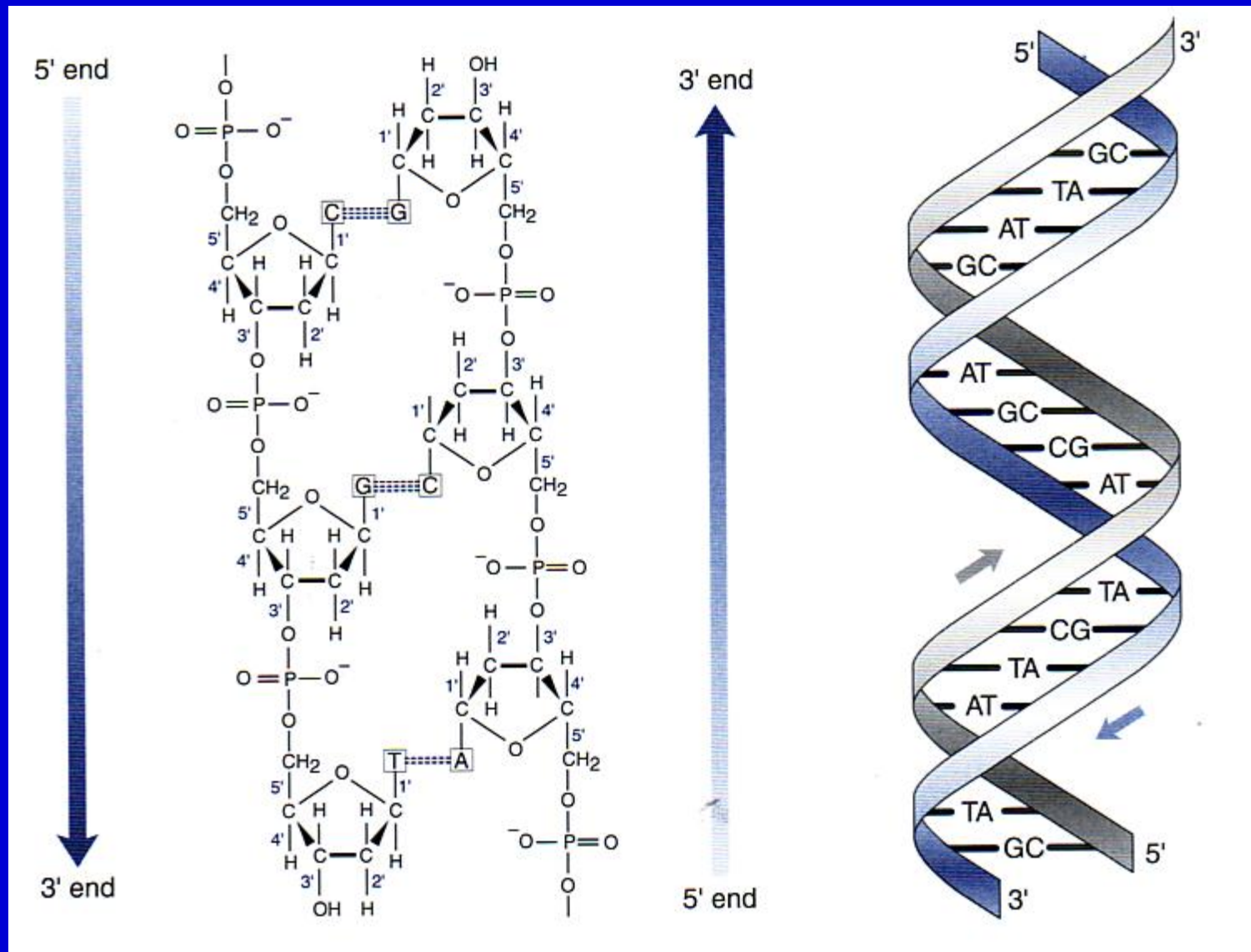


From Sticky Mucus to Probing our Past: Aspects and problems of the Biotechnological use of Macromolecules

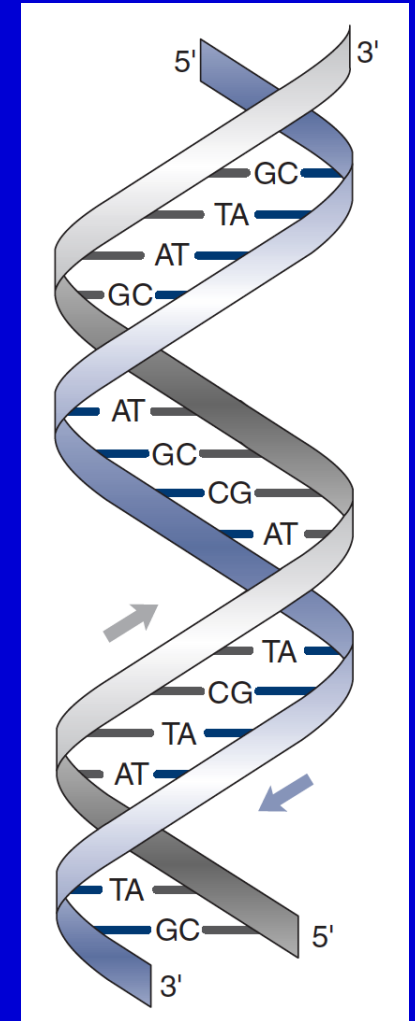
Datum/Zeit	Veranstaltungsort	Thema
Mi, 30.06.2010 12.15-13.45	SR 309 Carl-Zeiss-Str. 3	<i>Macromolecules as BioPharma mucoadhesives</i>
Do, 01.07.2010 08.15-09.45	SR 308 Carl-Zeiss-Str. 3	<i>Macromolecules as vaccines</i>
Do, 01.07.2010 13.15-14.45	HS Haus 1 August-Bebel-Str. 2	<i>Stability in response to Bioprocessing I. Thermal Processing, D, z and F values</i>
Fr, 02.07.2010 08.15-09.45	HS Haus 1 August-Bebel-Str. 2	<i>Stability in response to Bioprocessing II: Irradiation and freezing</i>
Fr, 02.07.2010 12.15-13.45	SR 307 Carl-Zeiss-Str. 3	<i>The use of non-recombining parts of the Y-chromosomal DNA and mitochondrial DNA as a probe into our past</i>

DNA – nature's most important glycoconjugate



DNA – nature's most important glycoconjugate

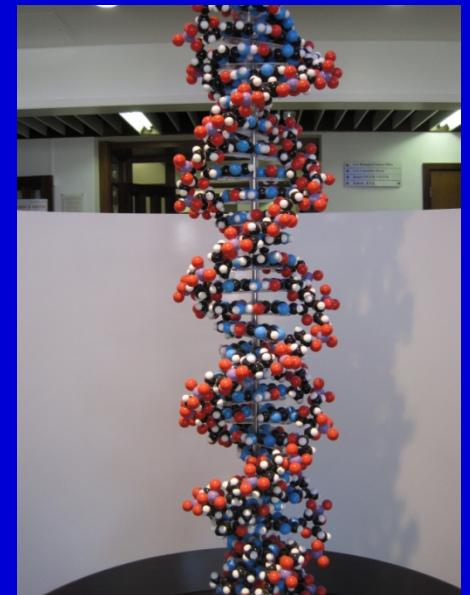
- ◆ High molecular weight
- ◆ Polyanionic
- ◆ Antiparallel chains of deoxyribose linked by the 5' and 3' residues by phosphate are held together by H-bonds between bases
- ◆ Packaged in chromosomes, in addition some circular DNA is found in mitochondria
- ◆ Carries the genetic code



The use of non-recombining parts of Y-chromosomal and mitochondrial DNA as a probe into our past

Steve Harding

NCMH Labs
University of Nottingham



The use of non-recombining parts of Y-chromosomal and mitochondrial DNA as a probe into our past



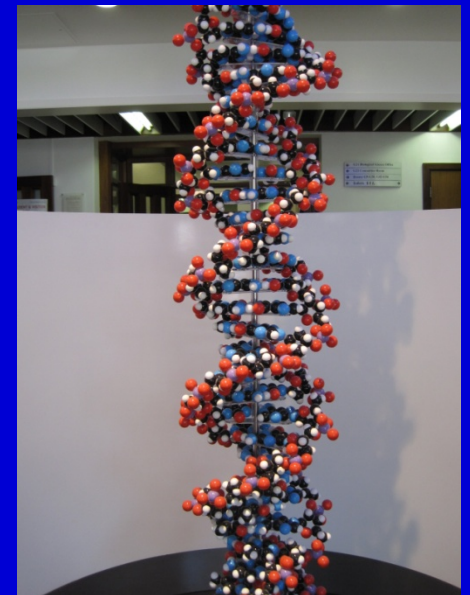
University of
Leicester



The University of
Nottingham

Steve Harding

**NCMH Labs
University of Nottingham**



Viking Genes of Northern England Project

- ◆ **Mark Jobling**
- ◆ **Turi King**
- ◆ **Steve Harding**
- ◆ **Judith Jesch**
- ◆ **Sigurd Aase & Harald Løvvik**

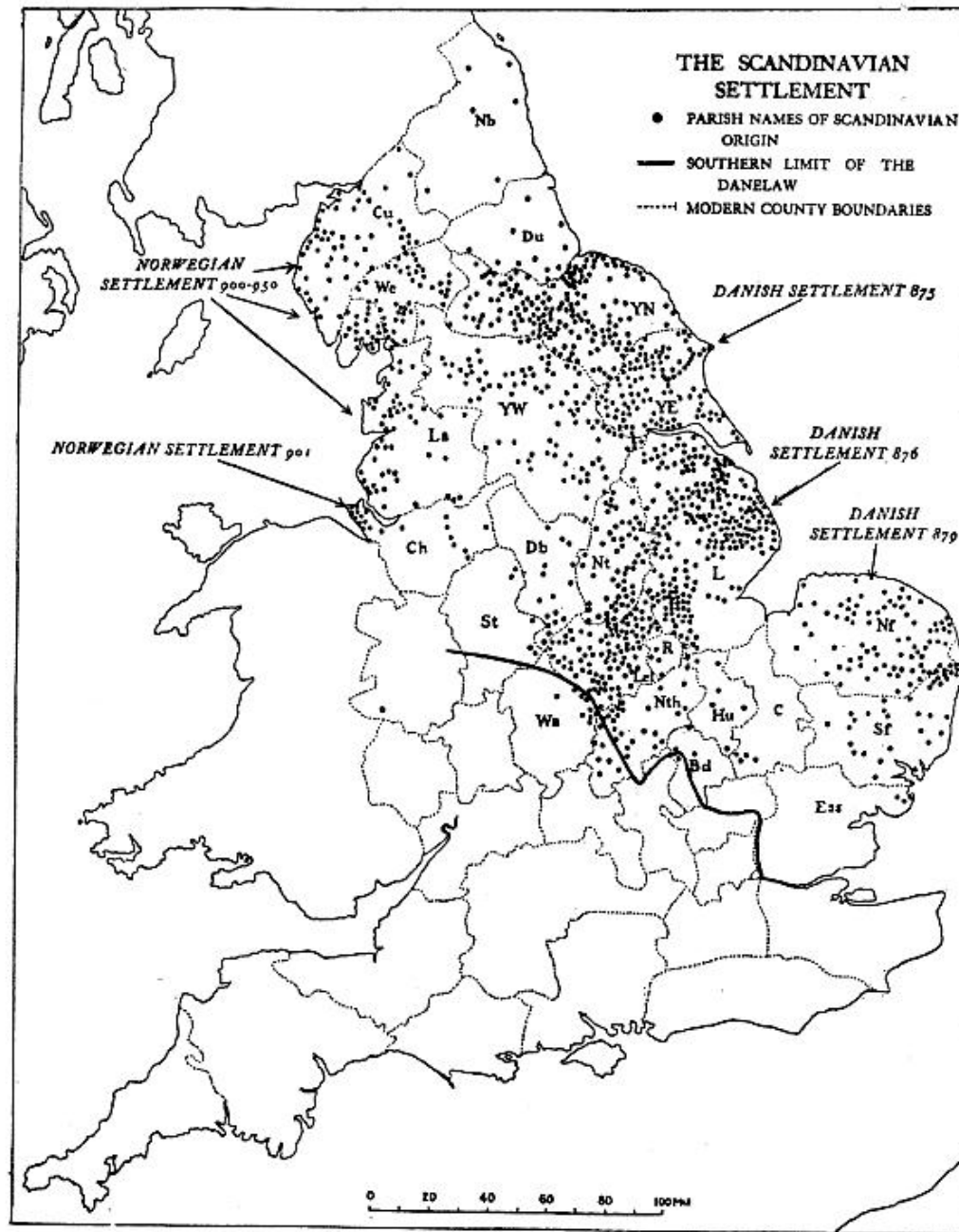


DNA Anniversary Award 2002 - 2007



2002 - 2012

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Jones, G. (1968)

Excavating Past Population Structures by Surname-Based Sampling: The Genetic Legacy of the Vikings in Northwest England

Georgina R. Bowden, Patricia Balaesque,* Turi E. King,* Ziff Hansen,† Andrew C. Lee,*¹ Giles Pergl-Wilson,† Emma Hurley,† Stephen J. Roberts,‡ Patrick Waite,§ Judith Jesch,|| Abigail L. Jones,¶ Mark G. Thomas,# Stephen E. Harding,† and Mark A. Jobling**

*Department of Genetics, University of Leicester, Leicester, United Kingdom; †National Centre for Macromolecular Hydrodynamics, University of Nottingham, Sutton Bonington Campus, Loughborough, United Kingdom; ‡The Queen Katherine School, Kendal, Cumbria, United Kingdom; §West Lancashire Heritage Association, Ormskirk, United Kingdom; ||School of English Studies, University of Nottingham, University Park, Nottingham, United Kingdom; ¶The Centre for Genetic Anthropology, Department of Biology, University College London, London, United Kingdom; and #Department of Biology, University College London, London, United Kingdom

The genetic structures of past human populations are obscured by recent migrations and expansions and have been observed only indirectly by inference from modern samples. However, the unique link between a heritable cultural marker, the patrilineal surname, and a genetic marker, the Y chromosome, provides a means to target sets of modern individuals that might resemble populations at the time of surname establishment. As a test case, we studied samples from the Wirral Peninsula and West Lancashire, in northwest England. Place-names and archaeology show clear evidence of a past Viking presence, but heavy immigration and population growth since the industrial revolution are likely to have weakened the genetic signal of a 1,000-year-old Scandinavian contribution. Samples ascertained on the basis of 2 generations of residence were compared with independent samples based on known ancestry in the region plus the possession of a surname known from historical records to have been present there in medieval times. The Y-chromosomal haplotypes of these 2 sets of samples are significantly different, and in admixture analyses, the surname-ascertained samples show markedly greater Scandinavian ancestry proportions, supporting the idea that northwest England was once heavily populated by Scandinavian settlers. The method of historical surname-based ascertainment promises to allow investigation of the influence of migration and drift over the last few centuries in changing the population structure of Britain and will have general utility in other regions where surnames are patrilineal and suitable historical records survive.

Introduction

Studies of the human past draw on lines of evidence

through studies of men sharing surnames (Sykes and Irven 2000; King et al. 2006; McEvoy and Bradley 2006). Al-

DNA – Messages from our ancestors

- ◆ DNA is a ‘text’ that changes slowly through time, and varies between individuals
- ◆ **Analyse DNA from skeletons**
 - ◆ ‘Real’ information about the past
 - ◆ Difficult, small sample sizes, prone to modern DNA contamination; maybe no descendants
- ◆ **Analyse modern people**
 - ◆ Easy to get samples
 - ◆ Can be unrepresentative of past populations, need methods of inference

Genetics of physical characteristics 1

- ◆ Blood groups
- ◆ Poorly discriminating and widespread
- ◆ Pigmentation, stature, facial shape
- ◆ Complex, poorly understood, wide distribution in N.Europe



9 A Dane from Jutland, whose facial features remind one irresistibly of his forerunner, Tollund man (1)



10 An Icelander from Reykjavik

LIVING EUROPEAN TYPES

11 A Norwegian woman



12 Max von Sydow, Swedish film actor



17 An English schoolgirl



18 Ivor Emmanuel, Welsh singer

Genetics of physical characteristics 1

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Geipel J (1969) *The Europeans: an Ethnohistorical Survey*. Longmans, London



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LIVING EUROPEAN TYPES

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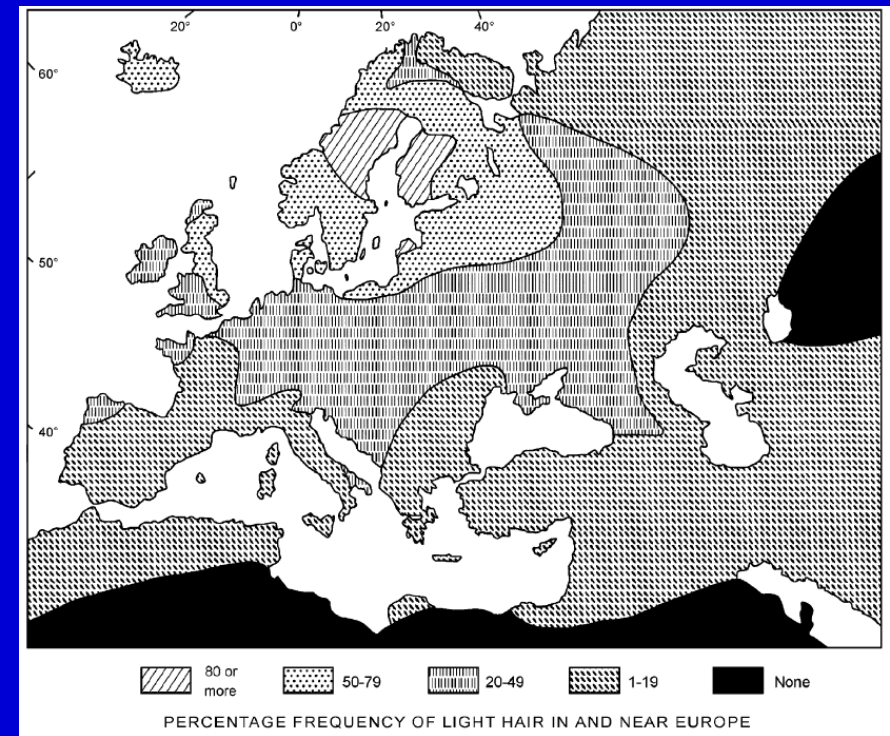
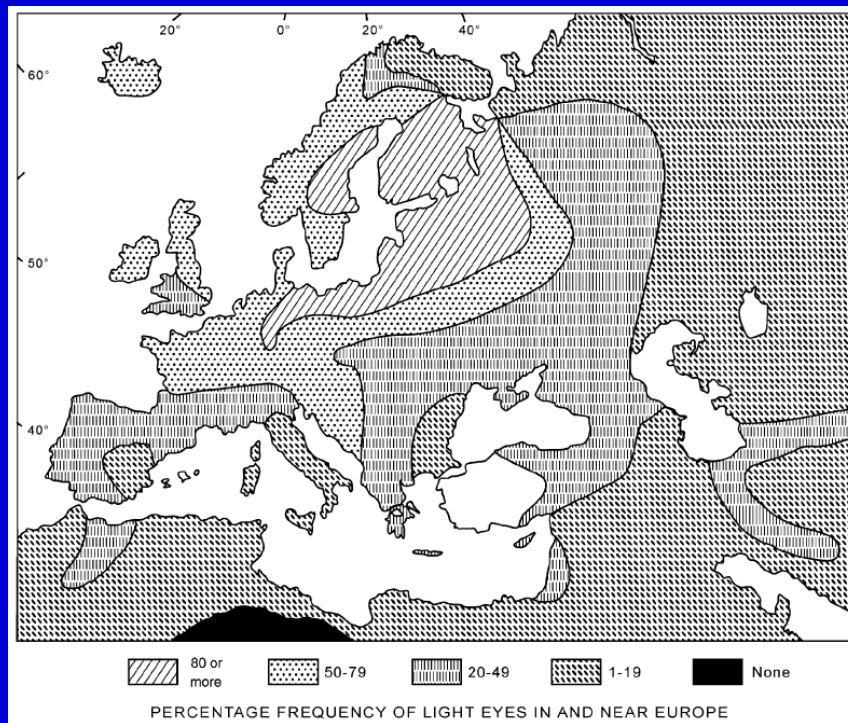
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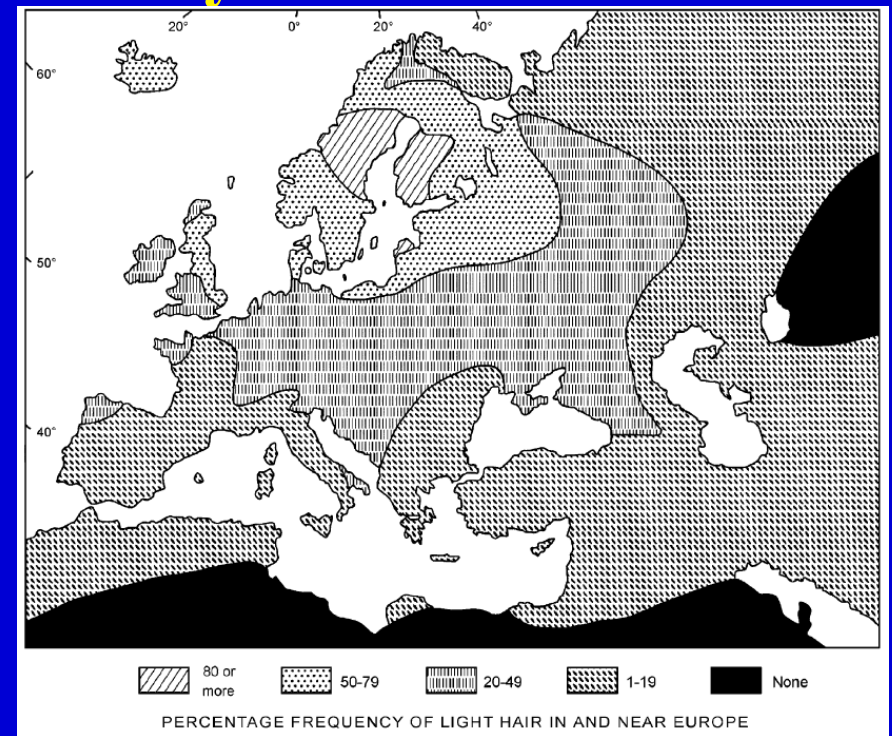
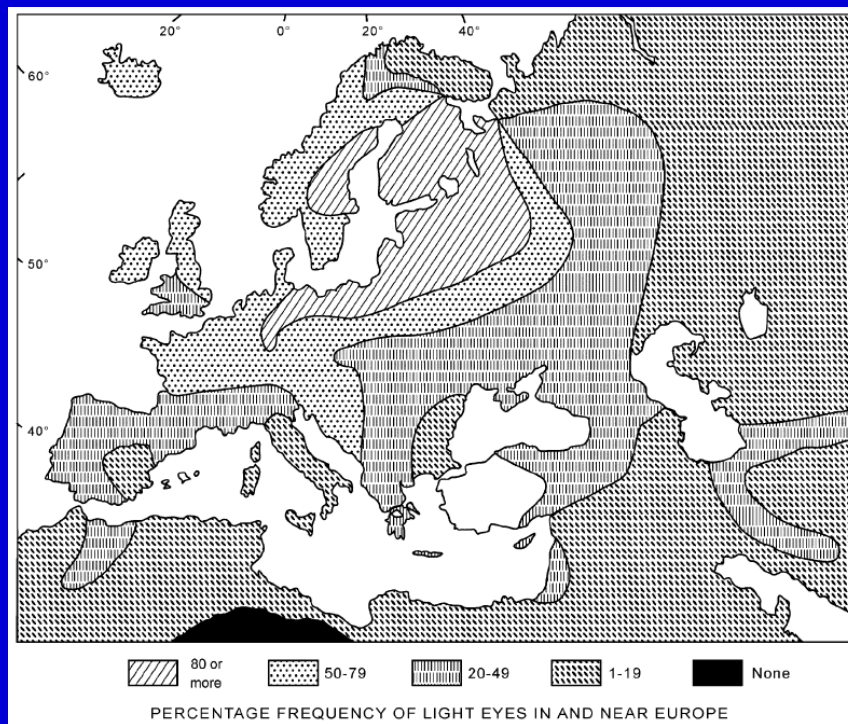
Genetics of physical characteristics 2

- ◆ for some physical phenotypes – eye colour, hair colour, the genetics are becoming better understood



Genetics of physical characteristics 2

- ◆ for some physical phenotypes – eye colour, hair colour, the genetics are becoming better understood
- ◆ DeCode (Iceland) can make good predictions of hair and eye colour based on genome analysis





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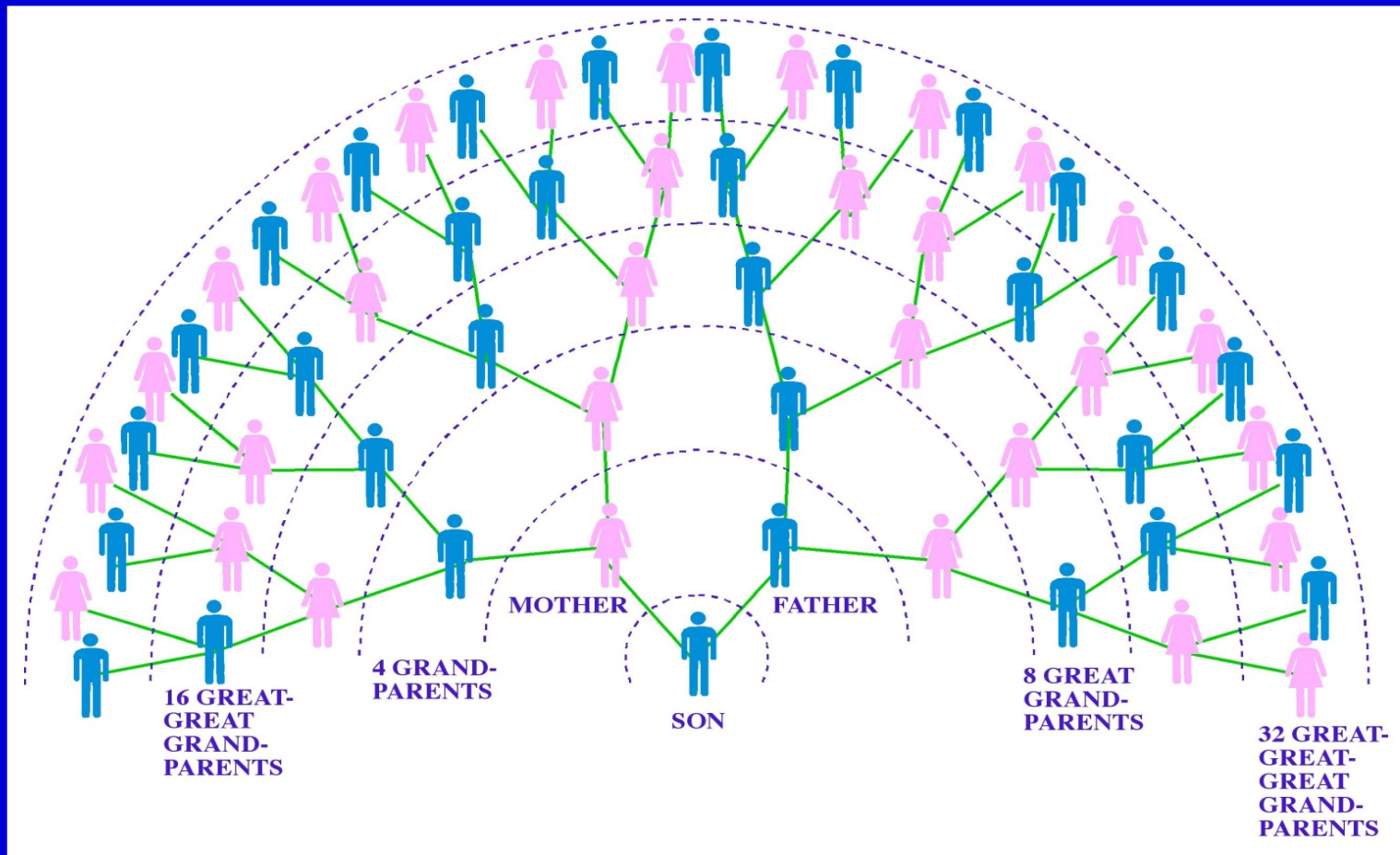
[HEALTHCARE PROFESSIONALS](#)

Genetics of physical characteristics 3



- ◆ **Dupuytren's / digitopalmar contracture**
- ◆ **Inherited - dominant**
- ◆ **Distribution suggests possible Viking origin**
- ◆ **Evidence from Icelandic sagas: *Longer Saga of Magnus of Orkney* – tells about a man called Sigurdr who after a pilgrimage to the shrine of Holy Magnus allegedly had a complete recovery – the fingers became supple and flexible and “could be put to any use”**
- ◆ **More frequent in regions of Britain influenced by Vikings**
- ◆ **But, crops up in other populations**
- ◆ **Recent evidence from one family that chromosome 6 is involved**

Problem: multiple ancestry



◆ $2^{40} = 1,099,511,627,776$ ancestors @ 40 generations ago

Problem: multiple ancestry

Oxford Ancestors
Putting the genes in genealogy.

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Was one of your ancestors a Viking?

As a new supplement to our popular Y-Line service, Oxford Ancestors can now identify if your paternal ancestor was a Viking, someone who travelled from Norway across the storm-tossed waters of the North Sea to settle in the British Isles.

We are able to offer this remarkable new service thanks to extensive research by the Centre for Ancient Genomes at UCL and the Centre for Mathematical Sciences at Cambridge University. This research compared Y-chromosomes from thousands of men from Scandinavia to identify a range of Y-Line signatures very likely to be passed on through the generations, so by analysing it we can reveal if your genealogy includes a Viking ancestor.

We are now able to check your own Y-Line signature against these research results. If it does match then, providing your paternal ancestry is confirmed, your paternal ancestor was a Norse Viking.

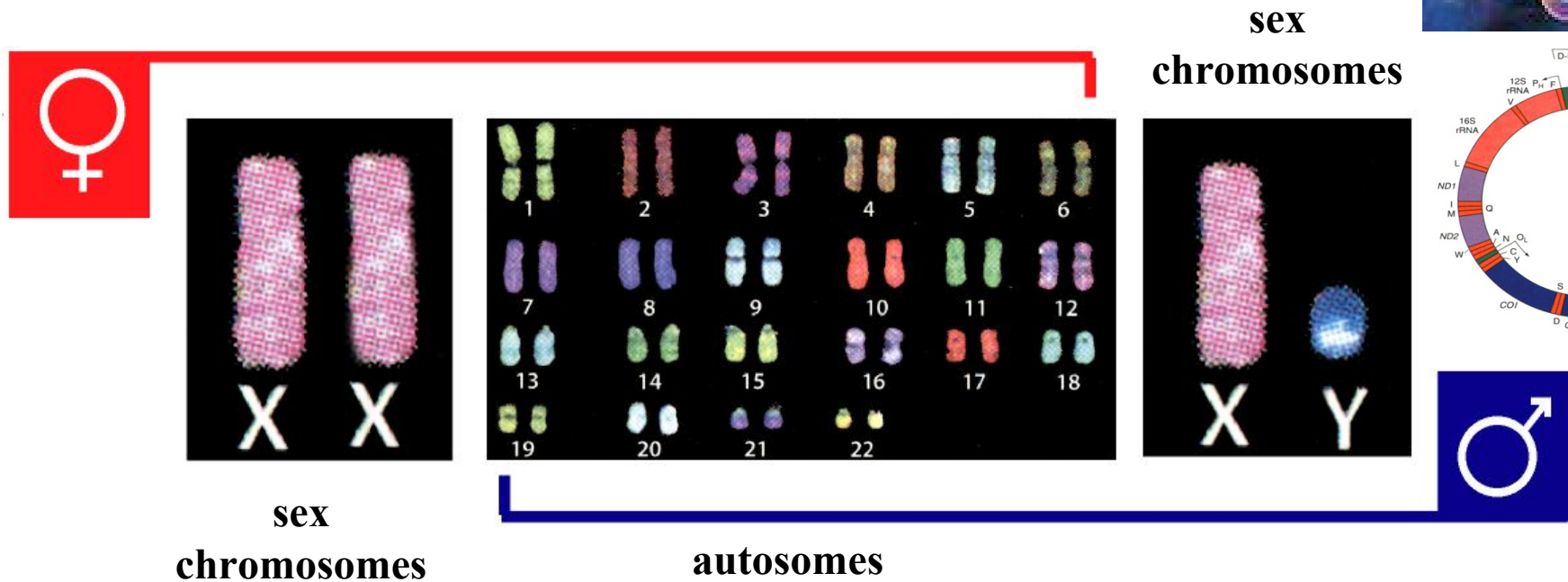
In order to do this, we will need to carry out a Y-Line analysis to produce a Y-chromosome signature for you. The cost for this analysis is £160 (\$235).

16 GREAT-GREAT-GRAND-PARENTS

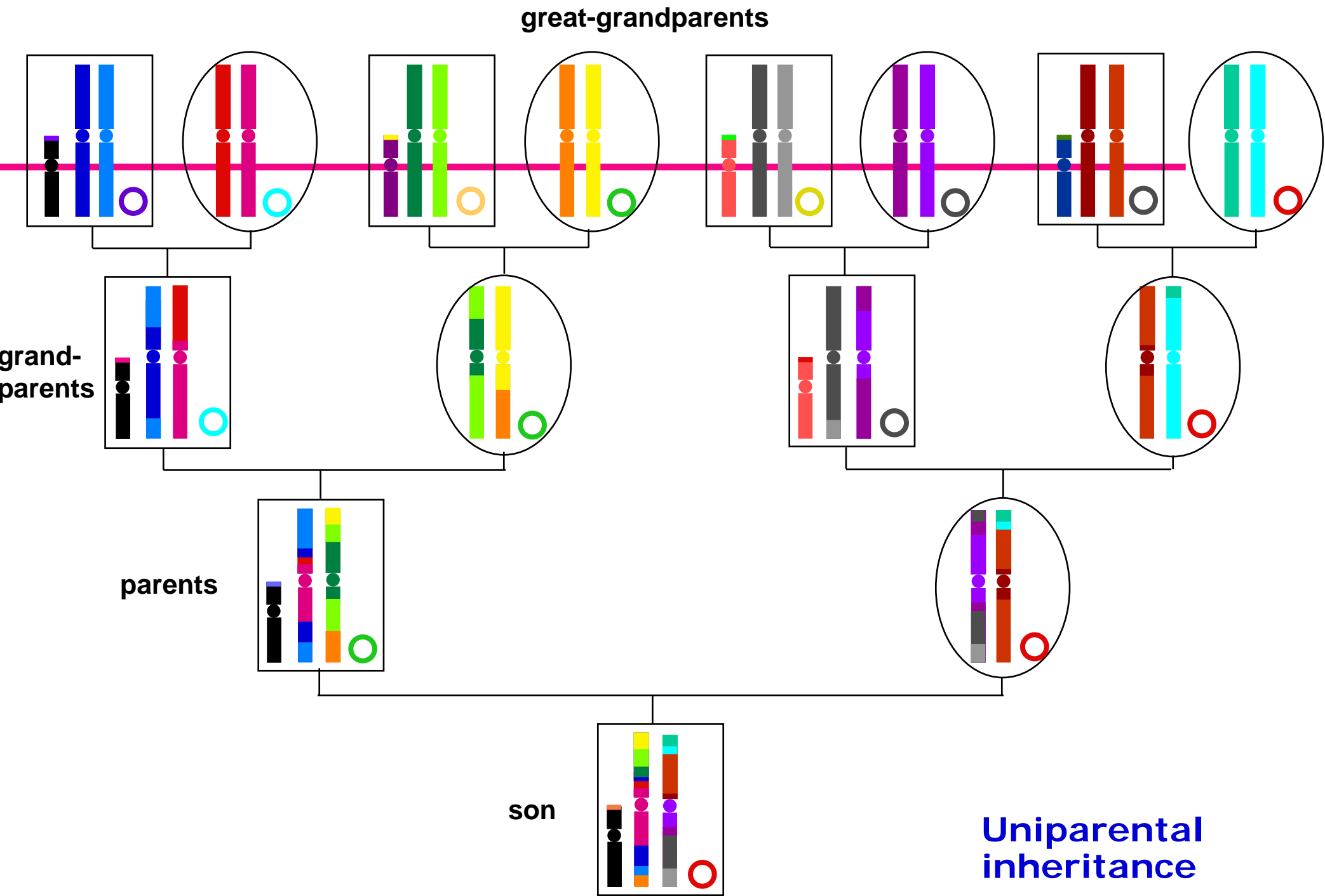
32 GREAT-GREAT-GRAND-PARENTS

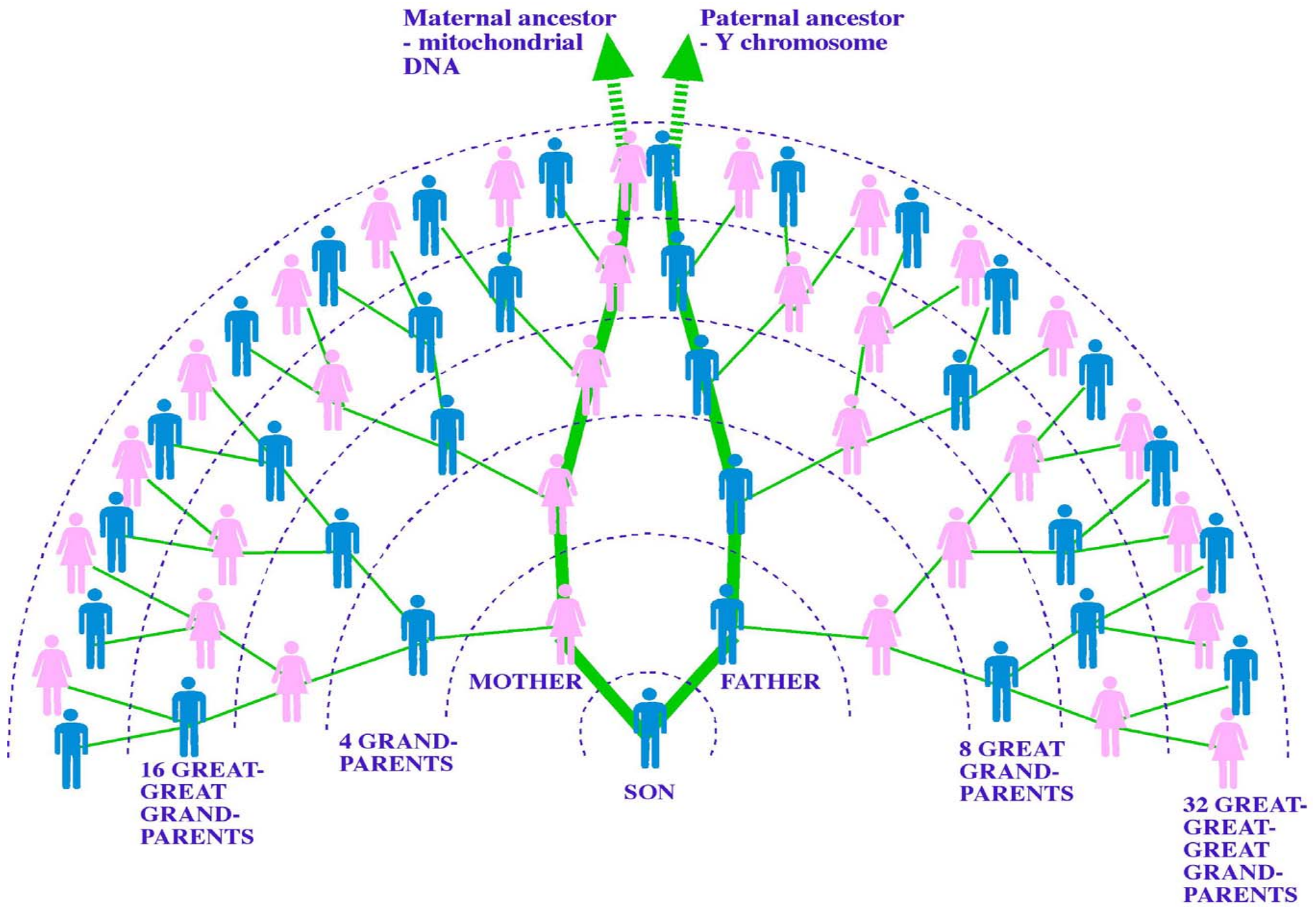
◆ $2^{40} = 1,099,511,627,776$ ancestors @ 40 generations ago

Genetic markers of inheritance



- ◆ Men have a Y chromosome - sex-determining
- ◆ Both sexes have mitochondrial DNA, but inherited only from mothers to offspring





For men we look for 2 types of variations in Y-DNA

SNP

MICROSATELLITE



Male 1 GTACTAGACTACTACTACTACTACTCTGGTG...
5 repeats

Male 2 GTACAAGACTACTACTACTACTACTACTCTGGTG...
6 repeats

Male 3 GTACAAGACTACTACTACTACTACTACTACTCTGGTG...
7 repeats

- The SNP's define a man's HAPLOGROUP
- The STR's define a man's HAPLOTYPE

Results for a man's Y-chromosome test

HAPLOGROUP		
<input type="radio"/> A <input type="radio"/> BC <input type="radio"/> DE <input type="radio"/> F* <input type="radio"/> G <input type="radio"/> H <input checked="" type="radio"/> I <input type="radio"/> J <input type="radio"/> K* <input type="radio"/> R1* <input type="radio"/> R1a <input type="radio"/> R1b		

HAPLOTYPE					
DYS436	<input type="text" value="12"/>	DYS391	<input type="text" value="10"/>	DYS389I	<input type="text" value="14"/>
DYS437	<input type="text" value="14"/>	DYS390	<input type="text" value="23"/>	DYS389II	<input type="text" value="30"/>
DYS438	<input type="text" value="10"/>	DYS393	<input type="text" value="13"/>	461	<input type="text" value="12"/>
DYS434	<input type="text" value="12"/>	DYS392	<input type="text" value="11"/>	462	<input type="text" value="12"/>
DYS435	<input type="text" value="11"/>	DYS388	<input type="text" value="15"/>	460	<input type="text" value="10"/>
DYS439	<input type="text" value="12"/>	DYS19	<input type="text" value="15"/>		

- Haplotype gives a much better resolution for individuals, although they can't be specified for mitochondrial DNA
- For population ancestry Y-chromosomal test can be linked to surnames ... this helps to get around the problem of modern population movements

Individual Viking ancestry?



Enter a man's Y-data into a database – YHRD, and look for matches

YHRD.ORG 3.0



R33: 86568 haplotypes

Search

Analyse

Research

Contribute

Meet

WELCOME TO YHRD

The ability to identify male-specific DNA renders polymorphic Y-chromosomal sequences an invaluable addition to the standard panel of autosomal loci used in forensic genetics. Y-STR haplotyping is particularly important for sensitive typing of male DNA in mixed stains as well as for rapid assortment of biological crime scene evidence. Moreover, Y chromosomal profiling can trace back paternal lineages into the past and has thus been proven a useful tool in genealogical and kinship testing. The individuality of the male-specific part of the Y chromosome can be optimally explored by the Y-STR haplotype analysis using a set of highly variable short tandem repeat markers approved by the forensic and scientific community. An extremely informative Y-STR core set or minimal haplotype (minHt) amplifiable in a multiplex reaction has been recommended for court use : [DYS19](#), [DYS389I](#), [DYS389II](#), [DYS390](#), [DYS391](#), [DYS392](#), [DYS393](#), [DYS385ab](#) ([REF](#) Kayser et al. 1997 and [REF](#) Pascali et al. 1999). This core haplotype can be extended by other hypervariable Y-STR loci ([DYS438](#), [DYS439](#), [DYS437](#), [DYS448](#), [DYS456](#), [DYS458](#), [DYS635](#), [YGATAH4](#)) to further increase the power of discrimination ([REF](#) Ayub et al. 2000, [REF](#) Redd et al. 2002 and [REF](#) Mulero et al. 2006). With the establishment of the Y-STR haplotype reference database (YHRD) in the year 2000 two important objectives are pursued:

- I. the generation of reliable Y-STR haplotype frequency estimates for Y-STR haplotypes to be used in the quantitative assessment of matches in forensic and genealogical casework ([Search Haplotypes](#))
- II. the assessment of male population stratification among world-wide populations as far as reflected by Y-STR haplotype frequency distributions ([Population Analysis](#))

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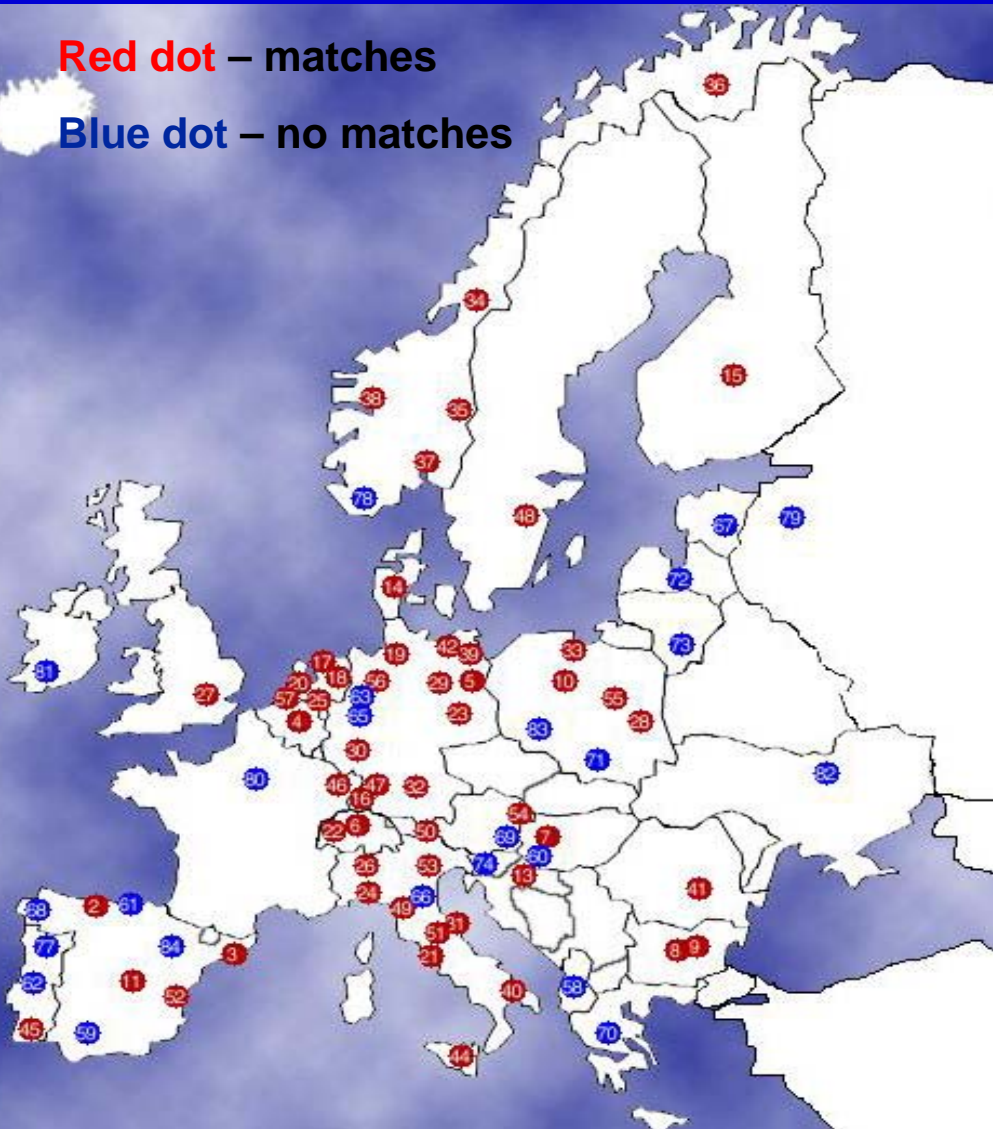
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Matches for Peter Forshaw

166 matches/13003

Red dot – matches

Blue dot – no matches

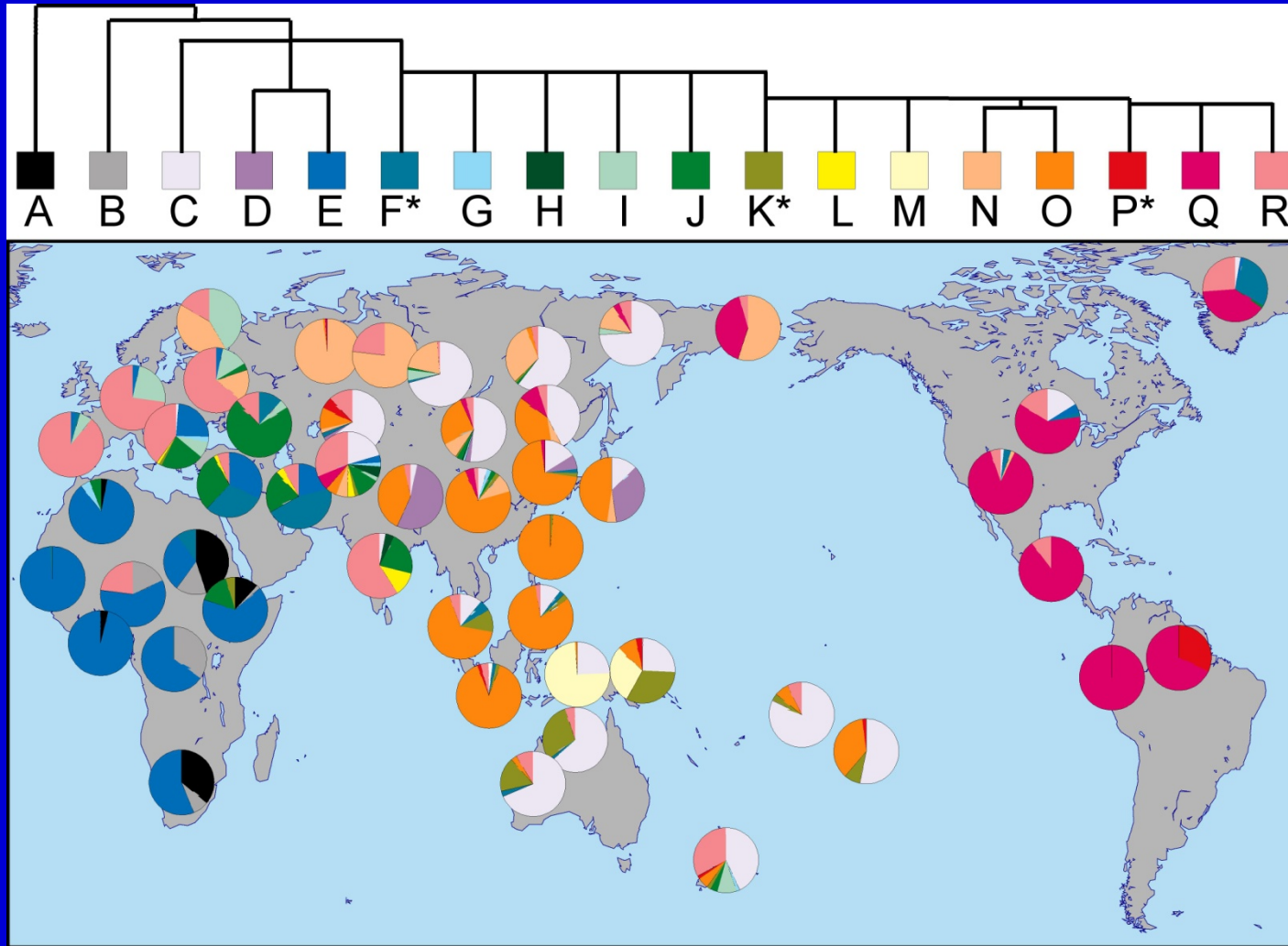


Population	Count	Frequency %
Norway Central	3 of 48	6
Norway East	5 of 85	6
Norway Oslo	2 of 33	6
Denmark	4 of 63	6
Norway North	2 of 45	4
Sweden	22 of 510	4
Zeeland	2 of 46	4
Budapest	3 of 117	3
Freiburg	12 of 433	3
Hamburg	3 of 114	3
Latium	6 of 222	3
Norway West	2 of 64	3

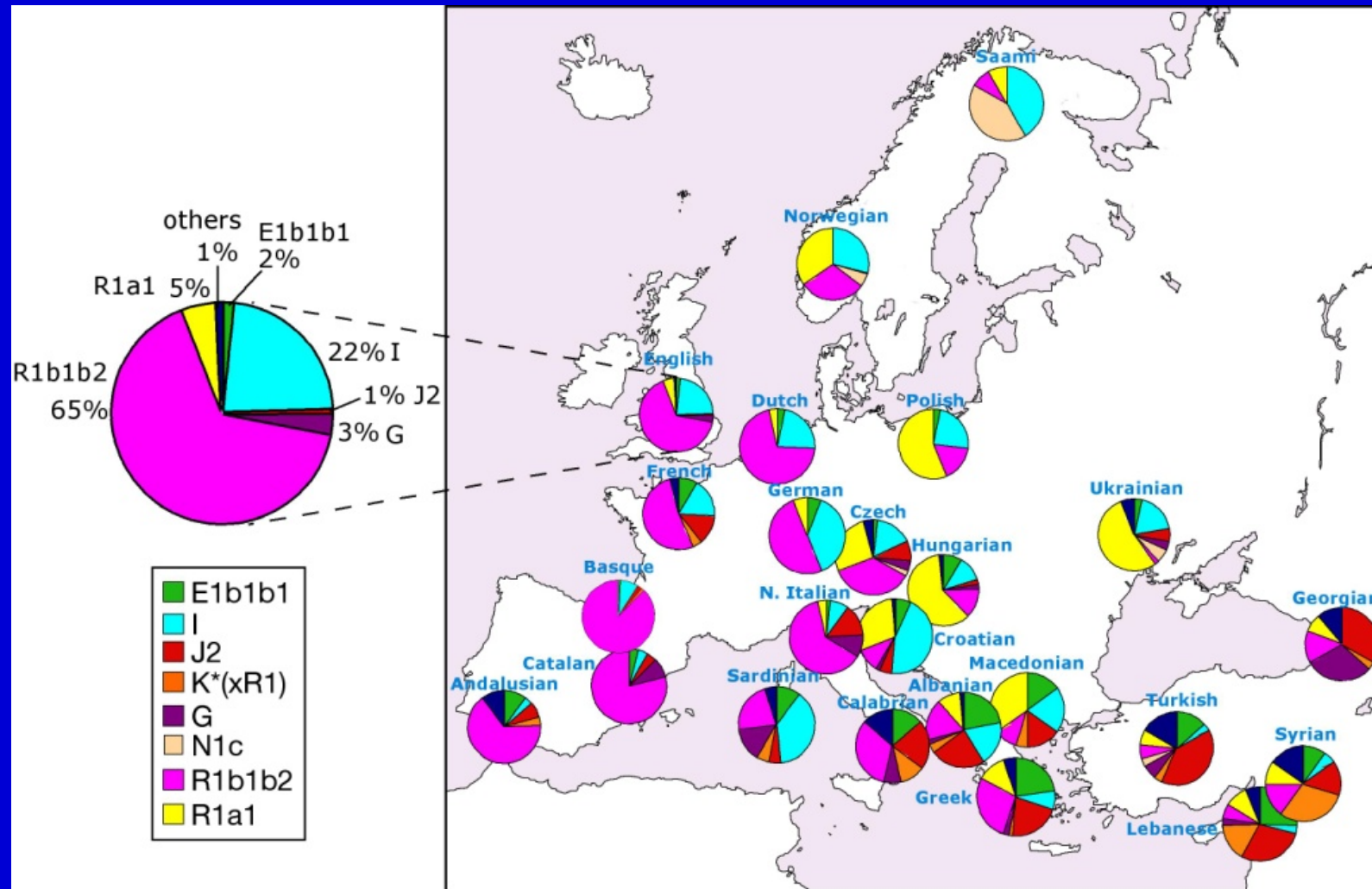
Population Viking ancestry: admixture approaches

- ◆ More secure at *population* level (≥ 20 people)
- ◆ Volunteer selection and the problem of modern population movements
- ◆ 2 generation and old surname based selection criteria
- ◆ Compare distributions of Y-chromosome types – “Admixture analysis”
- ◆ Resolution of the method is improving all the time

The major haplogroups – continents show major differences



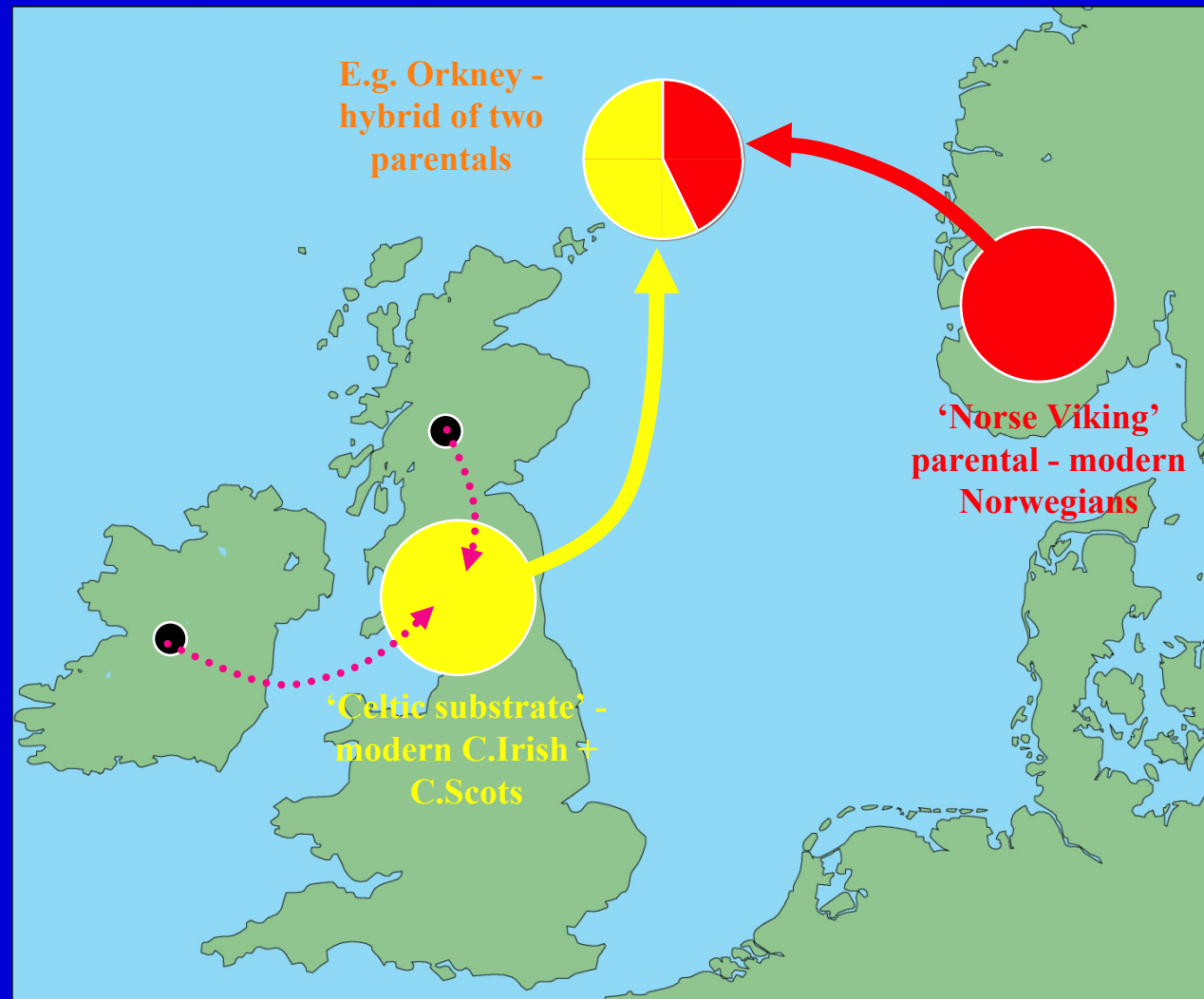
In Europe we also see different distributions using sub-haplogroups or subclades



... & there is further resolution at the haplotype level

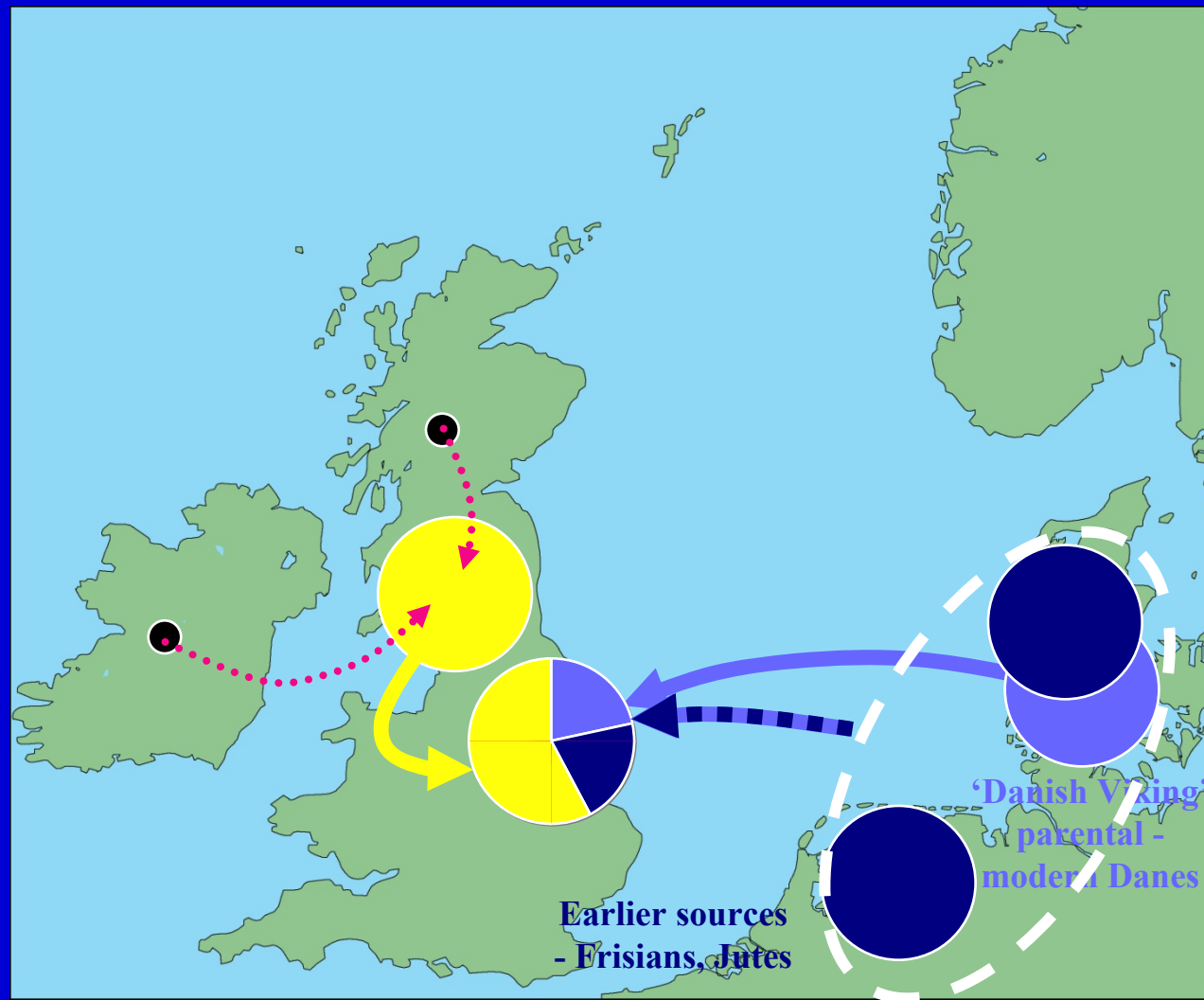
Norse Viking ancestry: admixture approaches

- ◆ **Admixture:** parental and hybrid populations
- ◆ Algorithms available to estimate proportions



Danish difficulties

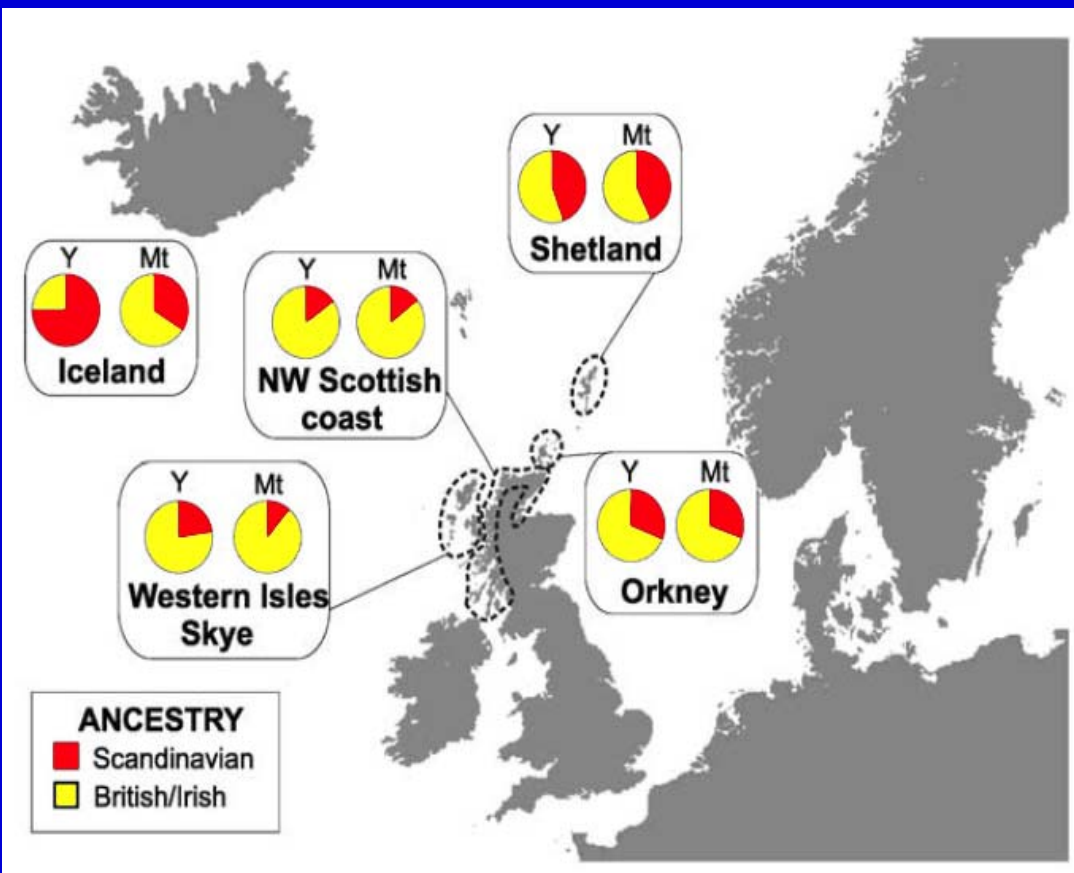
- ◆ Same approach?
- ◆ Putative sources for earlier migrations indistinguishable from Danes
- ◆ e.g. Anglo-Saxons (Frisia); Jutes (Jutland)



Genetic evidence for a family-based Scandinavian settlement of Shetland and Orkney during the Viking periods

S Goodacre^{1,4}, A Helgason^{2,4}, J Nicholson¹, L Southam¹, L Ferguson¹, E Hickey¹, E Vega¹, K Stefánsson², R Ward^{3,*} and B Sykes¹

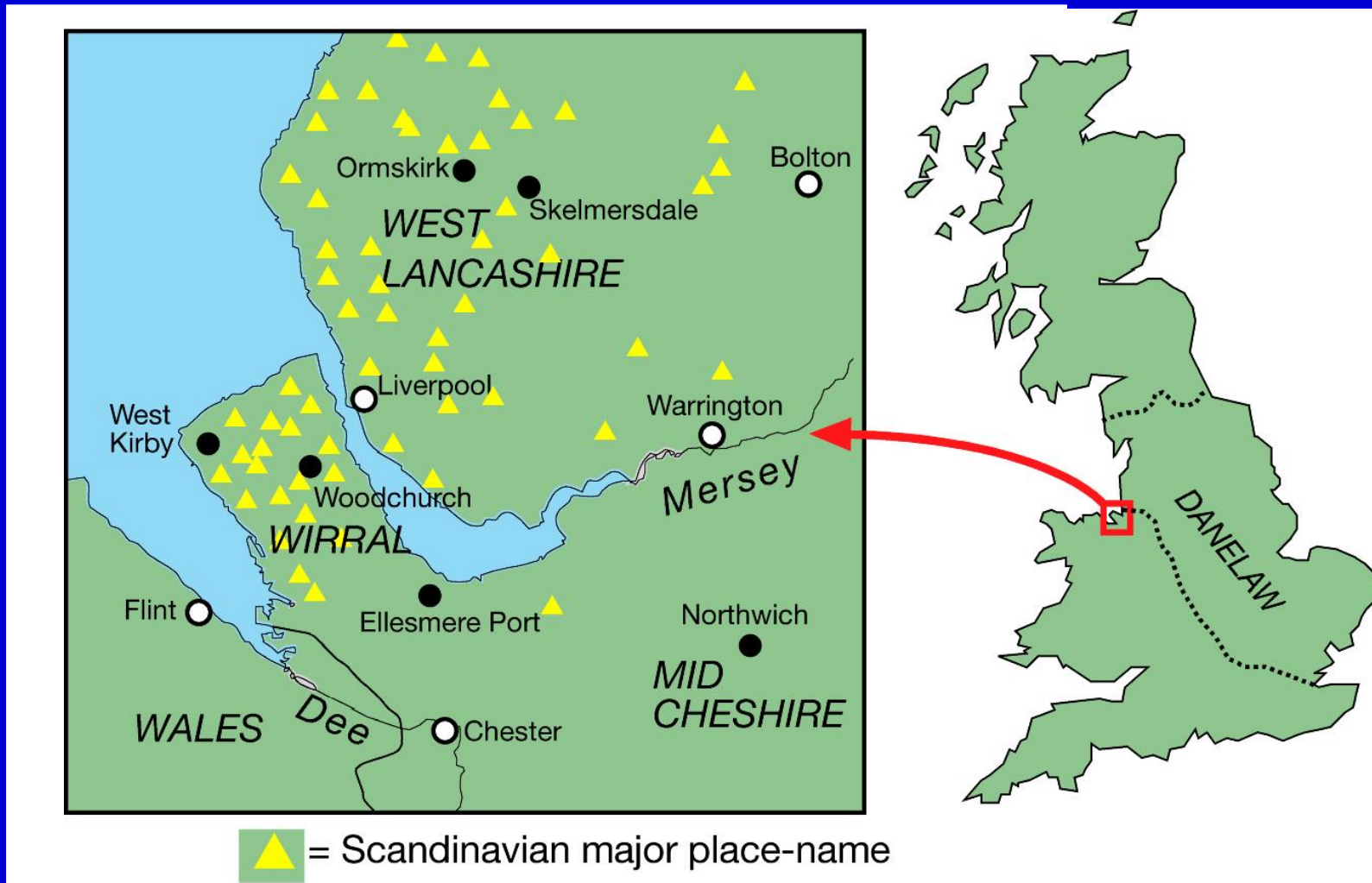
¹Weatherall Institute of Molecular Medicine, University of Oxford, Oxford OX3 9DS, UK; ²deCODE Genetics, Sturlugata 8, 101 Reykjavik, Iceland; ³Institute of Biological Anthropology, University of Oxford, Oxford OX2 6QS, UK



Goodacre, Helgason et al. 2005

- ◆ Analysed mtDNA and Y markers, and used admixture approach
- ◆ Close to home, male and female proportions similar, so family-based settlement
- ◆ Further afield, male-biased settlement
- ◆ Most biased in Iceland

Viking Genes in Northern England Project: 1. Wirral & West Lancashire



Bowden *et al.* (2008) Excavating past population structures by surname-based sampling: the genetic legacy of the Vikings in northwest England. *Molecular Biology and Evolution*, 25, 301-309

Viking Genes in Northern England Project: 1. Wirral & West Lancashire



Viking Genes in Northern England Project: 1. Wirral & West Lancashire





Stone 'most vital' find in 20 years

Professor gives talk on Bidston discovery

By LOUISE POWNEY

A PACKED room at Wirral Museum this week heard how Bidston has yielded probably the most important archaeological find from the Viking period for 20 years.

Professor Richard Bailey, Emeritus Professor of Anglo-Saxon Civilisation at the University of Newcastle, gave a ringing endorsement of the 10th century Viking Hagdnock which was discovered in a Bidston garden in 2004 and called the area a 'crucial site'.

And now campaigners for the preservation of the area hope the find will provide leverage for their campaign for a complete archaeological assessment of the area and the securing of the former observatory building as a museum.

The stone, which was placed on public display for the first time



Professor Richard Bailey

during Wednesday night's lecture, would have been used as a grave marker and is thought to have been created by local masons from locally quarried stone.

Although it is well known that

Viking invaders came to Wirral from Sicway, via Ireland, from 802 until 1014, it is believed the man who was buried beneath the Bidston stone arrived on the peninsula from a different direction.

Said Professor Bailey: "The last time I was so excited by a find was 30 years ago. My jaw has never dropped so far when the stone was first shown to me.

"It appears from the stone's decoration that this man was part of an Hiberno-Norse trading group from Yorkshire where there are comparable carvings.

"From this we can tell that he never forget he was a Yorkshireman and in death he kept that identification and was evidently an important man.

"Someone in Yorkshire would have known about trade coming in from the Irish Sea and would have sent someone in to try to control it."



Peter Crawford and Jenny Whalley with the Viking stone

Code: PW051105G

Carvings of the Viking period look representations beyond the megalithic world and often featured martial images or hunting references.

The Bidston stone shows two fanged beasts, assumed to be bears which are often found in Scandinavian artwork, whose tongues are interlaced in an elaborate design with a three-fold knot between their paws.

Peter Crawford, chairman of the Bidston Preservation trust, in whose garden the stone was found, has been keeping the stone at home but is in no doubt where he would like to see the unique treasure end up.

He said: "I want it to take pride of place in the observatory when it has been turned into a living museum."

"The observatory is a crucially important maritime building and the stone indicates the area has a far earlier maritime past."



2706



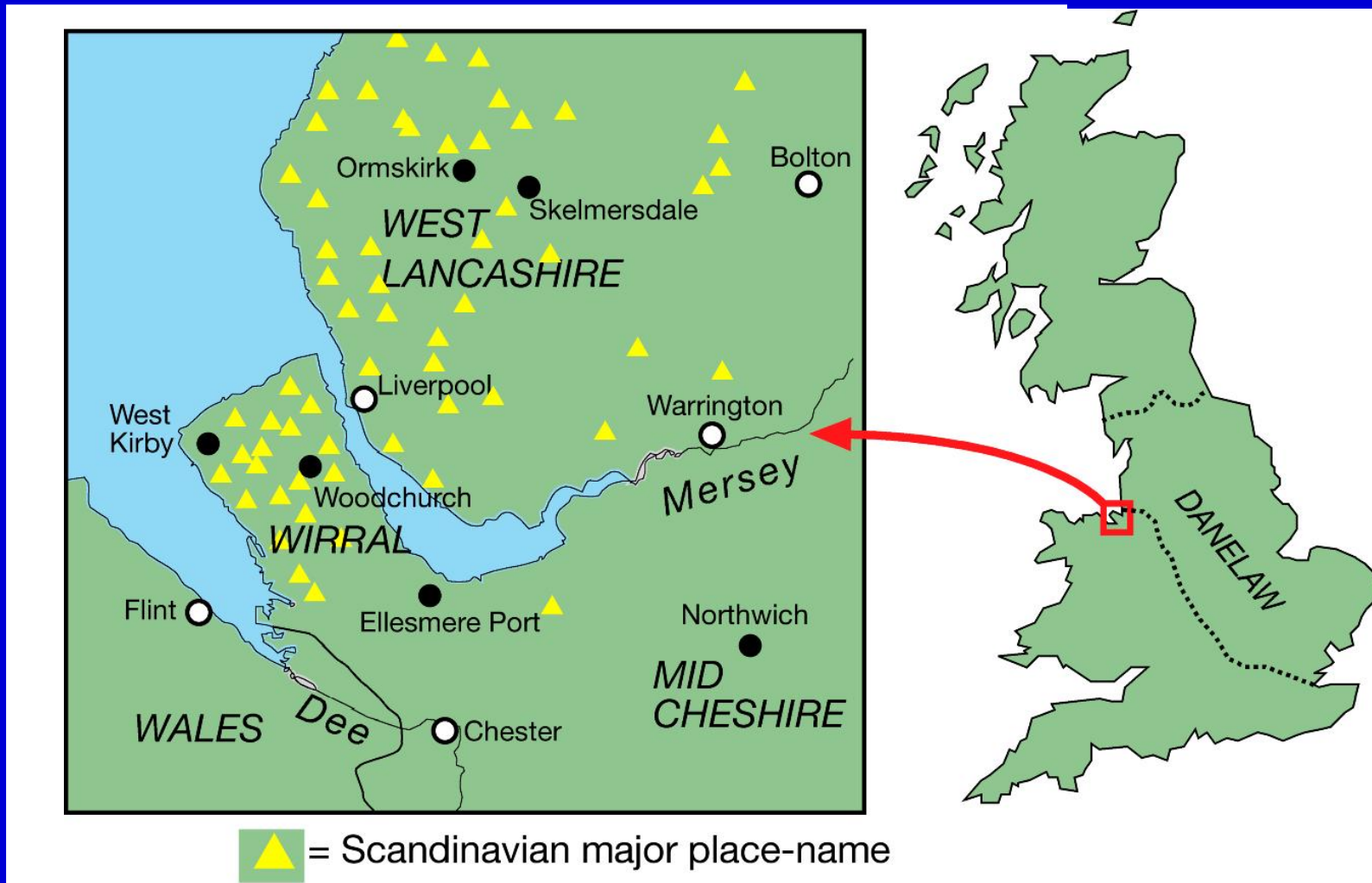
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130



Viking Genes in Northern England Project: 1. Wirral & West Lancashire



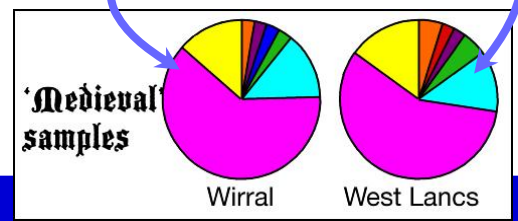
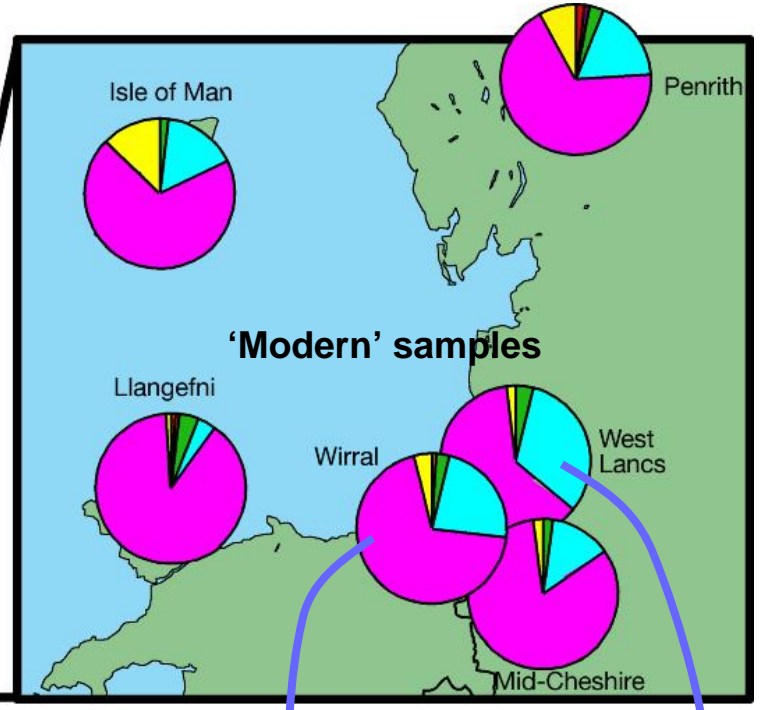
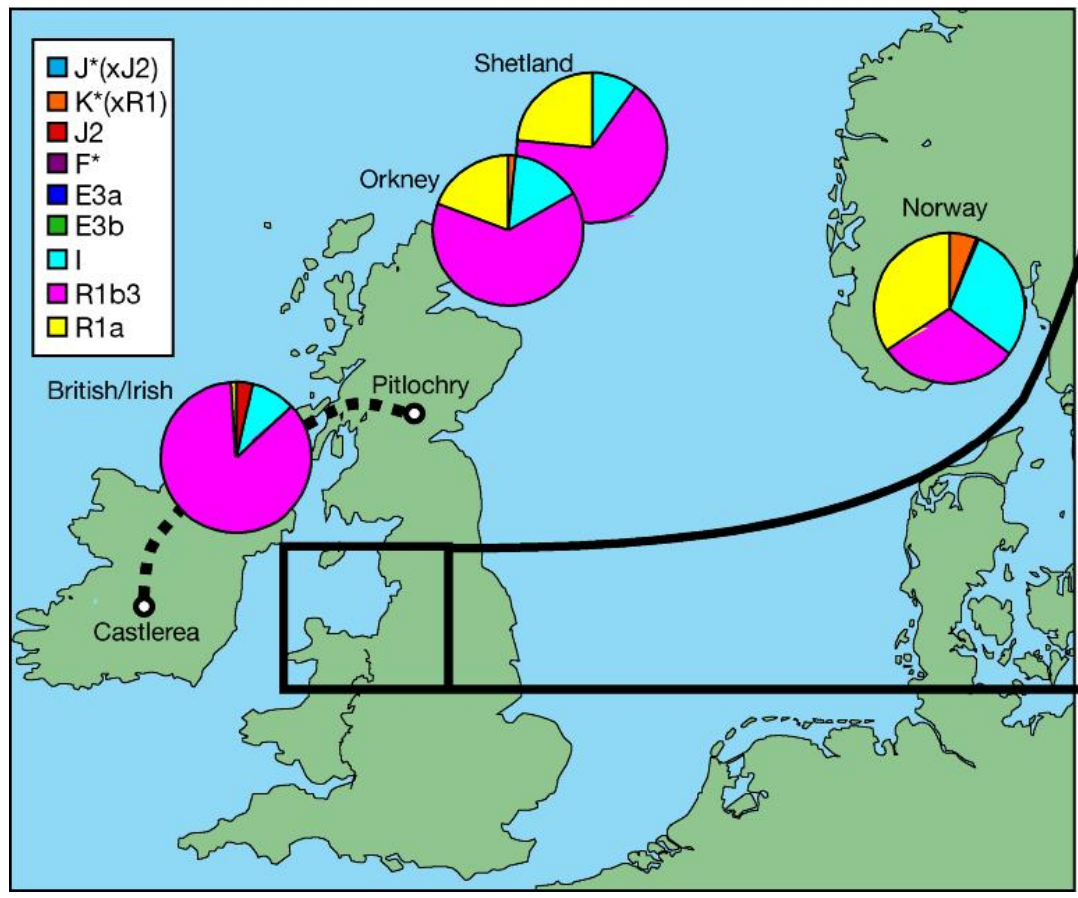
Bowden *et al.* (2008) Excavating past population structures by surname-based sampling: the genetic legacy of the Vikings in northwest England. *Molecular Biology and Evolution*, 25, 301-309

Problem of large population movement following the “Industrial Revolution”

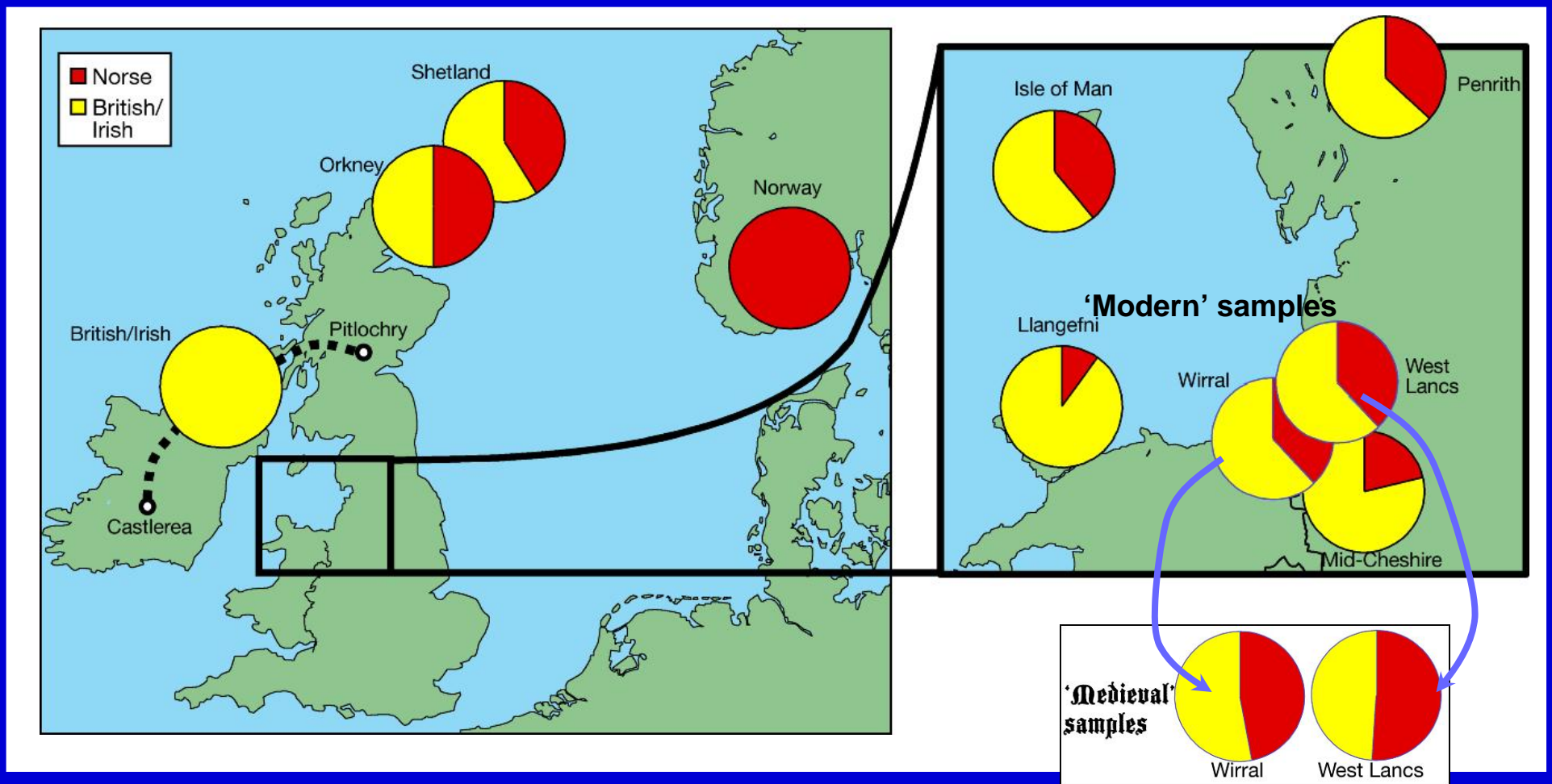
So, we tested 2 population sets tested for Wirral and West Lancashire

- “Modern” – men whose parental grandparents from that area
- “Medieval” – men whose parental grandparents from that area AND possessing a surname present in the area prior to 1600 (Medieval tax records, criminal proceedings, lists of people paying towards salaries of priests etc.)

'Medieval' samples differ from 'moderns'



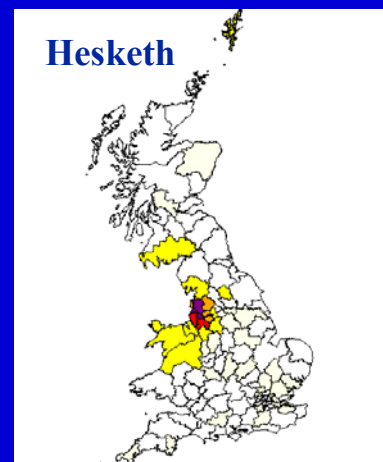
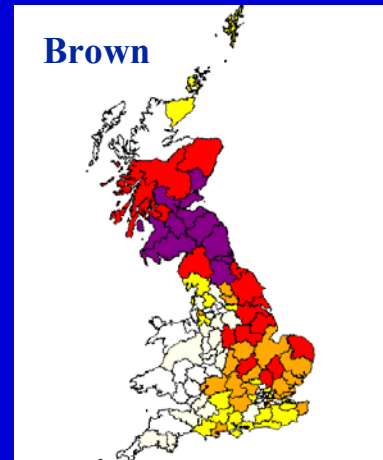
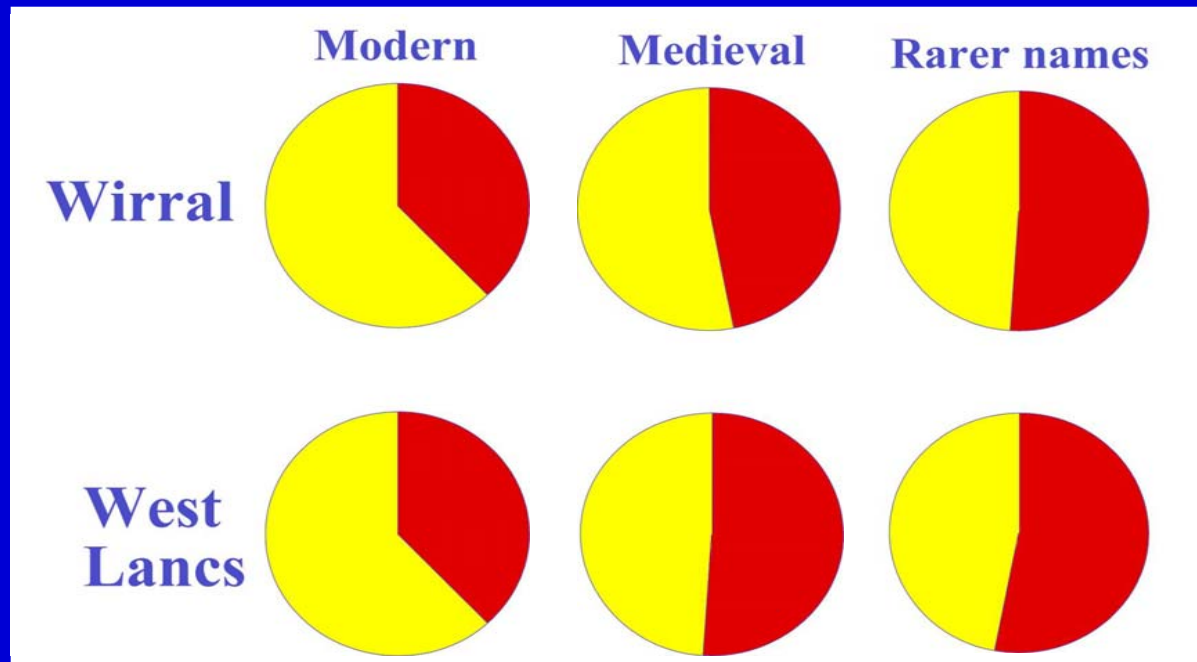
Viking admixture results



◆ Increases in 'medieval' samples

~50% Norse ancestry

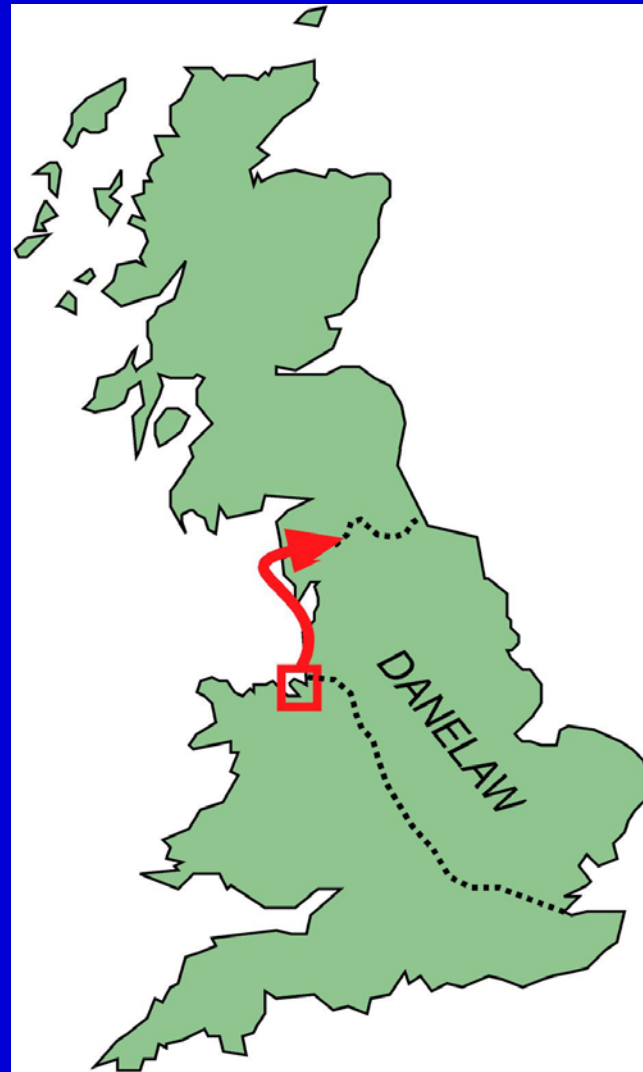
Effect of surname frequency



Admixture level increases further when common surnames are excluded – significant differences between modern and rarer names

Part 2: N. Lancashire, Cumbria and N. Yorks

... currently underway



... and seeking improved control data from Scandinavia



Karmøy Lokal Avaldsnes

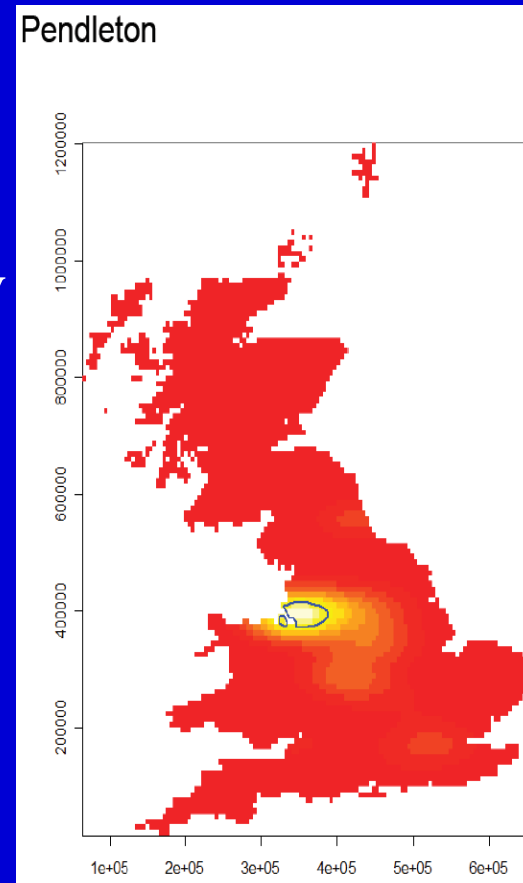
Jakter på viking-gen



Forskertrioen Stephen Harding (t.v.), Turi King og Mark Jobling trenger hjelp av norske menn til DNA-undersøkelsen. Den kan fint gjen nomføres hjemme. En prøve av munnepiteceller fra insiden av kindet med denne pinnen er det som skal til. (Foto: Terje Størksen)

Perspectives

- **The results confirm the belief that the coastal regions of North-West England were once heavily settled by Norse Vikings**
- **Sampling strategy important in linking old genes with modern geography; surname method is very useful but only for male history**
- **Surname strategy could be useful in other areas of Europe and the world where population movements have been large – we can now use surname CORES rather than having to resort to lists.**



References

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- **Harding, S.E., Jobling, M.A. and King, T.E. (2010) *The Wirral and West Lancashire Viking DNA Project*, Countywise, Birkenhead, U.K.**
- **Jobling, M.A., Hurles, M.E. and Tyler-Smith, C. (2003) *Human Evolutionary Genetics*. Garland Science, New York**
- **King, T.E., Ballereau S.J., Schurer, K., Jobling, M.A. (2006) Genetic signatures of coancestry within surnames. *Current Biology* 16, 247-260**