

# Putting Genes into Genealogy - Part 1

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*In the course of our genealogy research many of us have frequently allowed the thought to cross our minds, “I wonder if I am related to the Chiefly line of Clan Campbell or any other historic Campbell or royal bloodlines?” Remarkably, whether the question concerns our Chief’s family, the original Mac Cailein Mor, or even the Kings of Spain, the answer is probably ‘Yes!’ – if you go back far enough. Some few could also be descended from MacGregors or Irish MacCumhails who changed their name to Campbell.*

This is the first of two articles that will explore the relationship of genetics and genealogy. DNA testing is now establishing itself as the third, and newest, core source in the field of family history, supplementing knowledge gained from oral and documentary records. This article will attempt to provide a very brief introduction to the emerging science of ‘genetic genealogy,’ and briefly summarize what genetic testing can and cannot determine genealogically.

In addition, the article will describe the newly initiated **Campbell DNA Project** – an independent effort to collect and organize Campbell DNA samples worldwide.

## *The Basics – Your Body’s Code*

For hundreds and perhaps thousand of years, man has traced his paternal bloodline through the use of his surname – a gift handed down from father to son.<sup>1</sup> However, nature demanding ‘equal opportunity’ has been more vigilant, ensuring that a certain set of genes are also handed down from mother to daughter, besides those handed down from father to son.

In genetic parlance, the set of genes passed only from father to son is monitored by biologists in what is referred to as the Y-chromosome test, and the set of genes passed only from mother or daughter is referred to as the mitochondrial DNA test. In each case, heredity ensures that a unique genetic “fingerprint” is passed down the bloodline.<sup>2</sup> In current genetic science, the DNA fingerprint is expressed in a string of numbers, allowing comparison with the numbers of the DNA of other people.

The Y-chromosome in the DNA of every living man resembles that of his father and his paternal grandfather and is carried by male cousins of any degree that share the same male ancestor. Tests of tiny chemical markers in one part of the Y-chromosome that does not change much over time will reveal the testee’s **haplogroup**, one of 19 such groups shared by all humans on the planet.

Tests of other markers in another part of the Y-chromosome, one that changes more rapidly, reveal the testee’s **haplotype**, the numeric pattern of their individual DNA. Combined together the two tests distinguish one male-to-male lineage from another, and reveal a ‘DNA signature’ for each individual man.

So the **haplogroup** gives evidence of our general original ancestry, where the **haplotype** is more specific to an individual man’s DNA imprint.

The mitochondrial test looks at the mitochondria, a special part of nearly all human cells, which is passed on female-to-child

and is inherited down the female line. The mitochondrial test is generally used to study long-term population developments such as migrations and has no real use for family historians. The Y-chromosome test can only be taken by men while the mitochondrial test can be taken by both men and women.

The results of one Campbell Y-chromosome test, referred to as a Y-STR test, are shown below<sup>3</sup>. In this test, 25 markers (i.e., loci) were tested on a male chromosome. Each of the 25 positions corresponds to a DYS number<sup>4</sup> or a marker that was tested, while the allele is the numeric “value” or result of that test. For example, the range of valid alleles for DYS393 are 9, 10, 11, 12, 13, 14, 15, 16, and 17 which represent different forms of the marker present at that DYS location.

**Table 1**  
**Sample Results of a Single Y-STR DNA Test**

Locus	DYS#	Alleles	Locus	DYS#	Alleles
1	393	13	14	459a	9
2	390	24	15	459b	10
3	19*	14	16	455	11
4	391	10	17	454	11
5	385a	11	18	447	25
6	385b	15	19	437	15
7	426	12	20	448	19
8	388	12	21	449	30
9	439	12	22	464a	16
10	389-1	13	23	464b	16
11	392	13	24	464c	17
12	389-2	30	25	464d	18
13	458	19			

This “Campbell DNA Sample” may or may not be the same as that of the original Gillespie Campbell (d. circa. 1281) whose grandfather had first been given the by-name ‘caim beul’ from which his descendants called themselves Campbell. It is just the DNA fingerprint of one modern man’s who is named Campbell. Was his ancestor a MacGregor who took the name Campbell, or was he descended from the first man named Campbell? Only as more Campbells have their DNA analyzed will such issues be clarified.

## Genealogy as Anthropology

In one sense, “genetic genealogy” is about drawing large-scale anthropological conclusions around recent ethnic origins. For instance, geneticists believe that all people alive today are the genetic descendents of a single man and woman. However, scientist believe that this man and woman never met since our most recent common male ancestor lived about 59,000 years ago in Africa, some 84,000 years after “Mitochondrial Eve.” Professor Bryan Sykes has documented this generally accepted scientific assertion in his book the *Seven Daughters of Eve* and other papers are available that document the “Genetic Adam.”

The fact that we all have common DNA notwithstanding, the ability to follow mutations and changes in DNA over time can help us draw anthropological and genealogical conclusions.

For instance, the Campbell DNA sample above most closely maps into what geneticists refer to as a particular variation known as haplogroup HG1<sup>5</sup>. Members of haplogroup HG1 are thought to be the descendants of the Paleolithic hunter-gatherers who arrived in Europe before the last Ice Age about 40,000 years ago. That pattern is most common in Western Europe, but is also found in all other parts of Europe. The above sample also includes a haplotype known as the Atlantic Modal Haplotype or AMH that is present primarily along the Atlantic coast in Europe and more specifically within the United Kingdom.<sup>6</sup>

For contrast, members of HG2 group are believed to be the descendants of two later waves of humans coming into Europe. The last of these waves arrived about 8,000 years ago and is credited with introducing agriculture into Europe. HG2 is most common in Southern and Central Europe, but that haplogroup is also often seen in those of Anglo-Saxon and Scandinavian descent. The haplogroup HG3 is seen more frequently on the eastern side of Europe (9% of the population of Turkey is HG3). But HG3 is also common in Scandinavia, and is said by some to be indicative of “Viking blood” when seen in paternal lines originating in the British Isles. The forefather of all HG3s is thought to have been born in the Ukraine during the last Ice Age about 15,000 years ago.

Professor Jim Wilson of the University College London writes the following concerning the general genetic composition of the Orkney Islands (off the north coast of Scotland):

*Archaeologists once presumed that the British Isles were colonized by successive waves of invaders from the Paleolithic through the Neolithic, the Iron Age and into historical times. However, today many scholars dismiss this migrationist view of prehistory in favour of an indigenous origin for many prehistoric material cultures. We have used a number of genetic marker systems to determine the genetic legacy of these cultural changes focussing in particular on the Scandinavian invasions and the origin of the Celtic-speaking populations. Orkney is an archipelago located off the North coast of Scotland which has a very strong Norse cultural identity reflected in place names, language and folklore. To test whether Orkney’s Viking heritage is genetic as well as cultural, we compared Orcadian, Norwegian, Irish and Welsh Y chromosomes. The Irish and Welsh samples were very similar, made up mostly of haplogroup 1 chromosomes (and within haplogroup 1, a haplotype we call the Atlantic Modal Haplotype {AMH}), while the*

*Norwegians were mostly haplogroup 2 and 3. The Orcadian frequency distribution was intermediate between the Celtic-speakers and the Norwegians, consistent with an origin by admixture between two such populations. Given the extreme similarity of the Irish and Welsh samples, it would seem they represent the pre-Anglo-Saxon British component in the British Isles today.*

The academic work by David Sellar of Edinburgh University (1973) on the origins of the Campbells suggests that they were Britonic [culturally Celtic] from the Lennox in the north of Strathclyde. If this is true, Campbell DNA would be expected to be the same as the people from Wales and Bretagne (Brittany) – or as ‘Picts’ to the north of the Lennox.

Perhaps another argument DNA could settle is how much the English and Lowland Scots are Britonic people rather than descendants of the Anglo-Saxon-Fresian Germanic invaders. English historians have promoted a concept that all are Anglo-Saxon and that they pushed indigenous Britonic people of Celtic culture into the extremities of the west and north, including Wales and Lowland Scotland. This could prove to be a racial myth.

## Genealogy – Knocking Down Brick Walls

Many of us are documenting our Campbell ancestors -- trying to document at least one more generation back in the chain. The difficulty is getting past brick walls created by lost, burned or never-existing records of births, deaths, marriages, etc. Hopefully DNA testing could help you get past your brick wall. How can that happen?

The simple answer is for you to find a match between your Campbell DNA and that of another Campbell family who has a documented family tree that precedes your own. Then you can focus on the missing link between your family and the family with matching DNA. The DNA results will not tell you who links to your tree, but it will tell you that your families have a common male ancestor. Geneticists call this the Most Recent Common Ancestor (MRCA).

For example, Table 2 shows the accuracy of various test markers in determining the number of generations back for an

<b>Number of Matching Markers*</b>	<b>50% probability that the MRCA was no longer than this number of generations</b>	<b>Average number of years back to most recent common ancestor</b>	<b>Range of possible years back to most recent common ancestor.</b>
10 of 10	89.5	1270 yrs	280 - 3760 yrs
11 of 12	38	760 yrs	110 - 2690 yrs
12 of 12	14.4	288 yrs	20 - 1660 yrs
23 of 25	28.5	570 yrs	120 - 1570 yrs
24 of 25	17.5	350 yrs	50 - 1180 yrs
25 of 25	7	140 yrs	0 - 760 yrs

\* Note: Unmatching markers are off by one number.

MRCA for two related individuals. If two people who participate in the project have 12 out of 12 markers that are identical (match exactly), then their MRCA is less than 14.4 generations back for them 50% of the time or 288 years on average. If two people who participate in the project have 25 of 25 markers that are identical (match exactly), then their MRCA is less than 7 generations back for them 50% of the time or 140 years on average.

Anything less than a 10 out of 12 markers or 23 out of 25 markers between two individuals is not considered a strong match. In this case the two people may be related, but the common ancestor may have been quite a long time ago as you can see in the last column of the table.

From a genealogical perspective, the trick is to reduce the uncertainty in the determination of that MRCA until you have identified the individual who is the father of both of your family lines. The ideal process starts with a verification of your own family line of DNA by having distant male Campbell cousins take either the 12 marker or 25 marker DNA test. By proving that they both carry the exact same Y chromosome DNA, you have a solid benchmark that you can compare with the results from other Campbell families who do the same.

As you find Campbell families with matching DNA, you must map them to your own family tree and history. The degree to which your DNA matches determines how far back you probably shared a common ancestor.

It is hoped that the Campbell DNA project can aid in this process by eventually obtaining DNA samples from the well-documented Campbell lines. These lines might include Campbell families whose articles in Burke's *Peerage* or *Landed Gentry* suggest that they have a documented connection to the first Campbell, or other families whose documented connection is published in their own family histories and in the collection of the CCS(NA) library. Obviously no pressure should ever be put on anyone to have their DNA tested.

Table 3 shows how this works for 25-marker match results. The figure illustrates how you can use the DNA data and documented family history in combination.

The figure assumes you are test participant A, and you want to trace your ancestry back beyond your oldest

documented ancestor MRCA1. The first step is to find a male cousin such as B in the figure to participate in the test. MRCA1 is the most recent common ancestor for the two of you. You (A) and participant B should have DNA that is a perfect 25/25 marker match because of the small number of generations between the two of you and your common ancestor.

After you have proven your DNA matches that of male cousin B, then you are ready to compare your DNA with that of other test participants to find other cousins. In Table 3, test participant A finds that his DNA is a 24 of 25 marker match with participant C. As illustrated in Table 2, this match means that A and C share most recent common ancestor MRCA2 who probably lived about 350 years ago. If test participant C has a documented ancestry back to MRCA2, then you are in luck. If not, then you at least have another Campbell with whom you can compare research notes as you both search for MRCA2.

The last example in the above figure is the match between A and D. In this case, A finds that he has a 23 of 25 marker match with test participant D. As indicated in

Table 2, the 23/25 match indicates A and D are probably related, but it also indicates their most recent common ancestor MRCA3 is farther back in the chain of Campbell males than MRCA2 -- about 570 years. Again, a fully documented ancestry between D and MRCA3 would give you a great area in which to focus your own research. Knowing the details of MRCA3 and his descendants may help you find the missing links between your own MRCA1 and MRCA3.

As more Campbell males participate in the DNA testing, the number of potential matches for your DNA increases. The more matches you find, the closer you can pin down the MRCAs for you and the matches that you find. Creating an ancestry map like the one in the figure below will help you know when you have identified each MRCA

### Conclusion

This article has attempted to introduce the concepts of DNA testing and "genetic genealogy." Although a complex topic, there a number of final points that the reader should remember:

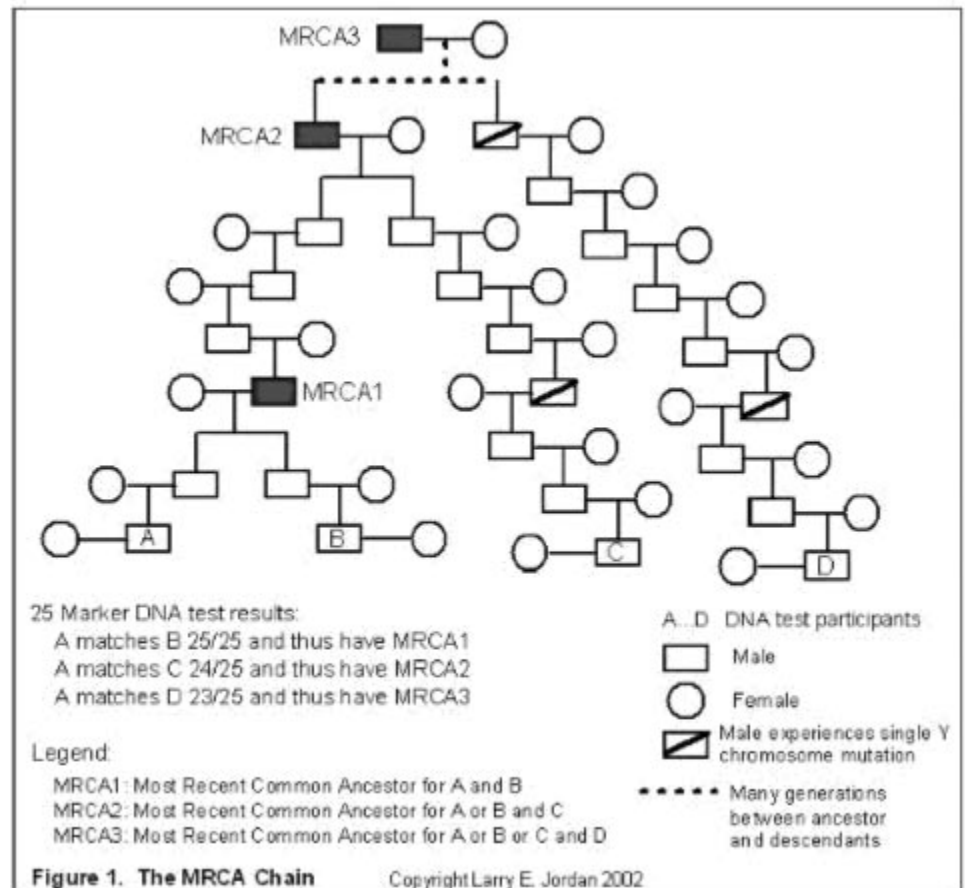


Table 3

DNA test will NOT tell you who your ancestors are. The test WILL tell if two or more participants share a common ancestor, and give you a probability of the number of generations to the Most Recent Common Ancestor

A Y-Chromosome match does NOT prove a relationship between two people. Although no evidence is ever absolutely certain, the confidence level for a 12 of 12-marker match is typically that there is less than one chance in a 1,000 that the demonstrated relationship is in error.

Even for well-documented lines you may discover many Campbell families that are your cousins that you did not know about before and learn new information and family histories that will be useful to you.

To use DNA testing to your advantage you should have a question you are trying to answer and you should choose the people to test based on the question. A broad question could be: Are the Southern US Campbell families related to the Northern US Campbell families? Here you would pick several male Campbell surnamed descendants from early Southern and Northern lines and compare the results of their tests. A narrow question would be how closely am I related to the line of the family now represented, for example, by the Earl of Breadalbane. Here you would pick two or three documented descendants of your line and compare the results of their DNA tests with that of any known descendants of the Breadalbane family, should any of them at any point choose to have their DNA

analyzed. Depending on the number of differences in their test results, you could prove or disprove your question.

We anticipate posting information concerning the Campbell DNA project on the CCSNA web site in the near future. In the mean time, here are some excellent introductions and explanations available on the web that can tell you much more about the science behind this than is possible here. For a straightforward introduction try this website (<http://freepages.genealogy.rootsweb.com/~allpoms/genetics.html>), and if you feel that you would like rather more scientific depth, try <http://www.le.ac.uk/genetics/maj4/SurnamesForWeb.pdf> or for the really brave <http://www.cstl.nist.gov/biotech/strbase/y-strs.htm>.

Additional information is also available on the FamilyTreeDNA web site at <http://www.ftdna.com>. After learning more about this topic, interested readers can sign-up for the Campbell Surname project on this site or e-mail me for additional details on this topic.

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### ***Endnotes:***

1. A complication in tracing Highland genealogy is that between the 1400s and the 1700s men's names evolved

from being 'patronymics' – Lachlan son of Donald would be Lachlan MacDonald while his son Angus in turn could be Angus MacLachlan. In this way many different genetic bloodlines were probably assimilated.

2. While DNA is a unique genetic fingerprint, DNA mutations sometimes occur that result in a difference in the father-son or mother-daughter DNA matches. Biologists believe that the likelihood of a mutation is .002 or 1-in-500 for any given father-son or mother-daughter transmission.

3. This test reflects the 25-marker test performed by FamilyTreeDNA. Other testing services may use other markers.

4. The DYS code corresponds to a specific gene. (D = DNA; Y = Chromosome; S = (STR) Single Tandem Repeats) The DYS numbering scheme (e.g. DYS388, DYS 390) for the Y-STR haplotype loci is controlled and administered by an international standards body called HUGO, Human Gene Nomenclature Committee based at the University College, London.

5. More recently, a different classification scheme has denoted this haplogroup as "R1b".

6. Atlantic Modal Haplotype (AMH), which is designated HT1.15 is defined by just 6 markers (alleles), namely DYS 19, 388, 390, 391, 392, & 393 with values of 14, 12, 24, 11, 13, & 13.

Note that the above example is a close match but not an exact match.