



NATIONAL GEOGRAPHIC

The Human FAMILY *Tree*

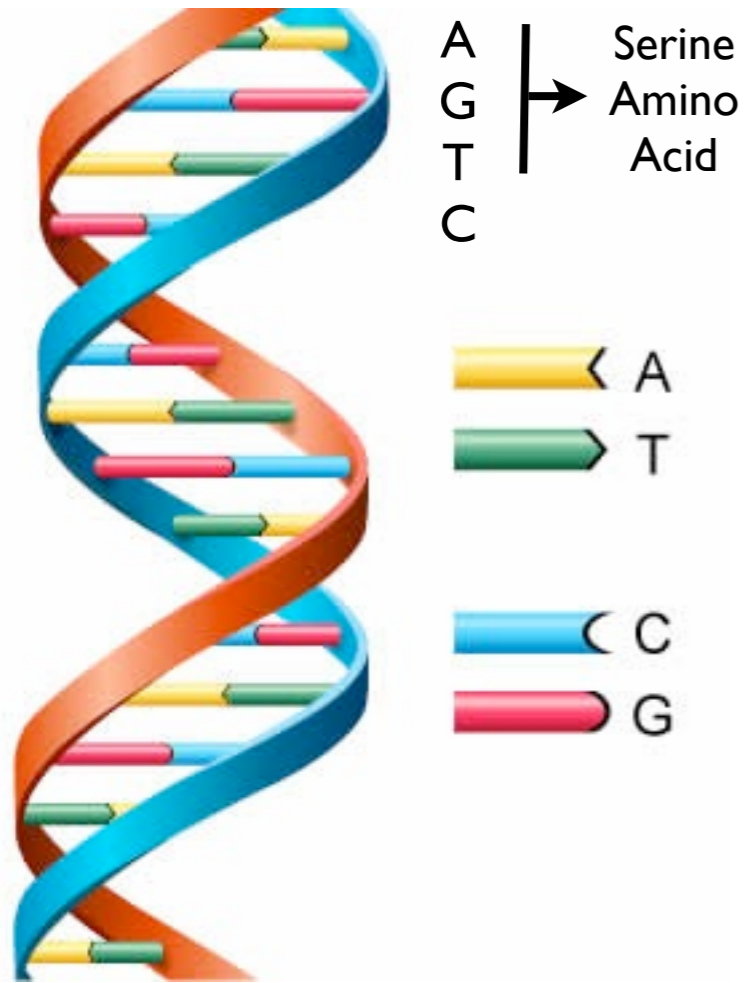
TRACING THE HUMAN JOURNEY THROUGH TIME

ALL - April 20, 9:30 AM

25 min. - Introduction - Denis Jarvis

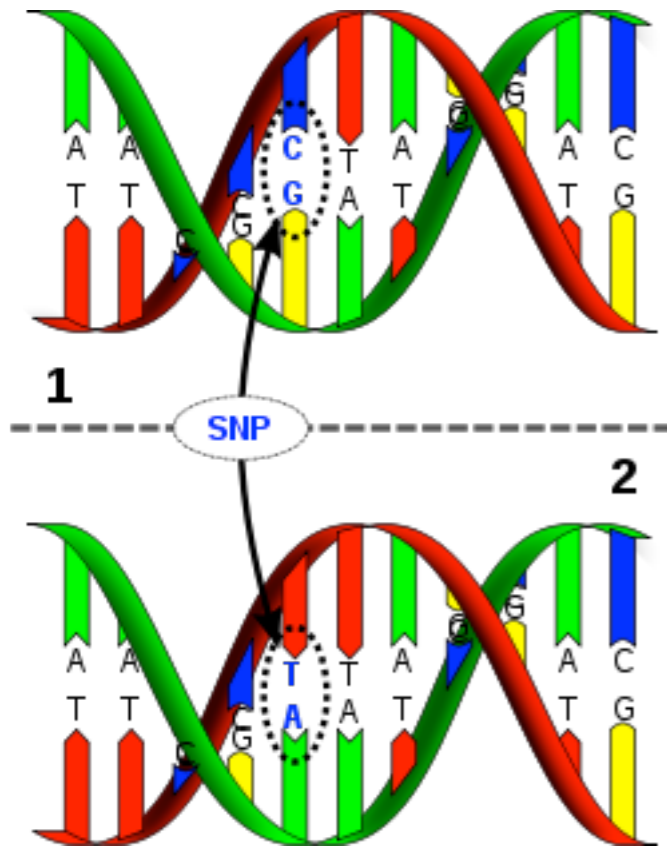
95 min. - DVD, including 10 min. Break

DNA Genetics



- DNA Double Helix = sequence of complementary Base Pairs.
- Transcribed in groups of 3 → sequence of protein Amino Acids.
- Gene blueprint for a protein is 5,000 - 50,000 base pairs.
- Proteins regulate and construct the organism.
- Human has in each cell:
 - ▶ 25,000 genes in 2x23 Chromosomes in its Nucleus.
 - ▶ 37 genes in 16,000 base pairs in each Mitochondria.
 - ▶ Plus much more Junk (non-coding) DNA.

DNA Duplication



- As each cell duplicates during growth and repair, DNA must similarly duplicate.
- Double helix structure provides reliable duplication. Also there is a repair mechanism.
- But, a few mutations get through.
- Common mutation is an SNP = Single Nucleotide Polymorphism. In one position $C \rightarrow T$, $G \rightarrow A$, etc. At this position (Locus, or Marker), there are now “alleles”.
- If it occurs within the organism itself, it can cause cancer - not part of this class.
- If it occurs in the germline, and in a non critical part of the DNA, then it can become part of the DNA of succeeding generations.
- Mutation can also consist of the insertion of a sequence of DNA (ALU) or a variation in the number of repeats of some small sequence (STR). The mutations tested in Y-DNA are of this form but, for simplicity, details will not be considered in this introduction.

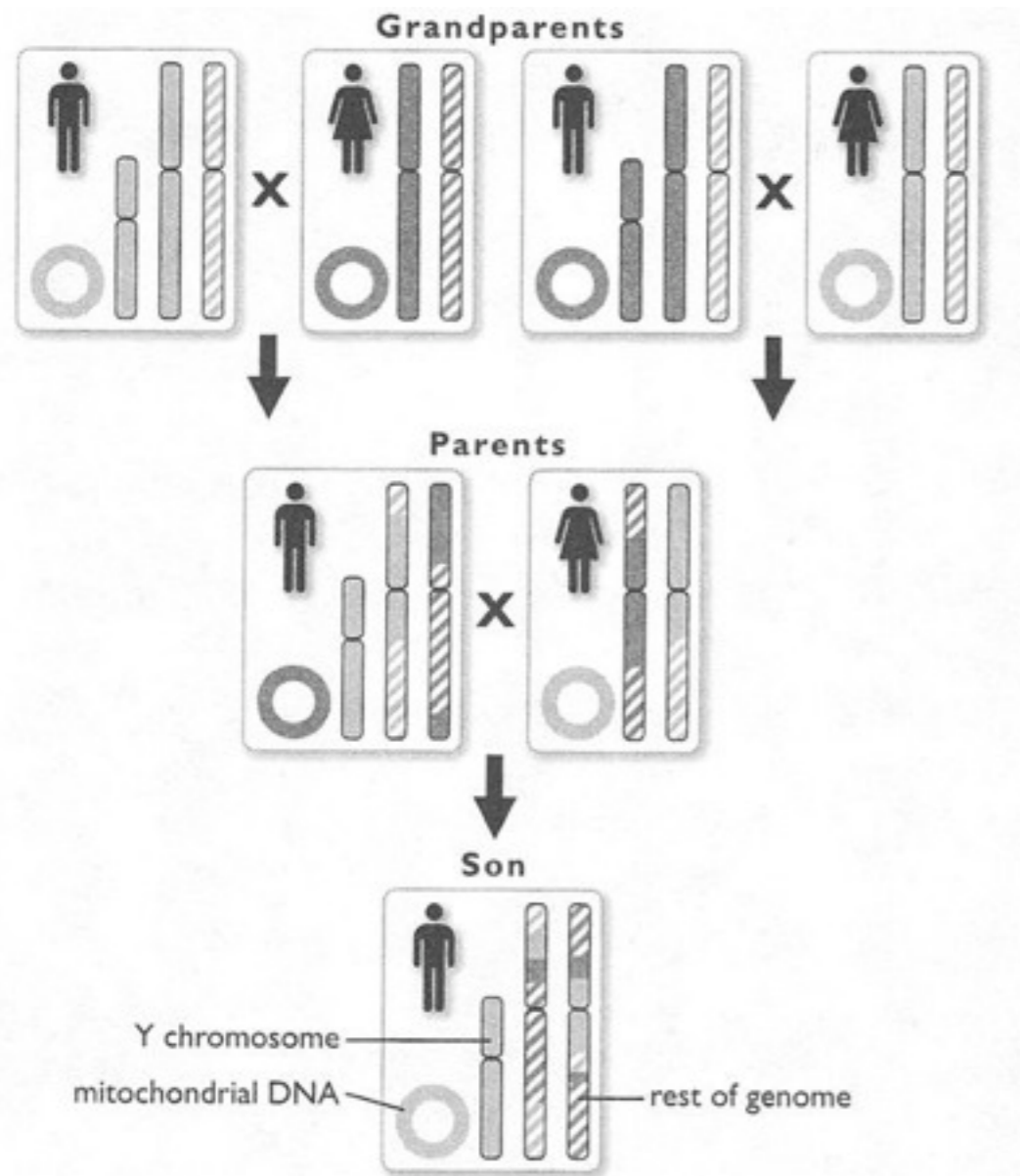
SNP Detection



- Under the guidance of Kari van Zee at OSU, in Spring 2008, members of ALL tested for a particular ALU in their own DNA. It cannot be too difficult !
- Swab cells from mouth with salty water, centrifuge to separate cells from saline.
- Add “InstaGene” stabilizing reagent, heat to break cells and release DNA, centrifuge to leave DNA in liquid.
- Combine some of this liquid with “Master Mix” (DNA bases, DNA polymerase, DNA Primers) and put in PCR thermal cycler. Leave for 40 cycles, which replicates designated section of DNA, 10^{12} times.
- Primers are short synthesized DNA polymers which attach (as complementary) to the two ends of a section of DNA which contains the ALU to be studied. This “section” is the only DNA amplified.
- Place PCR result on Electrophoresis gel and run. After staining, image shows if ALU is present or not.
- Mass testing involves much automation and use of “GeneChip”, containing a grid of SNP, ALU, STR markers.

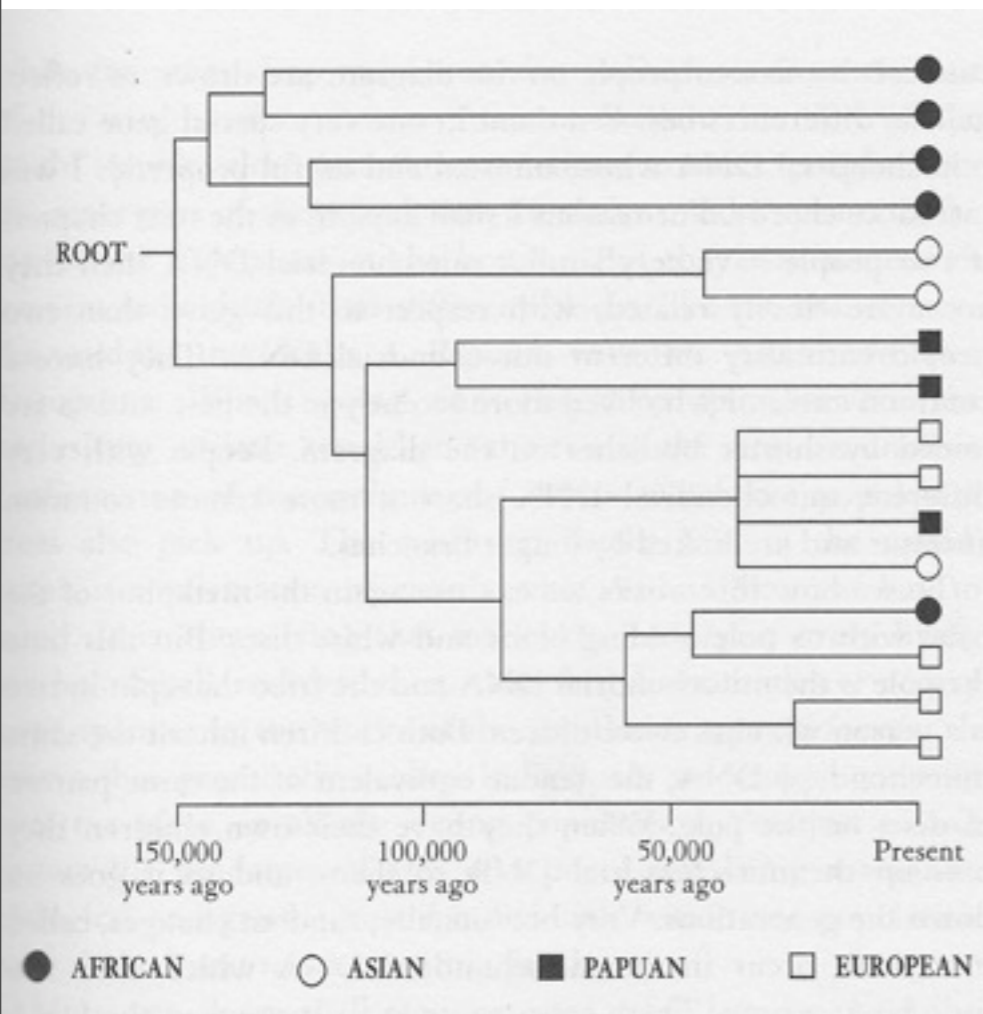


DNA Crossover (Recombination)



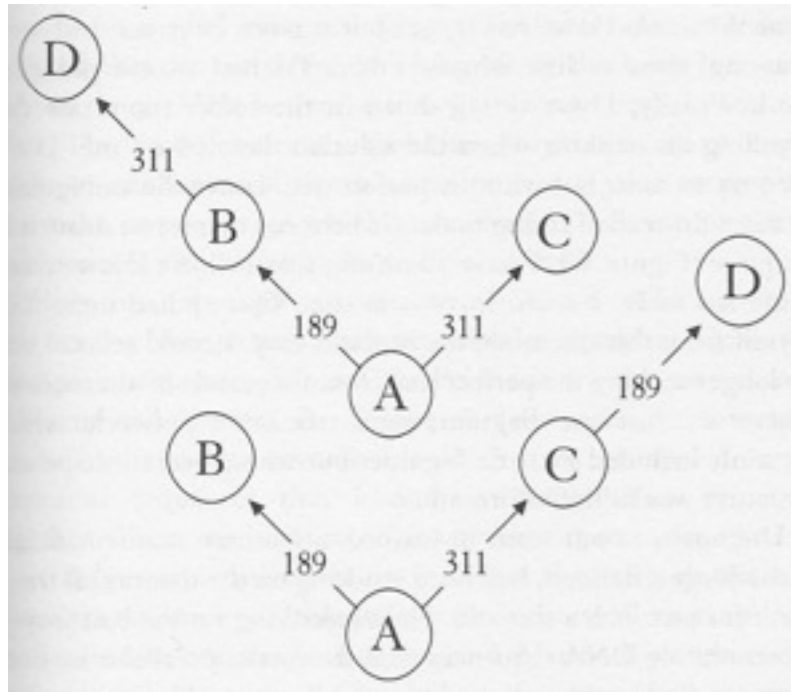
- Mitochondria contain DNA in a small ring, which replicates independently and without crossover.
- In the human cell nucleus, the DNA is 22 pairs of chromosomes plus XX(female) or XY(male).
- In the formation of sperm in the male, and the egg cell in the female:
 - ▶ Each pair of chromosomes is reduced to one of same length, after crossovers between them.
 - ▶ The one has parts, randomly, from each parent.
- After conception each new pair has parts (and SNPs) from both parents and so:
 - ▶ An individual's main DNA is unique - Forensics.
 - ▶ Paternity can be determined by SNP similarities.
- Except, showing ANCESTRY over many generations:
 - ▶ Y-DNA is unchanged through male lineage.
 - ▶ mtDNA is unchanged through female lineage.

Maternal Ancestry



- To be inherited, a “mt” mutation must:
 - ▶ occur in female embryo
 - ▶ be benign - generally in 500 base control section.
 - ▶ occur in the germline producing her eggs.
 - ▶ be in one of the (few) eggs fertilized to produce a new female adult.
- Such female may have both mutated and original mt in each cell. After average 6 human generations, mt revert to all original or all have the mutation. During this time human is typed as both!
- This mutation is lost if its maternal lineage ends.
- On average, 1 mutation retained each 20,000 years.
- If 2 individuals have mt with 1 SNP different, then last common mother lived about 10,000 years before.

mtDNA Haplogroup



- Present day mtDNA cannot determine exact order in which mutations occurred in the past, so no exact tree of inheritance.
- mtHaplotype is a particular set of deviations from Reference, defined as first (500 base) sequence made by Cambridge in 1981.
- mtHaplogroup is a cluster of highly related mtHaplotypes which seem to define population groups as move through time/space.
- Measure distribution of haplogroups at present and in any available ancient bones, using as many samples as possible.
- Infer logical probability of how each Haplogroup could have been derived from the others.
- Incorporate evidence from Archaeology, Anthropology and Linguistics and so infer migration of peoples over time.

LOCATION	73	152	199	204	207	250	263	309.1	315.1	16129	16223	16391	16519
REFERENCE	A	T	T	T	G	T	A	:	:	G	C	G	T
M	G	C	C	C	A	C	G	C	C	A	T	A	C

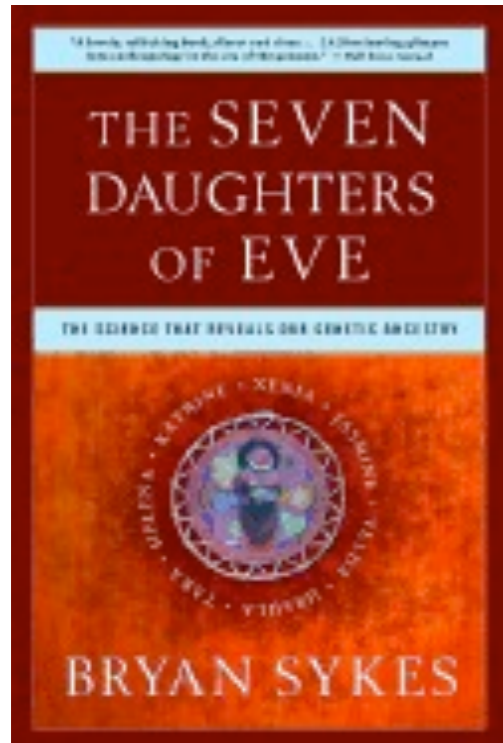
Y-DNA Haplogroups

- To be inherited, a “Y” mutation must:
 - ▶ occur in male embryo
 - ▶ occur in a Y-Chromosome in the germline producing his sperm.
 - ▶ be benign - generally in Junk region, outside SFR gene.
 - ▶ be in one of the (few) sperm which fertilize to produce a new male adult.
- Such adult is 100% mutated but this mutation can be lost if paternal lineage ends.
- On average, 1 mutation retained each 10,000 years.
- Y-DNA haplotype defined as number of STR at a set of locations on Y.
- Measure distribution of haplogroups, using as many samples as possible, as with mtDNA.
- Infer logical probability of how each Haplogroup could have been derived from the others.
- Incorporate evidence from Archaeology, Anthropology and Linguistics and so find migration of peoples over time.

Location	19a	19b	385a	385b	388	389I	389II	390	391	392	393	426	438	439	441	447	448
Value	14	-	11	14	12	14	30	24	11	12	13	12	12	12	14	25	19
Location	449	454	455	458	460	461	463	464a	464b	464c	464d	464e	464f	YCAIIa	YCAIIb	Y-GATA-H4.1	
Value	29	11	11	17	11	12	24	15	15	17	18	-	-	19	23	22	

R1b

The Seven Daughters of Eve



- 2001 - The first book on this subject to stir the popular imagination. But antagonized some scientists with fictional account of Clan Mother life.
- Bryan Sykes is Professor of Genetics at Oxford University.
- 1989 - Sykes first to extract/analyze mtDNA from archeological bones.
- 1990 - Sykes showed all hamsters have the same mtDNA, unchanged after 250 generation since one female from Syria in 1930. Slow rate of change.
- 1991 - Sykes extracted DNA from 5000 year old “Iceman” of Italy and found a descendant in present day England.
- 1993 - from mtDNA samples from polynesians, Sykes proved that they spread across the Pacific 27,000 years ago from South China/New Guinea and, contrary to Kon Tiki, not from South America.
- 1994 - Sykes helped when DNA from remains buried in Russia, compared with existing Royalty, showed Tsar+family murdered by Bolsheviks.
- 1994 - Sykes showed that the small variation in mtDNA of homo sapiens implied Neanderthals were a distinct species which died out. Confirmed in 1997 by difference with mtDNA from their excavated bones.
- 1996 - Sykes showed 80% of European’s ancestors Hunter-Gatherers, 20% were Farmers from Middle-East. Culture not people conquered 10,000 ya. Confirmed by mtDNA haplogroup of 12,000 year old Cheddar man.
- Created web site and service so anyone could have their DNA tested and so determine which clan of ancestors they belonged.

My son was tested:
Y haplogroup = R1b
mt haplogroup = M

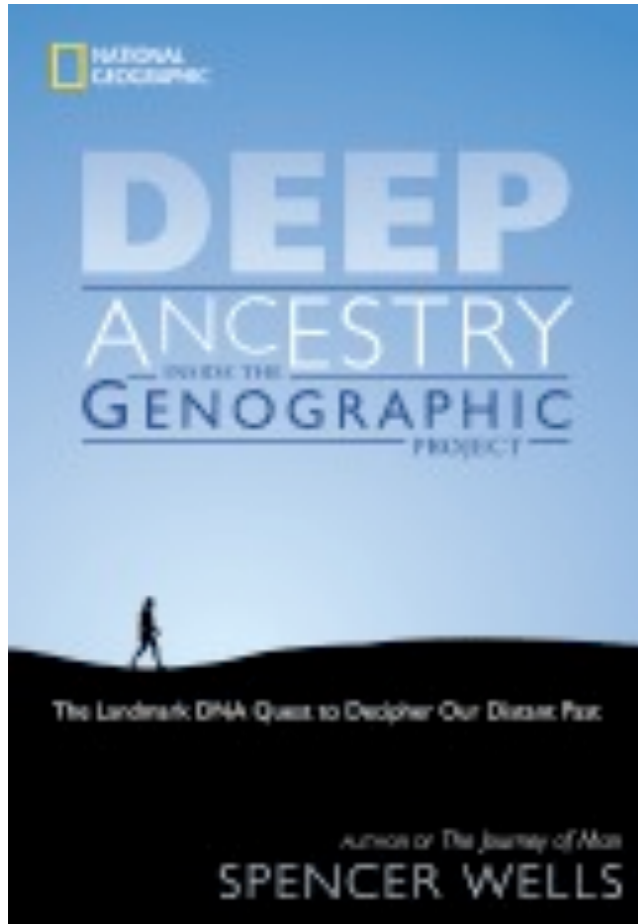
Professor Luigi Luca Cavalli-Sforza

- A distinguished Geneticist, born in Italy, who researched in Europe in 50's and 60's.
- 1970 he moved to Stanford, where he is Emeritus Professor.
- First with blood groups, then genetics and Y-DNA, he found ways to understand population migrations and ancestry and correlate with archeology, anthropology and linguistics.
- Over 50 years in this field and collaborating with many people has made him very distinguished.
- He summed up his work for laymen in five topics covered in “Genes, Peoples, and Languages”, Translated by Mark Seielstad, year 2000.
- But it is not recommended as an easy read for the layman.

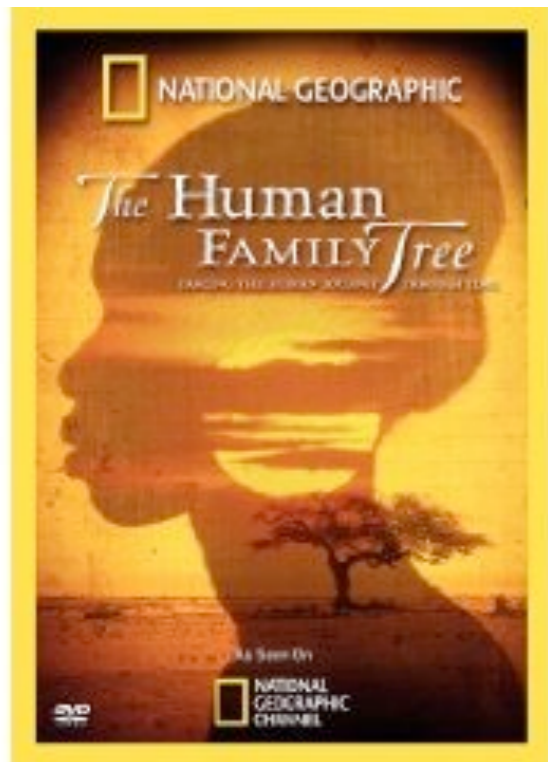
Professor Alan Wilson

- 1955-1991 at Berkeley. Established world center for molecular genetics and human evolution.
- Trained over 200 PHDs in this field and has had great influence but died at age 51.
- 1987 - He pioneered use of mitochondrial DNA in evolution and genetics.
- All Humans have a common mtDNA female Ancestor who lived 150,000 years ago, in Africa. Homo sapiens started in Africa, migrated over the World, replacing any Homo erectus.

Genographic Project



- 5-year, \$40M, Research Project, started in 2005 by National Geographic, sponsored by IBM and the Watt Family Foundation.
- Scientific, peer reviewed, Project - lead by Dr. Spencer Wells, who is a Geneticist/Anthropologist, and also a visiting lecturer at Cornell.
- 2000, in Luigi Luca Cavalli-Sforza lab, Wells was part of team on Y_DNA which showed ancestral Adam lived in Africa 60,000 years ago.
- The Project will collect vast numbers of Y-DNA and mtDNA data from indigenous and traditional groups, who have been geographically stable.
- Over 300,000 ordinary people have purchased a \$100 test kit which is processed at University of Arizona, to find their own genetic ancestry, and also provide more data for the Project.
- Then by statistical computer analysis, improve our knowledge of our genetic roots and population migrations over last 60,000 years.
- Deep Ancestry describes the background science and Project results through 2006.
- The DVD “The Human Family Tree”, which will be shown in this class, serves a similar purpose.



Hugo

- Human Genome Organization - HUGO - International collaboration of scientists involved in mapping genetics, started in 1988
- Generally works in the background.
- Recently HUGO explored the historic migration patterns in South-East Asia:
<http://www.genomeweb.com/arrays/hugo-pan-asian-snp-consortium-maps-genetic-diversity-asia>

Homework

- Homework is for your benefit. There is no Test.
- After the Class go to: <http://www.all-osuaa.org/> Item: The Human Family - Homework
- There you can replay this Introduction, follow references and view Wikipedia topics.

The Human Family - Homework

- The following books may be borrowed from Corvallis Library and/or OSU Library, or may be purchased from Amazon and other sources.
 - ▶ The Seven Daughters of Eve: The science that reveals our genetic ancestry - Bryan Sykes.
 - ▶ Deep Ancestry: Inside the Genographic Project - Spencer Wells.
 - ▶ Genes, Peoples, and Languages - Luigi Luca Cavalli-Sforza.
- Here are some corresponding web sites.
 - ▶ <http://www.oxfordancestors.com/> Popular site of Professor Bryan Sykes MA PhD DSc
 - ▶ <https://genographic.nationalgeographic.com/genographic> Background and updates.
 - ▶ <http://www.hugo-international.org/>
 - ▶ <http://www.genomeweb.com/arrays/hugo-pan-asian-snp-consortium-maps-genetic-diversity-asia>
- Here are some interesting and relevant items in Wikipedia: <http://www.wikipedia.org/>
 - ▶ Seven_Daughters_of_Eve
 - ▶ Genographic_project
 - ▶ Luigi Luca Cavalli-Sforza
 - ▶ Alan Wilson (molecular geneticist, Berkeley)
 - ▶ Genealogical DNA test
 - ▶ Haplogroup
 - ▶ Human_mitochondrial_DNA_haplogroup
 - ▶ The Journey of Man: A Genetic_Odyssey - 2002 book by Spencer Wells