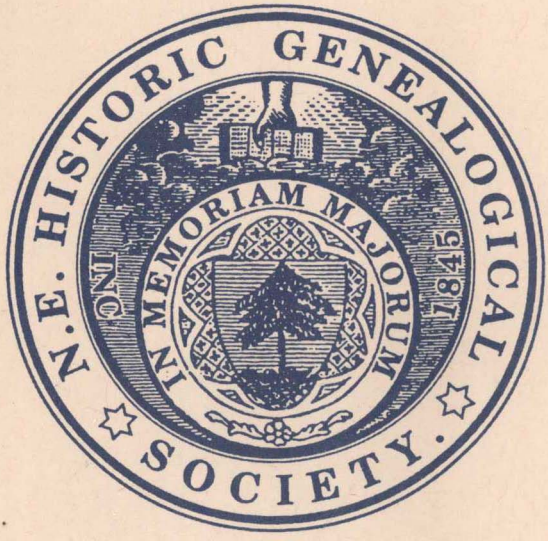
The New England Historical *and* Genealogical Register



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EDITORIAL

The issue begins with companion DNA articles by Alvy Ray Smith: **The Probable Genetic Signature of Thomas[1] Riggs, Immigrant to Gloucester, Massachusetts, by 1658**, and **The Probable Genetic Signature of Edward[1] Riggs, Immigrant to Roxbury, Massachusetts, in 1633**. These two articles combine regular genealogical research with DNA techniques to establish, with high probability, the genetic signatures of two immigrants from the DNA testing of living male descendants in genealogically distant lines. That these two immigrants were related had already been established by previous DNA testing. These two articles taken together increase the resolution and rigor of this connection, to reveal the signatures of the immigrants by removing mutations in a systematic way from those of living descendants, and to demonstrate how mutations can be used to distinguish the two related immigrant families.

In preparing **English Ancestry of Bennett Hodsoll, First Wife of Edmond[1] Freeman of Sandwich, Massachusetts**, author Richard L. Bush soon saw that Bennett Hodsoll's father had been married twice. In an effort to identify Bennett's mother, the author theorized that the name Bennett might indicate a connection to someone with the surname Bennett. This approach was successful, and he found that Bennett Hodsoll's maternal grandmother had married a man named John Bennett. A careful review of all relevant wills and the places (as well as names) mentioned therein allowed the author to reconstruct the Hodsoll family.

Annotating a brief **Hopkins Bible Record**, from the R. Stanton Avery Special Collections Department at NEHGS, led to evidence proving a line from Stephen[1] Hopkins of the *Mayflower* that was shown confusingly and tentatively in the 1948–50 Hopkins genealogy in the *Register*.

Building on a 1976 article that showed John Gay married the widow of John Borden, Eldon Wilson Gay and Christopher Challender Child demonstrate that she was **Joanna Hooker, Wife of John[1] Borden and John[1] Gay**. Their article presents what is known of Joanna's ancestry in Kent.

Richard[1] Bowen of Rehoboth, Massachusetts, left a large number of descendants, but no comprehensive genealogy is yet in print. Cherry Fletcher Bamberg has concentrated on **Nathaniel[4] and Esther (Carpenter) (Bardeen) Bowen and Their Family**, tracing their ten children and forty-six grandchildren. The oldest grandchild was a Peleg Bowen, whose adult history is unclear. The rest of this first installment treats Thomas[5] Bowen — who moved from Warren, Rhode Island, to Richmond, New Hampshire, in the late 1760s — and his twelve children and their spouses.

The place of origin in Suffolk, England, was already known for **William[A] Dwight, Father of John[1] and Timothy[1] Dwight of Dedham, Massachusetts**. Further research located William's will and that of his brother, Nicholas Dwight, providing the basis for Leslie Mahler's expanded account of the Dwight family.

In his article, **The English Origins of William[1] Whitredge of Ipswich, Massachusetts**, author David A. Whittredge presents a classic case of identifying an immigrant and his parents. The baptismal dates for William "Whitred" and his oldest son Thomas agree with their ages on a 1635 passenger list. When William was married in 1623, he was called "son of Robert," allowing the author to identify William's parents and siblings, based on Robert Whitred's will.

Immigrants arriving in New England in the eighteenth century are unlikely to have received much genealogical attention unless a descendant happens to be interested. Yet their ancestry in the British Isles may be easier to trace than that of Great Migration immigrants, since the search begins a century or more later. Such is the case presented in Ralph E. Wadleigh, Jr.'s article, **Identification of Miss Bell Traill of Kirkwall, Orkney, as Isabella (Traill) Tate of Boston, Massachusetts, with a Royal Descent**. Isabella arrived in Boston in 1760 and married there two years later. Not only did a Traill genealogy include her, but also the author inherited documents that supported the genealogy. In the course of confirming Isabella's parents and grandparents, it became apparent that her grandmothers were sisters and had royal descents, one of which is given here.

Notes on the Children of John[1] and Mary (Woods) Bellows of Concord and Marlborough, Massachusetts, by Michael W. Kearney, adds substantially to the published accounts of the Bellows family by showing that two of the children moved to New London County, Connecticut, and left descendants. These two children were Mary[2] (Bellows) (Smallbent) Rood and Nathaniel[2] Bellows.

Book reviews will resume in the July 2010 issue.

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The April editorial each year has been a convenient place to thank the many people who help with the *Register*. Associate editor **Helen Ullmann** reviews and edits all drafts of *Register* articles and does further research, as needed. Two editors are definitely better than one. Consulting editor **David Dearborn** answers my frequent phone calls for help with sources on the sixth floor of NEHGS. Other consulting editors review articles (particularly **Gary Boyd Roberts**), do research, and/or comment on articles submitted (particularly **Robert Charles Anderson** for Great Migration articles). **Julie Otto** produces excellent indexes to the *Register*.

For their help with articles, thanks are due to **Joe Anderson**, **Drew Bartley**, **Eric Grundset**, **Anita Lustenberger**, **Andrew MacEwen**, **Nancy Pexa**, **Ned Smith**, and **Alicia Williams**.

Colleagues at NEHGS continue to be responsive and supportive, especially **Lynn Betlock**, **Lynne Burke**, **Tom Champoux**, **Marie Daly**, **Anika Ebanks**, **Michael Forbes**, **Judy Lucey**, **Rhonda McClure**, **Carolyn Oakley**, **Rick Park**, **Tim Salls**, **Steven Shilcusky**, **Brenton Simons**, **Scott Steward**, **Penny Stratton**, **Josh Taylor**, **Olga Tugarina**, **Jim Viall**, **Tom Wilcox**, and **Ryan Woods**.

And we are always grateful to **Ruth Bishop** for her thoughtful and generous endowment of the *Register*.

– Henry B. Hoff

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THE PROBABLE GENETIC SIGNATURE OF THOMAS[1] RIGGS, IMMIGRANT TO GLOUCESTER, MASSACHUSETTS, BY 1658

*Alvy Ray Smith**

Genetic genealogy provides a powerful tool for easily and convincingly establishing the existence of family memberships. Once the genetic signature of an ancestor is established, a simple numeric matching test determines if a candidate is a genetic descendant of the ancestor. One can then launch an attack on the more difficult problem of determining the actual descent from the ancestor using classic genealogy with a confidence heightened by knowledge that such a descent must exist. Thus the first problem is determining the genetic signature of the ancestor.

This paper presents a methodology for establishing the genetic signatures of the founding immigrants (or any ancestor), using as exemplar Thomas[1] Riggs, who was born in Lancashire in 1633 and had settled by 1658 in Gloucester, Massachusetts. His genetic signature is formally established on 67 markers.

GENETIC GENEALOGY REVIEW

Genetic genealogy is based on the simple facts that a father passes his Y-chromosome DNA (YDNA) unchanged (except perhaps for one or more mutations) to his sons, and a mother passes her mitochondrial DNA (mtDNA) to her children of both genders but only daughters pass it on. So YDNA is passed down the male line and mtDNA down the female line (with perhaps a male at the end of the line). Here we are concerned only with YDNA and unbroken lines of male descent. Briefly, a living Riggs male carries the same YDNA as all his male Riggs ancestors (to within minor modifications due to occasional mutations).

The YDNA is a single, very lengthy molecule composed of tens of millions of chemical units called *nucleotides* (A, C, G, or T).[1] DNA technology lets us look at specific positions, called *markers*, on this long stretch of DNA. Typically a marker is a *short tandem repeat* (STR), a short sequence of nucleotides repeated numerously. For example, the first number in the genetic signature of Thomas[1] Riggs is shown here to be 12, meaning that the short nucleotide sequence AGAT was repeated 12 times in succession (tandem) at a particular location on Thomas's Y chromosome. The number (e.g., 12) is the marker's *repeat count*, often called its *value* here. Thus with a 67-marker test, the lengths of 67 different STRs are

* The author acknowledges the help of Robert Charles Anderson, FASG, and Prof. Bruce Walsh, University of Arizona, with methodology; James Dempsey, Barbara Lambert, and Bonnie J. Riggs for Riggs records; Alison Gopnik for presentation; the eight DNA contributors; and John Cardinal.

[1] For the four chemical units adenine, cytosine, guanine, and thymine from which DNA is constructed. The chemistry is immaterial to genealogy.

examined, and a string of 67 numbers is returned, being the repeat counts of the respective STRs. It is this string of numbers which constitutes a (*genetic*) *signature* (also called a *haplotype*).

A genetic signature is usually obtained from a cheek swab of a contributor's mouth. The swab is processed by a special laboratory that returns to the contributor a string of numbers comprising his signature. For genealogical purposes, only the repeat counts matter and the order in which they appear, the exact nucleotides repeated in STRs being unimportant. The ordering used is that defined by FamilyTreeDNA, which provided and processed the swabs for all tests reported.[2] Only 67-marker tests were employed here, unless otherwise indicated.

A mutation of an STR manifests as a change in repeat count by ±1 typically.[3] A mutation in a single marker is a rare event, occurring at an average rate of roughly once every 250 generations. Two signatures on 67 markers are considered a *match* by FamilyTreeDNA if at least 64 of the repeat counts match (64/67), meaning that the two persons with high probability had a *most recent common ancestor* (MRCA) within genealogical time (i.e., several hundred years).[4]

METHOD

The basic method employed can be described as pushing each marker value "up the descent tree" from living descendants, whose genetic signatures are known, toward the ancestor stopping at each branch point where a simple mutation-minimizing probability argument is applied to decide the value of the marker to be passed on up the tree. The algorithm is presented via a small example.

Suppose Thomas[1] Riggs had two sons Thomas[2] and John[2]. Suppose that Thomas[2] had sons Moses[3] and Aaron[3], and John[2] had son Jeremiah[3]. Assume the simplest case of a genetic signature consisting of only one marker. Suppose that the DNA of each of the three grandsons was sent for testing, and the results (the repeat counts, or values, for the one marker) were 12, 13, and 13 for Moses[3], Aaron[3], and Jeremiah[3], respectively. The problem is to determine the value of the marker that the ancestor Thomas[1] must have had, assuming his DNA is not accessible.[5]

The value of the marker for Thomas[2] is uncertain (but only to within ±1). Since one of his sons tested to 12 and the other to 13, Thomas[2] himself must have

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[2] See *www.familytreedna.com* (accessed 15 March 2010) for details.

[3] Larger changes happen, but rarely. This paper contains only mutations by ±1.

[4] FamilyTreeDNA computes the probability of a MRCA within 4 generations at about 90% for a 67/67 match, within 5 generations at about 95%, and within 8 generations at about 99%. This is to be compared to about 12, 14, and 18 generations, respectively, for a 64/67 match. The actual number of generations can vary slightly from these, but these are indicative. For 37 markers (the next smaller test offered by FamilyTreeDNA), a match is considered to be 35/37 or better. That these are not fixed rules will be demonstrated.

[5] The family structure is accurate, but the marker values are fictitious.

had one or the other.[6] With the given data, we cannot further determine the signature of Thomas^2 on the one marker. We have pushed 12 for Moses^3 and 13 for Aaron^3 up the tree to the branch point occupied by Thomas^2 and determined that the value of the marker for Thomas^2 was most likely 12 or 13, but cannot further choose between the two values the one that was the mutation. This uncertain value is represented by the "value" 12 or 13. This local uncertainty does not imply that the signature of Thomas^1 is undetermined, as is shown next.

The signature of John^2 is assumed simply to be that of his son. Here we have pushed 13 for Jeremiah^3 up the tree to the point occupied by John^2 and determined that John^2 (most likely) had 13 for the repeat count of the marker.

The signature for Thomas^1 is determined as follows: Since Thomas^2 must have had 12 or 13 at the one marker, and since John^2 must have had 13 there, then Thomas^1 (most likely) had 13 there by the argument that two 13s and a single mutation to 12 is more likely than one 12 and two independent mutations—in the same direction (+1)—to two 13s.

Suppose instead that Aaron^3 tested to 12 on the marker. Then Thomas^2 would have value 12 at that marker because both sons tested to 12.[7] Hence Thomas^1 would have value 12 (pushed up from Thomas^2) or 13 (pushed up from John^2). That is, the value of the marker for Thomas^1 would be uncertain, but the uncertainty is only between the two values.

The following two rules capture the operations at each point in a descent tree, working from the descendants toward the ancestor, as in the examples above:[8]

1. A father with only one son (no branching) is assumed to have the same marker value as his son. If the son's marker value is (un)certain, then so is the father's.

2. A father at a branch point is assumed to have the value derived from the values of his sons that minimizes mutation probabilities. If this is (un)certain, then the father's value is (un)certain.[9]

Repeated application of these rules for all 67 markers of actual DNA contributors' signatures pushed up through the descent tree of Thomas^1 Riggs will yield the probable genetic signature for him. The "probable" is required because of the off-chance that Mother Nature chose the more unlikely events.[10]

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[6] There is a rare possibility that he had neither, that there was an independent mutation at the procreation of each son.

[7] Strictly speaking, he might have had two mutations that were exactly the same at the procreation of his two sons, but both mutations being the same would be even more unexpected (i.e., improbable) than that there were two mutations, itself a rare event.

[8] The method used here is called the method of maximum parsimony (fewest number of mutations required to explain a change) [Joseph Felsenstein, *Inferring Phylogenies* (Sunderland, Mass.: Sinauer Associates, 2004), 1–9].

[9] All branching nodes in this paper have only two sons, but rule 2 is worded to handle two or more. If an uncertainty has three possible values, say, then the uncertain value would be 11 or 12 or 13, for example, and so forth for even more sons.

[10] Or that one or more of the rare mutation events described in the preceding notes did actually occur. Also in the class of rare possibilities considered unlikely is a marker that mutated

In this paper the genetic signature of Thomas[1] Riggs is established on 65 markers with the remaining two markers established to within two values each, differing by only 1 in both cases. The uncertain markers serve to distinguish subfamilies of Thomas[1] Riggs, a positive contribution of mutations.

Specifically, the following descents are established using classic genealogy. Under each person's lineage list is his YDNA test result on 67 (or 37) markers,[11] using the code a = 1, b = 2, . . . , z = 26, A = 27, B = 28, . . . , Z = 52 for repeat counts to save space. Doubly underlined letters mark departures of an individual's signature from the Thomas[1] Riggs signature established in the final section:

A Riggs[12] (*Leonard Emery*[9], *William Wyman*[8], *George W.*[7], *Elias G.*[6], *Gowen*[5], *Aaron*[4], *Moses*[3], *Thomas*[2–1]):
lxnknpllkmmCsijkkyosCopqqkjswooqrKLllkiophjjhjjluwpjllohlwtmlkmkkll

B Riggs (*Francis Porter*[8], *Fitz B.*[7], *Aaron*[6], *Joshua*[5], *Aaron*[4–3], *Thomas*[2–1]):
lxnknpllmmCsijkkyosCoqpqkjswooqrKLllkiophjjhjjluwpjllohlwtmlkmkkll

C Riggs (*Don Albert*[10], *Albert Smith*[9], *Robert Ensign*[8], *Azial Litchfield*[7], *Amasa*[6], *John*[5–4], *Jonathan*[3], *John*[2], *Thomas*[1]):
lxnknpllmmCsijkkyosCopqqkjswoorrKLml

The first two contributors are descendants of Thomas[2] Riggs, their MRCA. Since the last contributor is a descendant of John[2] Riggs, the MRCA of all three was Thomas[1] Riggs, so it is his genetic signature that is derived here.

Register format is used for proofs of the descents, stripped to the bare essentials, and falling short of a full genealogy by any measure. Only the sons necessary for the descents are listed. Death records are usually omitted. In cases of multiple wives, only those are presented who are mothers relevant to the descents being proved, and few details of them are provided, just enough to assist in proving father-son descent in this strictly male-line analysis. Statements of parentage have been omitted since the sources cited vary, for instance, as to whether mothers are named, either with or without maiden names.

Proofs of Descent

1. Thomas[1] Riggs was born probably in March 1632/3, baptized shortly thereafter in Hawkshead, Lancashire, England, 25 March 1633. He died in Gloucester, Massachusetts, 26 February 1721/2, aged about 90 years. He married in Gloucester 7 June 1658, **Mary Millett**.[13] The first volume of Gloucester town records contains this property transaction: "[1704] Thomas Riggs se[nior]

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one direction, then mutated back the other direction to its original value. The title's "probable" is dropped henceforth but should be remembered for all these reasons.

[11] It will be shown that no information is lost in this particular study using only 37 markers.

[12] Name, dates, and mother's maiden name of living persons are suppressed, but reviewers had full data.

[13] Alvy Ray Smith and Robert Charles Anderson, "Proposed Hawkshead, Lancashire, Origins of Edward[1] Riggs of Roxbury, Massachusetts, and Thomas[1] Riggs of Gloucester," *The American Genealogist* 82 (2007):120–29.

claimed 5 comon rights 1 he have son Tho Riggs 1 to son John Riggs 1 to son in Law Nathanael Wharff 2 reserve [p. 285]."[14]

Sons [this line omitted hereafter]:

2 i. THOMAS[2] RIGGS, b. Gloucester 7 Dec. 1666.
3 ii. JOHN RIGGS, b. Gloucester 25 Feb. 1669/70.

2. THOMAS[2] RIGGS (*Thomas*[1]) was born in Gloucester 7 December 1666, and married **ANN WHEELER**.[15] Thomas's will mentions "my two Sons Aaron and Joshua Riggs" and "the heirs of my son Moses Riggs decd."[16]

4 i. MOSES[3] RIGGS, b. Gloucester 31 March 1698.
5 ii. AARON RIGGS, b. Gloucester 18 Jan. 1700/1.

3. JOHN[2] RIGGS (*Thomas*[1]) was born in Gloucester 25 February 1669/70, and married **RUTH WHEELER**.[17]

6 i. JONATHAN[3] RIGGS, b. Gloucester 20 Dec. 1700.

4. MOSES[3] RIGGS (*Thomas*[2–1]) was born in Gloucester 31 March 1698, and married **MERCY GOWEN**.[18]

7 i. AARON[4] RIGGS, b. say 1735.

5. AARON[3] RIGGS (*Thomas*[2–1]) was born at Gloucester 18 January 1700/1, and married **ANNA[3] RIGGS**.[19]

8 i. AARON[4] RIGGS, b. Gloucester 18 March 1749/50.

6. JONATHAN[3] RIGGS (*John*[2], *Thomas*[1]) was born at Gloucester 20 December 1700, and married **SARAH PHIPPS**.[20]

9 i. JOHN[4] RIGGS, b. Gloucester 6 May 1749.

7. AARON[4] RIGGS (*Moses*[3], *Thomas*[2–1]) born say 1735,[21] was probably the aged Aaron Riggs who died at the workhouse in Gloucester 26 August 1811.[22] He

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[14] As transcribed into "City of Gloucester Archives, Names & Property of Early Settlers 1642–1714/15, Compiled from 1850 Transcript of First Volume of Gloucester Town Records," Phillips Library, Peabody–Essex Museum, 59–60.

[15] *Vital Records of Gloucester, Massachusetts, to the End of the Year 1849*, vol. 1, births (Topsfield, Mass.: Topsfield Historical Society, 1917), vols. 2 and 3, marriages and deaths (Salem, Mass.: Essex Institute, 1923–24), 1:584, 2:455, for birth and marriage, respectively.

[16] Essex County Probate, 334:102–04, dated 27 September 1750, proved 18 October 1756.

[17] *Vital Records of Gloucester* [note 15], 1:580, 2:453.

[18] Ibid., 1:582, 2:455.

[19] Ibid., 1:577, 2:452. Anna was Aaron's cousin.

[20] Ibid., 1:581, 2:454.

[21] Moses and Mercy Riggs had four children born or baptized in 1727, 1729, 1731, and 1733 (ibid., 1:580–82, 584).

married **RACHEL** _____, who was born about 1737, and died at the same workhouse 7 March 1813, aged about 75.[23] That Aaron[4] was son of Moses[3] Riggs is based onomastically on his naming two of his children Mercy and Gowen, the first and last names of the wife of Moses[3], surely his mother.[24] Furthermore, her maiden surname Gowen was common in the descent through son Gowen[5] and nowhere else in the extensive family of Thomas[1] Riggs.[25]

10 i. GOWEN[5] RIGGS, b. Gloucester 5 Sept. 1756.

8. AARON[4] RIGGS (*Aaron*[3], *Thomas*[2–1]) was born in Gloucester 18 March 1749/50, and married **MARTHA ADAMS**.[26]

11 i. JOSHUA[5] RIGGS, b. Gloucester 22 March 1785.

9. JOHN[4] RIGGS (*Jonathan*[3], *John*[2], *Thomas*[1]) was born in Gloucester 6 May 1749,[27] and married **SARAH WOODARD**.[28]

12 i. JOHN[5] RIGGS, b. Attleborough, Mass., 2 Jan. 1772.

10. GOWEN[5] RIGGS (*Aaron*[4], *Moses*[3], *Thomas*[2–1]) was born at Gloucester 5 September 1756,[29] and married **ELIZABETH GOVE**.[30] Widow Elizabeth Riggs was appointed guardian of the minor children of Gowen Riggs on 8 January 1806, including Elias, over 14.[31]

13 i. ELIAS G.[6] RIGGS, b. Edgecomb, Maine, 27 July 1790.

11. JOSHUA[5] RIGGS (*Aaron*[4–3], *Thomas*[2–1]) was born in Gloucester 22 March 1785, and married **THOMAZINE/TAMMY GROVER**.[32]

14 i. AARON[6] RIGGS, b. Gloucester Sept. 1818.

12. JOHN[5] RIGGS (*John*[4], *Jonathan*[3], *John*[2], *Thomas*[1]) was born in Attleborough, Massachusetts, 2 January 1772, [33] and married **SARAH SHURTLEFF**.[34]

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[22] Ibid., 3:256, 258; John James Babson, *Notes & Additions to the History of Gloucester. Part First: Early Settlers* (Gloucester, Mass.: M. V. B. Perley, 1876), 61.

[23] *Vital Records of Gloucester* [note 15], 1:580, 583, 3:258.

[24] Ibid., 1:580, 582.

[25] Based on a scholarly genealogy of the Thomas[1] Riggs family of 552 pages and 10 generations: Alvy Ray Smith, *Thomas Riggs (1633–1722) of Gloucester, Massachusetts, and His Descendants to 2006*, at *alvyray.com/Riggs/vol5/ThomasRiggs5_v5.2.pdf*, electronically published 21 December 2009.

[26] *Vital Records of Gloucester* [note 15], 1:578; 2:452.

[27] Ibid., 1:581; Bristol County, Massachusetts, Probate, 126:218, 324.

[28] *Vital Records of Attleborough, Massachusetts, to the End of the year 1849* (Salem, Mass.: Essex Institute, 1934), 538.

[29] *Vital Records of Gloucester* [note 15], 1:580.

[30] Edgecomb, Maine, Town and Vital Records, 249 [FHL 0,010,845].

[31] Lincoln County, Maine, Probate, 9:262.

[32] *Vital Records of Gloucester* [note 15], 1:581; 2:454.

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15 i. AMASA[6] RIGGS, b. Montgomery, Mass., 9 Oct. 1797.

13. ELIAS G.[6] RIGGS (*Gowen*[5], *Aaron*[4], *Moses*[3], *Thomas*[2–1]) was born in Edgecomb, Maine, 27 July 1790.[35]

In 1830 Elias "Rigs," 40–50, resided in Sunkhaze, Maine, with children including one male under 5.[36] In 1840 Elias Riggs, 40–50, resided in Greenbush, Maine, with children including one male 10–15.[37] In 1850 Elias G. Riggs, 59, born in Maine, resided in Greenbush with George W., 21, born in Maine.[38]

16 i. GEORGE W.[7] RIGGS, b. Bangor, Maine, 16 July 1828.

14. AARON[6] RIGGS (*Joshua*[5], *Aaron*[4–3], *Thomas*[2–1]) was born in Gloucester September 1818, and married **LEONORA AMANDA SEAVEY**.[39]

17 i. FITZ B.[7] RIGGS, b. Gloucester 16 June 1855.

15. AMASA[6] RIGGS (*John*[5–4], *Jonathan*[3], *John*[2], *Thomas*[1]) was born in Montgomery, Massachusetts, 9 October 1797,[40] and married **MARVILLA LITCHFIELD**.[41]

18 i. [A]ZIAL LITCHFIELD[7] RIGGS, b. Mass. 4 Nov. 1824.

16. GEORGE W.[7] RIGGS (*Elias G.*[6], *Gowen*[5], *Aaron*[4], *Moses*[3], *Thomas*[2–1]) was born in Bangor, Maine, 16 July 1828, and married **LOUISA PRATT**.[42]

In 1860 George W. Riggs, 31, born in Maine, resided in Greenbush, Maine, with Louisa, 24, and four children including William W., 4, born in Maine. In an adjacent dwelling was Elias G. Riggs, 69, born in Maine.[43]

19 i. WILLIAM WYMAN[8] RIGGS, b. Greenbush 3 May 1855.

17. FITZ B.[7] RIGGS (*Aaron*[6], *Joshua*[5], *Aaron*[4–3], *Thomas*[2–1]) was born in Gloucester 16 June 1855,[44] and married **ADA P. SWIM**.[45]

In 1900 Fitz B. Riggs, born July 1855 in Massachusetts, resided in Gloucester with his wife of 20 years, Ada P., and three children including "Frances" P., 11, born January 1889 in Massachusetts.[46]

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[33] *Vital Records of Attleborough* [note 28], 219.
[34] *Vital Records of Montgomery, Massachusetts, to the Year 1850* (Boston: NEHGS, 1902), 51.
[35] Greenbush, Maine, Family Records [FHL 0,010,924 Item 1], family of Elias G. Riggs.
[36] 1830 U.S. Census, Sunkhaze, Penobscot County, Maine, roll 51, p. 485.
[37] 1840 U.S. Census, Greenbush, Penobscot County, Maine, roll 149, p. 163.
[38] 1850 U.S. Census, Greenbush, roll 266, p. 276.
[39] *Vital Records of Gloucester* [note 15], 1:578; 2:452.
[40] *Vital Records of Montgomery* [note 34], 28.
[41] Westfield, Hampden County, Mass., Births, Marriages and Deaths, D:119 [FHL 0,185,474].
[42] Greenbush Family Records [note 35], families of Elias G. Riggs, George W. Riggs, and Herrimin Pratt.
[43] 1860 U.S. Census, Greenbush, Penobscot County, Maine, roll 445, "Page No. 29."
[44] Massachusetts Vital Records from 1841, 90:166.
[45] Massachusetts Vital Records from 1841, Gloucester Marriages, 307:172.

20 i. FRANCIS PORTER[8] RIGGS, b. Gloucester 31 Jan. 1889.

18. [A]ZIAL LITCHFIELD[7] RIGGS (*Amasa*[6], *John*[5–4], *Jonathan*[3], *John*[2], *Thomas*[1]) was born in Massachusetts 4 November 1824,[47] and married **EMELINE EUGENE KNOX**.[48]

21 i. ROBERT ENSIGN[8] RIGGS, b. Mass. 21 Sept. 1851.

19. WILLIAM WYMAN[8] RIGGS (*George W.*[7], *Elias G.*[6], *Gowen*[5], *Aaron*[4], *Moses*[3], *Thomas*[2–1]) was born in Greenbush, Maine, 3 May 1855,[49] and was buried in Kingfield, Maine, next to his wives and sons, including Leonard Emery.[50] William married **MARY ELIZABETH STREETER**.[51]

22 i. LEONARD EMERY[9] RIGGS, b. Maine 13 Feb. 1899.

20. FRANCIS PORTER[8] RIGGS (*Fitz B.*[7], *Aaron*[6], *Joshua*[5], *Aaron*[4–3], *Thomas*[2–1]) was born in Gloucester 31 January 1889,[52] and married **MARGERY** _____ [wife's maiden name suppressed].

i. B[9] RIGGS [living].

21. ROBERT ENSIGN[8] RIGGS (*Azial Litchfield*[7], *Amasa*[6], *John*[5–4], *Jonathan*[3], *John*[2], *Thomas*[1]) was born in Massachusetts 21 September 1851, and died in Teton, Fremont County, Idaho, 9 November 1933. He married **AGNES SMITH**.[53]

23 i. ALBERT SMITH[9] RIGGS, b. Idaho 1 Jan. 1890.

22. LEONARD EMERY[9] RIGGS (*William Wyman*[8], *George W.*[7], *Elias G.*[6], *Gowen*[5], *Aaron*[4], *Moses*[3], *Thomas*[2–1]) was born in Maine 13 February 1899,[54] and married **LOUISA** _____.[55]

i. A[10] RIGGS [living].

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[46] 1900 U.S. Census, Gloucester, Essex County, Massachusetts, roll 641, p. 239, sheet 24B.

[47] *Utah Cemetery Inventory*, on *Ancestry.com* (all accesses to *Ancestry.com* made 22 April 2009), Zial Litchfield Riggs; *Windows of Wellsville, 1856–1984* (Providence, Utah: Wellsville History Committee, 1985), 662, Azial Riggs.

[48] Granby, Hartford County, Connecticut, Town Records [FHL 1,317,454 Item 3], 1:48.

[49] Greenbush Family Records [note 35], in list titled "George W. Riggs and family."

[50] *Riverside Cemetery, Kingfield, Maine*, on *www.rootsweb.com/~mefrankl/rvsdkcem.htm* (accessed 22 April 2009).

[51] *Maine Marriages, 1892–1996,* on *Ancestry.com* [citing FHL 0,010,357, by bride].

[52] Massachusetts Vital Records from 1841, Births, 394:248.

[53] Shauna C. Anderson, Christina T. Anderson, Carol A. Duncan, and Ray D. Duncan, *Records of Persons Buried in the Teton-Newdale Cemetery* (Provo, Utah: S. C. Anderson, 1997–1998), 53.

[54] *World War I Draft Registration Cards, 1917–1918*, on *Ancestry.com* [citing FHL 1,653,907], Leonard Emery Riggs, nearest relative Elizabeth Mary [*sic*] Riggs.

[55] Information provided by a living person; source suppressed.

23. ALBERT SMITH[9] RIGGS (*Robert Ensign*[8], *Zial Litchfield*[7], *Amasa*[6], *John*[5–4], *Jonathan*[3], *John*[2], *Thomas*[1]) was born in Idaho 1 January 1890, and died in Teton, Idaho, 19 August 1949. He married **IRIS NANCY SIMPSON**.[56]

24 i. DON ALBERT[10] RIGGS, born Idaho 10 April 1920.

24. DON ALBERT[10] RIGGS (*Albert Smith*[9], *Robert Ensign*[8], *Zial Litchfield*[7], *Amasa*[6], *John*[5–4], *Jonathan*[3], *John*[2], *Thomas*[1]) was born in Idaho 10 April 1920. He died 5 June 1976 and was buried in Teton.[57] [Wife's name suppressed].

i. C[11] RIGGS [living].

GENETIC SIGNATURE OF THOMAS[1] RIGGS

To simplify the derivation of the signature of Thomas[1] Riggs, notice that all three signatures of the contributors agree at 32 of the first 37 markers. The rightmost 30 markers of the two 67-marker signatures are identical, so it is safe to assume that the one 37-marker signature would probably also match on these 30 markers.[58]

Because of an anomaly in the testing process, the four markers 22-25 often must be reordered for maximum matching.[59] Thus values oopq for these markers from contributor B are (minimally) rearranged to opoq for maximum matching with A's and C's opqq. Therefore Thomas[1]'s signature is already determined at 63 of 67 markers (a comma represents an initially undetermined marker):

lxnknpll,mmCsijkkyosCop,qkjswoo,rKL,lkiophjjhjjluwpjllohlwtmlkmkkll.

So a contributor's signature will be represented at the four problematic markers only, at locations 9, 24, 32, and 36, respectively, as shown here:

A: k q q l
B: l o q l
C: l q r m

Consider marker 9. Apply rule 1 from the method section to push the k up the descent tree from the living descendant A to Moses[3] and the l up the tree from B to Aaron[3], sons of the MRCA of A and B, Thomas[2]. Apply rule 2 to Thomas[2] to determine that marker 9 most likely had value {kl} (read "k or l") for him.

Use rule 1 to push the l from C up the tree to John[2]. Then apply rule 2 to Thomas[1] to determine that marker 9 most likely had value l in his signature. Given a {kl} from Thomas[2] and an l from John[2], the logic of maximum parsimony

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[56] *Records of Persons Buried in the Teton-Newdale Cemetery* [note 53], 52.

[57] Ibid.

[58] This claim is strongly supported by five additional signatures subsequently presented.

[59] These four markers (officially DYS 464a, b, c, and d) are always reported in order of increasing value, not in the fixed order assumed by the algorithm here. Accepted practice for comparing them between contributors is to reorder them for maximum pairwise marker matches, in as few steps as possible, and so that the final result for them from the algorithm is in order of increasing value.

argues for only one mutation, l to k, rather than two independent mutations (in the same direction yet).

Repeat the above algorithm for the other three problematic markers to get this sequence of values in location order: lq{qr}{lm}, where the value {qr}, for example, means that the data is insufficient for deciding between values q or r.

Reinserting these four values yields the following 67-marker signature as that most likely to have been the genetic signature of the immigrant Thomas[1] Riggs:

lxnknpllllmmCsijkkyosCopqqkjswoo{qr}rKL{lm}lkiophjjhjjluwpjllohlwtmlkmkkll.

Let this signature be formally known as the "Thomas[1] Riggs modal signature," where it is noted that the curly braces at markers 32 and 36 indicate uncertainties as to which value Thomas[1] must have had at those locations. A companion paper proves that they resolve to q and l, respectively.[60]

As a measure of robustness of the derived signature, consider the following five proved descents, the proofs of which are omitted for brevity:

D Riggs (*Arthur Norton*[9–8], *John Gowen*[7], *Gowen*[6–5], *Aaron*[4], *Moses*[3], *Thomas*[2–1]):
lxnlnpllllmmCsijkkyosCopqqkjswooqrKLllkiophjjhjjluwpjllohlwtmlkmkkll

E Riggs (*Homer Chase*[9], *Daniel Burnham*[8], *Solomon A.*[7], *Asa*[6], *Aaron*[5–4], *Moses*[3], *Thomas*[2–1]):
lxnknpllllmmCtijkkyosCopqqkjswooqrLLllkiophjjhjjluwpjllohlwtmlkmkkll

F Riggs (*John Edward*[9-8], *George B.*[7], *John*[6–5], *Aaron*[4–3], *Thomas*[2–1]):
lxnknpllllmmCsijkkyosCopqqkjswooqqKLllkiophjjhjjluwpjllohlwtmlkmkkll

G Riggs (*Ursel*[9], *Robert Ensign*[8], *Azial Litchfield*[7], *Amasa*[6], *John*[5–4], *Jonathan*[3], *John*[2], *Thomas*[1]):
lxnknpllllmmCtijkkyosCopqqkjswoorrKLmlkiophjjhjjluwpjllohlwtmlkmkkll

H Riggs (*Burns Broadbent*[10], *John Ensign*[9], *Brigham Adelbert*[8], *John Ensign*[7], *Amasa*[6], *John*[5–4], *Jonathan*[3], *John*[2], *Thomas*[1]):
lwnknpllllmmCrijkkyosCppqqkjswoorrKKmlkiophjjhjjluwpjllohlwtmlkmkkll[61]

These five signatures do not change the derived signature for Thomas[1] Riggs nor do they resolve the two uncertainties. The reader can check that removal of any one of the three contributors A, B, or C from the derivation results in a more uncertain, if not misleading, signature for the immigrant Thomas[1] Riggs.

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[60] Alvy Ray Smith, "The Probable Genetic Signature of Edward[1] Riggs, Immigrant to Roxbury, Massachusetts, in 1633," *Register* 164 (2010):95–103. So mutation values r and m on markers 32 and 36 indicate the subfamily of Amasa[6] Riggs.

[61] This signature proves to be a 61/67 match to Thomas[1] Riggs, which although highly unusual, demonstrates that a 64/67 or better match is not a definite requirement for descent, just a strong indicator.

THE PROBABLE GENETIC SIGNATURE OF EDWARD[1] RIGGS, IMMIGRANT TO ROXBURY, MASSACHUSETTS, IN 1633

Alvy Ray Smith[*]

The genetic, or Y-chromosome DNA, signature of Edward[1] Riggs, a 1633 immigrant in the Great Migration[1] to Roxbury, Massachusetts, is formally established on 67 markers.[2] The importance of the signature of Edward[1] Riggs, or any immigrant (or any ancestor for that matter), is that a simple matching test against it determines whether a living male is a direct male-line descendant.[3]

Another use of signatures is determination of relationships, or lack thereof, between immigrants (or ancestors) of the same surname. This paper is a companion to one that established the genetic signature of Thomas[1] Riggs, also a 17th-century immigrant to Massachusetts.[4] A surprising finding is that Thomas[1] and Edward[1] Riggs must have been related during genealogical time,[5] despite neither (sub)family of descendants having been aware of it.[6] The relationship is formally established here and used not only to complete the derivation of the signature of Edward[1] Riggs but also to determine the two markers in the signature of Thomas[1] Riggs left unresolved in the companion paper. A review of genetic genealogy theory and practice appears in the companion paper, hence is not repeated here.

METHOD

The basic method employed[7] can be described as pushing each marker value—i.e., the marker's repeat count—"up the descent tree" from living

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[*] The author acknowledges the help of Robert Charles Anderson, FASG, and Prof. Bruce Walsh, University of Arizona, with methodology; and the four DNA contributors.

[1] Robert Charles Anderson, *The Great Migration Begins: Immigrants to New England, 1620–1633*, 3 vols. (Boston, NEHGS, 1995), 3:1583–85, Edward Riggs.

[2] Alvy Ray Smith, "The Y-DNA Signature of Edward Riggs of Roxbury," *New England Ancestors* 6:3 (Summer 2005):46–48, presents Edward's genetic signature on 25 markers only, and does not prove the descents necessary to establish it rigorously.

[3] Strictly speaking, a matching test is definitive if negative—a mismatch implies non-descendancy—whereas a positive match means that the living male is a descendant of the putative ancestor *or* both descend from a common ancestor.

[4] Alvy Ray Smith, "The Probable Genetic Signature of Thomas[1] Riggs, Immigrant to Gloucester, Massachusetts, by 1658," *Register* 164 (2010):85–94.

[5] Roughly, that relatively recent human history of several centuries during which genealogical records have been kept more-or-less continually. Genealogical time is definitely less than historical time, and minute compared to biological time.

[6] Alvy Ray Smith and Robert Charles Anderson, "Proposed Hawkshead, Lancashire, Origins of Edward[1] Riggs of Roxbury, Massachusetts, and Thomas[1] Riggs of Gloucester," *The American Genealogist* 82 (2007):120–29.

[7] Called the method of maximum parsimony (fewest number of mutations required to explain a change); see Joseph Felsenstein, *Inferring Phylogenies* (Sunderland, Mass.: Sinauer Associates, 2004), 1–9. A tutorial example appears in the companion paper.

descendants, whose genetic signatures are known, toward the ancestor, applying at each person a simple mutation-minimizing probability argument to decide the value of the marker to be passed on up the tree. The algorithm consists of repeated applications of the following two rules at each point in a descent tree, working from the descendants up the tree toward the ancestor:

1. A father with only one son (no branching) is assumed to have the same marker value as his son. If the son's marker value is (un)certain, then so is the father's.
2. A father at a branch point is assumed to have the value derived from the values of his sons that minimizes mutation probabilities. If this is (un)certain, then the father's value is (un)certain.

The approach adopted in the companion paper is to "triangulate" on the signature of Thomas[1] Riggs using genetic evidence from living descendants as widely separated, genealogically speaking, as possible—namely descendants from two sons of Thomas[1] Riggs. That approach cannot be used here because Edward[1] Riggs had only one son reaching maturity, Edward[2] Riggs (also an immigrant to Roxbury in 1633). The actual approach taken is to establish the signature of Edward[2] by triangulation and push it, with rule 1, up the tree to Edward[1]. This results in two uncertainties in Edward[1]'s signature, which are resolved by applying the rules above *outside* Edward[1]'s direct family, using the Thomas[1] Riggs signature derived in the companion paper.[8] Happily this technique also resolves two uncertainties that remained in Thomas[1]'s signature in the companion paper.

The following two descents are established using classic genealogy. Under each is that person's YDNA test result on 67 markers.[9] The doubly underlined letters mark departures of an individual's signature from the Edward[1] Riggs signature established in the final section:

A Riggs (*Samuel Homer*[10], *Charles Oral*[9], *Samuel Davis*[8], *Ransom*[7], *Jeremiah*[6], *Ebenezer*[5–4], *Samuel*[3], *Edward*[2–1]):
lxnknpIIImmCsijkkyosCooqqkjswooqrKLIIkiophjjhkjluwpjIlohlwtmlkmkkII

B [Frederick Wheeler[11]] Riggs (*Frederick Wheeler*[10], *Joseph Cowles*[9], *Norman*[8], *Joseph*[7], *Miles*[6–5], *Joseph*[4], *Edward*[3–1]):
lxnknpIIImmCsijkkyosCoo<u>q</u>qkjswooqr<u>J</u>LIIkiophjjhkjluwpjIlohlwtmlkmkkII

Contributors A and B have Edward[2] Riggs as their MRCA (most recent common ancestor), so they are used to establish the probable genetic signature of Edward[2], which is then extended to Edward[1]. The genealogical proofs below have only enough detail to prove father-son descent at each generation. Statements of

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[8] This is known as use of an outgroup to root a tree (Felsenstein, *Inferring Phylogenies* [note 7], 4; Wikipedia, Phylogenetic tree, at *en.wikipedia.org/wiki/Phylogenetic_tree*).

[9] Using the space-saving code for repeat counts: a = 1, . . . , z = 26, A = 27, . . . , Z = 52, and the ordering established by the testing company FamilyTreeDNA. See *www.familytreedna.com* (accessed 15 March 2010) for details. The letter notation permits the use of the notation {qr} to mean the value "q or r", for example, in case of uncertainty.

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