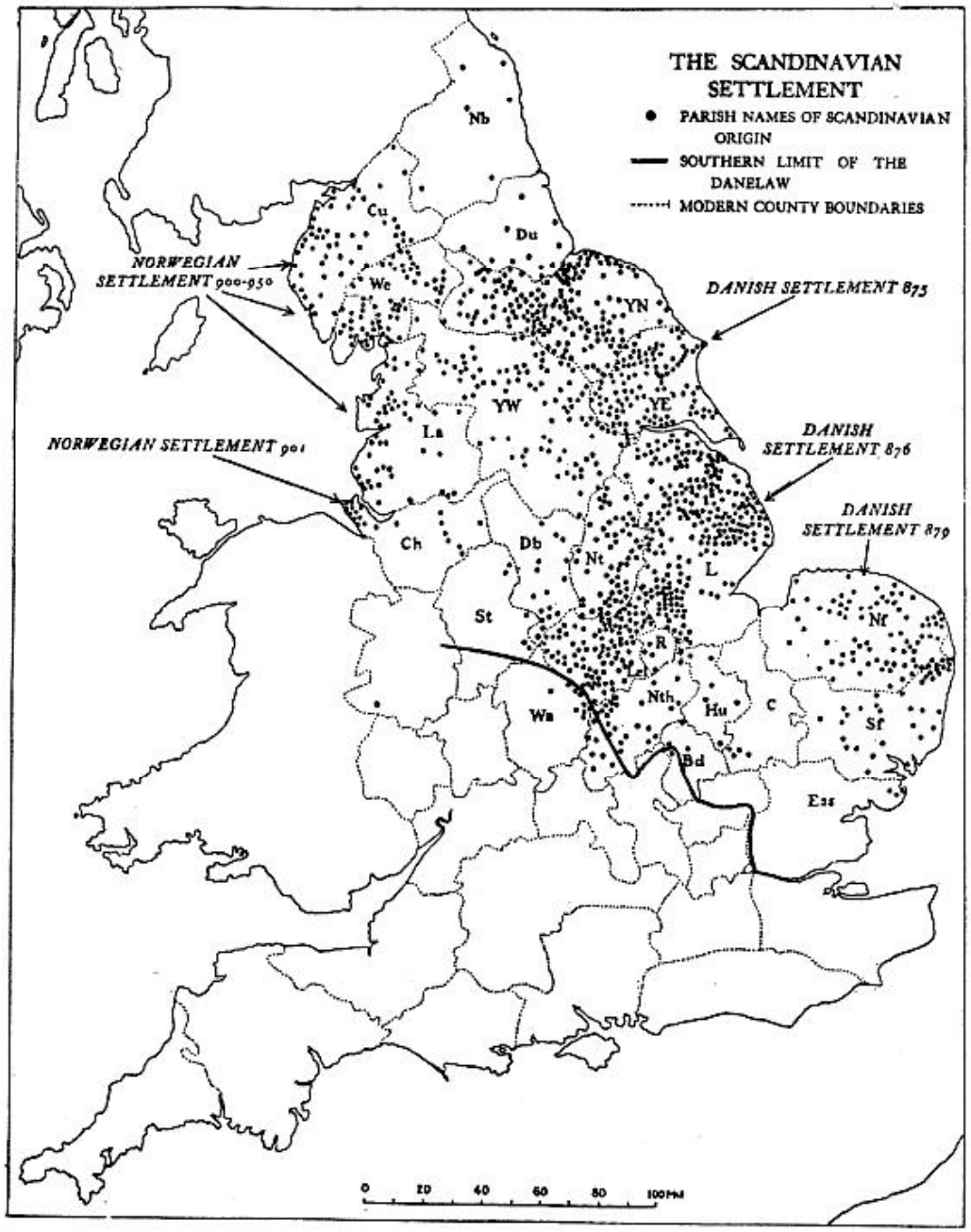
Genetic Legacy of the Vikings

Professor Steve Harding

The University of Nottingham


THE SCANDINAVIAN SETTLEMENT
PARISH NAMES OF SCANDINAVIAN ORIGIN
SOUTHERN LIMIT OF THE DANELAW
MODERN COUNTY BOUNDARIES
NORWEGIAN SETTLEMENT 900-950
NORWEGIAN SETTLEMENT 901
DANISH SETTLEMENT 875
DANISH SETTLEMENT 876
DANISH SETTLEMENT 879
Nb
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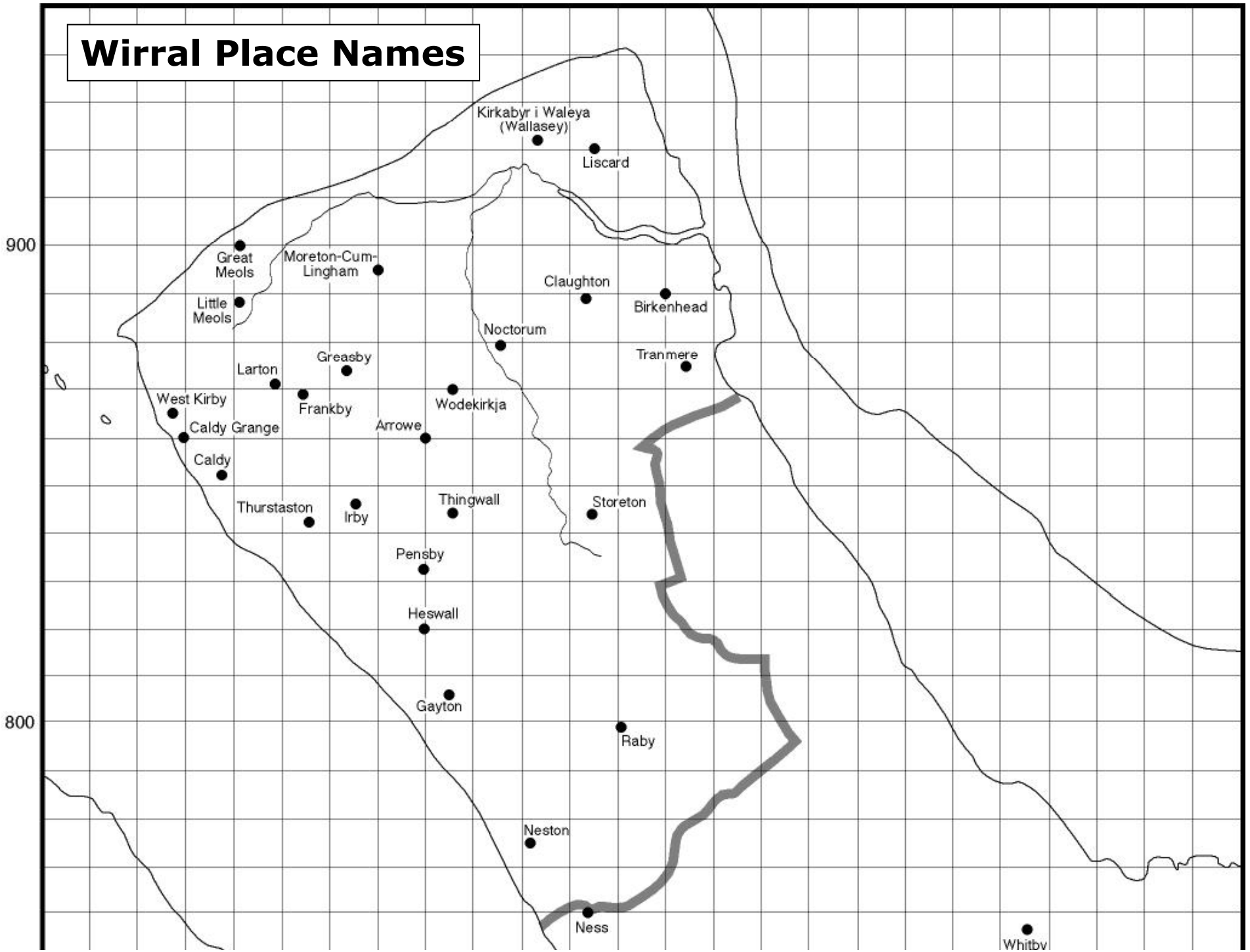
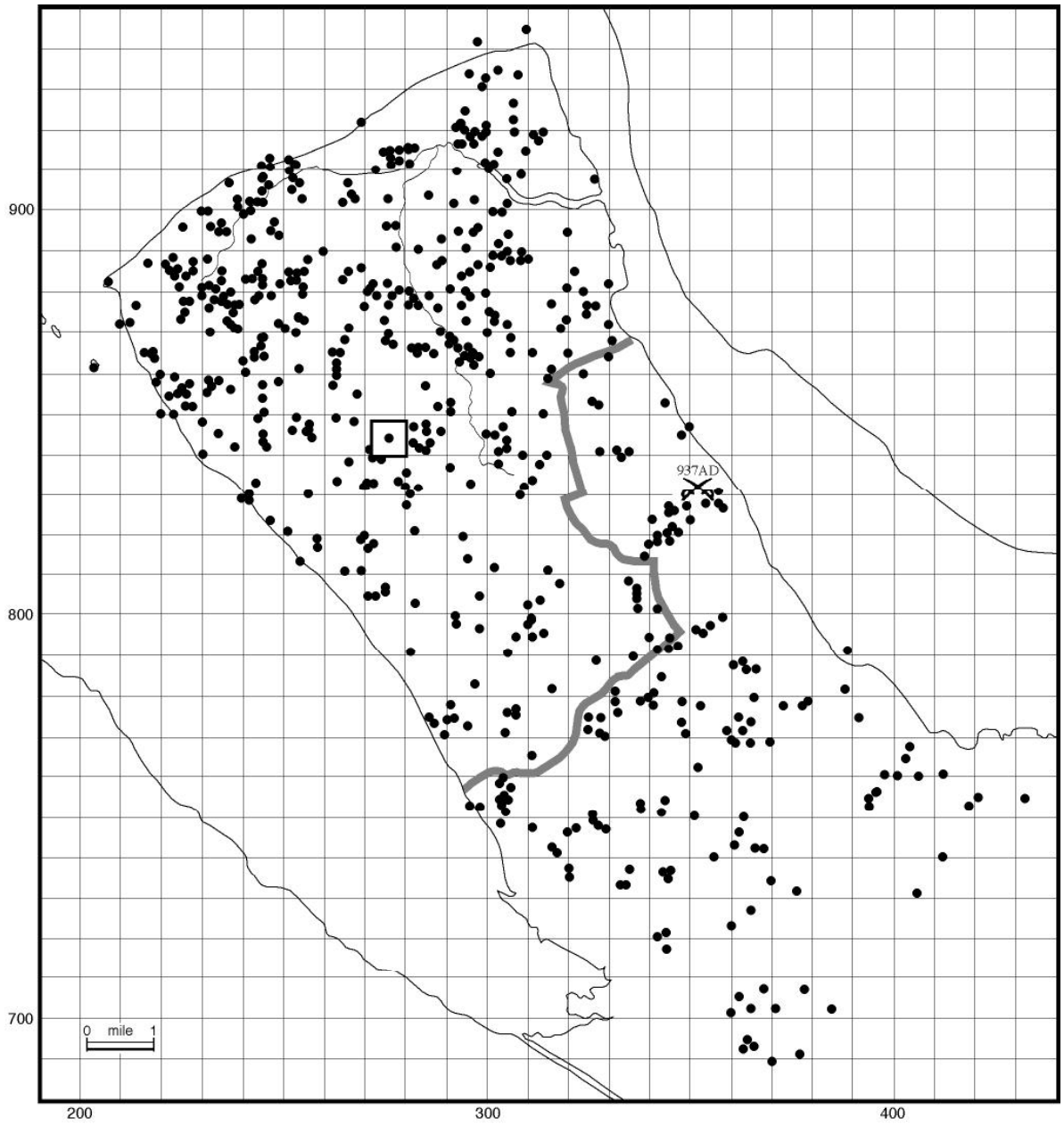
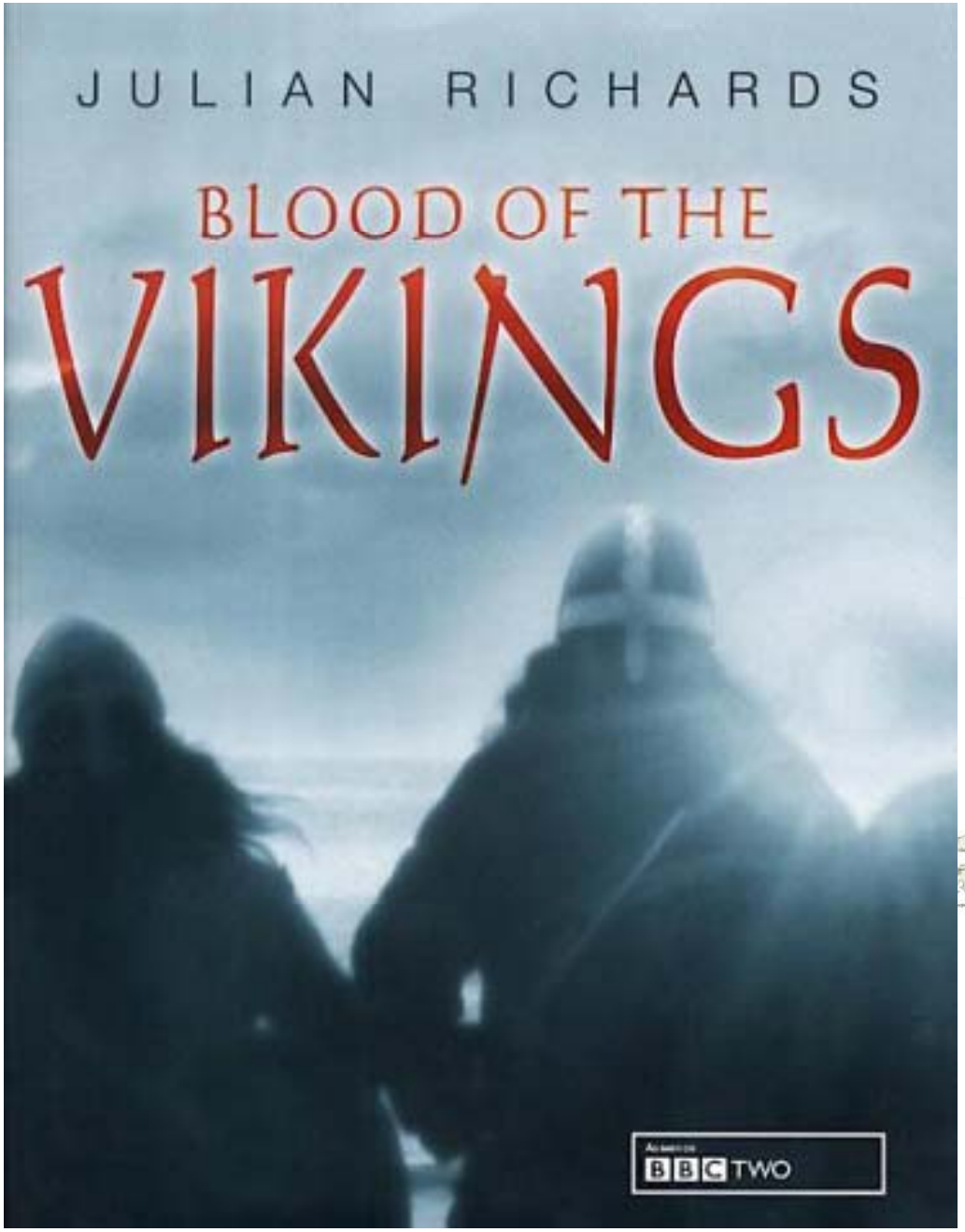

Wirral Place Names
Kirkabyr i Waleya (Wallasey)
Liscard
900
Great Meols
Moreton-Cum-Lingham
Claughton
Birkenhead
Little Meols
Noctorum
Greasby
Tranmere
Larton
West Kirby
Frankby
Wodekirkja
Caldy Grange
Arrowe
Caldy
Thurstaston
Irby
Thingwall
Storeton
Pensby
Heswall
800
Gayton
Raby
Neston
Ness
Whitby

Wirral Minor Names of Scandinavian origin



kjarr, holmr, rák, inntak, slakki, ærgi, skali, þveit etc.

2001:


JULIAN RICHARDS
BLOOD OF THE
VIKINGS
BBC TWO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A Y Chromosome Census of the British Isles

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Oxford OX1 3PS
United Kingdom

Summary

The degree of population replacement in the British Isles associated with cultural changes has been extensively debated [1–3]. Recent work has demonstrated that comparisons of genetic variation in the British Isles and on the European Continent can illuminate specific demographic processes in the history of the British Isles. For example, Wilson et al. [4] used the similarity of Basque and Celtic Y chromosomes to argue for genetic continuity from the Upper Palaeolithic to the present in the paternal history of these populations (see also [5]). Differences in the Y chromosome composition of these groups also suggested genetic signatures of Norwegian influence in the Orkney Islands north of the Scottish mainland, an important center of Viking activities between 800 and 1300 A.D. [6]. More recently, Weale et al. [7] argued for substantial Anglo-Saxon male migration into central England based on the analysis of eight British sample sets collected on an east-west transect across England and Wales. To provide a more complete assessment of the paternal genetic history of the British Isles, we have compared the Y chromosome composition of multiple geographically distant British sample sets with collections from Norway (two sites), Denmark, and Germany and with collections from central Ireland, representing, respectively, the putative invading and the indigenous populations. By analyzing 1772 Y chromosomes from 25 predominantly small urban locations, we found that different parts of the British Isles have sharply different paternal histories; the degree of population replacement and genetic continuity shows systematic variation across the sampled areas.

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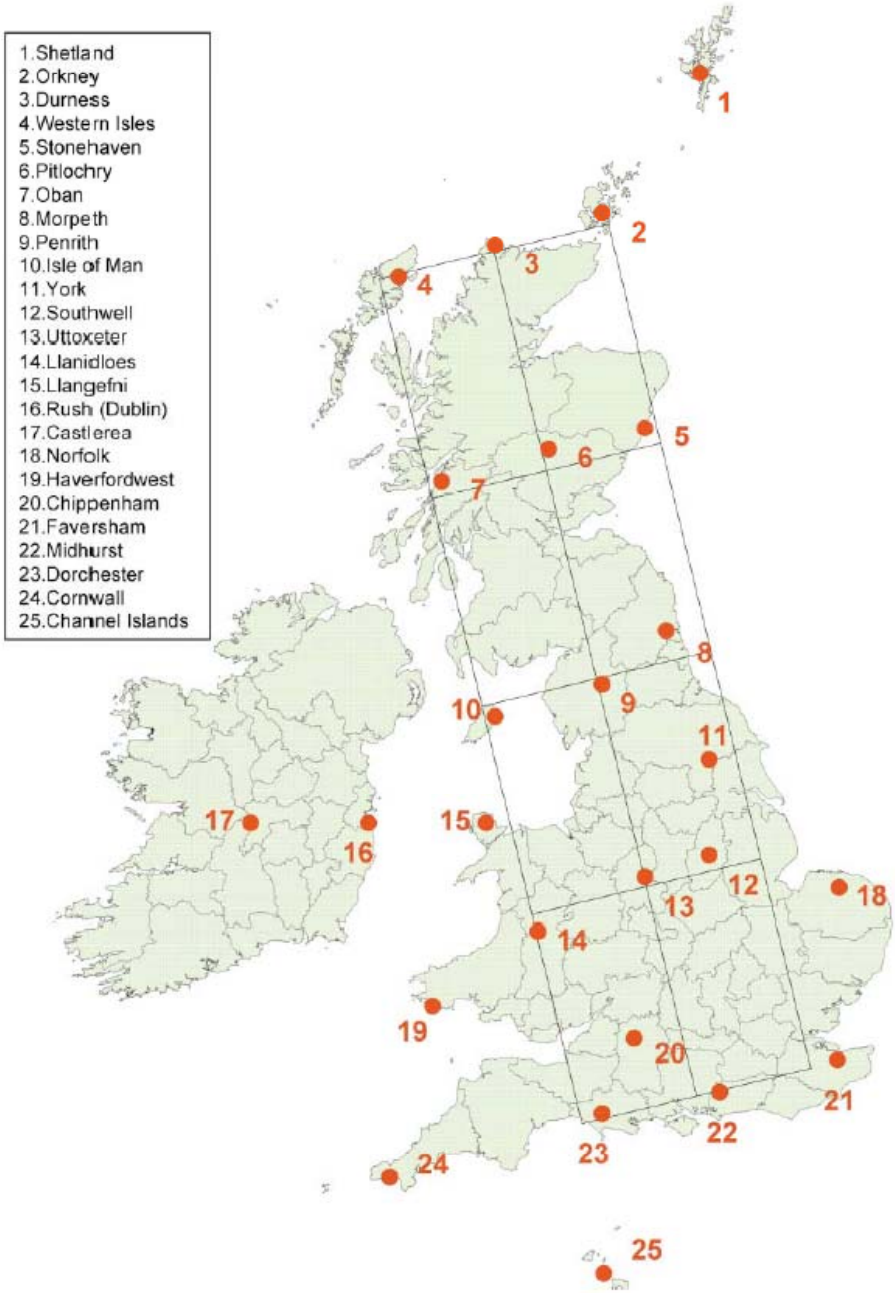
Results and Discussion

To represent the indigenous population of the British Isles, we have selected a site in central Ireland that has had no known history of contact with Anglo-Saxon or Viking invaders (Castlerea, see Figure 1). Given the demonstrated similarity of Celtic and Basque Y chromosomes [4, 5] ($p = 0.6$, using haplogroups), these sample sets were combined [8, 9] to provide a representation of the Y chromosomes of the indigenous population of the British Isles. Norwegian invaders were represented by two sites in western Norway (Bergen and Trondheim), Danes were represented by a general Danish collection, and Anglo-Saxons were represented by samples from their historical homeland in Schleswig-Holstein (North Germany). Linguistic and historical investigations seem to suggest that internal migrations were minor and have not unduly blurred the genetic landscape of North Germany and Denmark in the last 1500 years [10]. We also note that some historians view the Anglo-Saxons themselves as Germanic invaders from what is now North Germany/Denmark. Population differentiation between the continental and indigenous British Isles groups was assessed by using an analog of Fisher's exact test calculated by using haplogroup (hg) frequencies, as implemented by the Arlequin software package [11]. There was no significant difference between the Trondheim and Bergen samples or between the Danish and North German samples ($p = 0.8$), while the Norwegians were different from the other northern European samples ($p < 0.05$). We therefore clustered these source populations into two continental groups, referred to from now on as the Norway and German/Danish sample sets. Note that the similarity of the Danish and North German Y chromosomes means that, at the hg resolution, we cannot distinguish the genetic contributions to the British Isles of the two component groups. All continental populations, however, show significant differences from the indigenous group ($p < 0.01$), and Norway can be distinguished, though to a lesser degree, from the German/Danish sample ($p <$



Mol. Biol. Evol. 25(2):301–309. 2008

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

Georgina R. Bowden, Patricia Balaresque,* 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**

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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

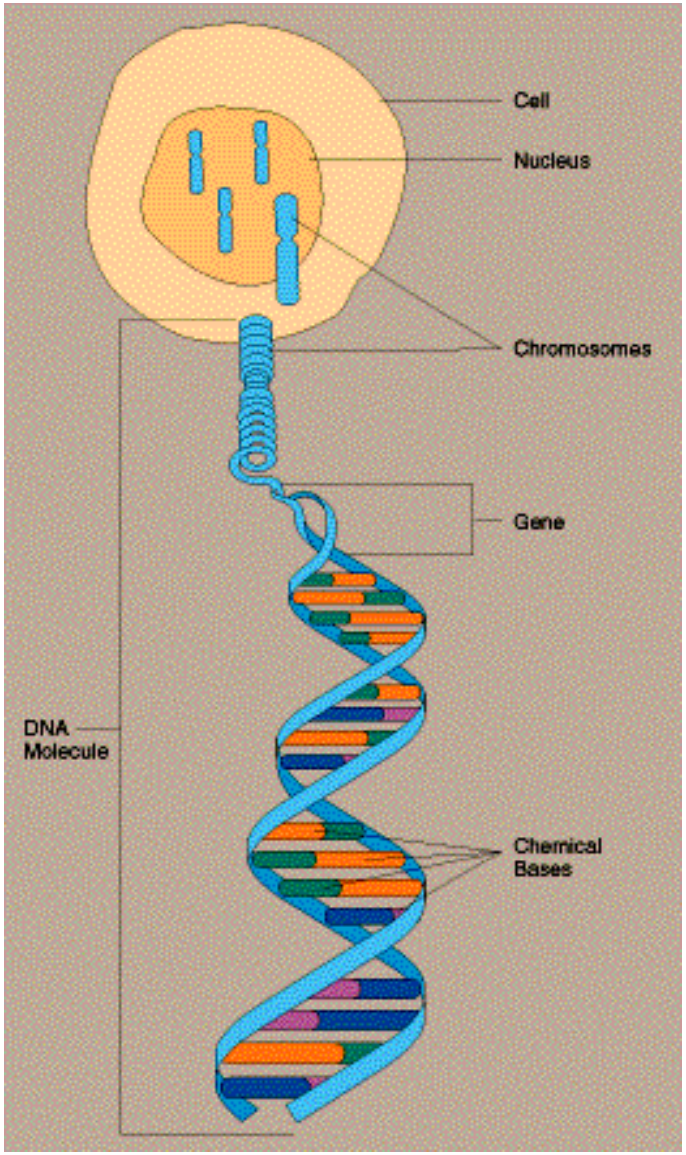
Studies of the human past draw on lines of evidence through studies of men sharing surnames (Sykes and Irven 2000; King et al. 2006; McEvoy and Bradley 2006). Al-

Knowsley Hall, 27 November 2007

DNA – message 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

DNA – message from our ancestors



<u>"Nucleotide Bases"</u>:

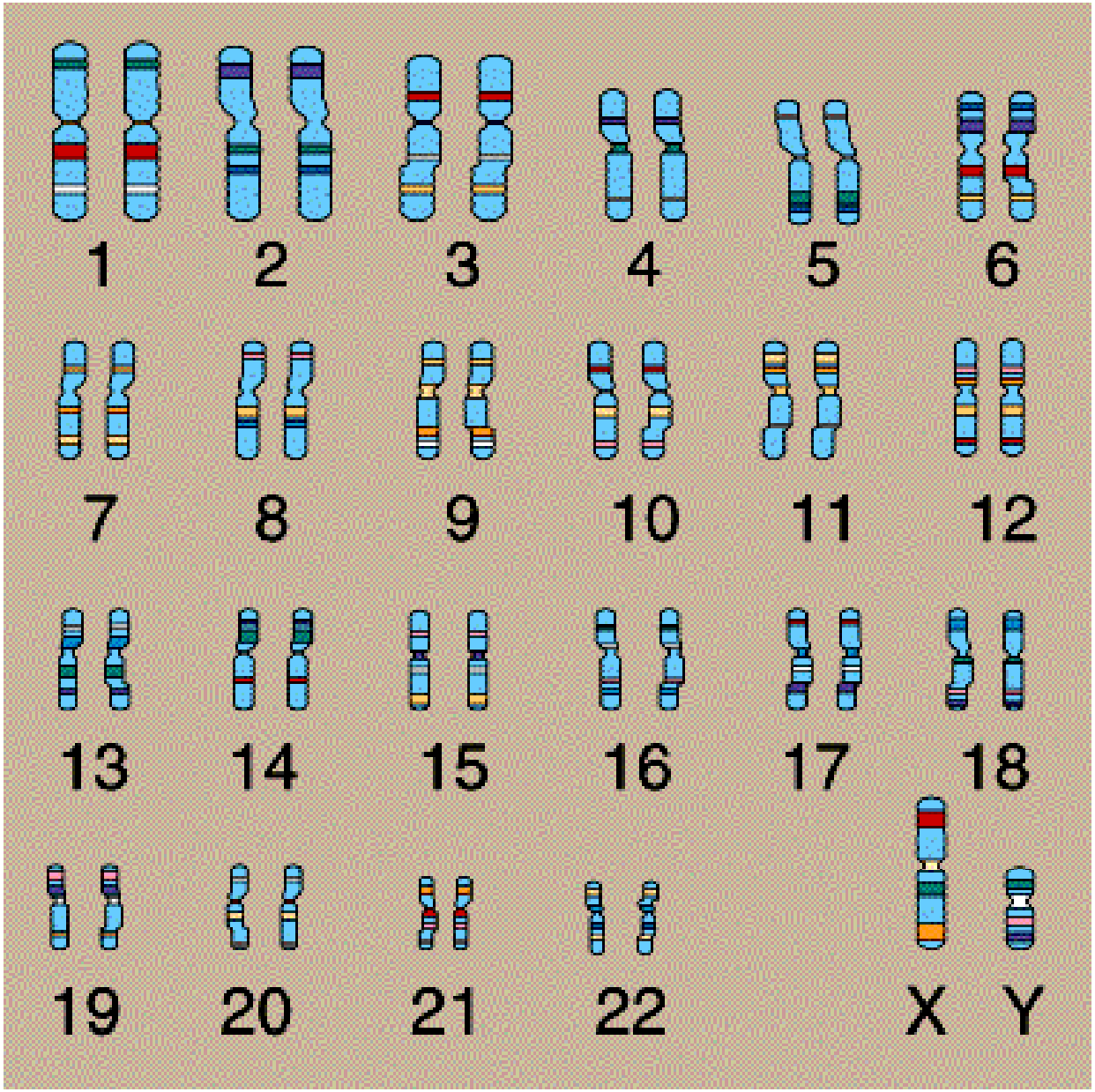
adenine A

Thymine T

Cytosine C

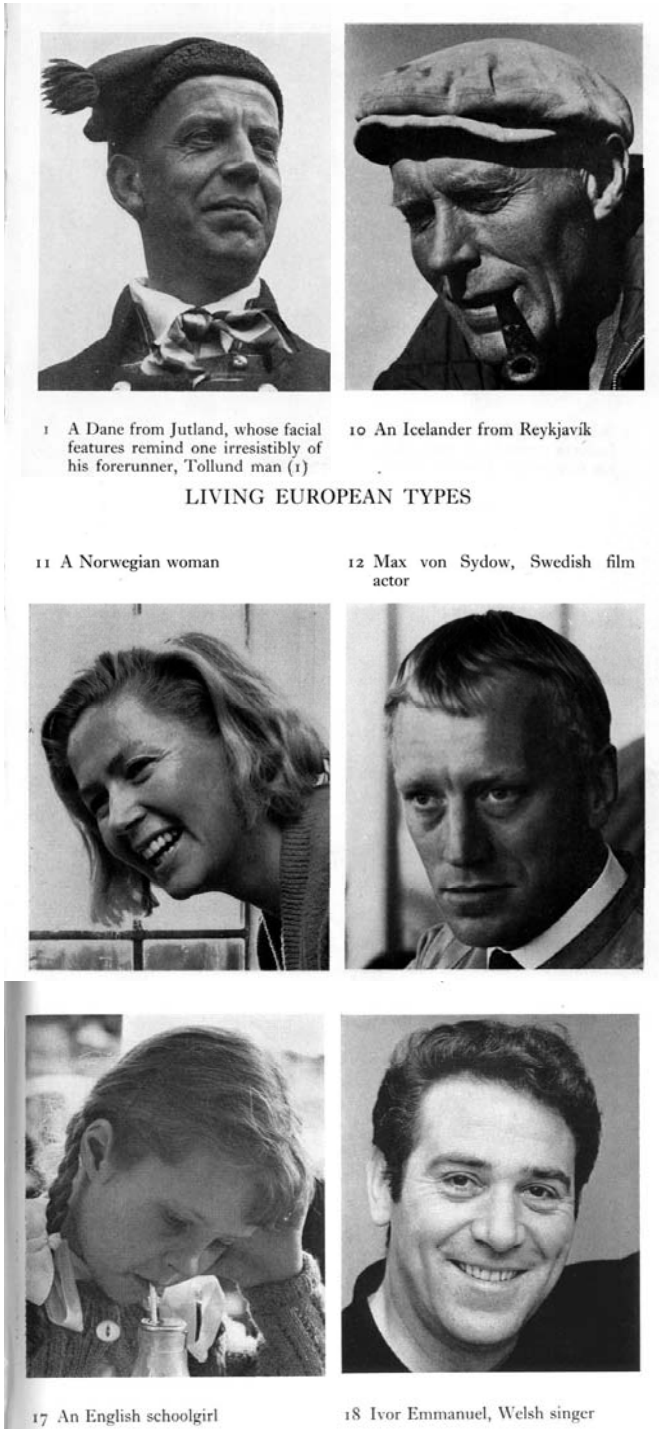
Guanine G

In a human cell nucleus there are 23 pairs of chromosomes



Genetics of physical characteristics

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



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

10 An Icelander from Reykjavík

LIVING EUROPEAN TYPES

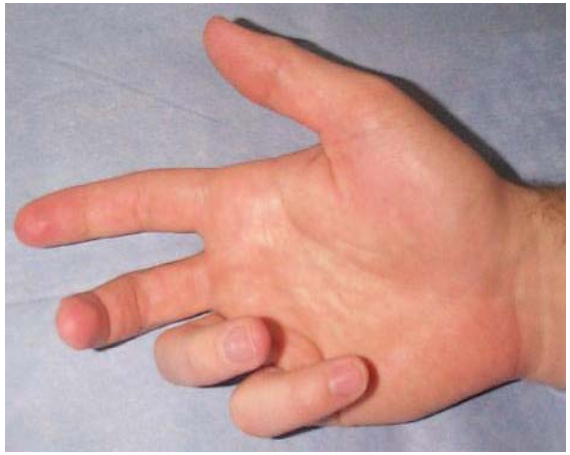
11 A Norwegian woman

12 Max von Sydow, Swedish film actor

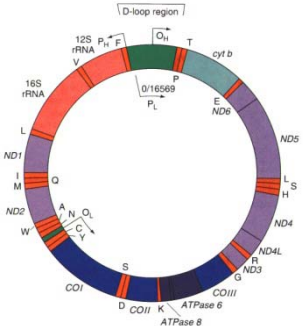
17 An English schoolgirl

18 Ivor Emmanuel, Welsh singer

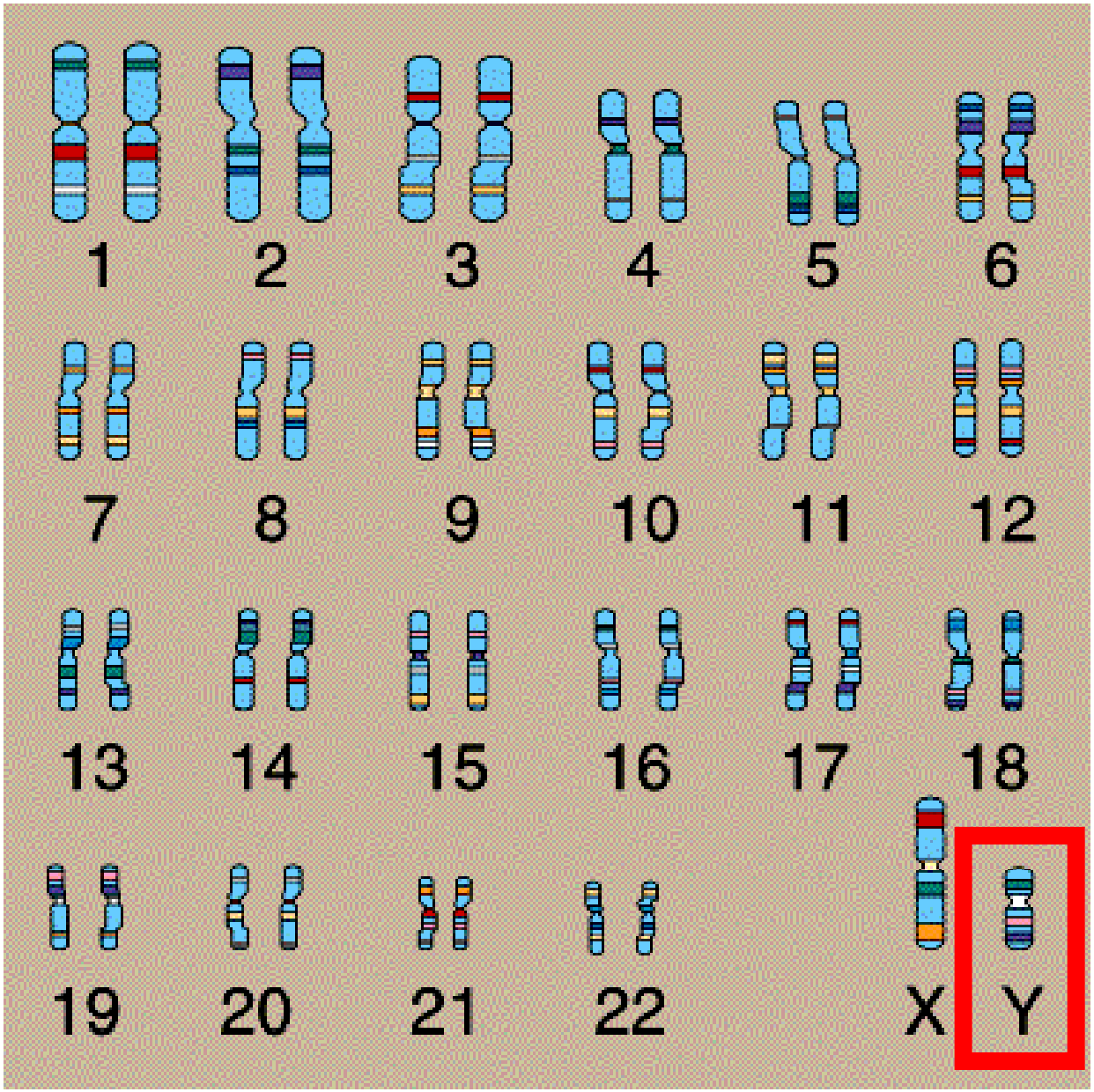
Genetics of physical characteristics



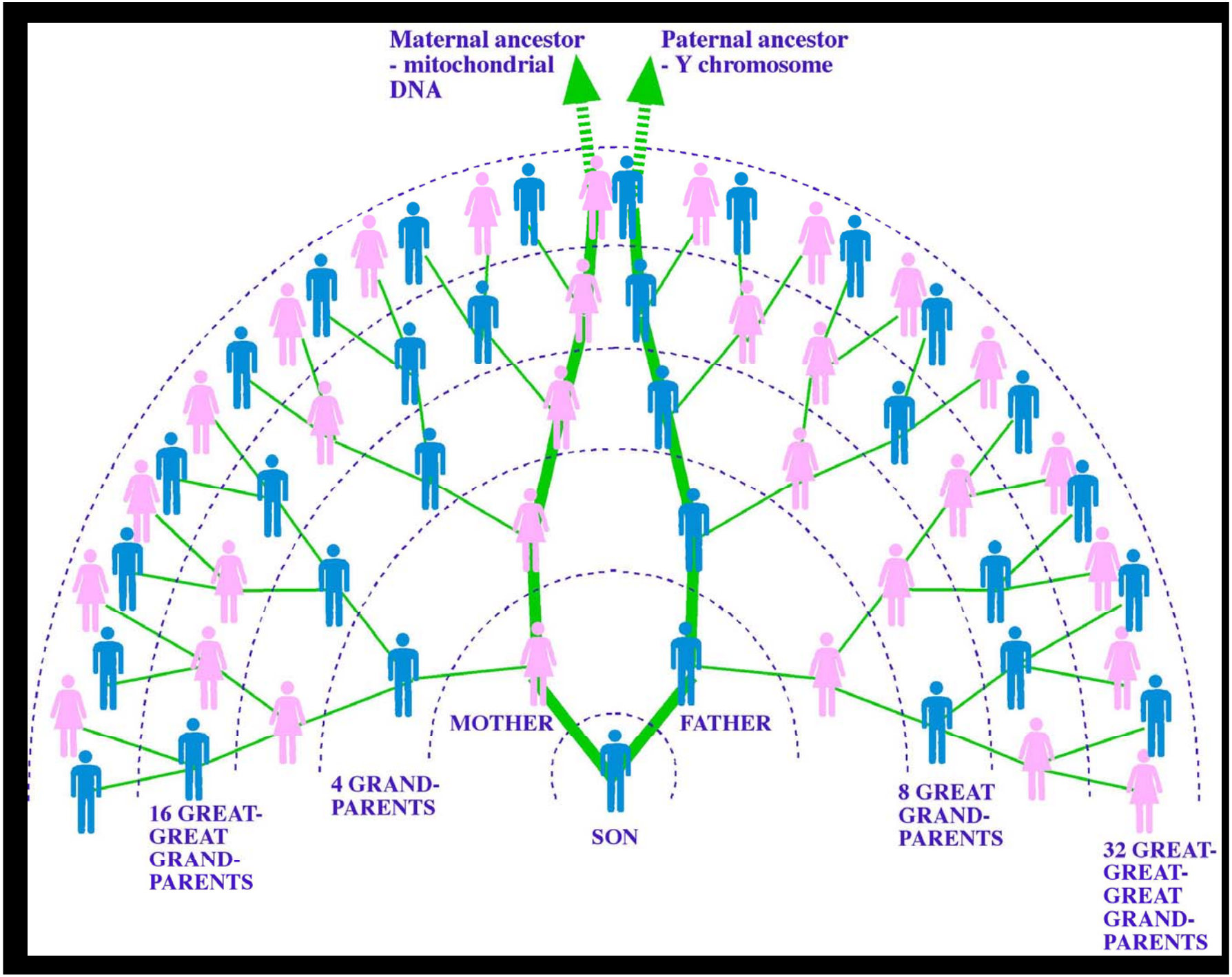
- Dupuytren's contracture
- Distribution suggests possible Viking origin
- Evidence from Icelandic sagas
- More frequent in regions of Britain influenced by Vikings
- But - genetic basis unknown
- Crops up in other populations

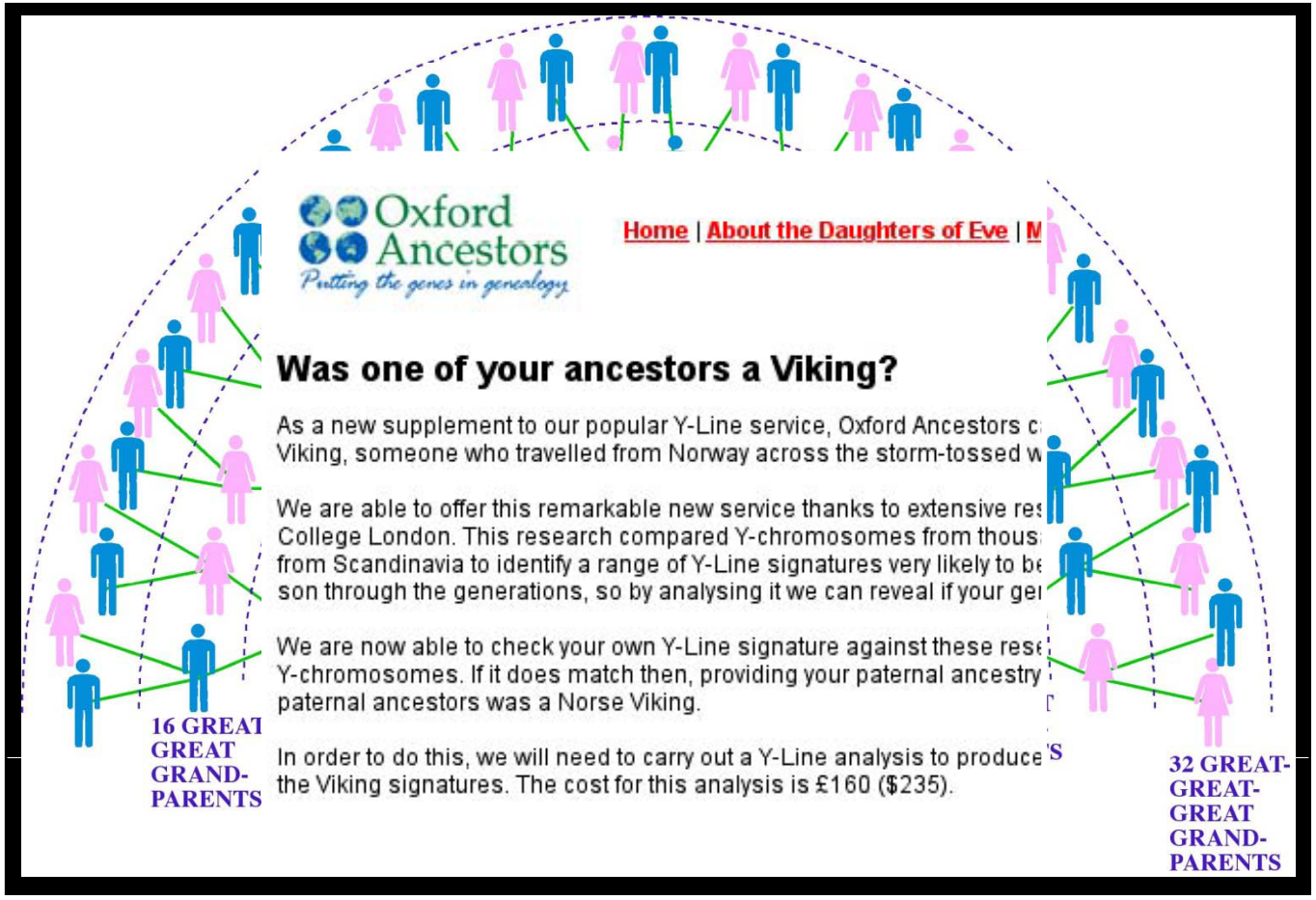


Maternally inherited mitochondrial DNA

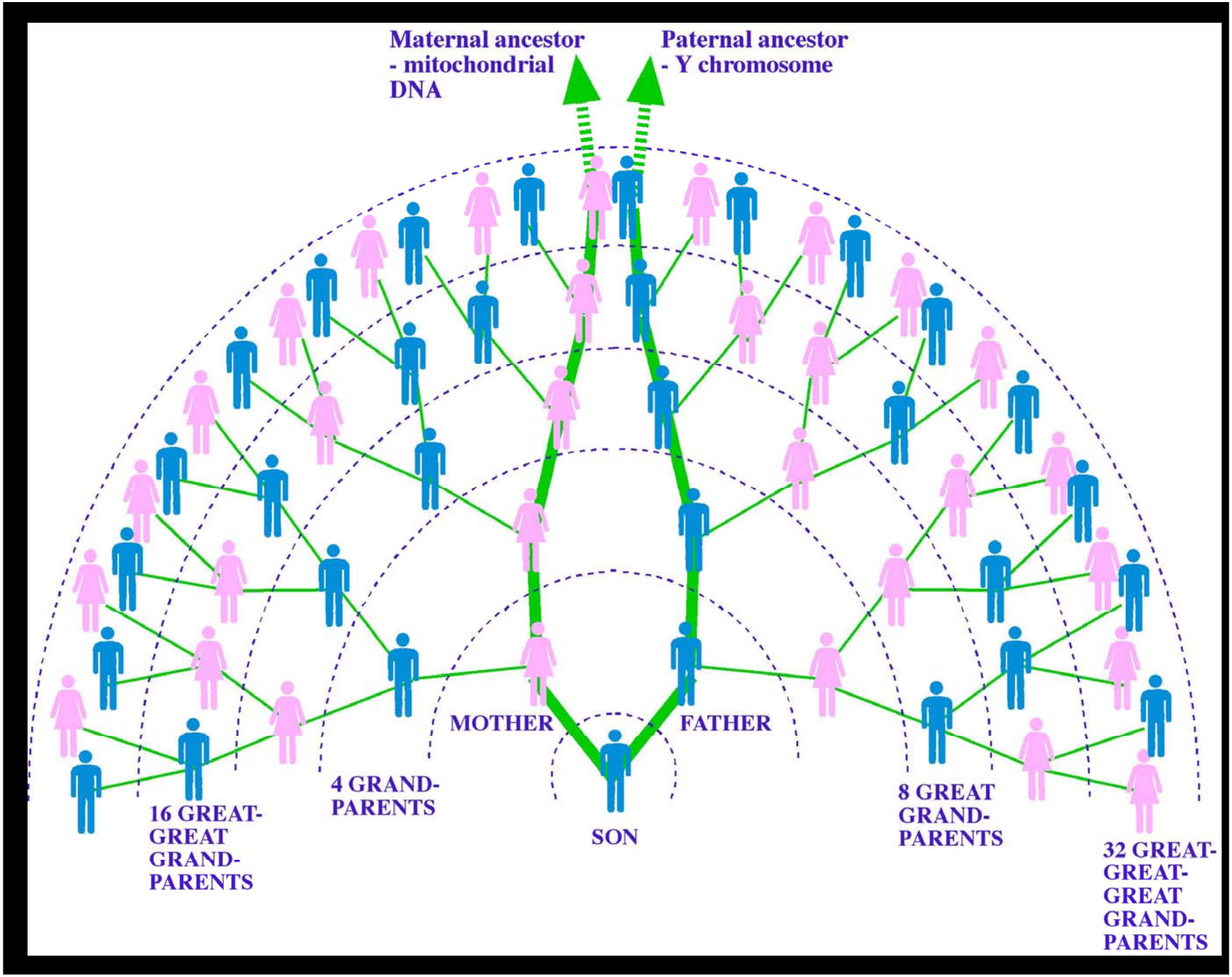


Male-specific Y-chromosome


Maternal ancestor
- mitochondrial
DNA
Paternal ancestor
- Y chromosome
MOTHER
FATHER
SON
16 GREAT-
GREAT
GRAND-
PARENTS
4 GRAND-
PARENTS
8 GREAT
GRAND-
PARENTS
32 GREAT-
GREAT-
GREAT
GRAND-
PARENTS

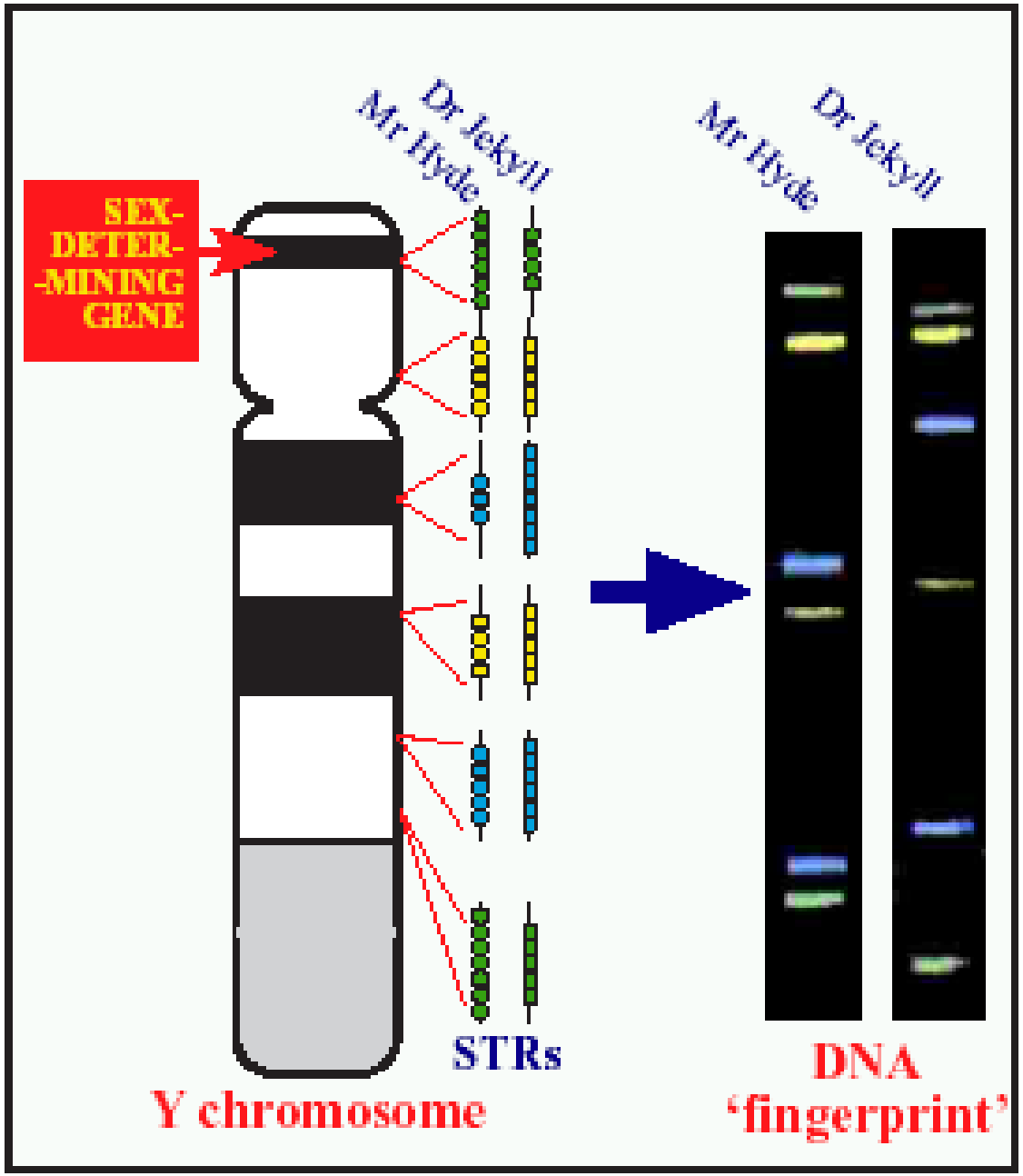


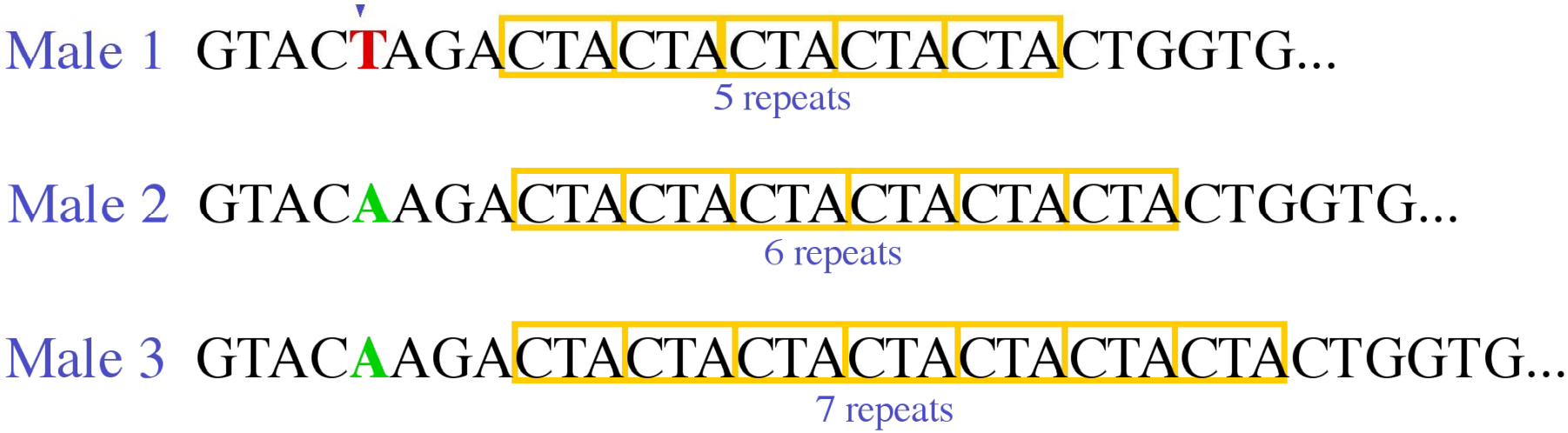
- **1,099,511,627,776 ancestors @ 40 generations ago**

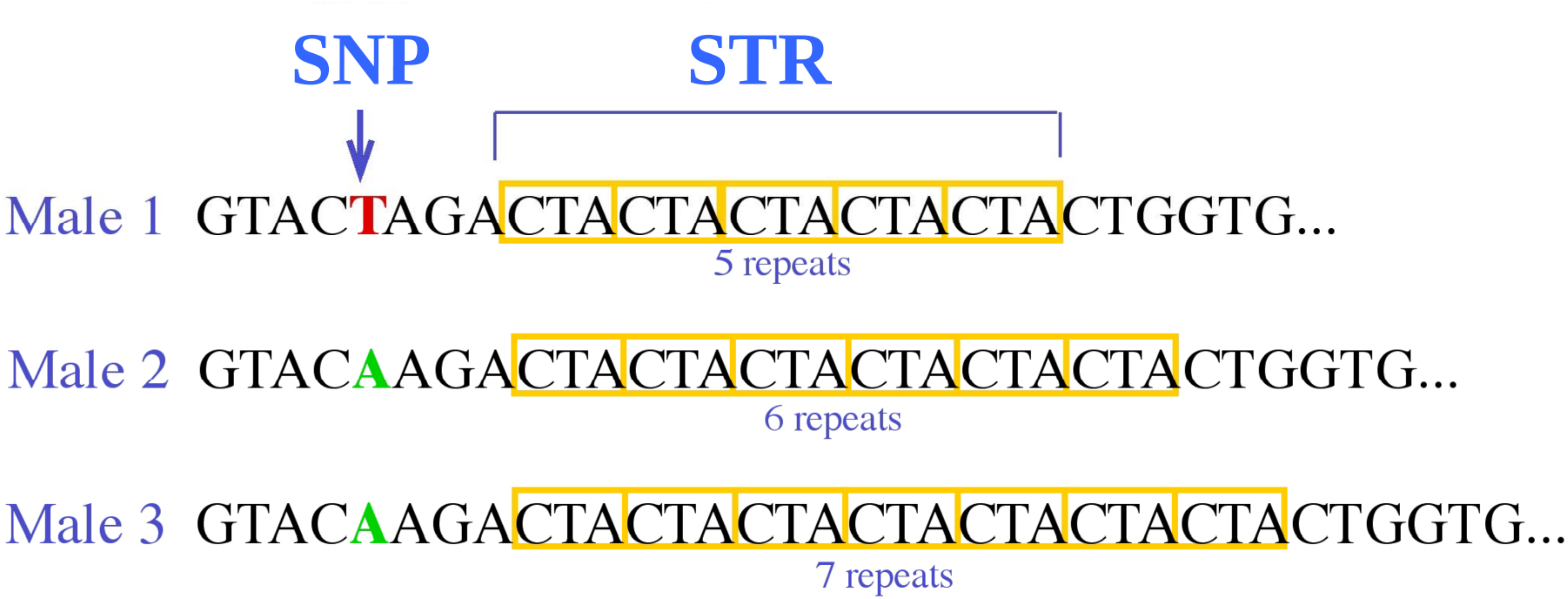

Maternal ancestor
- mitochondrial
DNA
Paternal ancestor
- Y chromosome
MOTHER
FATHER
SON
16 GREAT-
GREAT
GRAND-
PARENTS
4 GRAND-
PARENTS
8 GREAT
GRAND-
PARENTS
32 GREAT-
GREAT-
GREAT
GRAND-
PARENTS

Y-chromosome DNA 'fingerprint'

- Look for characteristic features in the non-recombining part of the Y-chromosome DNA



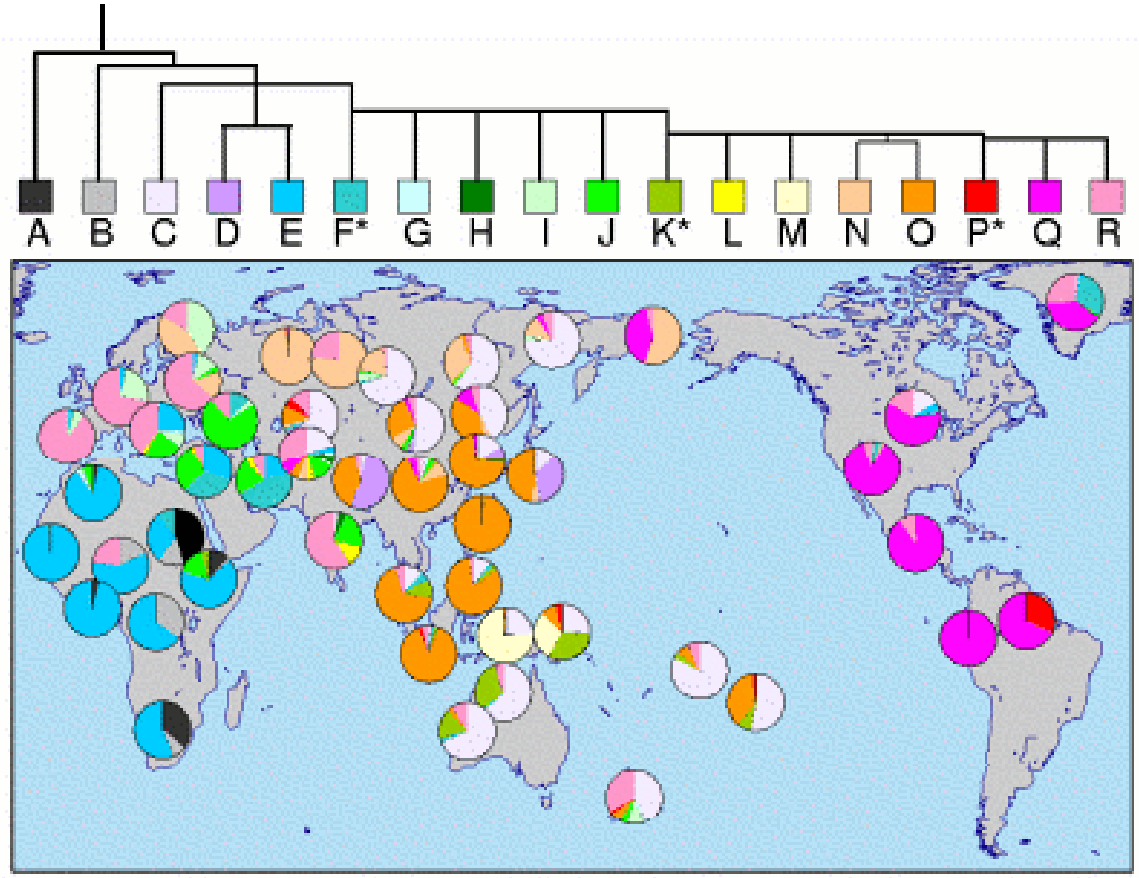

Male 1 GTACTAGACTACTACTACTACTACTGGTG...
5 repeats
Male 2 GTACAAGACTACTACTACTACTACTACTGGTG...
6 repeats
Male 3 GTACAAGACTACTACTACTACTACTACTACTGGTG...
7 repeats



SNP: Single Nucleotide Polymorphism: Haplogroup

STR: Short Tandem Repeat: Haplotype

Y-chromosome haplogroups



Courtesy of the Sanger Institute

Results from a man's Y-chromosome test

HAPLOGROUP

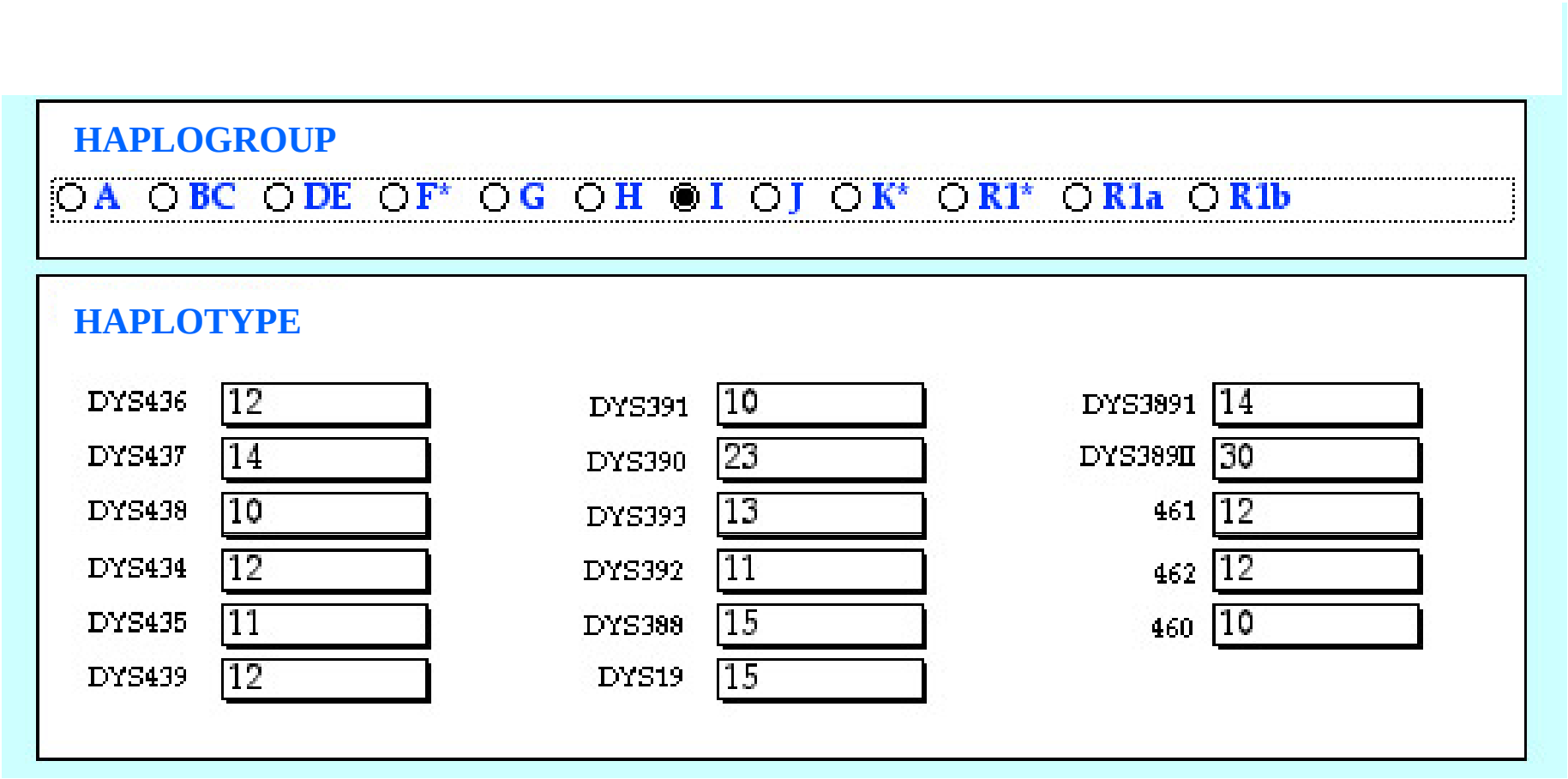
○ A ○ BC ○ DE ○ F* ○ G ○ H ◉ I ○ J ○ K* ○ R1* ○ R1a ○ R1b

HAPLOTYPE

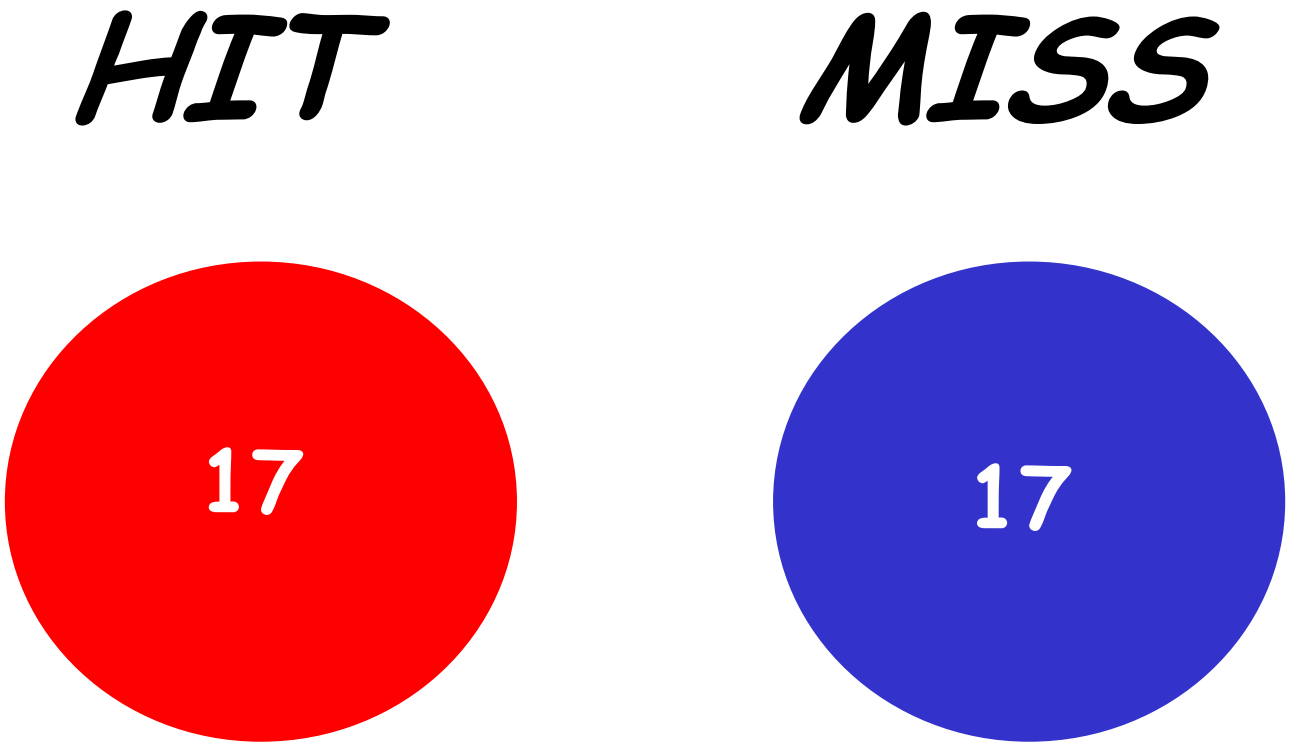
DYS436	12	DYS391	10	DYS3891	14
DYS437	14	DYS390	23	DYS389II	30
DYS438	10	DYS393	13	461	12
DYS434	12	DYS392	11	462	12
DYS435	11	DYS388	15	460	10
DYS439	12	DYS19	15		

Individual Viking ancestry?

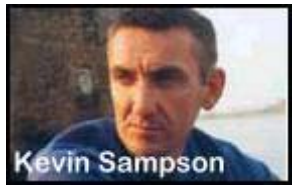
Results from a man's y-chromosome test



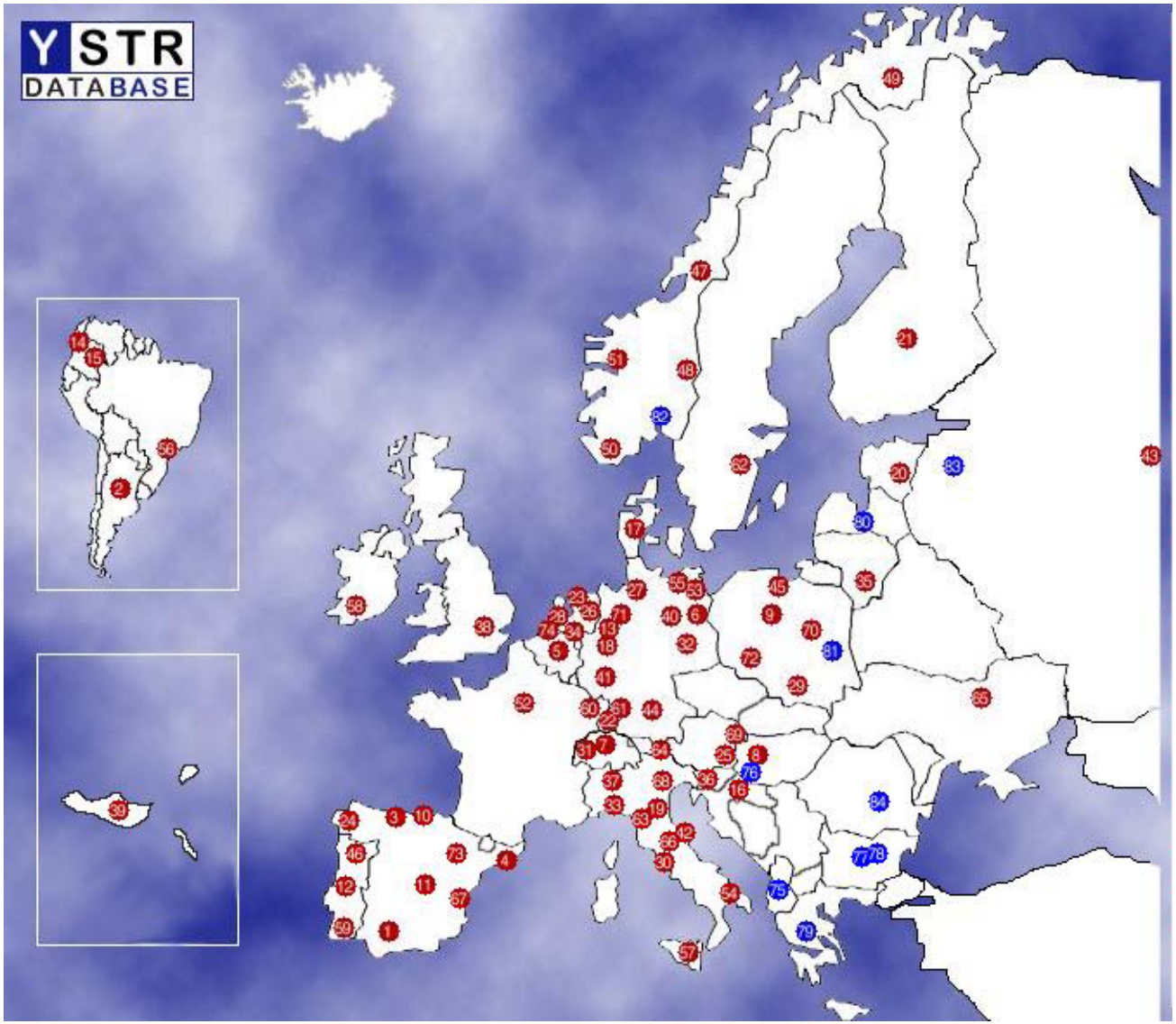
…enter his haplotype results into a database called "YHRD"…


HIT
MISS
17
17

Kevin Sampson



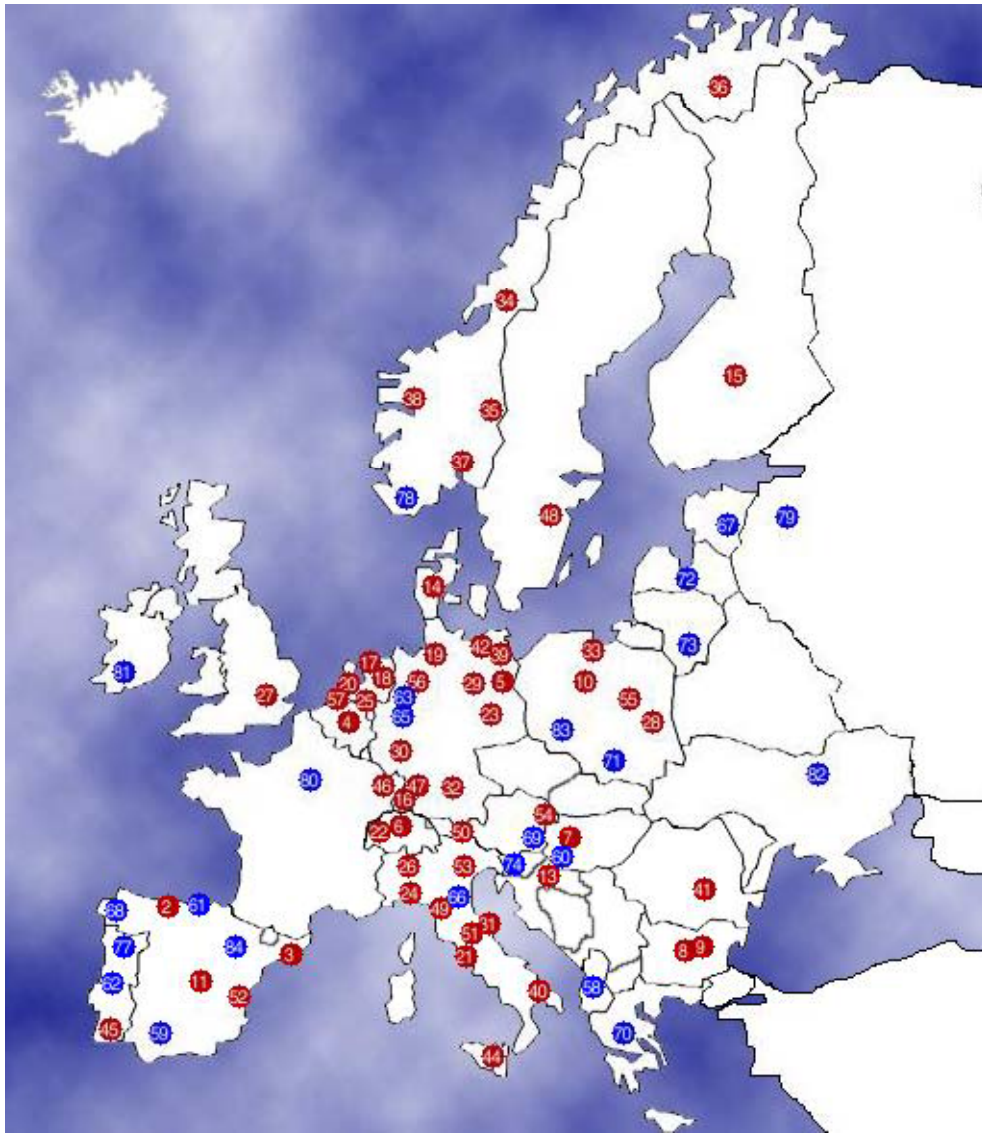
267 matches/13003



Population	Count	Frequency %
Denmark	**10** of 63	16
Holland	**13** of 87	15
Friesland	**6** of 44	14
Groningen	**6** of 48	13
Zeeland	**6** of 46	13
Belgium	**15** of 125	12
Norway South	**3** of 25	12
Cologne	**13** of 135	10
Strasbourg	**9** of 99	9
Stuttgart	**13** of 155	8
Asturias	**6** of 90	7
Central-EastSpain	**10** of 148	7
Freiburg	**32** of 433	7
London	**17** of 247	7
Pomerania	**14** of 208	7
Berlin	**32** of 548	6
Düsseldorf	**9** of 150	6

Peter Forshaw (Irby)

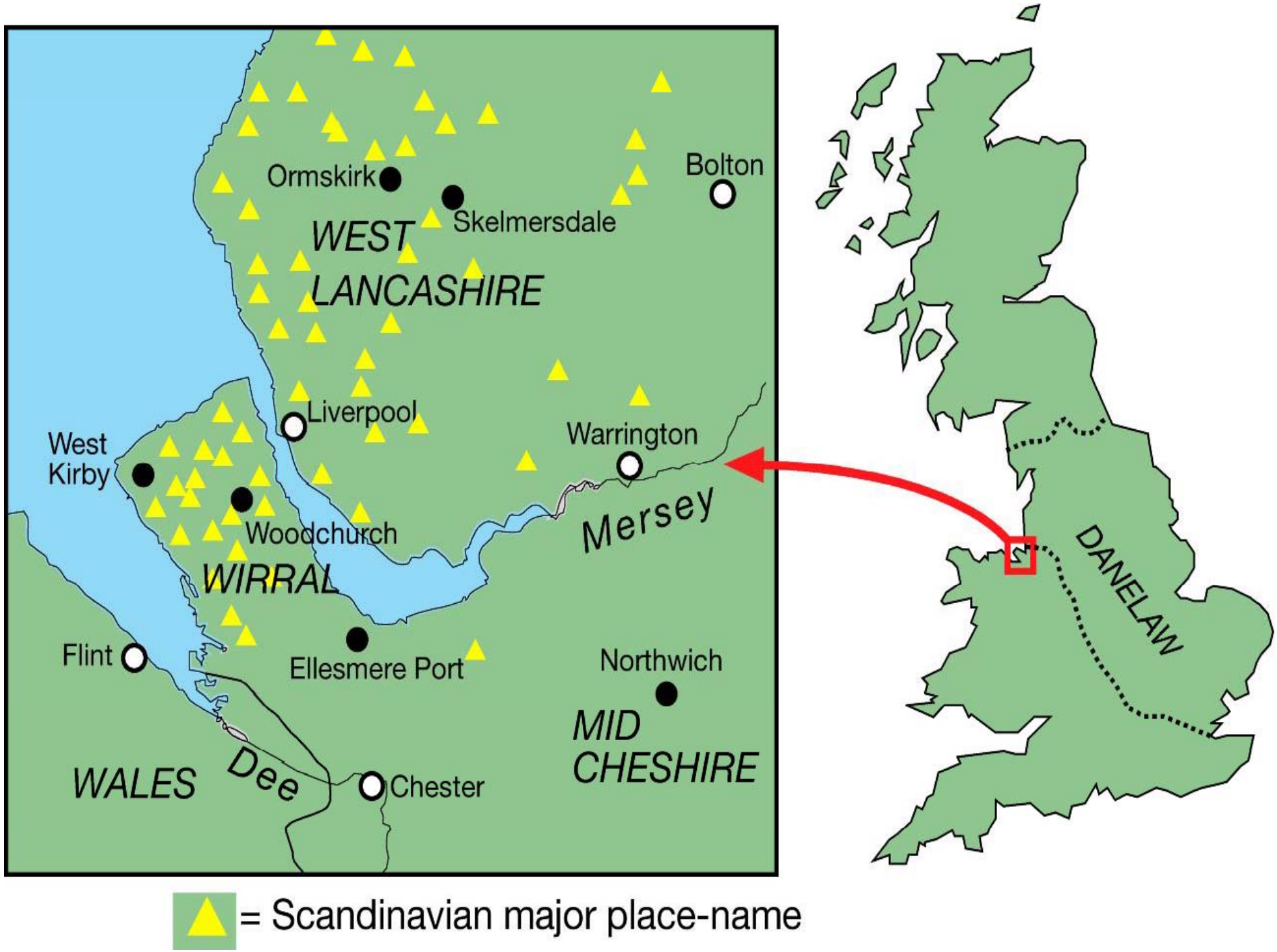
166 matches/13003



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

- **Comparisons at *individual* level insecure**
- **More secure using admixture approaches at population level (≥20 people)**
- **Resolution of the method improving all the time**
- **Still can't distinguish Danish Viking influence from Anglo Saxon**
- **Need to take into account modern population movements, especially in or near more urbanised areas**
- **2 generation and "old surname" criteria**


Ormskirk
Skelmersdale
Bolton
WEST
LANCASHIRE
Liverpool
Warrington
West
Kirby
Woodchurch
WIRRAL
Mersey
Flint
Ellesmere Port
Northwich
MID
CHESHIRE
WALES
Dee
Chester
DANELAW
= Scandinavian major place-name

Medieval Wirral Taxpayers/Criminals/Ale house records:

Adam, Allin, Alleyne, Andrew, Ball, Barber, Barker, Barrell, Barrow, Bailiff, Beck, Bennett, Bergs, Billing, Bird, Blackburne, Boland, Brant, Bratherton, Browne, Brunt, Burscough, Bryde, Burrows, Bushell, Caley, Carr, Carlile, Carlisle, Challoner, Charnock, Chantrell, Coley, Colley, Colton, Coke, Corf, Corfe, Corness, Cotton, Cowper, Cross, Dalby, Dane, Danold, Davey, Davy, Denham, Denson, Dobb, Doe, Done, Duke, Dunn, Edmonds, Edmunds, Ellcock, Fazackerley, Fiddler, Fidler, Foreshaw, Forshaw, Fox, Francis, Gallie, Gardener, Gardiner, Gardner, Garratt, Garrett, Gibson, Gill, Gleave, Glegg, Goodacre, Grace, Gray, Gregory, Grey, Grice, Hale, Hancock, Hand, Harding, Hare, Harper, Harrison, Harvey, Heath, Helsby, Hesketh, Hey, Heyward, Hide, Hill, Hogg, Hole, Holme, Holmes, Home, Hough, Hulme, Hulmes, Humphrey, Huntington, Hynes, Jennion, Jensen, Jeunds, Johnson, Jump, Kemp, Kirk, Kirkby, Leck, Lancelyn, Ledsham, Leighton, Lennard, Leonard, Ley, Lightfoot, Linacre, Little, Lunt, Macklin, Massie, Massey, Matthew, Mayle, Mayles, Middleton, Milner, Molyneuz, Moss, Moulding, Mutton, Nelson, Newbold, Newton, Otter, Otty, Page, Parr, Pearson, Pemberton, Pendleton, Pennington, Penketh, Penney, Philip, Phylip, Pigot, Pinnington, Plumbe,Poole, Potter, Prenton, Pye, Pyke, Radcliffe, Rathbone, Richardson, Rider, Ridley, Rimmer, Robinson, Rogerson, Russell, Rutter, Saddler, Sadler, Sampson, Scarff, Scarffe, Scarisbrick, Sclater, Scriven, Sefton, Sharpe, Shephard, Shepherd, Sherlock, Skinner, Smalley, Smythe, Spenser, Stones, Swain, Swaine, Swarbrick, Swindley, Tarleton, Taskar, Tellett, Thomason, Thomasson, Thomson, Threadgill, Threadgold, Tottey, Totty, Tumath, Tyldesley, Wade, Wainwright, Walley, Walton, Warburton, Waring, Warington, Watmough, Watt, Whalley, Wharton, Wilkinson, Williamson, Whitby, Whitehead, Whitelaw, Whitfield, Whitmore, Whittle, Whyte, Williamson, Willoughby, Worral, Woods, Woodward, Wilcock, Wise, Wyse, Young, Yoxon.

Volunteers

- **"Modern" Wirral and West Lancashire Volunteers**

  100 volunteers from Wirral and 49 volunteers from West Lancashire satisfying the "2 generation" criterion – paternal grandfather born in the area.

- **"Old" or "Medieval" Wirral and West Lancashire Volunteers**

  37 volunteers from Wirral and 42 volunteers from West Lancashire satisfying the "2 generation" criterion – paternal grandfather born in the area **AND** possessing a surname present in the area before 1572.

The "Medieval" names

- **Wirral (1545 subsidy rolls of Henry VIII, criminal and ale house records):**

  Barker, Beck, Bennett, Billing, Bird, Bryde, Bushell, Colley, Corfe, Edmunds, Forshaw, Gill, Green, Harding, Hesketh, Holmes, Hough, Joynson, Kemp, Kirk, Kirkby, Lunt, Rathbone, Richardson, Rimmer, Robinson, Sampson, Scarisbrick, Sherlock, Skinner, Taskar, Tellett, Tottey/Totty, Young, Oxton, Raby, Upton.

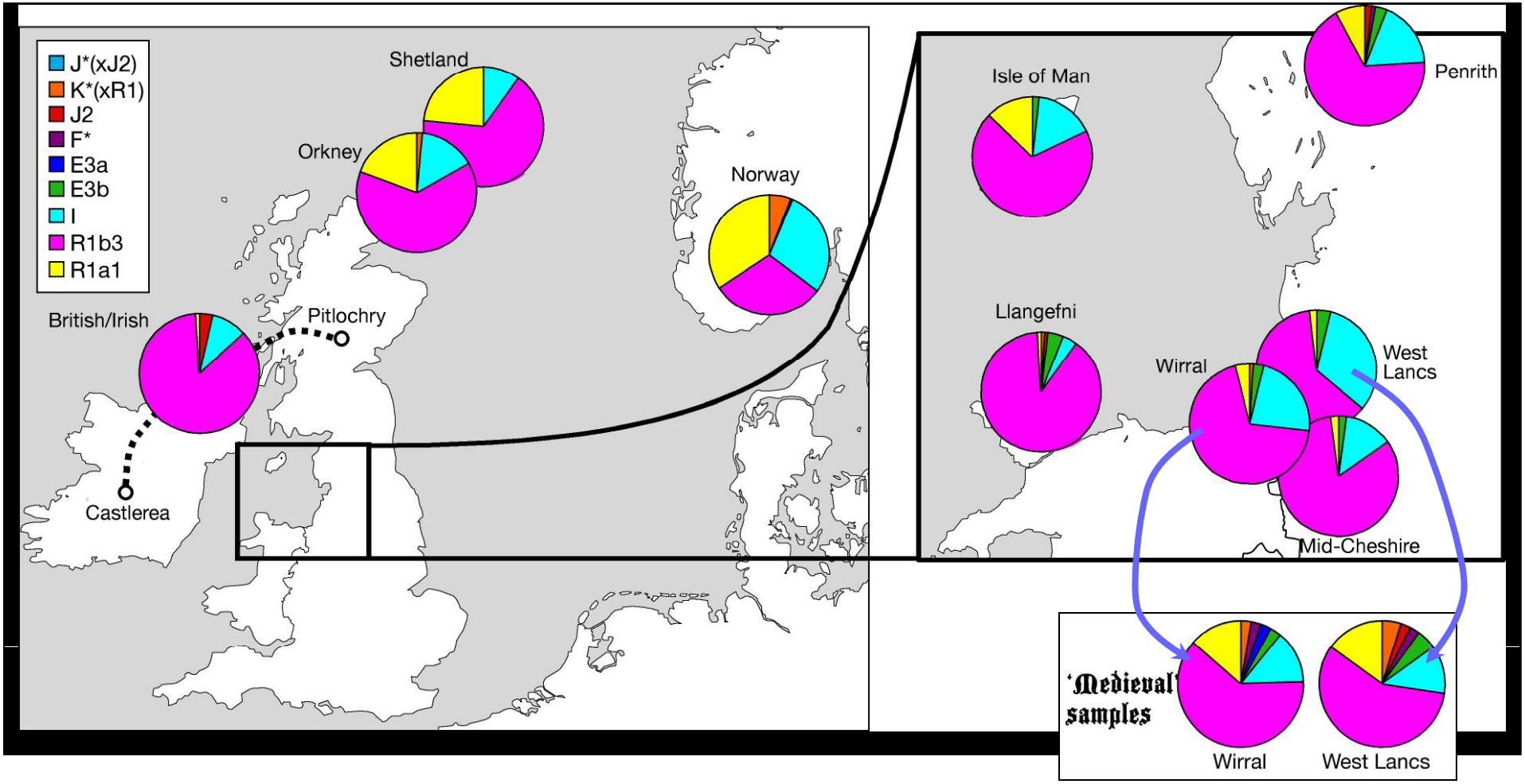
- **West Lancs (names of those promising to contribute to the stipend of the priest of the altar of Our Lady of Ormskirk, 1366; plus place-names):**

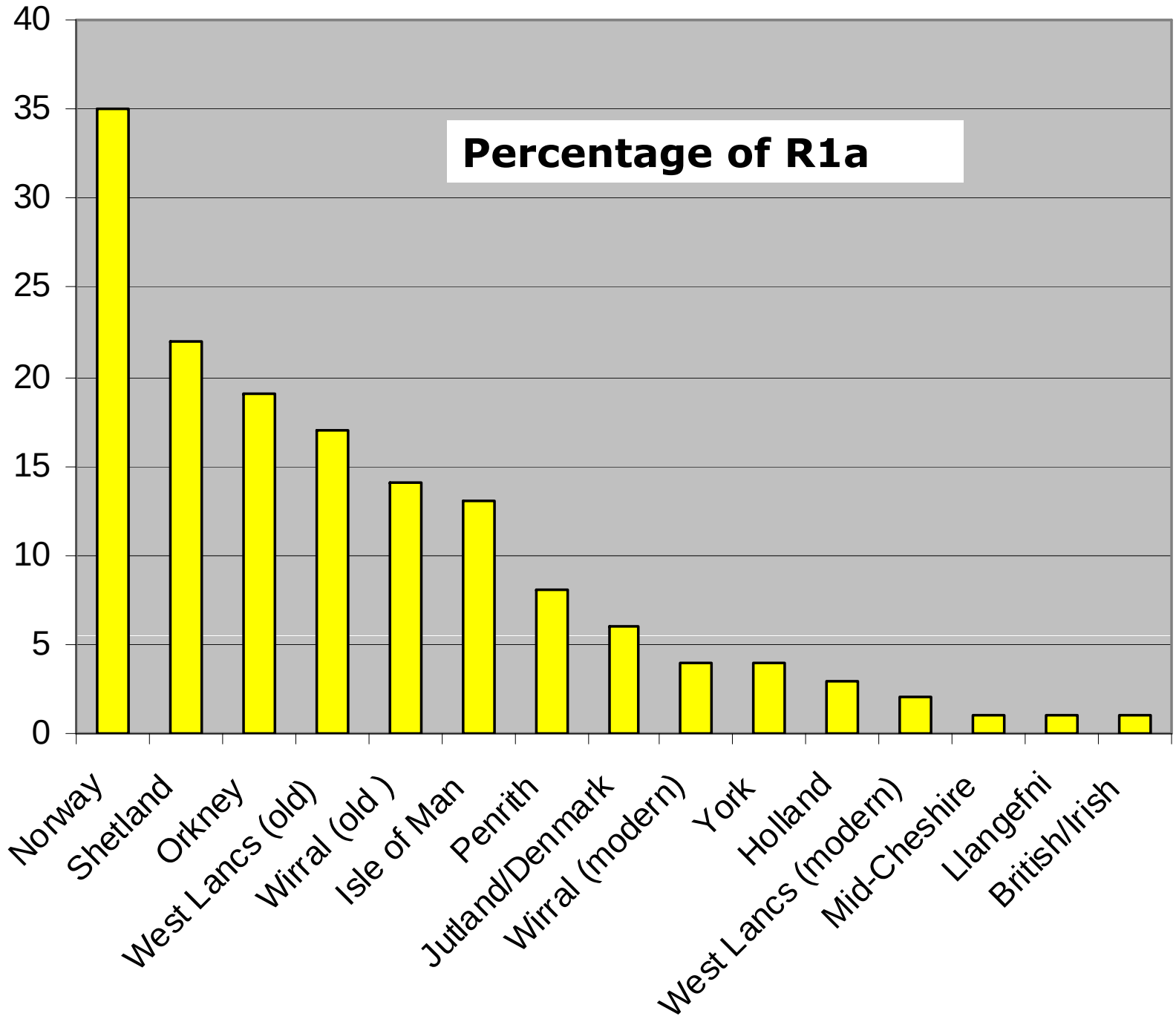
  Balshaw, Brown, Carr, Coly, Cook, Cooper, Fletcher, Gray, Holland, Holmes, Jones(son), Leyland, Melling, Molyneux, Otty, Prescott, Rimmer, Serjeant, Thomasson, Walsh, Webster, Westhead, Alker, Bilsborrow,

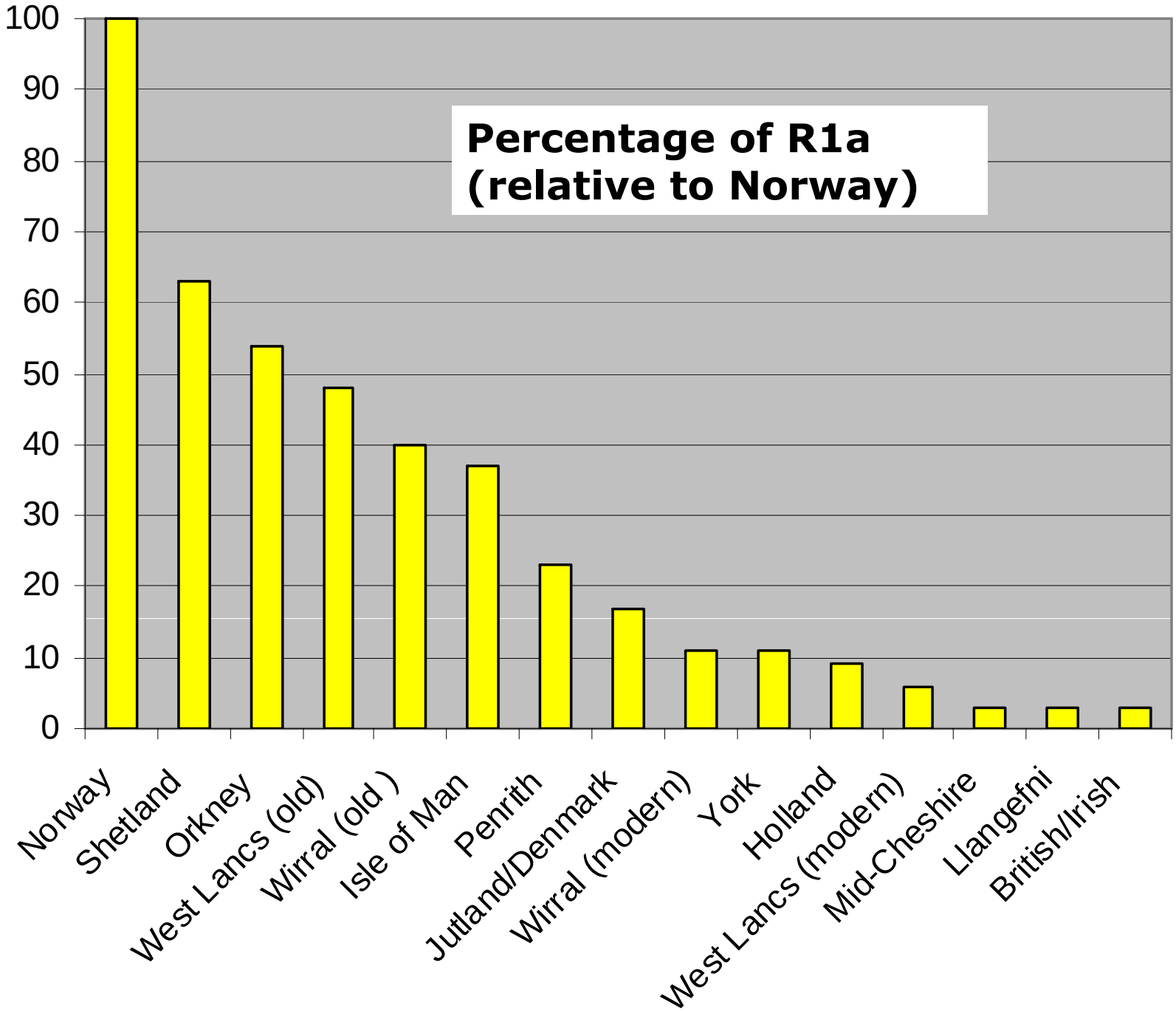
  Charnock, Corfe, Crombleholme, Gill, Hesketh, Hulme, Lunt, Pendleton, Penketh, Pennington, Rigby, Risley, Roby, Scarisbrick, Sephton, Swarbrick

Ormskirk, Nov. 2002: Sample testing

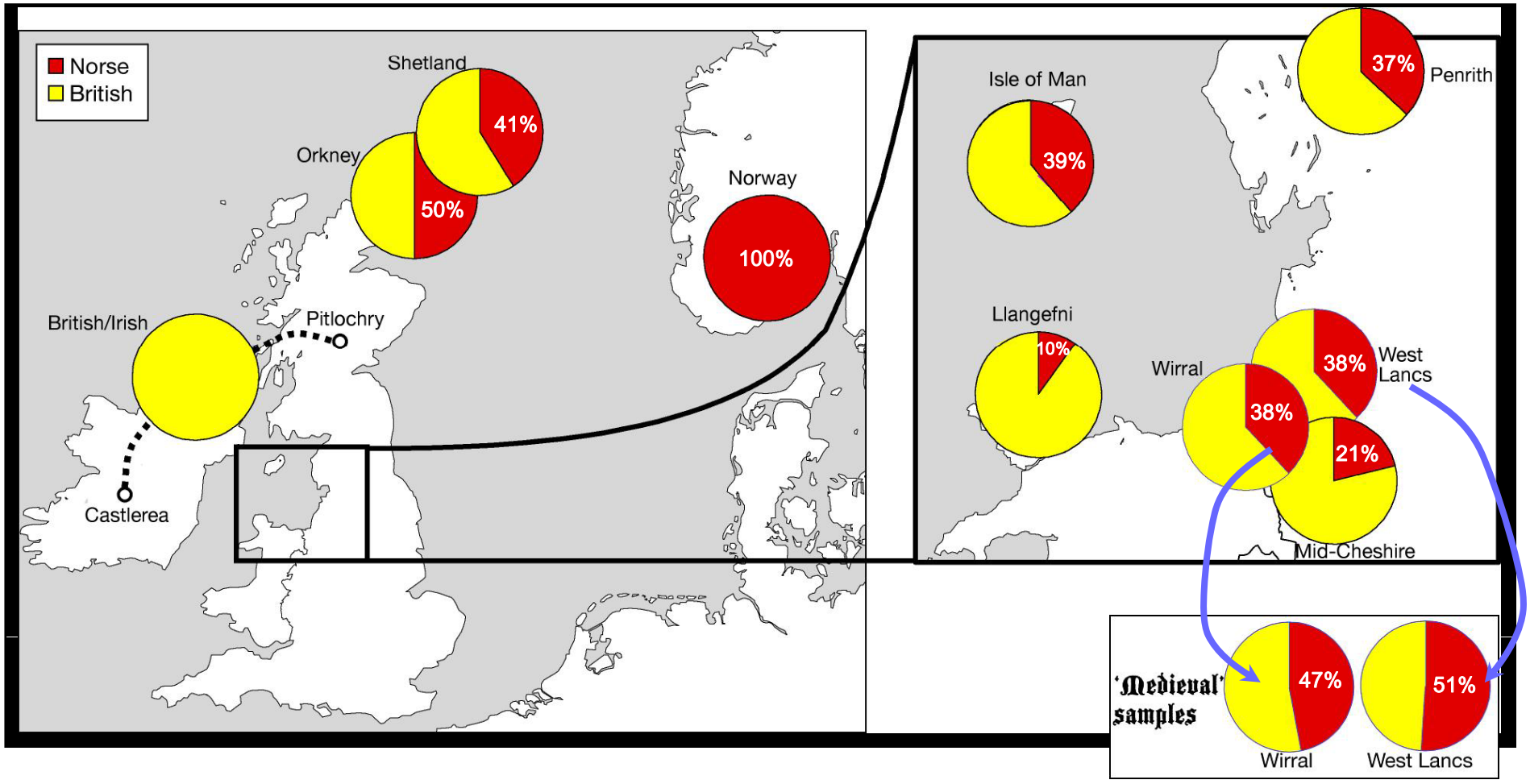
Y-chromosome haplogroup distributions




Percentage of R1a
40
35
30
25
20
15
10
5
0
Norway
Shetland
Orkney
West Lancs (old)
Wirral (old)
Isle of Man
Penrith
Jutland/Denmark
Wirral (modern)
York
Holland
West Lancs (modern)
Mid-Cheshire
Llangefni
British/Irish

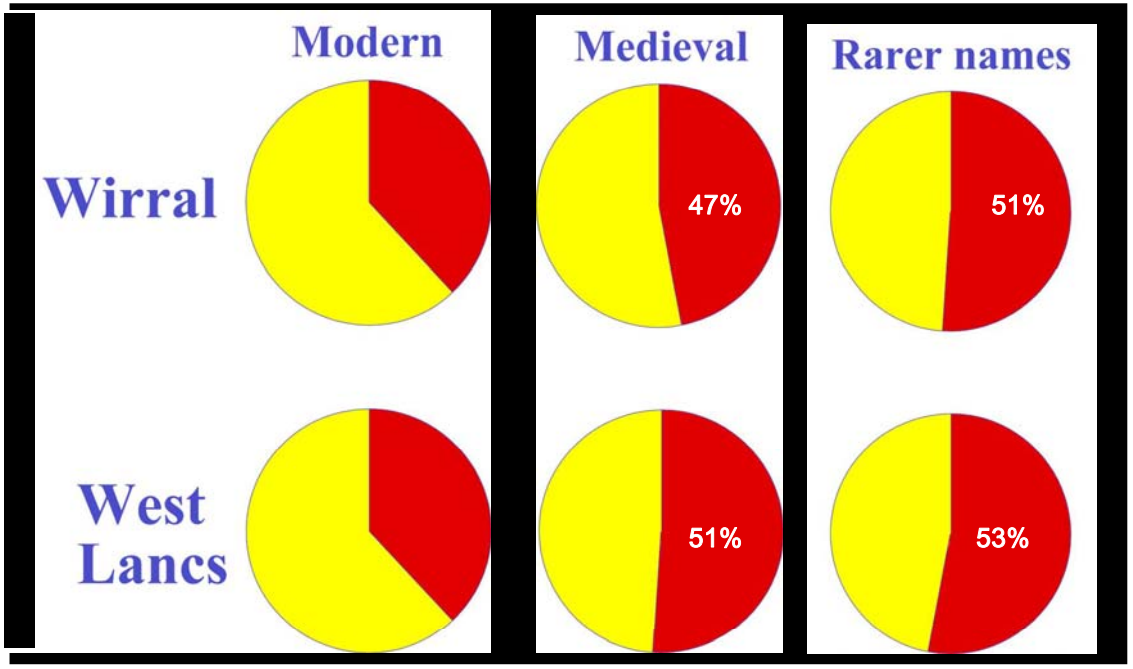

Percentage of R1a
(relative to Norway)
100
90
80
70
60
50
40
30
20
10
0
Norway
Shetland
Orkney
West Lancs (old)
Wirral (old)
Isle of Man
Penrith
Jutland/Denmark
Wirral (modern)
York
Holland
West Lancs (modern)
Mid-Cheshire
Llangefni
British/Irish

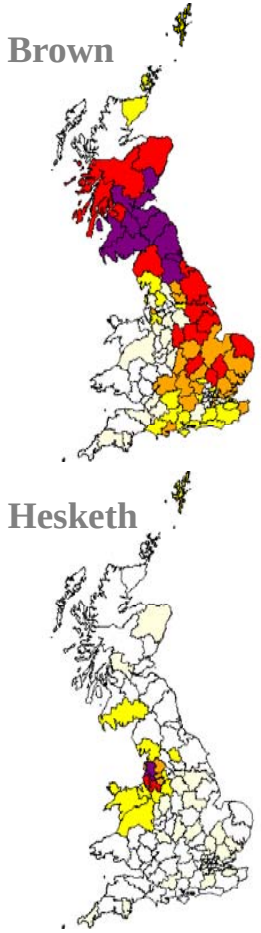
Full admixture "parent population" analysis



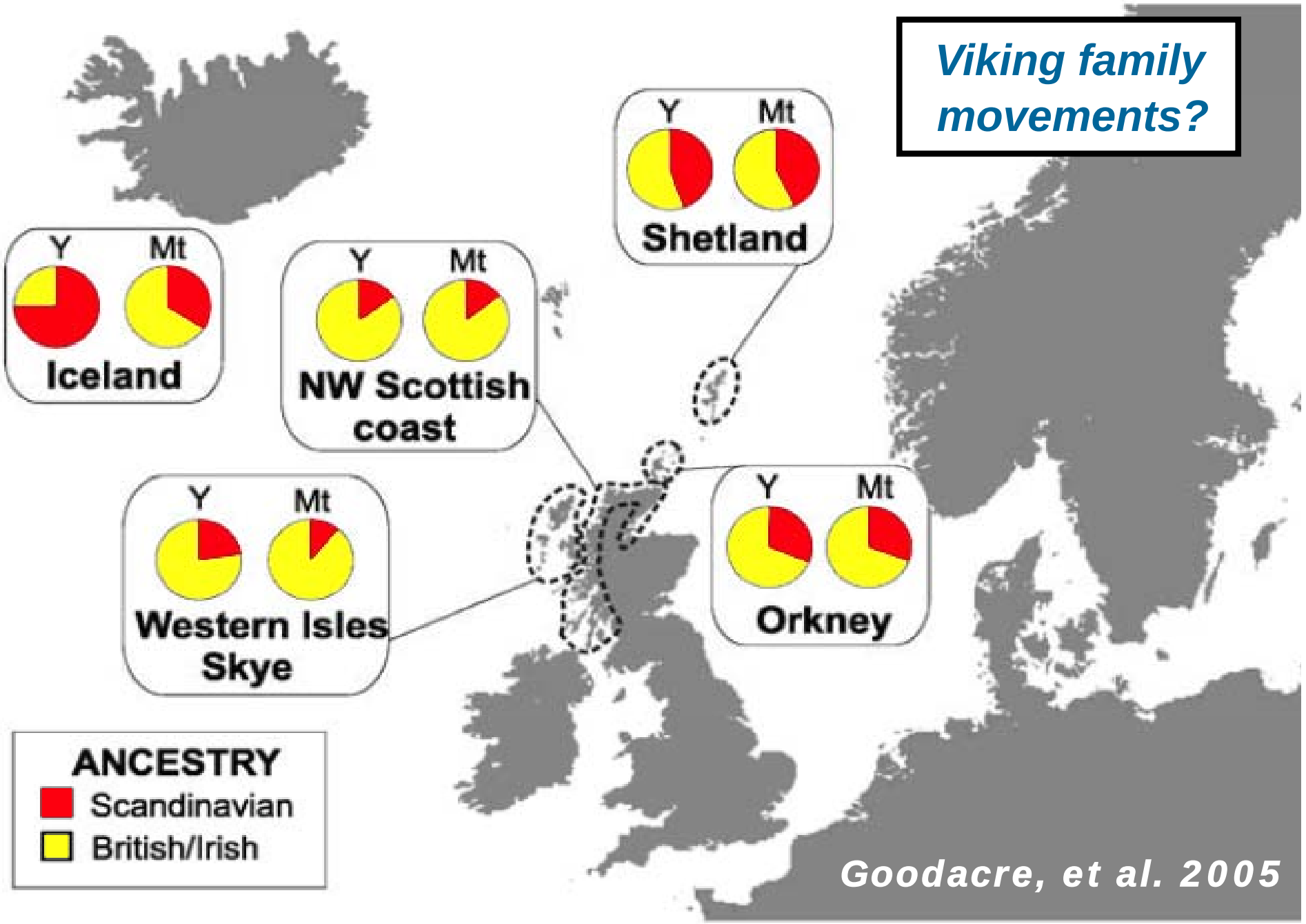
~50% Scandinavian

Effect of surname frequency





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


Viking family movements?
Y
Mt
Iceland
Y
Mt
NW Scottish coast
Y
Mt
Shetland
Y
Mt
Western Isles
Skye
Y
Mt
Orkney
ANCESTRY
Scandinavian
British/Irish
Goodacre, et al. 2005

Perspectives

- **The results confirm the belief that Wirral and West Lancs were once heavily settled by Norse Vikings: ~ 50% ancestry in medieval samples**
- **Admixtures methods are very approximate**
- **Sampling strategy important in linking old genes with modern geography; surname method is very useful but only for male history**
- **Good for assessing Norse ancestry, but currently cannot distinguish Danish Viking from Anglo-Saxon controls**
- **Resolution of the method improving all the time, and with better control data**
- **The studies have been extended to N. Lancs, Cumbria and N. Yorkshire**

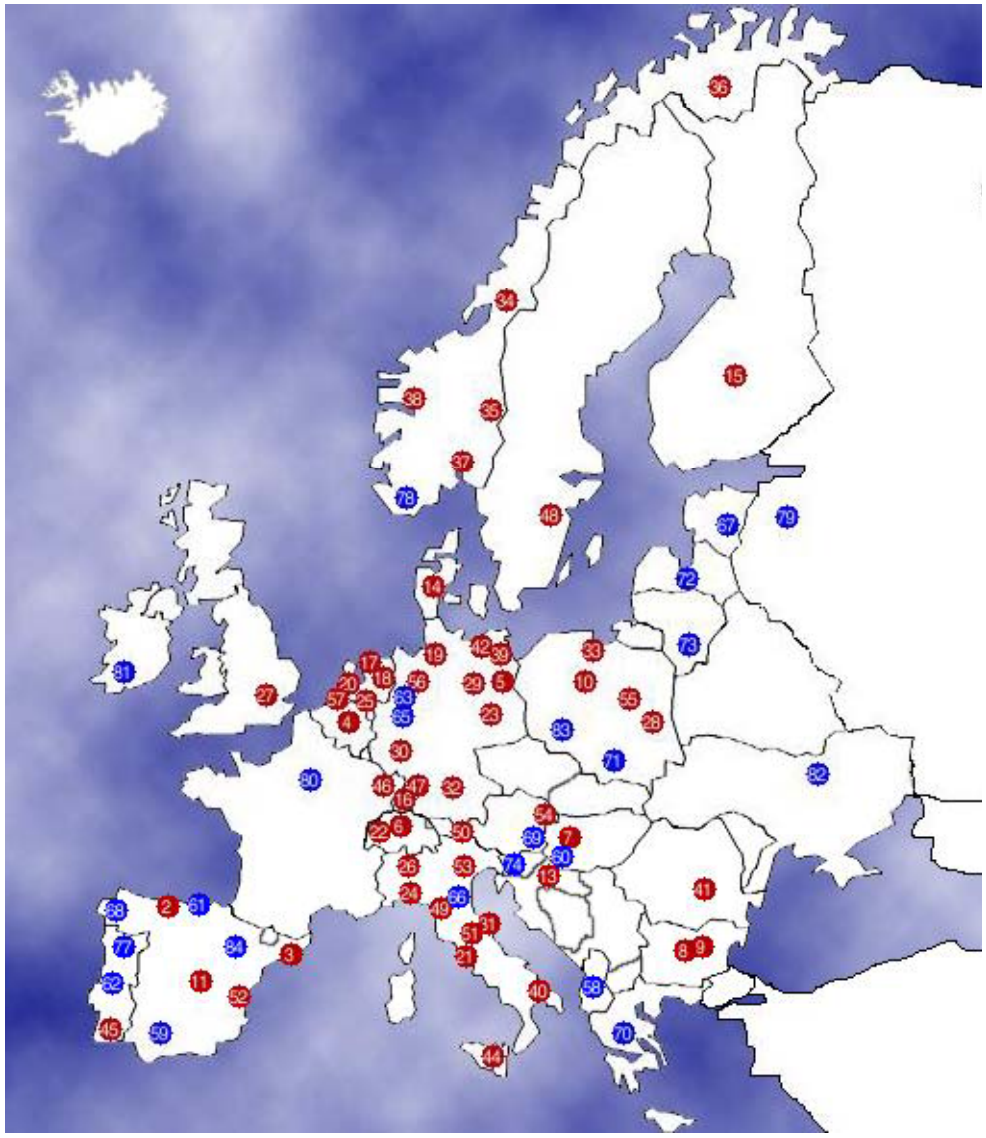
Viking genes in Northern England project

- **Part 1 - Wirral and West Lancashire (2002-2007)** Funded by BBSRC DNA anniversary award, results published February 2008 in *Molecular Biology and Evolution*
- **Part 2 - North Lancashire, Cumbria and N. Yorkshire (2008-2011)** Funded by the Wellcome Foundation

Merseyside Young Archaeologists, January 2003

Peter Forshaw (Irby)

166 matches/13003



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

My Viking Dad with my Viking dog!

Viking beer!

From Abigail Forshaw

More links to our Viking past

MORE Vikings have been found in Wirral!

Scientists found two men from Meols shared identical historical links to Scandinavia during DNA testing.

Bizarrely one – Stan Royden – is married to a Norwegian woman, Mette, and is chairman of the committee for the Scandinavian Church in Liverpool.

The second – Roy Shuttleworth – is secretary of the Friends of Meols Park and has been looking into the area's Viking past.

Although not related, the men were found to have very similar chromosome types.

Their strongest DNA link was to Gotland, an island off the east coast of Sweden.

The findings were released this week and are the result of a DNA ancestry event held last November as part of the Nordic Festival in Liverpool.

Viking expert Professor Steve Harding from Nottingham University and colleagues Professor Mark Jobling and Dr Turi King at Leicester University tested 195 men free of charge.

A genetic survey carried out last year by scientists from Nottingham and Leicester Universities and University College London found that up to 50% of the DNA of men from old Wirral families was Norse in origin.

Mr Royden, 64, said: "I was quite surprised because I thought I was all Anglo-Saxon!

"I've always felt an affinity with the place – my first job was in Norway, which is where I met my wife Mette."

In another bizarre coincidence, the Scandinavian Church Stan is involved with is in the Diocese of Gotland and comes under the jury

By LORNA HUGHES

isdiction of the Bishop of Gotland.

Mr Shuttleworth, 56, said he was "totally amazed" by the results.

He said: "I couldn't believe it , especially as we're working on a Viking project in Meols."

Only men can be tested for the Viking link because the test is based on DNA from the male Y chromosome which is passed down the paternal line from generation to generation, with little or no change.

Professor Harding said: "The results for Stan and Roy showed the match in both cases was Gotland in Sweden, where 15% of men have the same Y chromosome type as Stan and Roy.

"They also have matches elsewhere around Scandinavia.

"We can't say for sure but there is a very good chance they are both carrying the Y-chromosome of a Viking. Don't forget the Vikings moved all a lot, so they didn't necessarily come from just one place.

"They're just ordinary men but in every cell they have this link to Scandinavia."

●A research paper on the Wirral genetic survey was published last year. Find out more at http://www.nottingham.ac.uk/-sczsteve .

Professor Harding is giving a talk on Viking Wirral and Viking genes at Wallasey Central Library between 2.30 and 4pm on Mon, Oct 12.

For more information call 639 2334.

● Roy Shuttleworth (left) and Stan Royden (right) with Prof Stephen Harding.

Popular publication on the survey out soon:

The Wirral and West Lancashire Viking DNA Project 2002-2007 - with **Mark Jobling and Turi King**

www.nottingham.ac.uk/-sczsteve