The genetic evidence for prehistoric migrations

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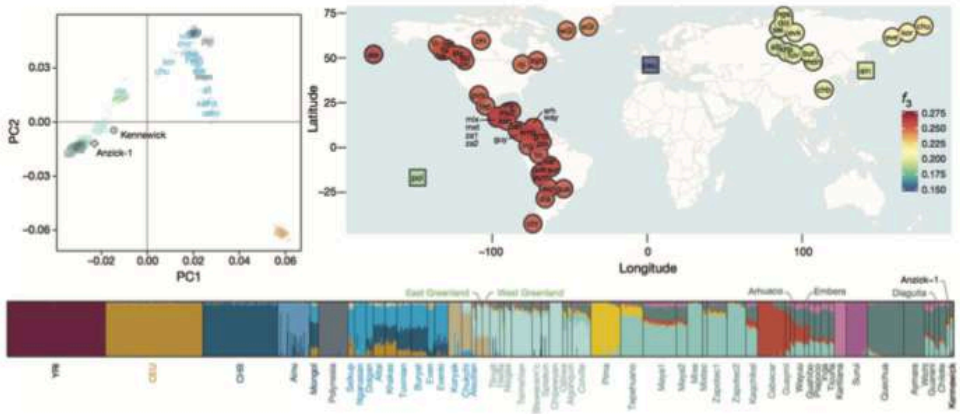
Natural History Museum of Denmark

Roots of Europe Summer Seminar 2018

Archaeomics Summer School

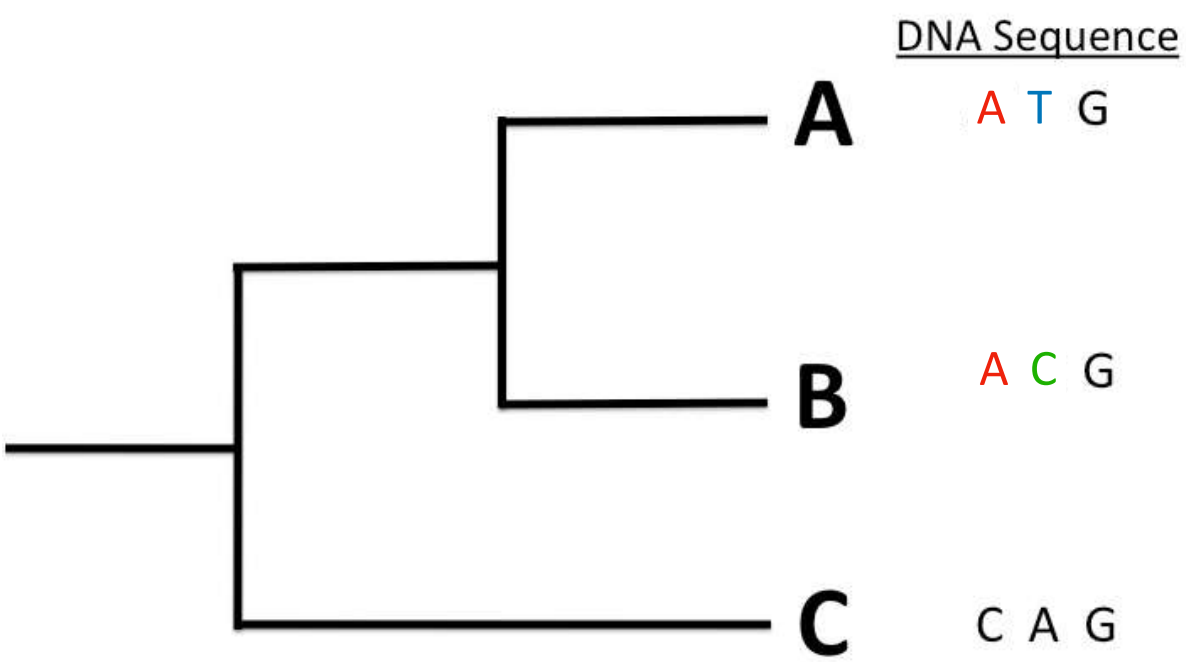
- aimed at students in archaeology, linguistics, history and related fields
- August 13-17, 2018
- www.archaeomics.ku.dk



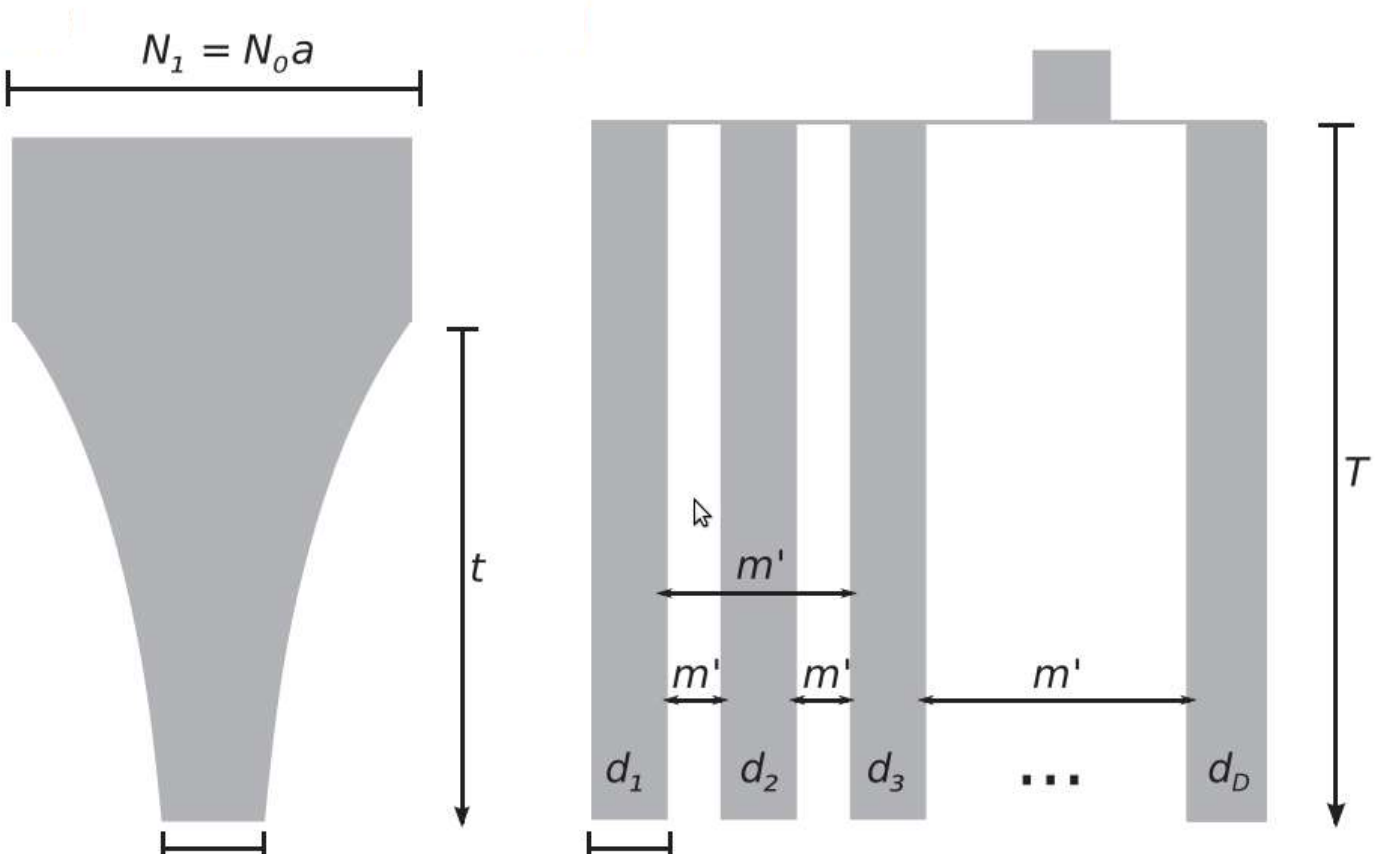
- Inferring migration from genetic data
- Insights from ancient genomes
- The population history of Europe
- Genetic ancestry, material culture and language

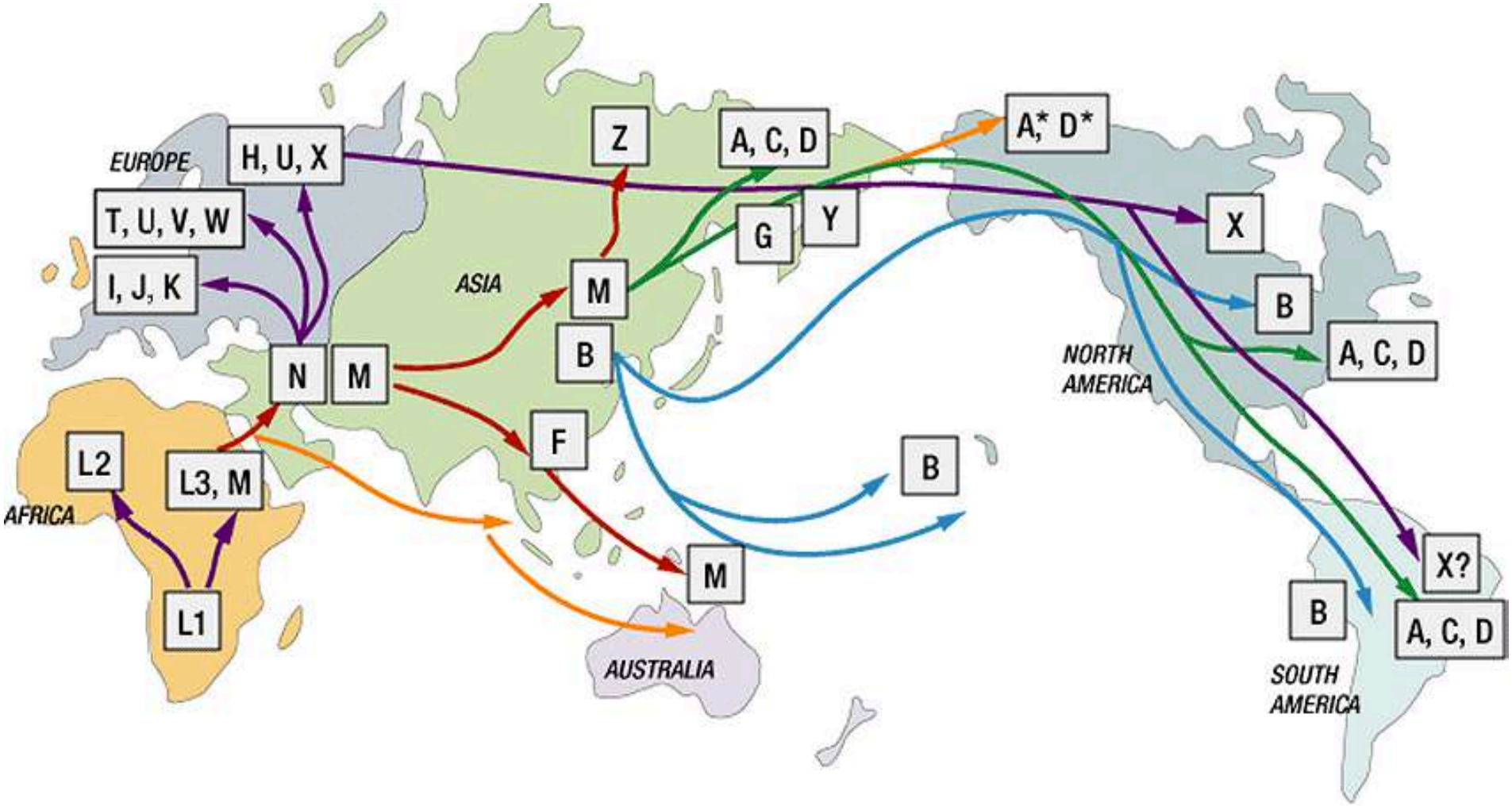
Inferring migration from genetic data

Phylogenetic relationships

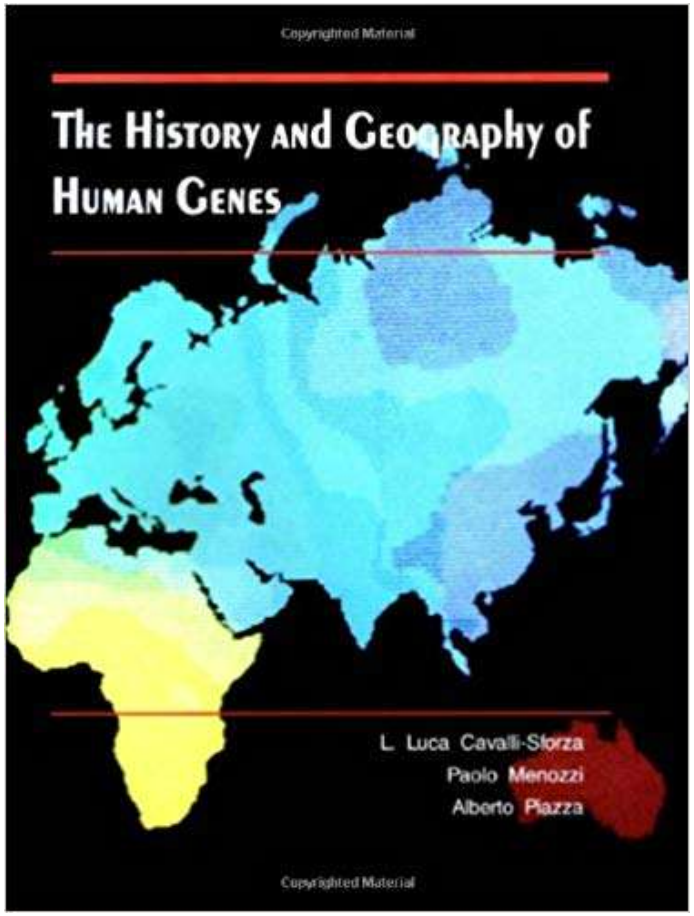


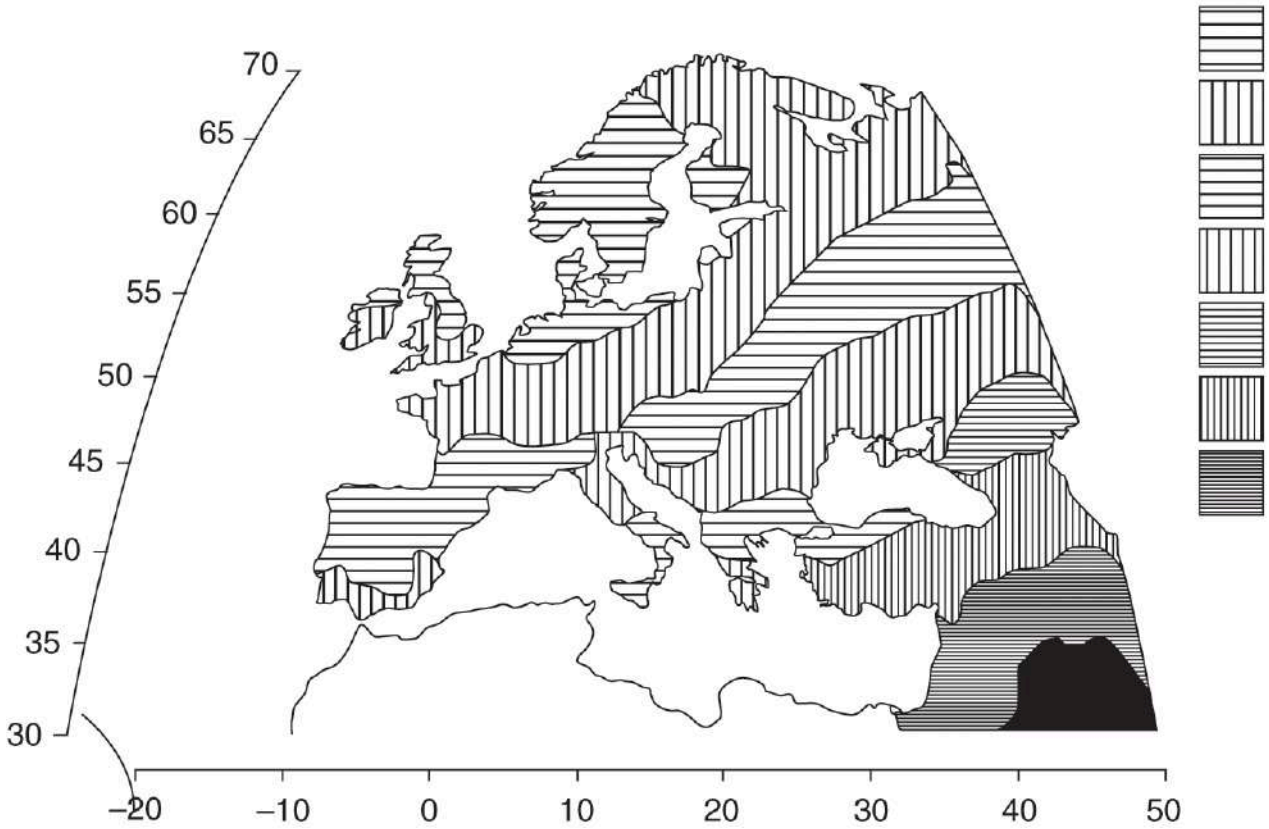
Inferring demographic histories from genetic data




EUROPE
H, U, X
T, U, V, W
I, J, K
N
M
ASIA
Z
M
B
A, C, D
G
Y
A* D*
X
B
A, C, D
NORTH AMERICA
F
B
M
AUSTRALIA
L2
L3, M
AFRICA
L1
B
X?
A, C, D
SOUTH AMERICA

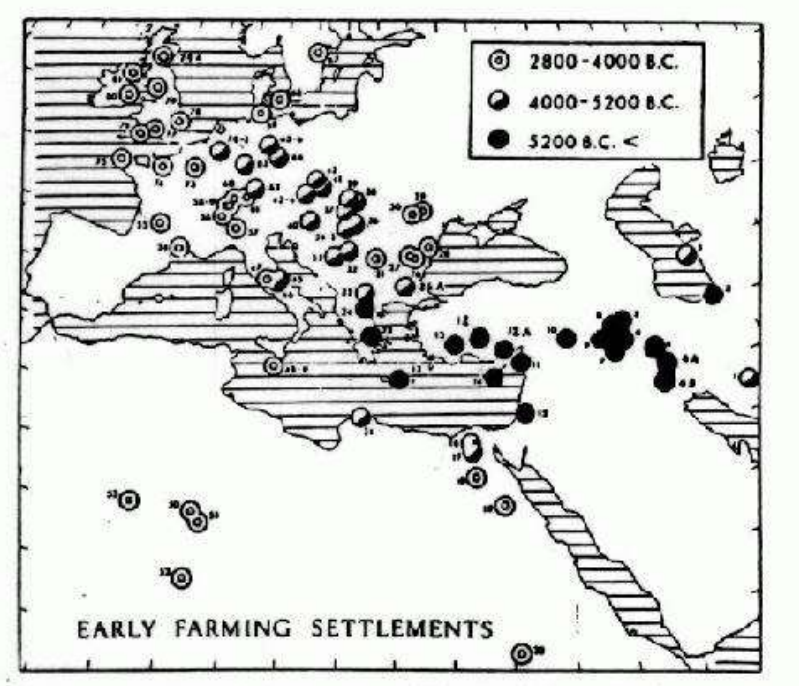
Inferring migration from genetic data



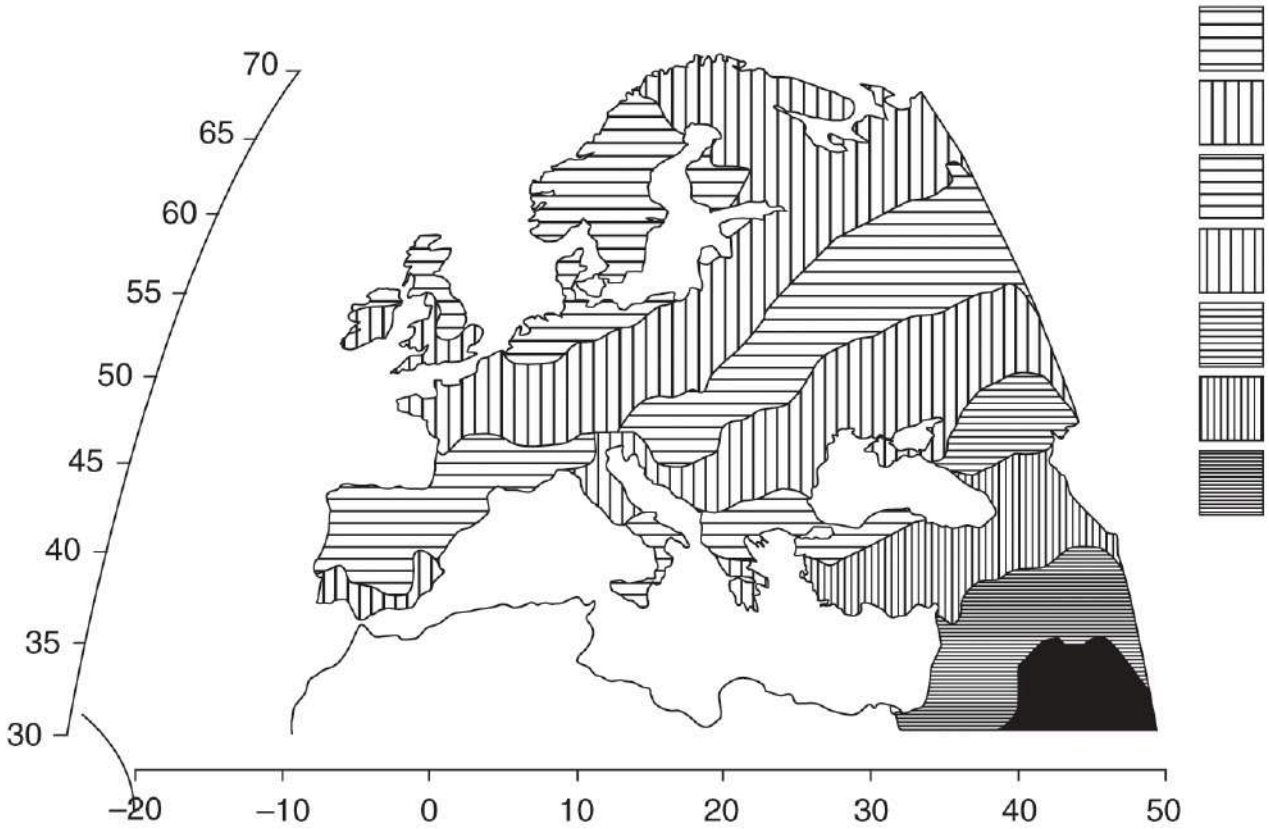


Cavalli-Sforza et al. 1996, The History and Geography of Human Genes

Inferring migration from genetic data



Clark, 1965, Proceedings of the Prehistoric Society

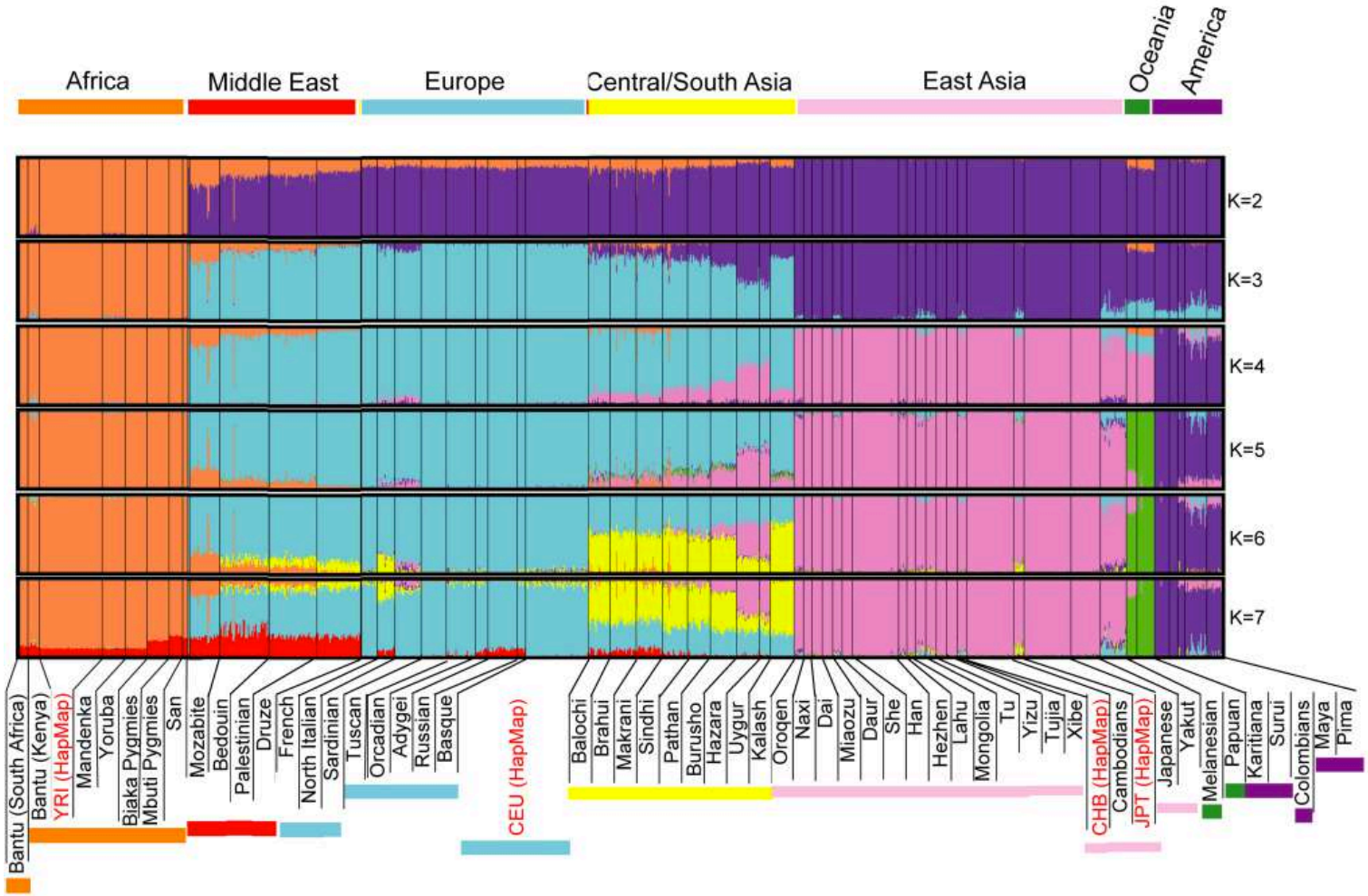


Cavalli-Sforza et al. 1996, The History and Geography of Human Genes

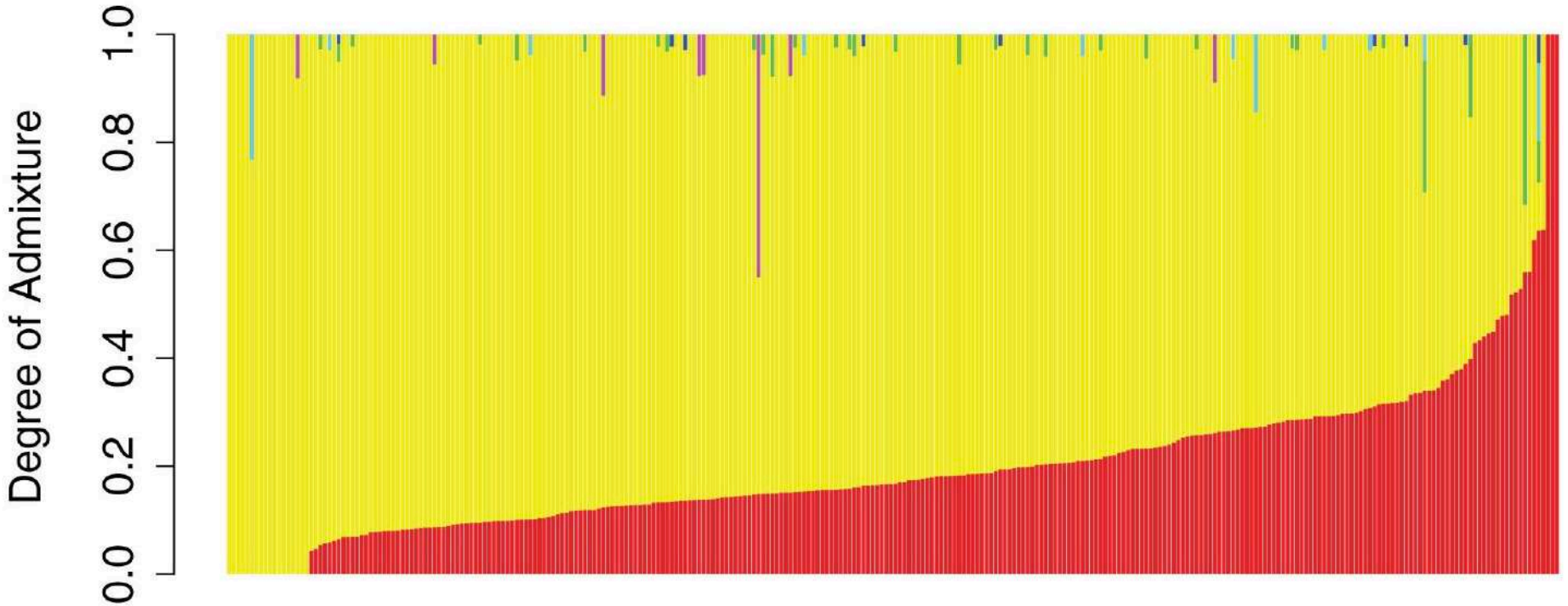
The sequencing revolution

- high sequencing output (millions of nucleotides per second)
- roughly 1 (modern) human genome (3 billion base pairs) an hour

Global admixture patterns

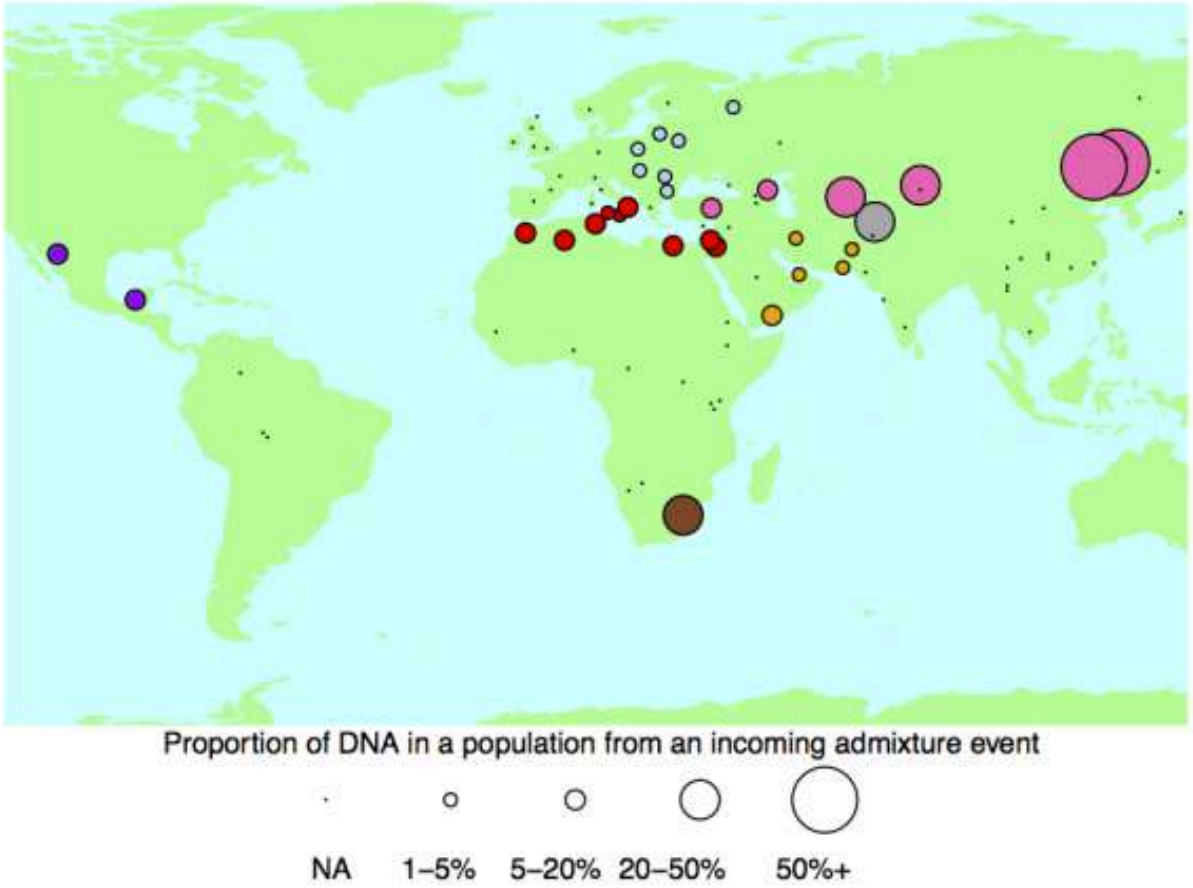


Admixture in African Americans



A Genetic Atlas of Human Admixture History

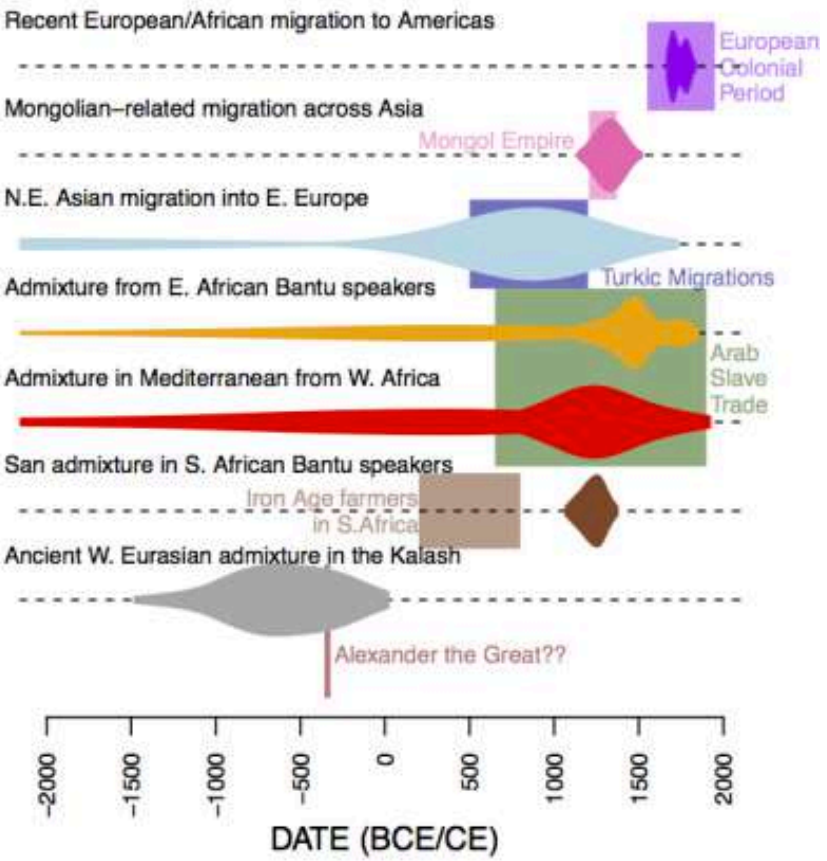
A summary of a selection of human migration events inferred only from genetic data using the new GLOBETROTTER method reported in: G. Hellenthal, G.B.J. Busby, G. Band, J.F. Wilson, C. Capelli, D. Falush & S. Myers **Science** *(14th Feb 2014)*



Proportion of DNA in a population from an incoming admixture event

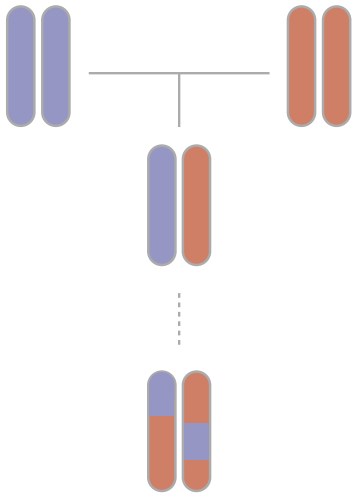
NA 1–5% 5–20% 20–50% 50%+

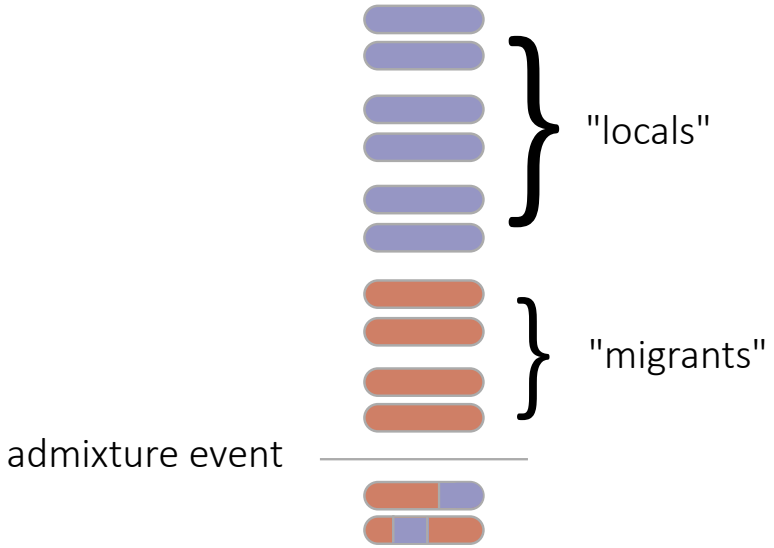
Timeline of events inferred by GLOBETROTTER



Hellenthal et al. 2014, Science

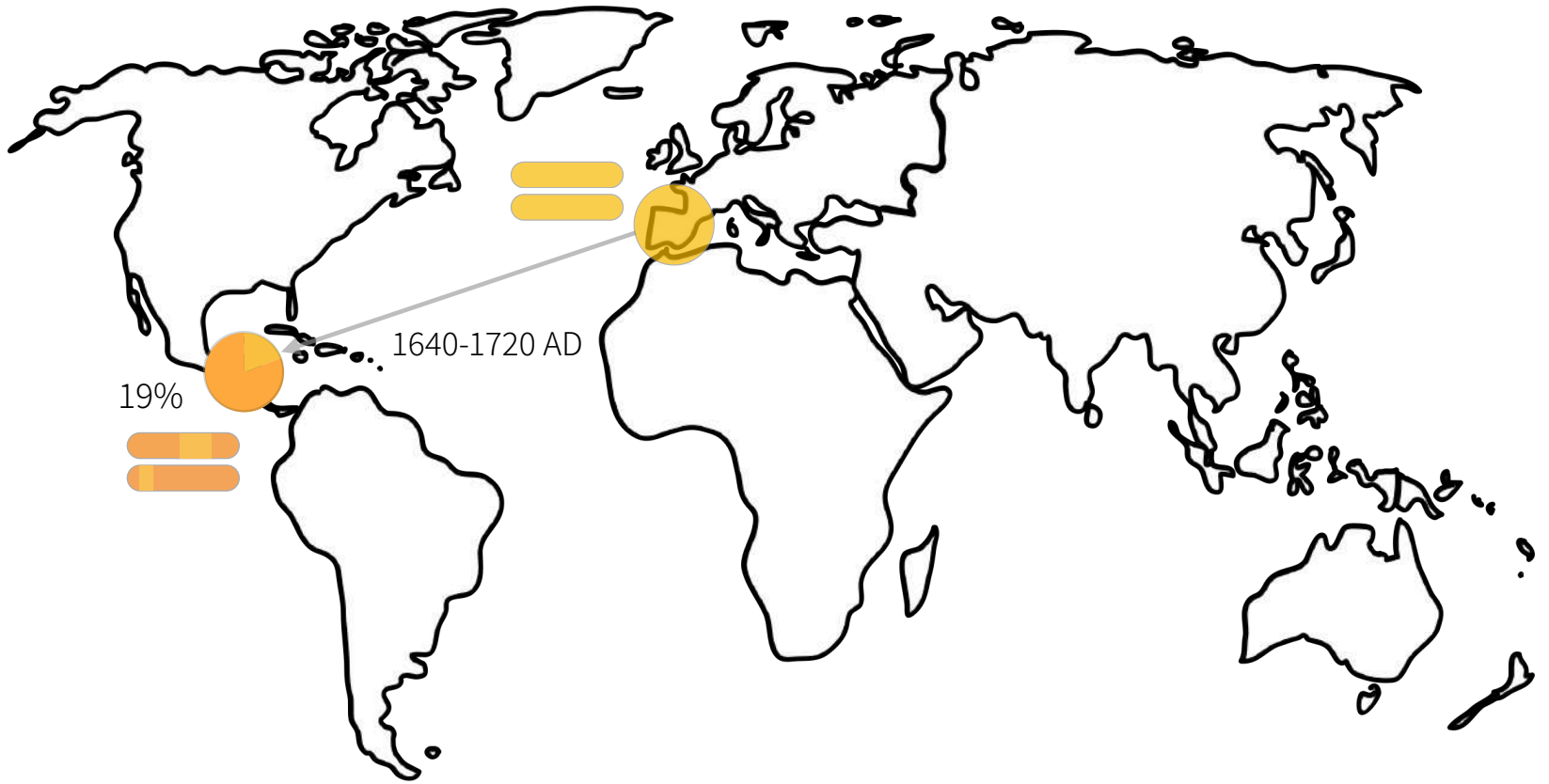
How we inherit our DNA





We can estimate when two groups intermixed by looking at the size of the blue and red segments.

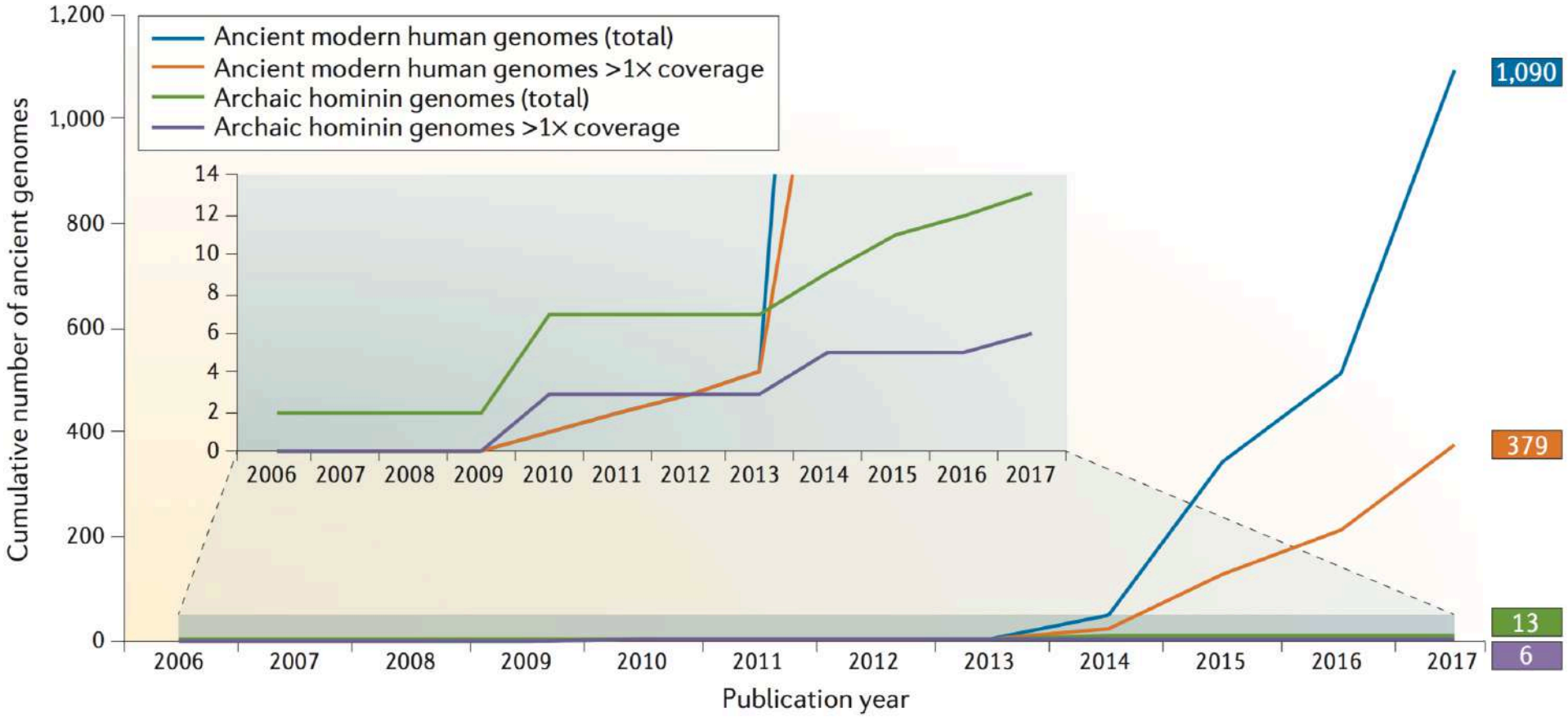
Dating admixture events



Data from: Hellenthal et al. 2014, Science

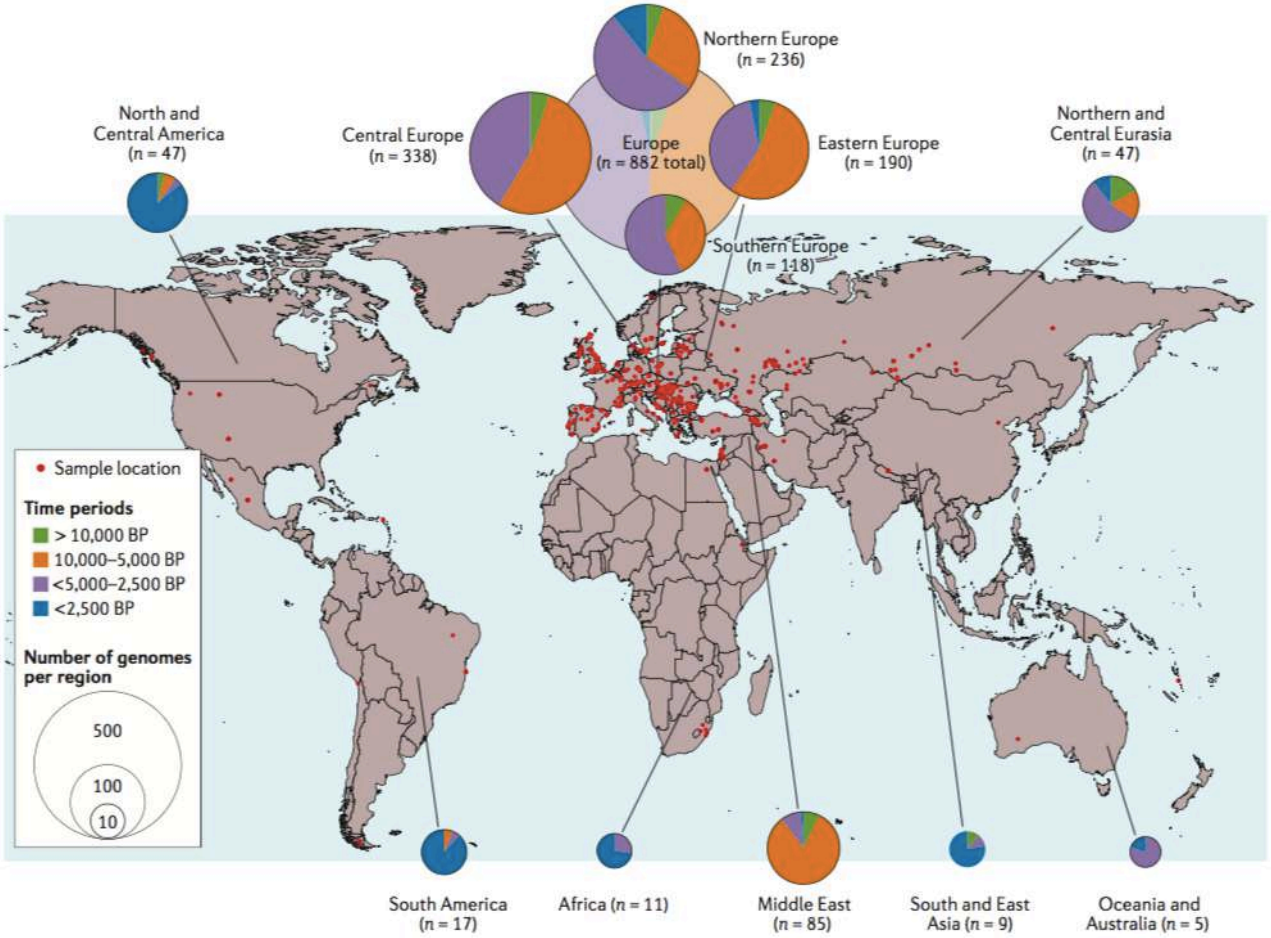
Insights from ancient genomes

The ancient DNA revolution



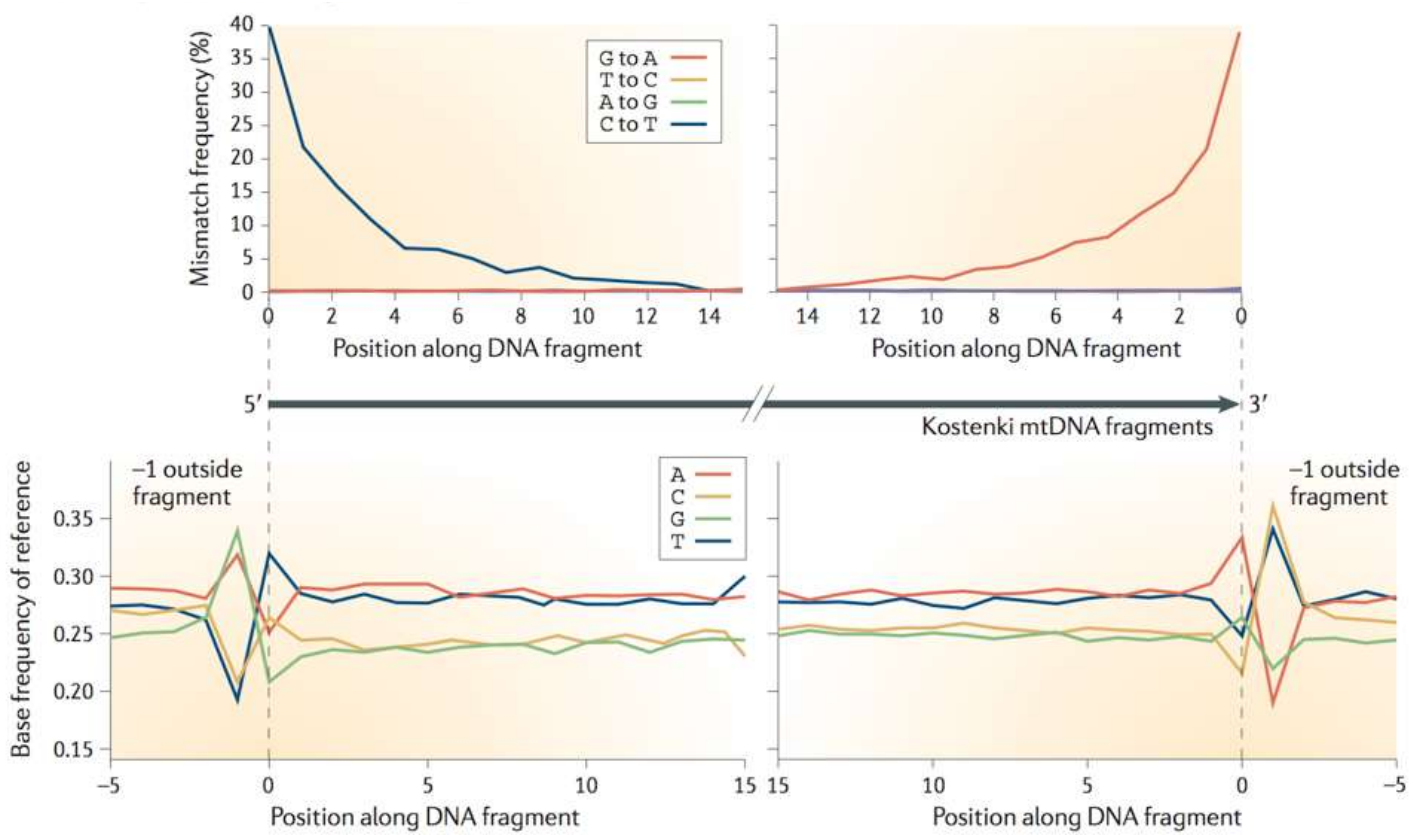
Marciniak and Perry 2017, Nature Reviews Genetics

The world of ancient genomes



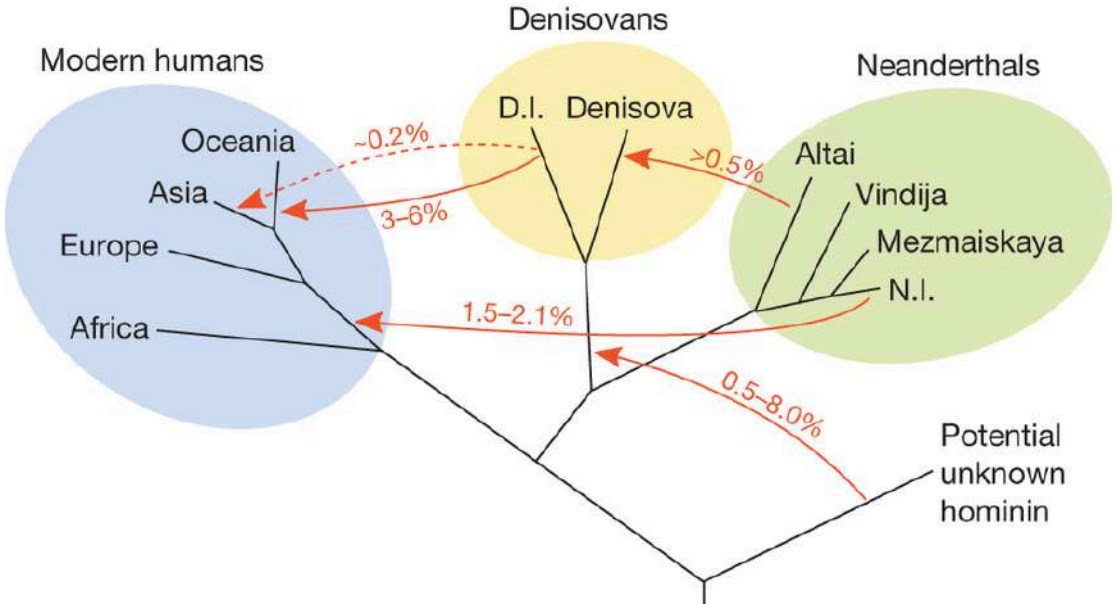
Marciniak and Perry 2017, Nature Reviews Genetics

Authenticating ancient DNA data



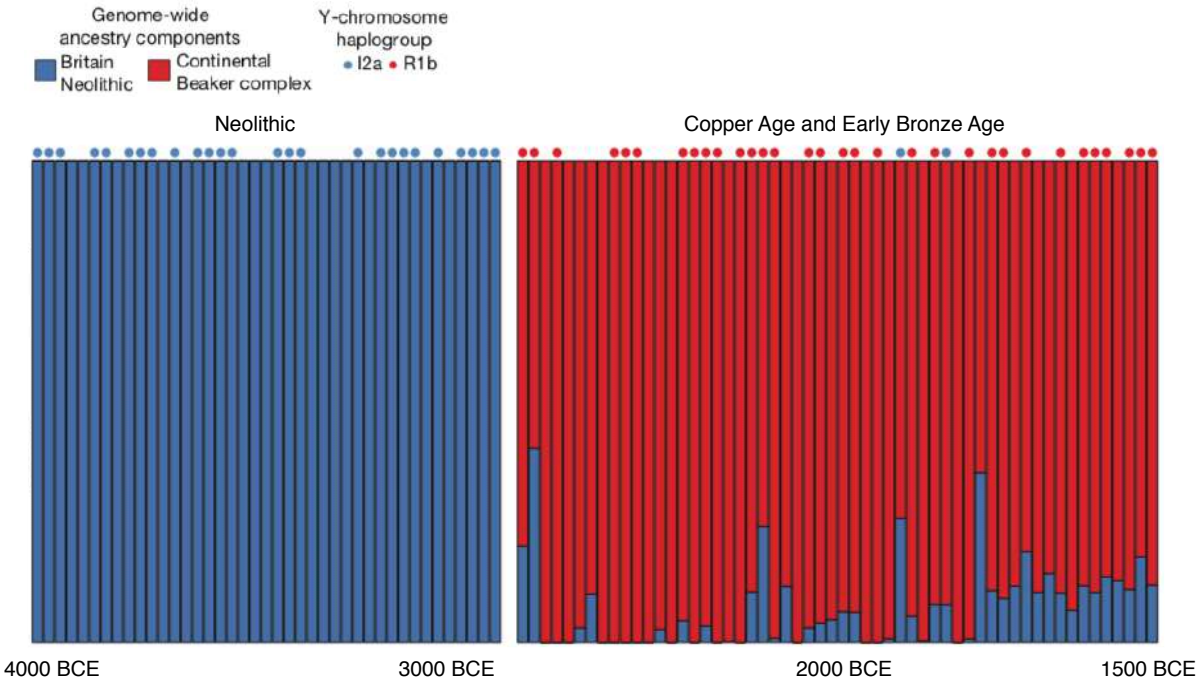
Stoneking and Krause 2011, Nature Reviews Genetics

Archaic hominins



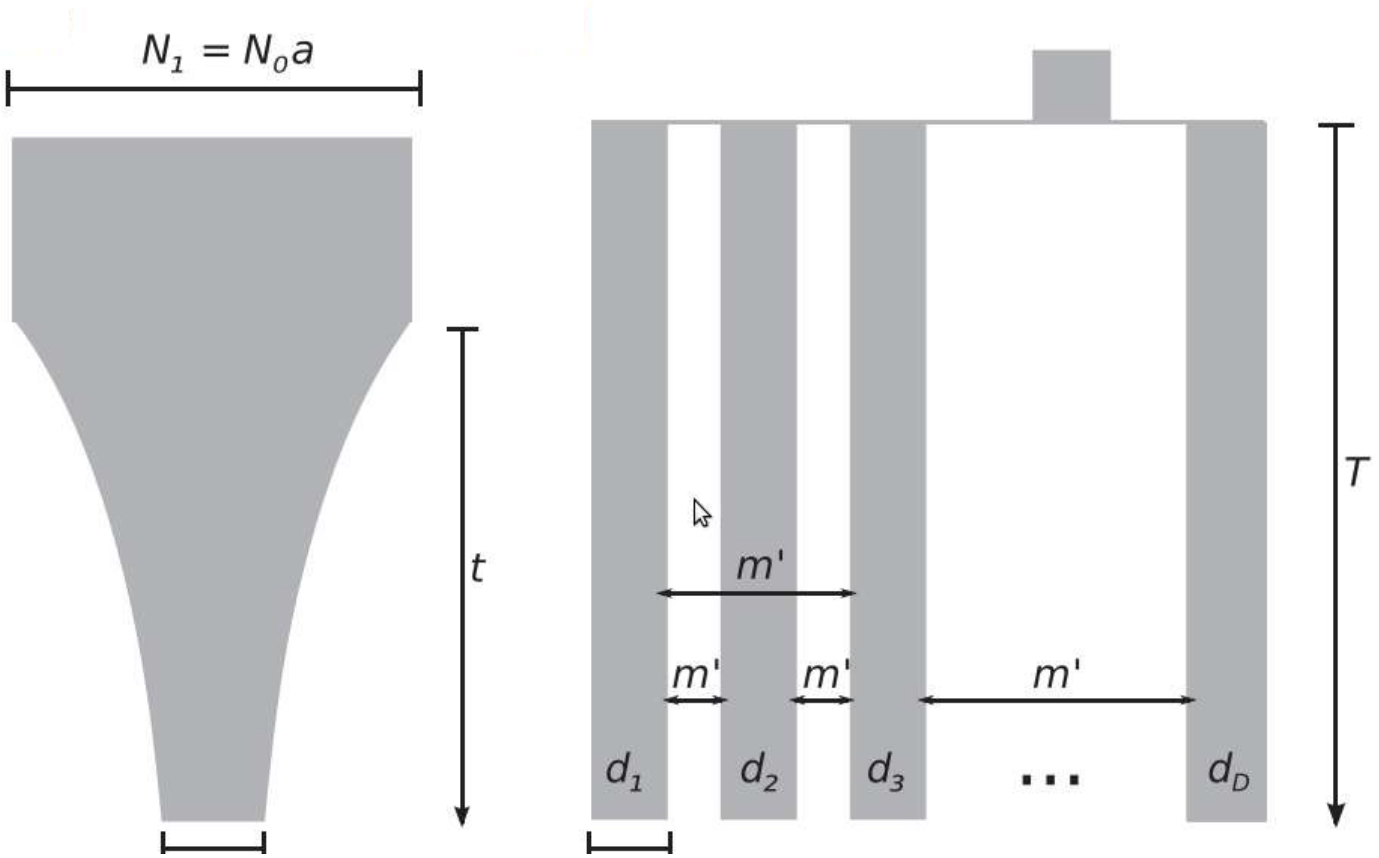
Prüfer et al. 2014, Nature

Inferring migration from ancient genomes



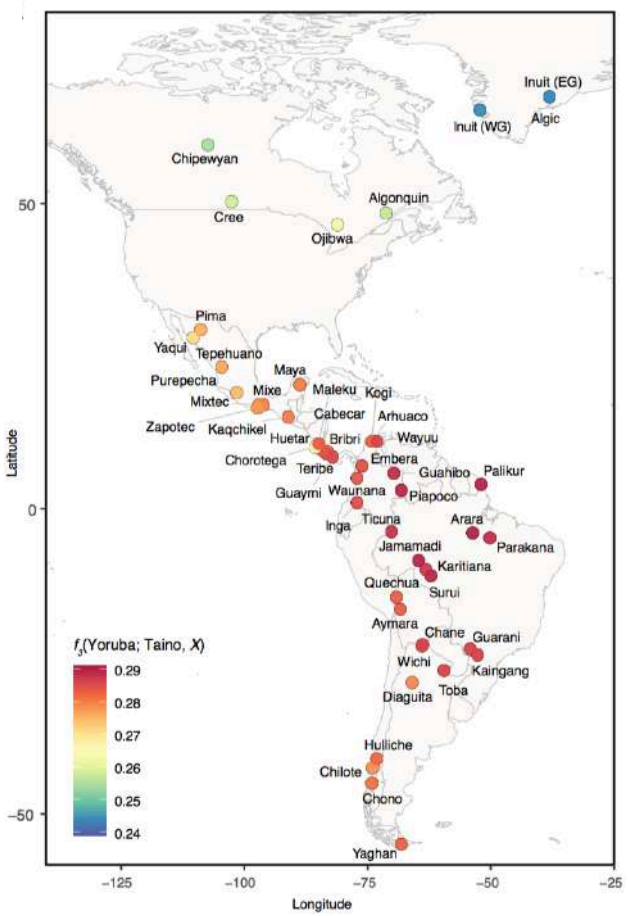
Olalde et al. 2018, Nature

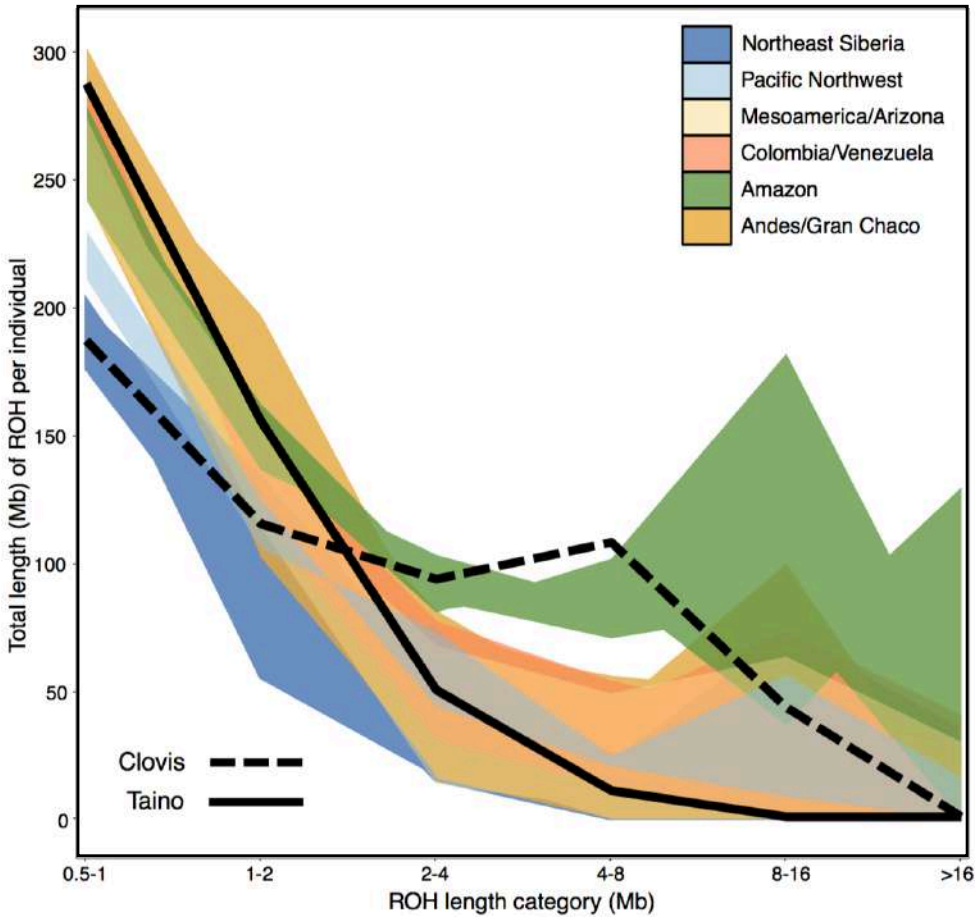
Inferring demographic histories



First ancient Caribbean genome

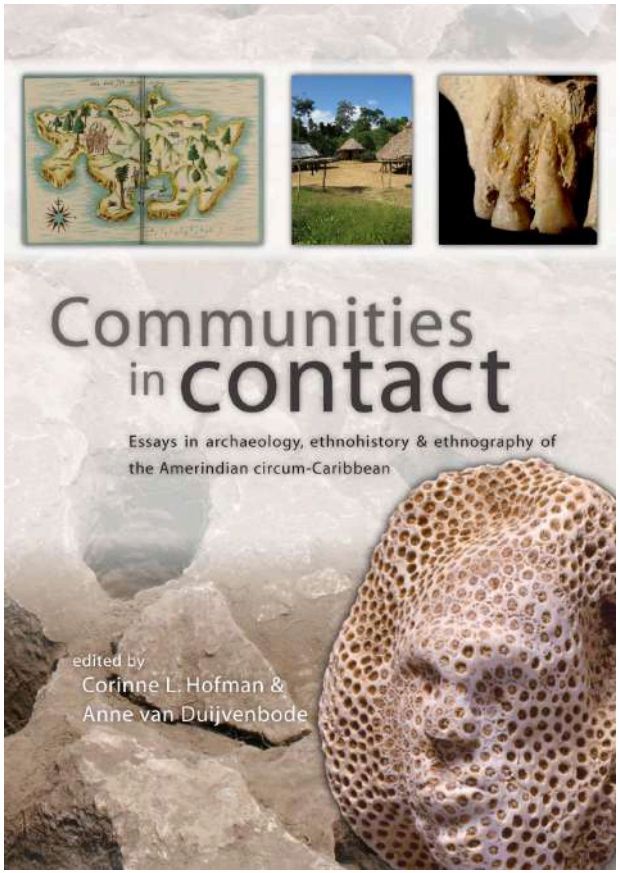
First ancient Caribbean genome

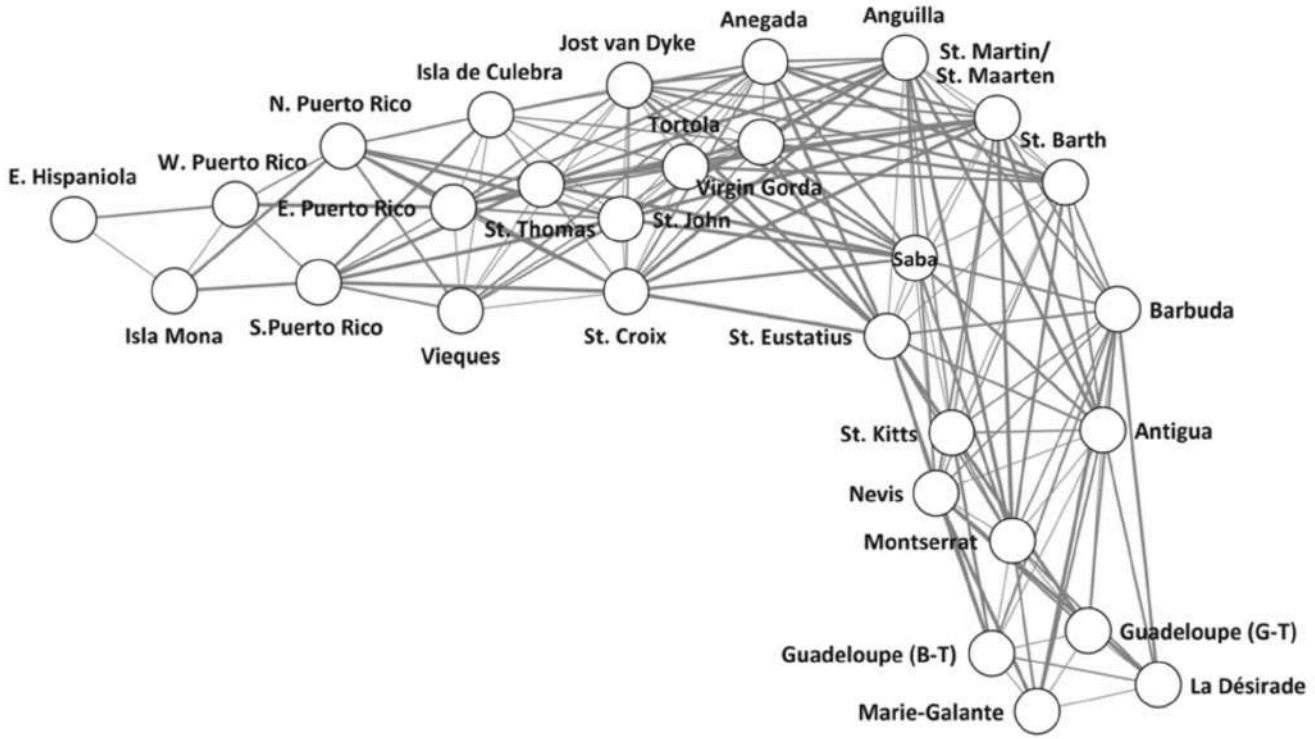




Schroeder et al. 2018, PNAS

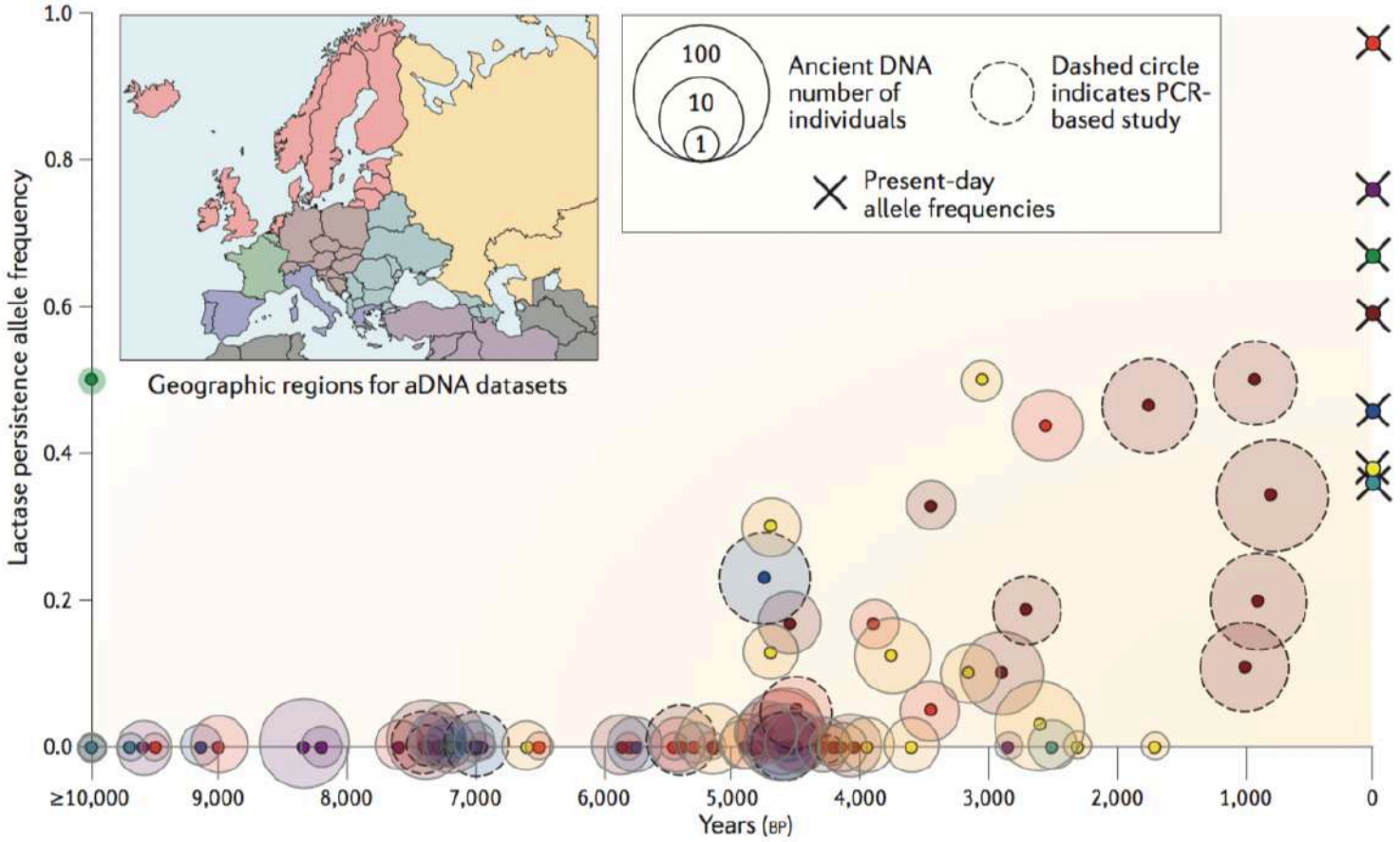
The Caribbean before 1492





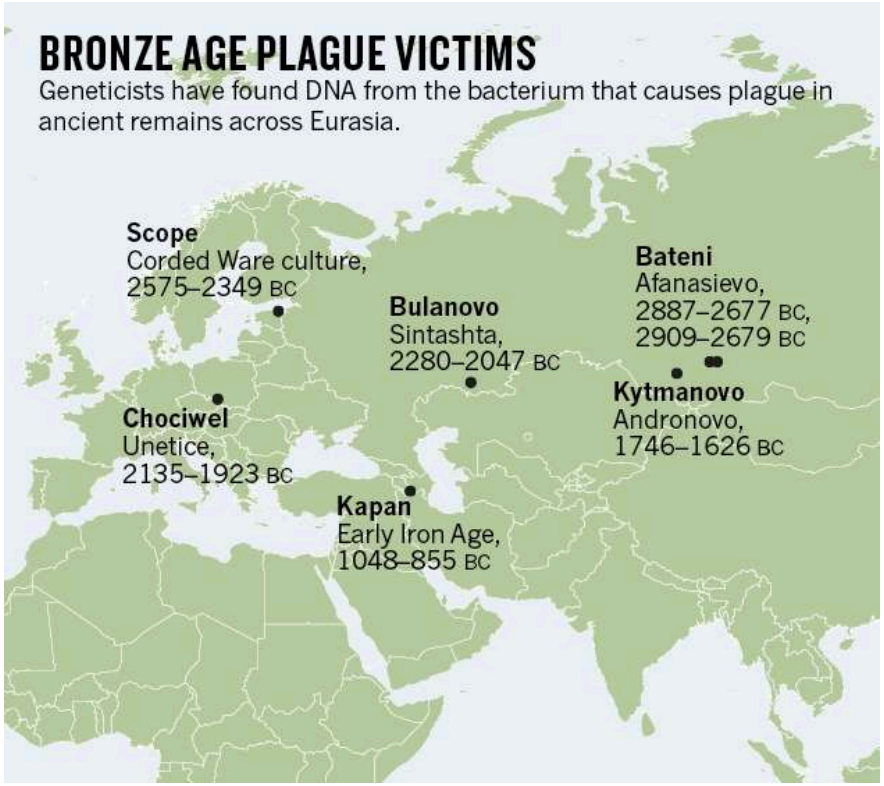
Mol et al. 2015, J Archaeol Method Theory

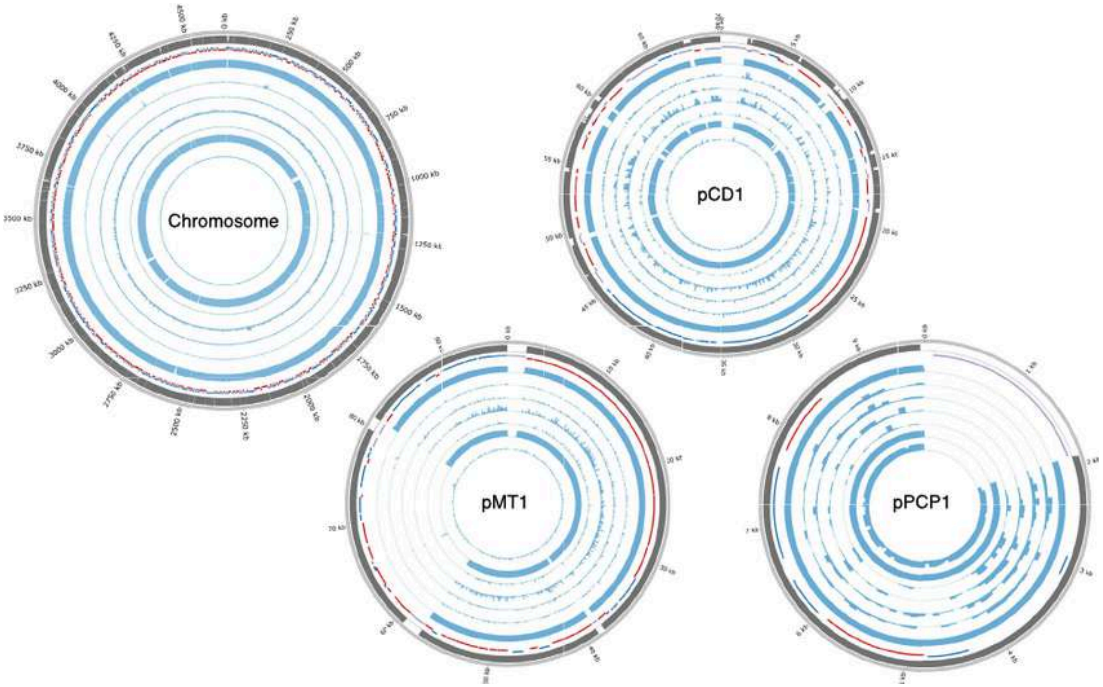
Adaptation & positive selection



Marciniak and Perry 2017, Nature Reviews Genetics

Spread and evolution of pathogens

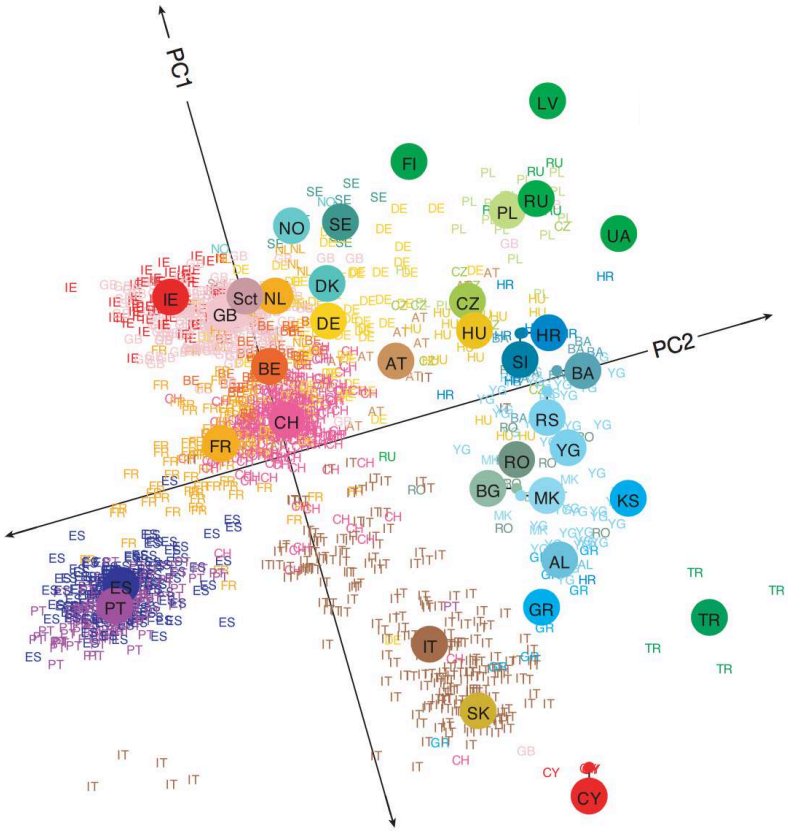


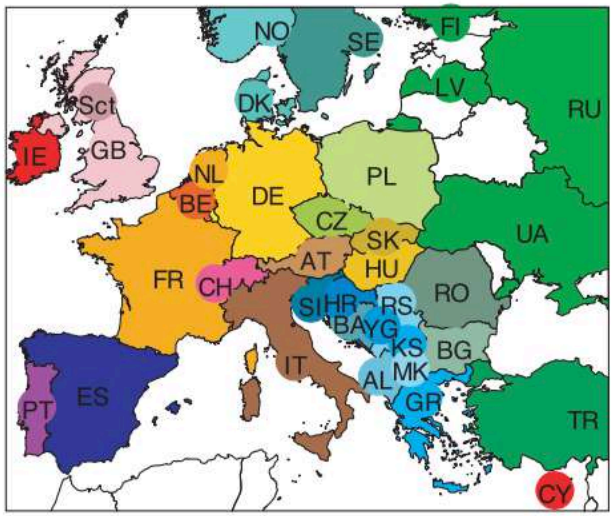


Rasmussen et al. 2015, Cell

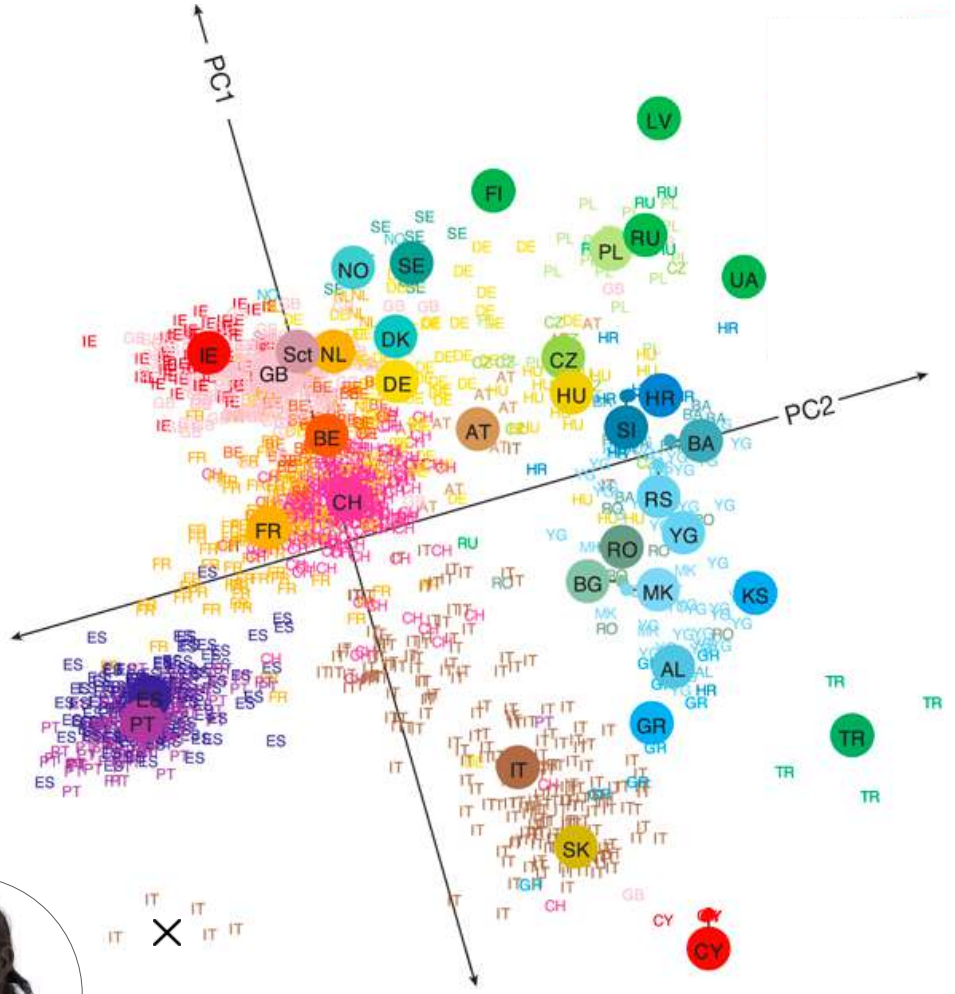
The population history of Europe

Novembre et al. (2008): "close correspondence between genetic and geographic distances"





Novembre et al. 2008, *Nature*

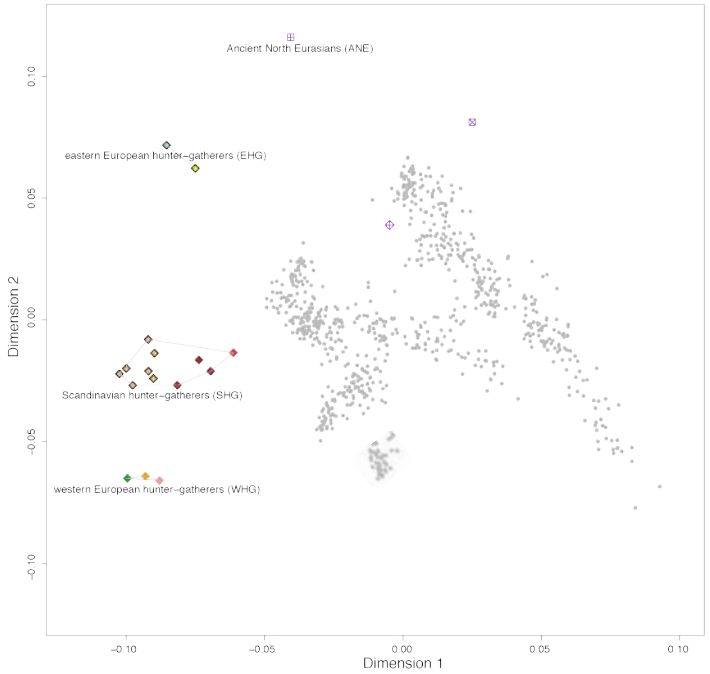


- "Ötzi", the Iceman
- lived ca. 3400-3100 BCE
- genetically closest to contemporary Sardinians

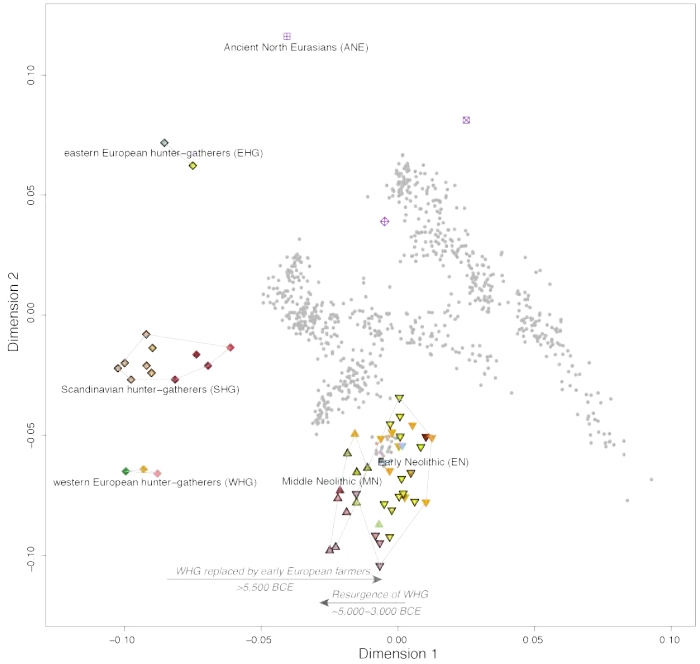
Novembre et al. 2008, ***Nature;*** Sikora et al. 2014, ***PLoS Genetics***

European population history

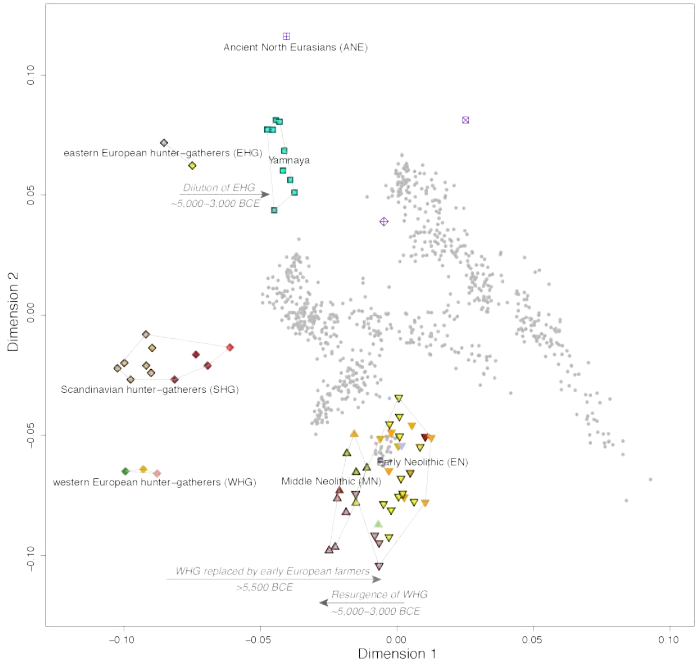
Mesolithic



Neolithic transition

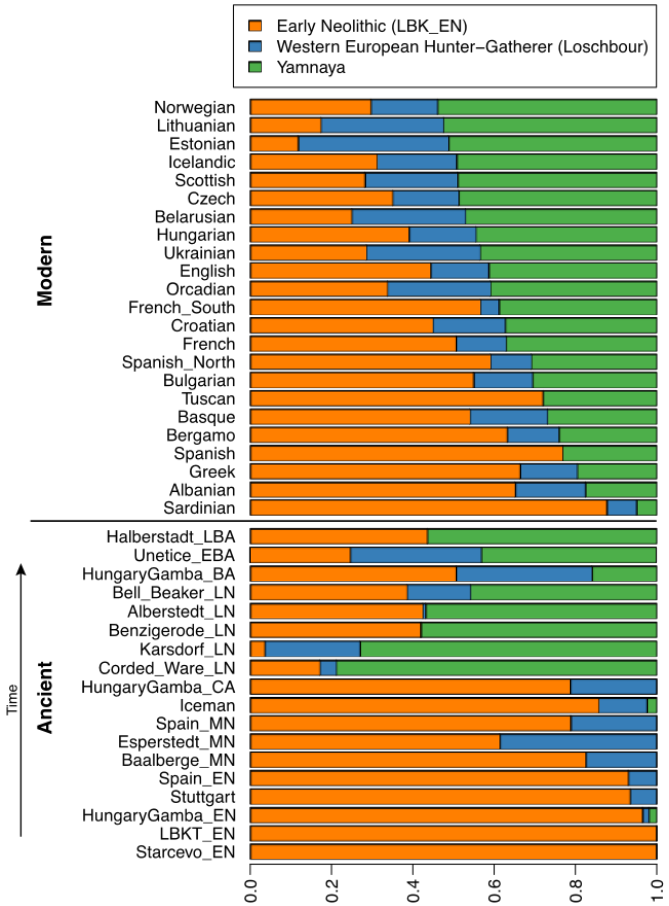


Bronze Age



Allentoft et al. 2015, Nature; Haak et al. 2015, Nature

Inferring migration from ancient genomes



Haak et al. 2015, Nature

The Kurgan hypothesis

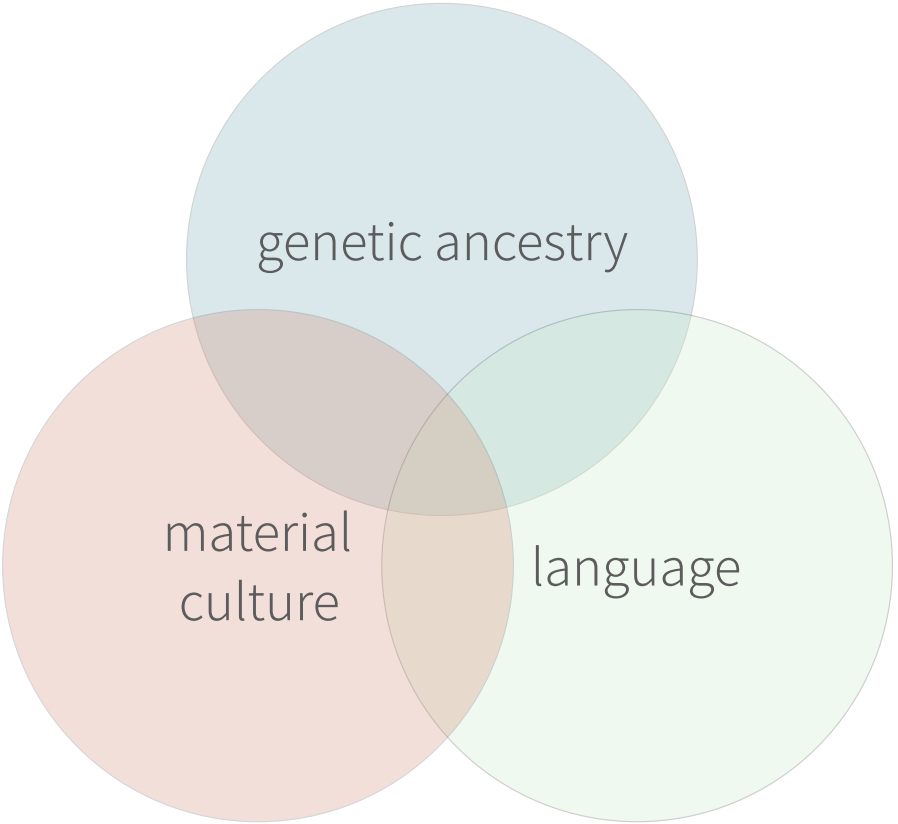
Marija Gimbutas 1921-1994

“The massive Kurgan Wave […] from the lower Volga region after 3000 B.C. into east-central Europe, caused major ethnic shifts.”

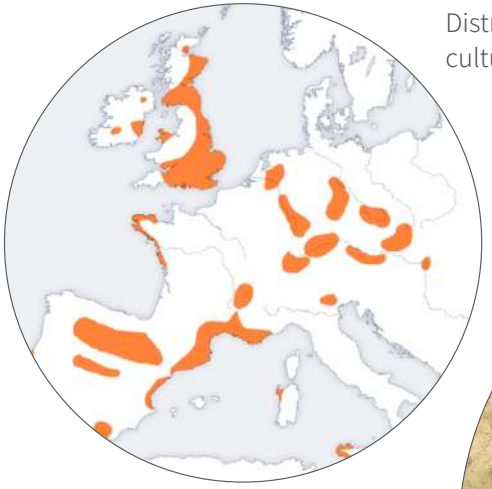
Marija Gimbutas, 1991

Genetic ancestry, ethnicity, material culture and language

Genetic ancestry, material culture and language

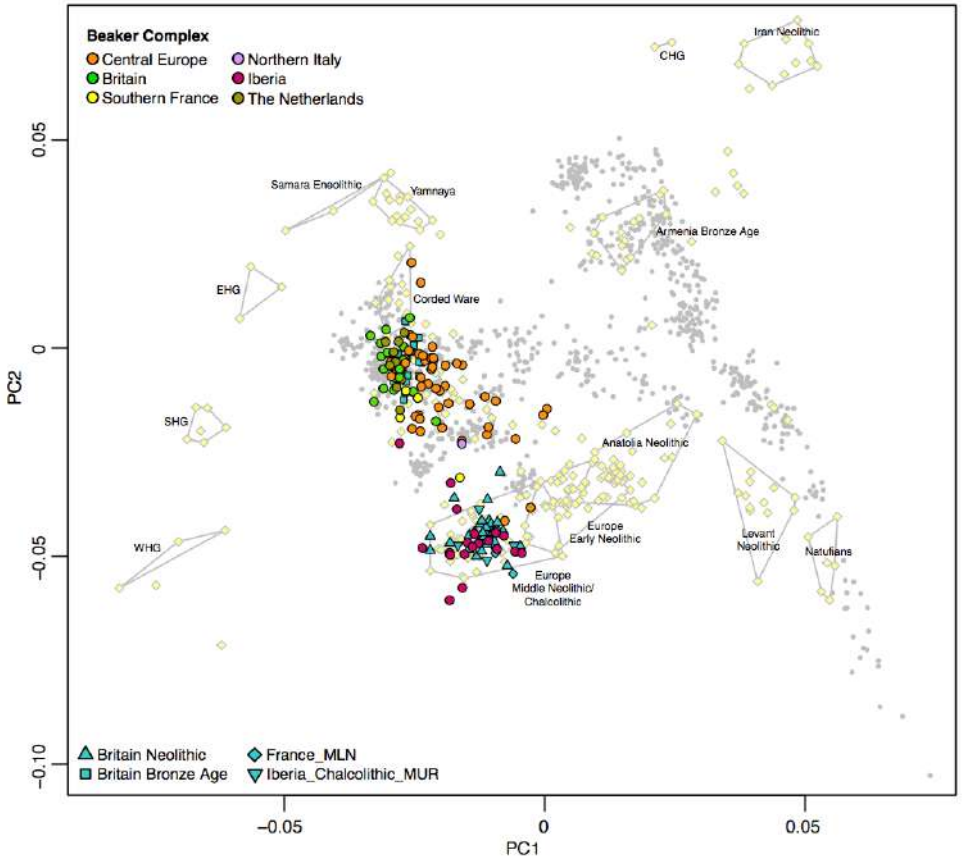


The Bell Beaker Phenomenon



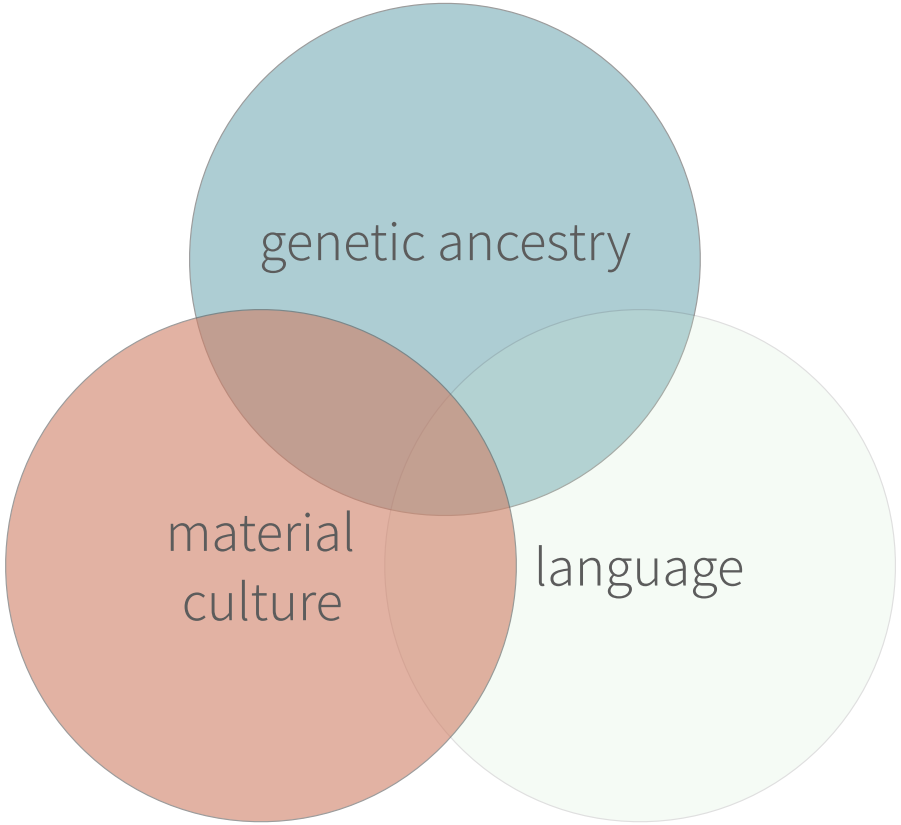
Distribution of Bell Beaker culture in Europe

Bell Beaker burial



Olalde et al. 2018, Nature

Genetic ancestry, material culture and language



Conclusions

- Ancient DNA can be used to identify past migrations
- Insights into demography, social organization, and human-environment interactions (pathogens)
- We can tie those movements to particular archaeological cultures (but not language)

Acknowledgments

- Friends and colleagues at the Natural History Museum of Denmark
- HERA Joint-Research Programme "Uses of the Past" (CitiGen)
- European Union’s Horizon 2020 research and innovation programme