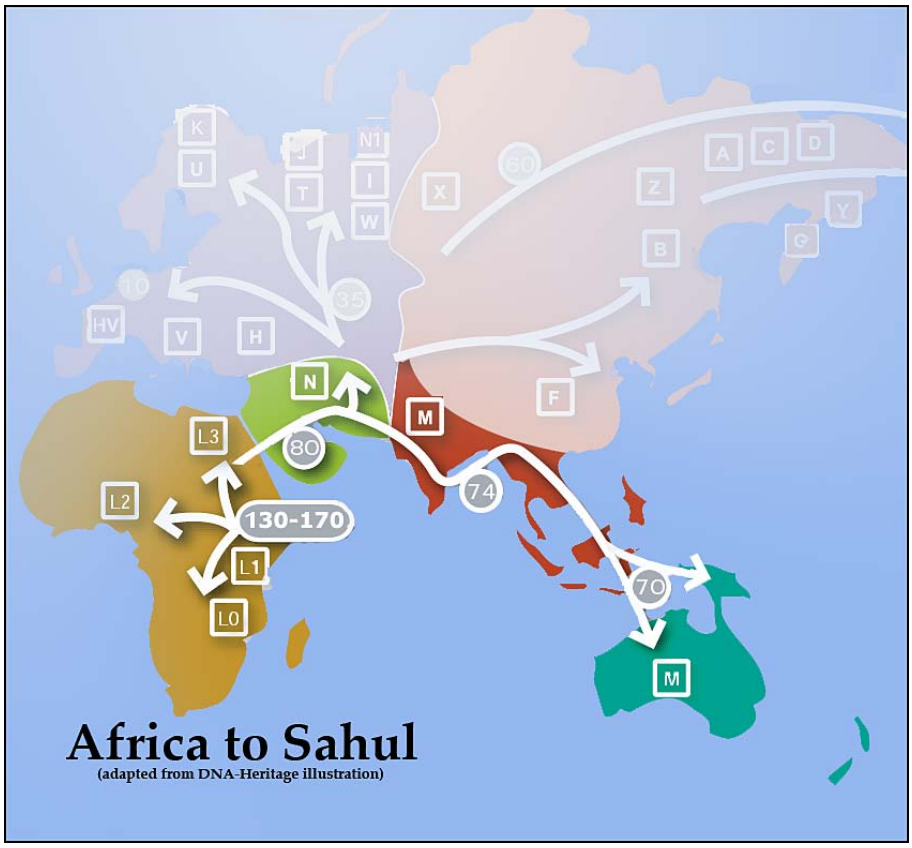
Exit into Asia

The people who set off on this successful excursion probably crossed into Asia somewhere near the Ethiopia/Yemen end of the Red Sea rather than at the northern, Egyptian end where — as it is believed — the earlier crossing had been made not only by *H. sapiens* but also *H. neanderthalensis* long before.

The Red Sea and the Gates of Grief

The Red Sea is part of the great Rift Valley and was formed by the African Plate drawing away from the Eurasia plate. In fact, it is still drawing away so the Red Sea is getting wider. It is shallow in much of its area but subject to strong winds and currents. It is not known how our remote ancestors made the crossing. It is generally believed that long before, when *H. erectus* made this journey, a land bridge probably existed, but by the time modern humans crossed the "Gates of Grief" as the mouth of the Red Sea is known, they would have had to cross water, maybe floating over on rafts. The general opinion among scientists is that it would have been a risky business and probably not all who attempted to leave Africa would have reached the Eurasian coast.

Those emigrants who did reach Asia soon branched out in different directions, some moving in a northerly direction whence eventually they would have reached the great steppes of Central Asia and from where they contributed to the peopling of the Far East. Others took the tropical route to Australia and Papua-New Guinea



Exit from Africa and the Journey to Sahul

— or, more correctly, since the two were still joined in one larger landmass, to Sahul. We know that *Homo sapiens* must have reached Australia by at least 40 KYA and maybe even earlier, because that is the date attributed to what is called "Mungo Man", the remains found in the dried-up lake bed of what was once Lake Mungo in South-Western New South Wales. We will deal with the populating of Sahul — with Australia and Papua — in detail in the next part of this course.

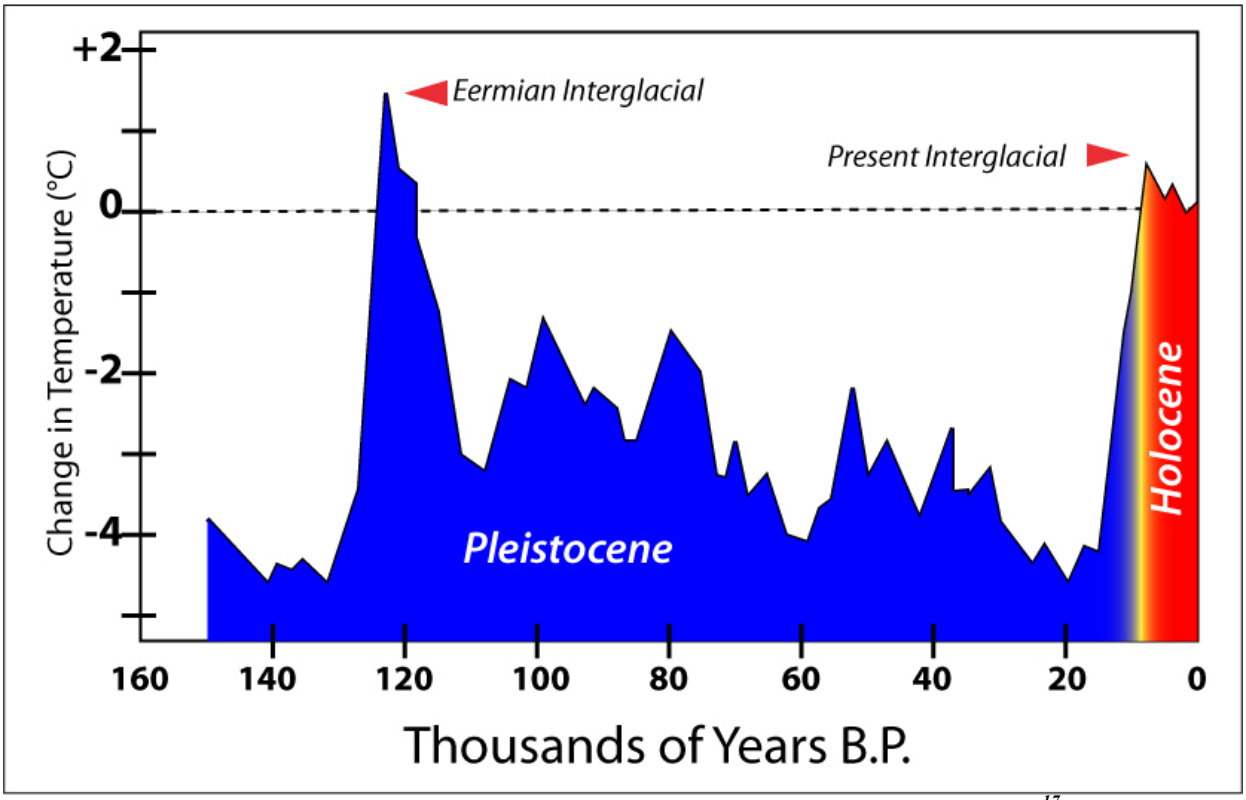
Meanwhile, the emigrants who took a more northerly route, ending up in what are now India and western China, would have had a more difficult journey. Not only would they have encountered more difficult terrain but they were also subject to the fluctuations of climate which were part of this, the Last Ice Age.

The "Last Ice Age"

When we talk of "the Last Ice Age" we normally mean that period from about 22 KYA to 12 KYA during which much of northern Europe, Asia and North America were covered by huge ice sheets, in some parts several miles thick, when sea levels were up to 125 meters lower than they are today and much of the earth's surface was covered by glacial desert, tundra or steppes so cold and wind-swept, few if any animals and plants lived there for long. This was the time when our European ancestors huddled in what are called "refugia", that is regions where life might still have been hard but at least life could still go on. Until recently, genetic genealogists have believed these refugia were found only in Southern France and northern Spain, in parts of the Balkans and near the Black Sea. More recently, however, some have been suggesting that other, smaller pockets of human habitation probably existed along the great rivers, in valleys or on parts of the Mediterranean coast where conditions were also liveable.

This extremely cold part of our history and its consequents is what we will be concentrating on for a good part of this course. It is officially called "The Last Glacial Maximum" or "LGM" for short.

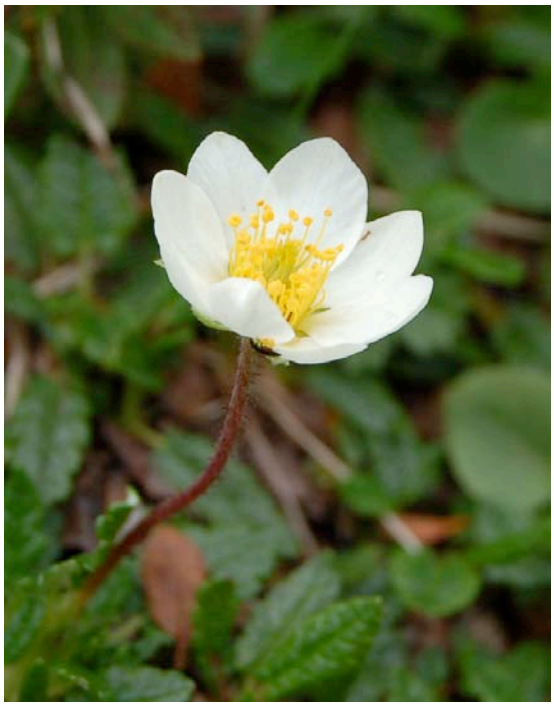
Truth is, we are still in the Last Ice Age. Ice Ages, by which is meant "*a period of long-term downturn in the temperature of Earth's climate, resulting in an expansion of the continental ice sheets, polar ice sheets and mountain glaciers* [16]." Since the Greenland and Antarctic ice sheets still exist, we are technically still in the Last Ice Age. There have been four Ice Ages in the Earth's history, this Last beginning about 40 MYA when an ice sheet formed in Antarctica. About 3 MYA — that is, during the Pleistocene — ice sheets formed in the Northern Hemisphere. Since then the ice sheets have alternately advanced and retreated roughly in cycles of 40,000 and 100,000 years. The periods of icy extreme are called "**glacials**" and those in between, "**interglacials**".



Temperature fluctuations during the Pleistocene showing short-lived interglacials [17]***.***
Note the two interglacials and the "stadia" or low spells at about 60 KYA and 45 KYA.

[16] Definition from Wikipedia, http://en.wikipedia.org/wiki/Ice_age
[17] Compiled by R.S. Bradley and J.A. Eddy based on J. Jouzel et al., Nature vol. 329. pp. 403-408, 1987 and published in EarthQuest, vol. 5, no. 1, 1991.

Peaking about 125,000 years ago, there was a major interglacial which scientists call the Eemian Interglacial. Then about 18,000 years ago, the "Present Interglacial" began — that is, from then on, with brief exceptions, the Earth began to warm up again. This Last Interglacial corresponds roughly to the Holocene, I say "roughly" because the Holocene is normally dated from the end of another cold spell called the "Younger Dryas". This was a period, sometimes called "The Big Freeze", which happened between 12,700 and 11,500 years ago and which has been named after a wildflower which grows on the tundra, *Dryas octopetala*. (There was an *Older Dryas*, at the end of the Pleistocene, but it lasted only about 300 years).



Dryas octopetala

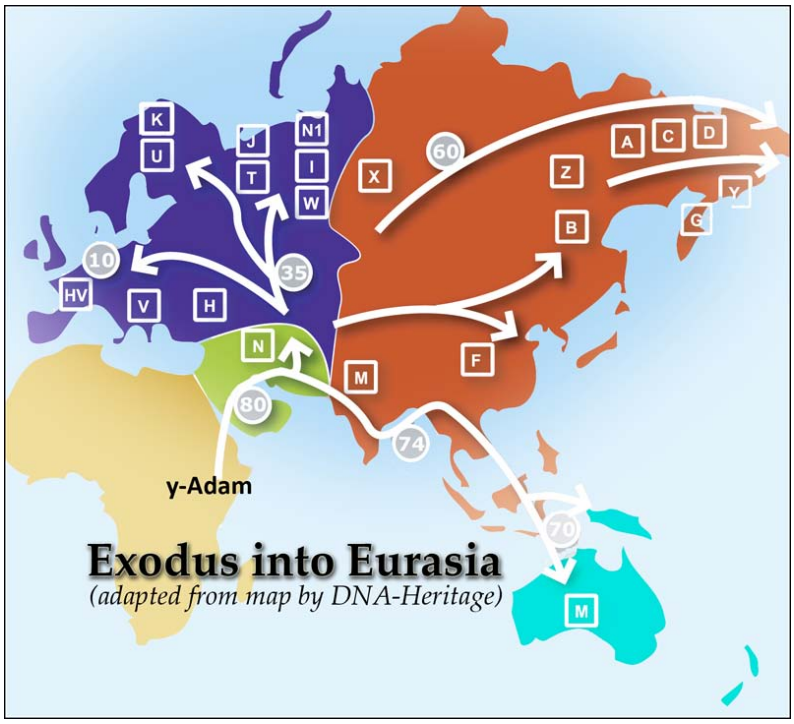
We will deal with the Younger Dyras in greater detail when we get to Europe and to agriculture. At the moment it is only necessary to know it was a very cold period lasting about 1300 years preceding the Holocene.

Lands of milk and honey

Around about 40–30,000 years ago the erratic ups and downs of the Ice Age stabilised for a period during which time average temperatures were ~3°C below our present. Human populations increased rapidly and expanded into Europe and northern Asia. During this time too, *H. neanderthalensis* became extinct, possibly through contact with *Homo sapiens*. The growth in population meant that there were more mutations so that new Haplogroups proliferated, two of which — U and H — reached Europe.

We will return to this later to examine in detail the route or routes people took to reach Europe and some of the places archaeologists can prove they inhabited during this Upper Pleistocene stage in our history.

So far, however, we have been able to trace human migrations through mtDNA as people moved around their native Africa (Hgs L0 – L6) , as they crossed into Asia (Hg M and N), later travelled through southern India and what is now the Indonesian archipelago and South East Asia (but which was then Sundaland) and reached Australia and Papua/New Guinea (Hgs M and N), or took a more northerly route and reached China (Hgs N and M). There, N and M diversified into Hgs A, B, C, D, E, F, G, M, and Y. Later immigrants to Papua-New Guinea



brought with them Hgs P and Q. Here, in ancient Australia, more varieties of N and M developed. And in Europe — in this course, our final destination — were people belonging to haplogroups H (and its predecessor HV to which I belong), I, J, K, T, U, V W and X. Just how some of the Neolithic haplogroups got there is a matter for another day….

The expansion into Eurasia

Populating the Americas

About 25,000 years ago the sea level was much lower than it is today and the continents of North America and Asia were connected by a land bridge, a land mass archaeologists call Beringea. Recent publications[18] suggest humans crossed into Beringia and stayed there for up to 20,000 years before moving south into the Americas. These pioneers carried mtHg A, B, C, D and a rather mysterious one called X, but we might come back to that later.

The populating of the Americas is still subject to considerable controversy because there is evidence for more than one major migration and some inconsistencies in the archeological record [19]. For those reasons (and partly because I am not particularly interested in American pre-history or genetic genealogy) I don't want to delve into the American mysteries in this course.

So, in summary, the world was populated by a series of migrations of human beings, a small number of whom came out of Africa sometime around 85 KYA. Maybe earlier, maybe a tad later. Whenever it was, our ancestors came forth and without doubt, multiplied excessively….

In the next session we will take a closer look at the peopling of Australia and Papua-New Guinea, and, following that, East Asia and how the Japanese archipelago was populated. Then we will go "home" to Europe as they used to say

[18] See http://www.eurekalert.org/pub_releases/2008-02/plos-hin021108.php
[19] Claims have been made for remains found in far South America dating to ~58 KYA. If true, this throws much of the genetic paleoanthropology into confusion.

when we were kids and take a look at the comings and going of our remote ancestors as they survived in an often hostile world.
