"An Extravagant Assumption": The Demographic Numbers behind Benjamin Franklin's Twenty-Five-Year Doubling Period

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BENJAMIN FRANKLIN'S 1751 essay *Observations concerning the Increase of Mankind* is well known to have influenced nearly a century of demographers and social philosophers. Though the essay's central topic was the interrelationship between population growth and subsistence, it was Franklin's novel proposal of a twenty-five-year doubling period for the colonial American population—a figure decidedly more vigorous than "old settled countries" could claim—that intrigued demographers and was cited repeatedly for succeeding decades. Furthermore, Franklin's twenty-five-year doubling period subsequently proved to be uncannily accurate into the nineteenth century. Unaccountably, however, Franklin never explained the source of his estimate, perplexing historians and even leading some to propose that it was simply a lucky guess. Herein we propose an explanation for the origin of Franklin's inscrutable number, showing that it can be arithmetically derived from the population figures he published in *Poor Richard Improved* for 1750 and 1754, and suggesting his methods, though he never "showed his work." These findings lend substance to an often suspected, but never demonstrated, connection between the Poor Richard data and the enigmatic twenty-five-year doubling period of the *Observations concerning the Increase of Mankind*.

Introduction

Historians of colonial American science have often noted that until well into the eighteenth century the current of intellectual influence ran almost

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exclusively in one direction, from England to America. Prior to that, though several talented American virtuosi provided materials worthy of publication in the Royal Society's prestigious *Philosophical Transactions*,[2] their contributions were not widely influential, and offered little counterbalance to the current of learned discussion that flowed westward from England, constituting essentially a one-way transatlantic conversation.

This, however, changed abruptly after Benjamin Franklin joined the discussion in the mid-1740s. With a now historic series of letters between 1747 and 1752 reporting to the Royal Society his experimental findings in the new science of electricity, Franklin virtually singlehandedly placed America on the scientific map with contributions that were original, fundamental, and widely influential. While his seminal contributions to electrical science are now widely known and extensively chronicled,[3] it is little known that during the same very productive hemidecade, 1747–52, Franklin also pursued a parallel interest in the equally new science of population statistics, then called "political arithmetick." Both sciences—electricity and political arithmetic—had emerged anew and almost simultaneously during the scientific Great Instauration of the preceding century, rapidly generating lively interest among natural philosophers. As Franklin's eighteenth century opened, though both sciences were the subjects of energetic study, electricity remained poorly understood and without practical application, whereas political arithmetic was flourishing in a wide array of useful applications, including medicine, public health, governance, and statecraft.

As political arithmeticians advanced their methods for "numbering the people," the new science focused attention upon the importance of populousness, long recognized as the key to the strength and vigor of nations. Consequently, as populousness became a leading desideratum in statecraft, political arithmetic became a potent catalyst of social and political thought. Political arithmeticians (demographers, in modern

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[2] No fewer than thirty-five contributions by colonial American scholars and scientists—such as Cotton Mather, Zabdiel Boylston, James Logan, and John Lining—were published in the *Philosophical Transactions* prior to 1750. The subjects comprised a broad array of natural sciences: geology, astronomy, zoology, botany, medicine, and meteorology.

[3] This area of Franklin historiography was spearheaded by I. Bernard Cohen, whose studies still dominate the field. See particularly idem, *Benjamin Franklin's Experiments: A New Edition of Franklin's "Experiments and Observations on Electricity"* (Cambridge, Mass.: Harvard University Press, 1941); *Franklin and Newton: An Inquiry into Speculative Newtonian Experimental Science and Franklin's Work in Electricity as an Example Thereof* (Philadelphia: American Philosophical Society, 1956); *Benjamin Franklin's Science* (Cambridge, Mass.: Harvard University Press, 1990). See also Joyce Chaplin, *The First Scientific American: Benjamin Franklin and the Pursuit of Genius* (New York: Basic Books, 2006).

usage) studied and discussed a growing array of population dynamics and their political, economic, and social interplay—the effect of population on land value, wages, manufactures, and trade; the effects of state policy on families and reproduction, and hence on population growth; and the apparent variations in salubrity and growth capacity of differing geographies and nations,[4] the latter customarily expressed as the "doubling period," the time required for a particular population to double itself.

Early in the eighteenth century yet another factor sharpened interest in political arithmetic.[5] It became suspected by British demographers that for reasons unknown birth rates were lagging considerably behind child-bearing capacity,[6] raising serious questions about whether the populations of England, the Continent, and, indeed, the world, were actually increasing or decreasing. Thus *de*population as a social and demographic issue became a subject of active discussion toward the mid-eighteenth century, encompassing not only arithmetical methods, but political, social, biological, and moral issues as well.[7] By some, the fate of mankind was feared to be in the balance, a concern that generated urgent and escalating debate among political arithmeticians and social philosophers toward the close of the century.[8]

In the 1740s Franklin became deeply interested in these population questions, particularly as he began to perceive that the American colonies appeared to possess their own distinctive, comparatively favorable properties of number and growth. Although he himself was not initially involved in the ongoing population controversies of distant Britain, his evolving thoughts on the subject, under specific circumstances to be discussed below, formed the subject of an essay written in 1751, *Observations concerning the Increase of Mankind, Peopling of Countries,*

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[4] Alan Houston, *Benjamin Franklin and the Politics of Improvement* (New Haven and London: Yale University Press, 2008), 116–22.

[5] The impetus for the ensuing eighteenth-century concern about depopulation is commonly ascribed to Montesquieu's 1721 *Lettres Persanes*. See Andrea Rusnock, *Vital Accounts: Quantifying Health and Population in Eighteenth-Century England and France* (Cambridge: Cambridge University Press, 2002), 179–81.

[6] R. R. Kuczynski, "British Demographers' Opinions on Fertility, 1660 to 1760," in *Political Arithmetic. A Symposium of Population Studies*, ed. Lancelot Hogben, 283 (London: George Allen & Unwin, 1938); Harald Westergaard, *Contributions to the History of Statistics* (New York: Augustus M. Kelley, 1969 [1932]), 84.

[7] Rusnock, "The Depopulation Debates," chap. 7 in idem, *Vital Accounts,* 179–209.

[8] E. P. Hutchinson, *The Population Debate: The Development of Conflicting Theories up to 1900* (Boston: Houghton Mifflin Co., 1967), chaps. 5–7; Rusnock, *Vital Accounts,* 179–82; D. V. Glass, *Numbering the People: The Eighteenth-Century Population Controversy and the Development of Census and Vital Statistics in Britain* (Farnborough, Hants., England: Saxon House, 1973), 11–67.

&c, which was published in 1755,[9] just as the population debates were drawing up sides.[10] As did his electrical experiments, Franklin's *Observations* also contained innovative ideas that captured the attention of those engaged in debating the questions cited above, adding yet another substantial contribution from colonial America to the learned discourse of the day. Thus at mid-century, with a new Philadelphia participant on the scientific scene, contributing ideas that commanded the attention of the scholarly community, the transatlantic intellectual current became bidirectional, a true conversation.

America's First Demographer

Benjamin Franklin's treatise *Observations concerning the Increase of Mankind, Peopling of Countries, &c* is well known to students of Franklin's life and of demographic history as a theoretical essay on the causes and extent of differences in population increase between "the old settled countries" and the New World.[11] Of central importance to the paper was Franklin's succinct statement of the relationship between population growth and subsistence, which, as is equally well known, was cited prominently by Thomas Malthus in his classic *Essay on the Principle of Population,* which in turn directly influenced Charles Dar-

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[9] Between 1751 and 1754 Franklin circulated the manuscript for comment to several knowledgeable friends in both England and the colonies. He first consented to its publication late in 1754 (a delay that will be commented on below), and it first entered print as: [William Clarke], *Observations On the late and present Conduct of the French, with Regard to their Encroachments upon the British Colonies in North America. . . . To which is added, wrote by another Hand; Observations concerning the Increase of Mankind, Peopling of Countries, &c.* (Boston: Kneeland, 1755). Franklin's *Observations* was immediately reprinted in London, thus entering scholarly circulation in 1755. The essay is reprinted, with extended editorial notes, in Leonard W. Larabee, ed., *The Papers of Benjamin Franklin* (New Haven: Yale University Press, 1961), 4:225; hereafter *PBF*.

[10] Demographic historian David Glass has proposed that the eighteenth-century population controversies can be viewed as beginning in 1754–56 with several contributions to the *Philosophical Transactions* by Rev. William Brakenridge, arguing that the population of London had fallen since the early eighteenth century. See D. V. Glass, "The Population Controversy in Eighteenth-Century England. Part I. The Background," *Population Studies* 6 (1952): 69–91, 70.

[11] Useful discussions of Franklin's essay include J. A. Leo Lemay, *The Life of Benjamin Franklin.* Volume 3. *Soldier, Scientist, and Politician 1748–1757* (Philadelphia: University of Pennsylvania Press, 2009), 240–64 (hereafter, Lemay, *Life of Franklin*, 3); editors' headnotes to *PBF* 4:225–26; Lewis J. Carey, *Franklin's Economic Views* (Garden City, N.Y.: Doubleday, 1928), 46–60; James H. Cassedy, *Demography in Early America. Beginnings of the Statistical Mind, 1600-1800* (Cambridge, Mass.: Harvard University Press, 1969), 161–71; Alfred O. Aldridge, "Franklin as Demographer," *Journal of Economic History* 9 (1949): 25–44; Houston, *Politics of Improvement*, chap. 3, "Population"; and Joyce E. Chaplin, *Benjamin Franklin's Political Arithmetic: A Materialist View of Humanity* (Washington, D. C.: Smithsonian Institution, 2008), 22–26.

win's development of the concept of natural selection. Franklin also in the same paper provided his own estimate of the doubling period of the New England colonies, the first to originate from an indigenous observer. Notably, his proposed doubling period of twenty-five years asserted a startlingly higher growth rate than that of cities and countries of the Old World, whose doubling periods ranged from forty years at the most rapid to several hundreds of years for older, more stable populations.

Although Franklin referred modestly to the essay as "a little paper,"[12] it generated much interest among demographers of the time, was republished several times into the next century, and directly influenced other population scientists in both the New World and the Old, e.g., Ezra Stiles in Newport, Rhode Island, and Richard Price and Adam Smith in England.[13] Indeed, Franklin's twenty-five-year doubling period ultimately entered the mainstream, sometimes with a familiarity that omitted its connection to the original essay; and a half century later, when Malthus cited it, he referred to it as "a rate in which all concurring testimonies agree." Generalizing even further than had been Franklin's original intent, Malthus declared that "it may safely be pronounced therefore, that population, when unchecked, goes on doubling itself every twenty-five years, or increases in geometrical ratio."[14] In 1830, three quarters of a century after publication of Franklin's essay, a dissenting participant in the vociferous population debates provoked by Malthus's *Essay on the Principle of Population* complained that "still the philosophers of Europe continue to appeal to his [Franklin's] notions on the subject."[15]

Moreover, Franklin's twenty-five-year doubling period, startling though it seemed at the time, proved uncannily accurate through the remaining four decades of his life and for the century after his death. This can be seen in the results of the United States Census—the world's

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[12] Franklin to William Shipley, 27 Nov. 1755. *PBF* 6:275.

[13] J. A. Leo Lemay, "The Influence of Benjamin Franklin's *Observations concerning the Increase of Mankind* (1751) on Ezra Stiles, Richard Price, and Adam Smith; on Thomas Malthus; and on Alfred Russel Wallace and Charles Darwin," in Lemay, *Life of Franklin*, 3:606–12; Dennis Hodgson, "Benjamin Franklin on Population: From Policy to Theory," *Population and Development Review* 17 (1991): 639–61, at 639; Norman E. Himes, "Benjamin Franklin on Population: A Re-examination with Special Reference to the Influence of Franklin on Francis Place," *Economic History. A Supplement to the Economic Journal, Volume VIII, 1934–37* (London: Macmillan, 1937), 388–98.

[14] T.[homas] R. Malthus, *Parallel chapters from the first and second editions of An Essay on the Principle of Population . . . 1798 : 1803* (New York: Macmillan, 1895), 82.

[15] Michael T. Sadler, *The Law of Population: a treatise in six books; in disproof of the superfecundity of human beings, . . . Volume the Second* (London: Murray, 1830), 46.

first constitutionally mandated, periodic population count,[16] in whose conception Franklin undoubtedly had a hand—first taken in 1790, ironically the same year that Franklin died. From that first census it may be calculated that the U.S. population, if doubled every twenty-five years for the next century, that is, four times, or sixteenfold, predicted the population in 1890 with an error of less than one seventh of 1 percent.[17] Further highlighting the accuracy of Franklin's estimate, in the same document he also predicted that the English population in the American colonies, with its rapid doubling, would within a century, i.e., by 1850, surpass that of England—another astonishingly accurate prediction that did in fact occur by Franklin's predicted date.[18]

Unaccountably, however, Franklin never discussed or revealed the source of his estimated doubling period, an omission that has remained an enigma since its first publication in 1755, and has led some to suggest that it may have been simply a lucky guess. Sixty-five years later, William Godwin, a vocal and biting disputant of Malthus's theory, and well aware of the influence of Franklin's *Observations* on it, carped facetiously, "It were to be wished that Dr. Franklin had given his reasons for this amazing superiority in the fruitfulness of the marriage-bed on the other side of the Atlantic." Franklin, Godwin charged, was "eminently an American patriot," his *Observations* "expressly written to exalt the importance and glory of his own country."[19] Another opponent labeled it an "extravagant assumption . . . a set of as

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[16] Scientific vogue aside, this requirement was determined primarily by the need for accurate population figures upon which to base the proportional representation of the newly-designed governmental form.

[17] 1790 census: 3,929,214; 1890 census: 62,947,714; 1890 *calculated* population: 62,867,424 (3,929,214 × 16); error: 80,290, 0.13 percent. From Conway Zirkle, "Benjamin Franklin, Thomas Malthus and the United States Census," *Isis* 48 (1957): 58–62, at 62.

[18] Zirkle, "Franklin and Malthus," 62. Though Franklin initially may not have intended so, this now well-known prediction soon assumed the dimensions of a veiled threat to the Crown, signaling the first possibility of American dominance, and thereby increasing rather than reducing tensions. Lemay has in fact titled his chapter on Franklin's *Observations* "The Fundamental Document of the American Revolution, 1751" (Lemay, *Life of Franklin*, 3:240). As the evolving tensions escalated, the noted statistician Richard Price, a close friend of Franklin's, in a paper presented to the Royal Society in 1769, replaced the gloves of subtlety with barbed words. Directly citing Franklin's doubling period, Price referred to "the colonies, formerly an increasing number of FRIENDS, but now likely to be converted, by an unjust and fatal policy, into an increasing number of ENEMIES" (emphasis in the original). The offensive words were expunged at the Royal Society reading, but were published later (Richard Price, "Observations on the Expectations of Lives, the Increase of Mankind, [etc.]," *Philosophical Transactions* 59 [1769], 89–125, at 122).

[19] William Godwin, *Of Population. An Enquiry Concerning the Power of Increase In the Numbers of Mankind, Being an Answer to Mr. Malthus's Essay on That Subject* (London: Longman et al., 1820), 127.

ungrounded assertions as ever abused public credulity."[20] Today, two and a half centuries later, the question stands unanswered still. With more scholarly reserve, the twentieth-century demographic historian E. P. Hutchinson has commented that Franklin's "basis for the estimate has not been found and perhaps it was only a reasonable estimate."[21]

In an age of muscular scientific empiricism, an era consciously epitomized in the Royal Society's motto *Nullius in verba* (Take nothing on authority), how did Franklin get away with this? Why was the usual expectation for justification of a bold new scientific claim relaxed in Franklin's case? An explanation may lie in the historic context. In 1755, when *Observations concerning the Increase of Mankind* was published, Franklin's *Experiments and Observations on Electricity* (1751) had recently dazzled the scientific world, rapidly going through three editions, including a French translation. Coming closely behind, his introduction of the lightning rod (1751–52) and the awarding to him of the Royal Society's coveted Copley Medal (1753) had given his name a level of both scientific and public credibility seldom seen before —extending from the most elevated tiers of the Royal Society to the lowest stableboy. With such cachet, to demand an explanation for the twenty-five-year doubling period might have seemed unnecessary, if not presumptuous.[22]

Moreover, following publication of Franklin's *Observations,* the demand for justification would have ebbed as new census figures accumulated to support the twenty-five-year doubling period. In 1761 Ezra Stiles, a clergyman and one of the earliest demographers of colonial America—until the late eighteenth century, churches and clergy were often the most punctilious, and in some cases the only, keepers of vital records—published a 139-page discourse on the Congregationalist Church in Rhode Island that included extensive discussion of population growth in New England. In it he presented two censuses "for the colony of Rhode Island, by the King's order in 1730 and 1755," which during that twenty-five-year interval documented a population increase of 103 percent, a doubling period of 24.5 years.[23] Stiles also cited other data from various New England populations exhibiting doubling periods even shorter, but his confidence in the twenty-five-year figure

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[20] Sadler, *Law of Population,* 29-30.

[21] Hutchinson, *The Population Debate*, 113.

[22] Franklin's rapid rise to prominence between 1750 and 1755 may also suggest an explanation for the four-year delay in publication of the *Observations*. His circulation of the essay to friends for approval from 1751 to 1754 (see n. 9) indicates a certain diffidence, possibly overcome by the encouragement provided by the scientific acclaim that arose so rapidly during that period.

[23] Ezra Stiles, *A Discourse on the Christian Union* (Boston: Edes and Gill, 1761), 109.

is reflected in a chart predicting that the then estimated half million inhabitants of New England would over the next seventy-five years, 1760–1835, undergo three doublings, an eightfold increase, growing to four million souls.[24]

Although published population data were sparse in colonial America, modern archival reconstructions of colonial demographics by the United States Census Bureau provide sufficient raw data to calculate doubling periods for all the American colonies prior to 1790 (the year of the first official census). In the tri-decade from 1750 to 1780, though some colonies individually experienced widely disparate growth rates (with doubling periods ranging from 8.4 to 58.5 years), their median doubling period was 24.9 years, and the mean computed for all thirteen as a whole was 25.7 years.[25]

The striking agreement of Franklin's estimate with subsequent population numbers—an unlikely product of intuition, howsoever astute—deserves elucidation. The present study proposes an answer to this continuing enigma—that, although Franklin did not "show his work," he did in fact present his raw data, and that from them his steps can be retraced.

Franklin's Demographic Interest and Activities

The immediate occasion for the writing of *Observations concerning the Increase of Mankind* was the passage in June 1750 of the British Iron Act, enacted at the behest of England's iron masters to restrict the colonial iron processing industry (rolling and slitting mills, hammering forges, and steel-making furnaces), whose competition was a threat to England's manufactories; but to permit and encourage (by elimination of duties) the colonial export of pig and bar iron, which England lacked.[26] That this event served as the provocation for Franklin's

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[24] Stiles, *Discourse*, 121.

[25] Computed from data in "Estimated Population of American Colonies: 1610 to 1780," in *Historical Statistics of the United States, Colonial Times to 1970,* 2 vols. (United States Bureau of the Census, 1975), 2:1168. The date range of calculated doubling periods presented here, 1750–80, is bracketed to reflect population counts that presumably would have been available in the decades following Franklin's 1750 estimate. Both the mean and the deviations from the mean of these retrospective calculations correspond closely to a footnote comment in Franklin's *Works*: "Strangers excluded, some parts of the northern colonies doubled their numbers in fifteen or sixteen years; to the southward they are longer; but, taking one with another, they have doubled by natural generation only, once in twenty-five years" (Benjamin Franklin, *The Complete Works, in Politics and Morals, of the Late Dr. Benjamin Franklin,* . . . 3 vols. [London: Johnson, Longman, et al., 1806], 3: 250n).

[26] See Carl Van Doren, *Benjamin Franklin* (New York: Viking Press, 1938), 216; Carey, *Franklin's Economic Views*, 48; Cassedy, *Demography in Early America*, 161; Houston, *Politics of Improvement*, 123–24.

Observations is reflected in his explanation to a friend that he had written it "to show that such Jealousies with Regard to Manufactures were ill-founded."[27] Accordingly, the essay argued that the new trade and manufacturing restrictions would negatively affect a rapidly growing population.[28]

Other purposes were at work as well, less imminent but equally weighty. Increasing tensions between Britain and France at their frontier along the Ohio Valley and Canadian territory (which would four years later ignite the French and Indian War) threatened colonial needs for expansion room to the north and west. Both countries were at the time exploring a possible treaty to settle the differences, though the attempt was ultimately unsuccessful. The matter as it stood in 1750 prompted Franklin in his *Observations* to argue a rationale based on the needs of an expanding population: "How important an Affair then to Britain, is the present Treaty for settling the Bounds between her Colonies and the French, and how careful should she be to secure Room enough, since on the Room depends so much the Increase of her People?"[29]

However, although these considerations may account for Franklin's taking up his pen to write *Observations,* they reveal little of the decades-long path that formed his understanding of eighteenth-century demographic thought. Neither does it explain how he arrived at his twenty-five-year doubling period, which he had probably worked out (as proposed here) by or before 1749, well before passage of the Iron Act, using methods that evince a thorough familiarity with the political arithmetic techniques of the day.

Although the popular view of Franklin does not count demography and statistics among his many accomplishments, it was in fact one of his longest-standing intellectual interests, dating from his teen years and pursued steadily throughout his life. Moreover, as noted above, at the time of Franklin's birth political arithmetic, then less than a half century old, was in conspicuous intellectual and scientific vogue. Introduced by John Graunt and William Petty in the 1660s,[30] the newfound efficacies of political arithmetic had energized the growing awareness of the power of numeric reasoning in science introduced by the works of Johannes Kepler, Galileo Galilei, Sanctorius, and William Harvey in

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[27] BF to William Shipley, 27 Nov. 1755. *PBF* 6:275.

[28] Franklin, *Observations*. *PBF* 4:226.

[29] Ibid., p. 233.

[30] All citations herein from Graunt and Petty are taken from Charles Henry Hull, ed., *The Economic Writings of Sir William Petty together with the Observations upon the Bills of Mortality more probably by Captain John Graunt* (Cambridge: Cambridge University Press, 1899); Hull, *Petty and Graunt*.

the late sixteenth and early seventeenth centuries. Though the specific focus of political arithmetic was upon the enumeration of vital events (births, deaths, and nuptials) and what could be surmised by calculation from those numerics, its broader and arguably more significant consequence was the demonstration that numbers alone could provide inferences of fact unavailable by other means—a conception unfamiliar and startling in its era.[31]

It was doubtless this intriguing power of the new political arithmetic to promote rational persuasion that appealed to Franklin's native facility with numeric patterns and his partiality for quantitative modes of persuasion.[32] This partiality for numeric decision making and statistical advocacy was reflected in multiple areas throughout Franklin's life, of which the demographic assertions in the *Observations concerning the Increase of Mankind* represented only one instance. Other prominent examples are found in Franklin's decades-long support of the controversial introduction of smallpox inoculation, for which he produced a steady stream of statistical information in the *Pennsylvania Gazette* to "prepare the minds of the people" about the safety and effectiveness of the new procedure; and, later, in his innovative pamphlet *Some Account of the Success of Inoculation for the Smallpox in England and America,*[33] a statistical landmark, assembling the largest series of inoculations yet reported (more than 14,000 cases), comparing survival in inoculated versus natural smallpox—an anticipation of what today would be termed a meta-analysis.[34] Another instance, remarkable for its everyday applicability, was his "prudential algebra," a technique for resolving personal dilemmas by assigning numeric value to pro and con factors in order to weigh, balance, and cancel them, including, even, tabulating the values.[35]

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[31] Graunt's new techniques of statistical calculation first brought to light, for example, the inherent regularity of vital phenomena such as rates of death and of many diseases previously thought to be "the sport of chance," the excess of male over female births, the approximate numerical equality of the sexes, the high rate of mortality in the early years of life, and the excess of the urban over the rural death rate.

[32] See Paul C. Pasles, *Benjamin Franklin's Numbers: An Unsung Mathematical Odyssey* (Princeton: Princeton University Press, 2008). Pasles's meticulously researched mathematical biography of Franklin adduces several notable examples of Franklin's use of persuasion employing a quantitative rationale.

[33] London: Printed by W. Strahan, 1759.

[34] I. B. Cohen, *The Triumph of Numbers: How Counting Shaped Modern Life* (New York and London: W. W. Norton, 2005), 91–94; Stanley Finger, *Doctor Franklin's Medicine* (Philadelphia: University of Pennsylvania Press, 2006), 49–65; J. A. Leo Lemay, *The Life of Benjamin Franklin.* Volume 2. *Printer and Publisher, 1730–1747* (Philadelphia: University of Pennsylvania Press, 2006), 455–58.

[35] BF to Joseph Priestley, 19 Sept. 1772. *PBF* 19:299. For a discussion of Franklin's prudential algebra, see Pasles, *Franklin's Numbers*, 100–01.

Franklin's inclination to numeric persuasion showed itself early in his *Silence Dogood No. 10,*[36] which he published in 1722 at only sixteen years of age. There, citing an extract from Daniel Defoe's *Essay on Projects,* he proposed a subscription fund for the benefit of widows, based wholly upon a statistical consideration of population and mortality figures of London, employing several then new concepts of population science, monetary risk sharing, and the recent "ingenious calculations" of William Petty's *Political Arithmetick*.[37] At the time, Petty's works had become the virtual scripture of statistical thought; and though the youthful Franklin may not have been closely familiar with Petty's work in 1722 when he put the famous statistician's words into the mouth of widow Silence Dogood, by 1729 he clearly had become so. For in his *Modest Enquiry into the Nature and Necessity of a Paper-Currency,* published in spring 1729 (within the first months after acquiring his own printing office), Franklin drew heavily upon Petty's *Treatise of Taxes and Contributions*.[38] Echoes of Petty's political arithmetic appear as well in Franklin's later personal writings.[39] The influence of other statistical writers, such as Charles Davenant and Thomas Short, is also observable in Franklin's writings, and several of their printed works are represented in his personal library.[40]

As owner and editor of the *Pennsylvania Gazette* after 1729, Franklin repeatedly applied statistics to information on trade, shipping, and population. He published weekly and yearly burial figures for Philadelphia, comparing them with those of Boston and several European countries.[41] In August 1731, the *Pennsylvania Gazette* ran a three-week serialized reprinting from a London publication, *The Political State*, citing

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[36] [Benjamin Franklin], "Silence Dogood, No. 10," in *The New-England Courant*, 13 Aug. 1722; reprinted in *PBF* 1:32–36.

[37] Franklin derived most of his text from Daniel Defoe's *Essay on Projects*, while he himself wrote only the introductory paragraph, acknowledging its origin in another "ingenious author." Nevertheless, the choice of that particular means of persuasion, in an era in which it was uncommon, says much about his cognitive style, even more tellingly so at such an early age. The statistical subjects in the discussion included the yearly Bills of Mortality, the constancy of death rates, the death rate in London ("one in 40 annually"), the predictability of rates of death in certain groups, the calculation of risk therefrom, and the comparison of risk between groups.

[38] Carey, *Franklin's Economic Views,* 46; J. A. Leo Lemay, *The Life of Benjamin Franklin.* Volume 1. *Journalist, 1706–1730* (Philadelphia: University of Pennsylvania Press, 2005), 399 (hereafter Lemay, *Life of Franklin,* 1); Benjamin Franklin, *The Nature and Necessity of a Paper-Currency*. *PBF* 1:139–41, esp. ed. notes.

[39] Benjamin Franklin, "Marginalia in a pamphlet by Josiah Tucker" (1766). *PBF* 17:348.

[40] Carey, *Franklin's Economics,* 46–47. Also see Edwin Wolf 2nd and Kevin Hayes, *The Library of Benjamin Franklin* (Philadelphia: American Philosophical Society and Library Company of Philadelphia, 2006).

[41] Lemay, *Life of Franklin,* 1:448–49.

medical information from the Bills of Mortality, and giving heavy emphasis (about 80 percent of the material cited) to a review of Edmund Halley's statistical paper in the 1693 *Philosophical Transactions,* "An Estimate of the Degrees of the Mortality of Mankind."[42] Halley's study of Breslaw [*sic*], Germany, discussing population assessment and calculation of a life table, came to form one of the cornerstones of early population science, and (as will be seen below) informed Franklin's later thoughts and methods in his own studies of New England's population.

At the conclusion of the three-week serialization, on the same page, Franklin provided his own tabulation of the "Burials in the Town of Boston, from the Year 1700, to 1731." Appended to the table's footnotes, in tiny italic typeface, is a typical Franklinian editorial nugget: "By comparing the Number of Inhabitants in Boston with the above Account, it appears, that not much above a 40th part of the People of that Place die yearly, at a medium." Inasmuch as the material in the Halley article had prominently discussed the mortality rate in Breslau as one in twenty-nine (a mortality rate nearly 40 percent greater than the Boston rate), it may have been about this time that Franklin began to suspect that the figures he had been accumulating suggested a greater salubrity in the American colonies.[43]

Franklin as an Active Demographer

Franklin's interest in population science remained largely intellectual and journalistic until the development of two consequential life influences. In the late 1740s, as clerk to the Pennsylvania Assembly, he became increasingly active in provincial affairs, involving him often in committee work that relied upon population figures that were often unavailable or of poor quality. Then, in 1748, fortified by the proceeds

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[42] Edmund Halley, "An Estimate of the Degrees of the Mortality of Mankind, Drawn from Curious Tables of the Births and Funerals at the City of Breslaw; With an Attempt to Ascertain the Price of Annuities upon Lives," *Philosophical Transactions* 17 (1693): 596–610; hereafter Halley, "Breslau Study."

[43] It is not known whether Franklin had at this time read Halley's original 1693 article in the *Philosophical Transactions*, or whether he relied on the 1731 review that he cited. But it is clear that no later than the following year, 1732, he was a regular reader of the *Transactions*, because from its 1694 issue he quoted at length in the *Gazette*, and intelligently commented on, an article by Thomas Molyneux on respiratory infections ("Dr. Molineux's [*sic*] Historical Account of the Late General Coughs and Colds; with some observations on other epidemick distempers," *Philosophical Transactions* 18 [1694]: 105–11). We suggest that Franklin was indeed already familiar with the original Halley article, and, recognizing its theoretical importance, used the appearance of the 1731 review to showcase the subject.

of his immensely successful *Poor Richard's Almanack*s, Franklin retired from the active management of his printing offices to pursue experimentation in electrical physics and to indulge his growing desire for a life of reflection in natural philosophy (i.e., scientific subjects). This initiated a major transition for him, a prolific period that saw the emergence of Franklin the statesman-scientist—a development that can justly be described as an intellectual breakout.[44]

Freed from the demands of business, Franklin turned to doing science as opposed to writing about it. Amid a busy and committed schedule of electrical experimentation he also began to focus on actively assessing the populousness of the American colonies, for which few or no data yet existed. Having collected vital records from the New England colonies since the early 1730s, he sought out information through correspondence and direct connections (such as his friendship with Cadwallader Colden, active in New York affairs and later lieutenant-governor; or his connections in the New Jersey legislature, for which he did much contract printing), and began to make his own calculations of "numbers of the people," growth rates, and mortality. In spring 1749, Franklin organized a census of dwellings in Philadelphia, the results of which were reported in the *Pennsylvania Gazette* for 18 May 1749: "The dwelling Houses of this City, being lately numbered, from a Motive of Curiosity, by twelve careful Persons, who undertook a Part, there were found as follows, . . . Total 2,076." A modern reader is liable to slide by the quiet phrase "from a motive of curiosity," seeing in it only a Franklinian wink. But if the term "curiosity" is taken, not in its modern sense of inquisitiveness, but with its now obsolete eighteenth-century connotation of "scientific or artistic interest; the quality of a curioso or virtuoso,"[45] it suggests that Franklin had more on his mind than a

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[44] The intensity of this surge of creativity is reflected in its chronology: 1743, establishes American Philosophical Society; 1744, begins deep immersion in electrical experiments; 1747–51, series of five pioneering reports to the Royal Society (via Peter Collinson) establishing new, fundamental principles of electricity; 1747, publishes pamphlet *Plain Truth* and, against staunch Quaker resistance, organizes the Pennsylvania militia and a lottery to purchase cannons for Philadelphia's defense; 1748, elected as alderman of Philadelphia; ca.1748–49, commences active study of colonial population; 1749, justice of the peace for Philadelphia; 1749–51, founds the Philadelphia Academy, later University of Pennsylvania; 1751, election to the Pennsylvania Assembly; 1751, co-founds the Pennsylvania Hospital; 1751, writes *Observations concerning the Increase of Mankind*; 1751, publication of *Experiments and Observations on Electricity*.

[45] *Oxford English Dictionary, Second Edition* (1989), *CD-ROM Edition* (Oxford University Press, 2004). This more serious connotation was a common usage in the eighteenth century, its associated adjective "curious" often invoked in the formal citations for the Royal Society's prestigious Copley Medal. For example, the citation for Franklin's own 1753 Copley Medal employed the term in that sense: "On account of his curious Experiments and Observations on Electricity."

gentleman scholar's number exercise. In fact, a more serious purpose was at work, as will shortly become apparent.

Within months of the dwelling census, i.e., by mid-1749, when compiling the *Poor Richard Improved* for the following year, Franklin had gathered enough statistical information on the populations and growth rates of the cities of Philadelphia and Boston, and the provinces of New Jersey and Massachusetts Bay, to commit it to print. The result appeared in a two-page article in the 1750 almanac, densely packed with three tables and a myriad of statistical data in text format, interspersed with minimal, terse explanation (figs. 1 and 2).[46] The piece, judged by historian James Cassedy to be "one of Franklin's most original demographic contributions,"[47] marks Franklin's earliest active efforts in the technicalities of population science, and can be seen as the precursor—indeed, an unintended "think piece"—for his subsequent *Observations concerning the Increase of Mankind*.

By 1753 Franklin had also obtained additional data on the province of West Jersey, and similarly included it in the 1754 *Poor Richard Improved* in a two-thirds page entry (fig. 3). Because the 1750 and 1754 entries contain analogous data and were published prior to the *Observations concerning the Increase of Mankind* (1755), we shall deal with them together as of a piece, and as indicators-in-common of Franklin's developing thought on population science.

The Poor Richard Demography Articles, 1750 and 1754

The two-page article on New England's growing population in the 1750 *Poor Richard Improved* gives little pause when viewed as an almanac piece; however, it presents significant problems if read as a demographic presentation. Readers of colonial almanacs expected to find a potpourri of useful information: lists and tables of facts, dates, and numbers, both local and general; agricultural and municipal detail, such as numbers of horses, cows, and sheep; numbers of widows and poor; commercial buildings and warehouses; inmates of almshouses and workhouses; populations of neighboring counties; and numbers of dwellings, warehouses, and churches. In this, Poor Richard's readers

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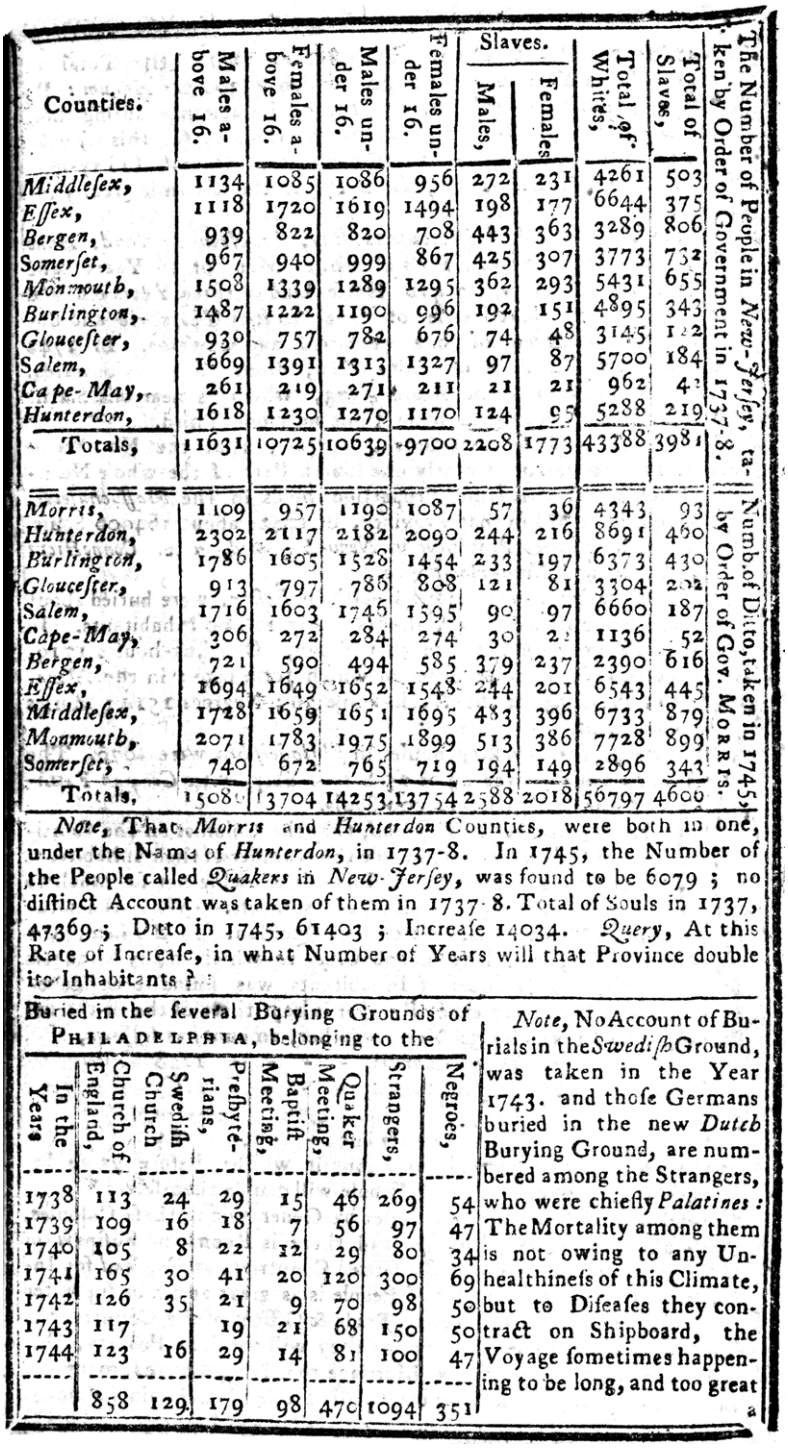
[46] A savvy businessman, Franklin was mindful that the appearance of a compact type page was for his frugal readers the almanac's equivalent of a baker's dozen. Adding to the impression of packed information in the demography entry was the use of a typeface that was unusually small (*brevier*, or 8 point) compared with that in the main body of the almanac (*long primer*, or 9.5 point), and was set unleaded. Franklin was known to be pleased that "he had a small Letter that no other Printer in America had besides himself" (John Webbe, "The Detection," in *American Weekly Mercury*, 1740; reprinted in *PBF* 2:265–69, at 268).

[47] Cassedy, *Demography in Early America*, 159.



The Number of People in *New-Jersey*, taken by Order of Government in 1737-8.

Counties.	Males above 16.	Females above 16.	Males under 16.	Females under 16.	Slaves. Males,	Slaves. Females	Total of Whites,	Total of Slaves,
Middlesex,	1134	1085	1086	956	272	231	4261	503
Essex,	1118	1720	1619	1494	198	177	6644	375
Bergen,	939	822	820	708	443	363	3289	806
Somerset,	967	940	999	867	425	307	3773	732
Monmouth,	1508	1339	1289	1295	362	293	5431	655
Burlington,	1487	1222	1190	996	192	151	4895	343
Glouceſter,	930	757	782	676	74	48	3145	122
Salem,	1669	1391	1313	1327	97	87	5700	184
Cape-May,	261	219	271	211	21	21	962	42
Hunterdon,	1618	1230	1270	1170	124	95	5288	219
Totals,	11631	10725	10639	9700	2208	1773	43388	3981

Numb. of Ditto, taken in 1745, by Order of Gov. MORRIS.

Morris,	1109	957	1190	1087	57	36	4343	93
Hunterdon,	2302	2117	2182	2090	244	216	8691	460
Burlington,	1786	1605	1528	1454	233	197	6373	430
Glouceſter,	913	797	786	808	121	81	3304	202
Salem,	1716	1603	1746	1595	90	97	6660	187
Cape-May,	306	272	284	274	30	22	1136	52
Bergen,	721	590	494	585	379	237	2390	616
Eſſex,	1694	1649	1652	1548	244	201	6543	445
Middleſex,	1728	1659	1651	1695	483	396	6733	879
Monmouth,	2071	1783	1975	1899	513	386	7728	899
Somerſet,	740	672	765	719	194	149	2896	343
Totals,	15085	13704	14253	13754	2588	2018	56797	4600

Note, That *Morris* and *Hunterdon* Counties, were both in one, under the Name of *Hunterdon*, in 1737-8. In 1745, the Number of the People called *Quakers* in *New-Jerſey*, was found to be 6079; no diſtinct Account was taken of them in 1737-8. Total of Souls in 1737, 47369; Ditto in 1745, 61403; Increaſe 14034. *Query*, At this Rate of Increaſe, in what Number of Years will that Province double its Inhabitants?

Buried in the ſeveral Burying Grounds of PHILADELPHIA, belonging to the

In the Years	Church of England,	Swediſh Church	Preſbyterians,	Baptiſt Meeting,	Quaker Meeting,	Strangers,	Negroes,
1738	113	24	29	15	46	269	54
1739	109	16	18	7	56	97	47
1740	105	8	22	12	29	80	34
1741	165	30	41	20	120	300	69
1742	126	35	21	9	70	98	50
1743	117		19	21	68	150	50
1744	123	16	29	14	81	100	47
	858	129	179	98	470	1094	351

Note, No Account of Burials in the *Swediſh* Ground, was taken in the Year 1743. and thoſe Germans buried in the new *Dutch* Burying Ground, are numbered among the Strangers, who were chiefly *Palatines*: The Mortality among them is not owing to any Unhealthineſs of this Climate, but to Diſeaſes they contract on Shipboard, the Voyage ſometimes happening to be long, and too great a

FIGURE 1. *Poor Richard Improved*, 1750. The Library Company of Philadelphia.

a Number crowded together. Excluſive of thoſe, the Total of Deaths in ſeven Years is about 2100, which is 300 *per Annum*: By which we ſhould have had nearly 10,500 Inhabitants during thoſe ſeven Years, at a Medium; for in a healthy Country (as this is) political Arithmeticians compute, there dies yearly One in Thirty-five. But in theſe laſt five Years, from 1744, the Town is greatly increaſed.

In the Province of *Maſſachuſetts Bay*, in *New-England*, *Anno* 1735, there were 35,427 Polls of white Men of 16 Years and upwards, 2600 Negroes, 27,420 Horſe-kind of three Years old and upwards, 52,000 Neat Cattle of three to four Years old and upwards, 130,001 ſheep of one year old and upwards. In 1742 there was 41,000 Polls of white Men, from 16 Years upwards. Increaſe of Men in ſeven Years 5573, which is near one Sixth. *New-Jerſey* increaſed in the ſame Time near one Third.

By the *New-Jerſey* Accounts it appears, that the Number of Males, aged above 16, is nearly one fourth Part of the whole Number of Souls. If the ſame Proportion holds in the *Maſſachuſetts*, they ſhould have had in that Province, in 1742, about 164000 Souls. There are three other Provinces in *New-England*, *viz.* *Connecticut* *Rhode Iſland*, and *New-Hampſhire*.

In 1742, a Year of middling Health in *Boſton*, were buried about 585, which multiplied by 35, makes nearly 18,000 Inhabitants. In the ſame Year were found in that Town, Dwelling-houſes 1719, Warehouſes 166, Widows 1200, of which 1000 poor; in the Almshouſe 111 Perſons; in the Work-houſe 36; Negroes 1514; Horſes 418; Cows 141.

In 1748-9, the Dwelling-houſes in *Philadelphia* were 2076. The following Summer arrived 24 or 25 Sail of Ships with *German* Families, ſuppoſed to bring near 12,000 Souls.

It has been computed in *England*, that the Colonies on the Continent, taken one with another, double the Number of their Inhabitants every Thirty Years. This quick Increaſe is owing not ſo much to natural Generation, as the Acceſſion of Strangers.---What the natural Increaſe of Mankind is, is a curious Queſtion. In *Breſlaw*, the Capital of *Sileſia*, a healthy inland City, to which many Strangers do not come, the Number of Inhabitants was found to be generally about 34,000. An exact Regiſter is kept there of the Births and Burials, which taken for 30 Years together, amount, as follows,

Births *per Annum*, - - - -	1238
Deaths *per Annum*, - - - -	1174
Yearly Increaſe but - - -	64

let the expert Calculator ſay, how long it will be, before by an Increaſe of 64 *per Annum*, 34,000 People will double themſelves?

Yet I believe People increaſe faſter by Generation in theſe Colonies, where all can have full Employ, and there is Room and Buſineſs for Millions yet unborn. For in old ſettled Countries, as *England* for Inſtance, as ſoon as the Number of People is as great as can be ſupported by all the Tillage, Manufactures, Trade & Offices of the Country, the Overplus muſt quit the Country, or they will periſh by Poverty, Diſeaſes, and want of Neceſſaries. Marriage too, is diſcouraged, many declining it, till they can ſee how they ſhall be able to maintain a Family.

FIGURE 2. *Poor Richard Improved*, 1750. The Library Company of Philadelphia.

IN our Almanack for 1750, we gave the Number of Inhabitants in *New-Jerſey*, as taken 1737-8, and 1745, by which it appear'd that the Total of all Ages, Sexes and Colours, amounted in 1737-8, to - - - 47369
in 1745, to - - - 61403
Which makes an Increaſe in ſeven Years of - 14034
being almoſt one Third, tho' that is a Province into which there are but few direct Importations of Strangers.

In 1699 an Account was taken of the Freeholders in *Weſt-Jerſey*, by which it appear'd that there were, *viz.*

In *Burlington* County, and *Maidenhead*,	302
In *Glouceſter*, and *Egg-Harbour*, - -	134
In *Salem* County, - - -	326
In *Cape-May* County, - -	70
In all, Freeholders,	832
If we ſuppoſe ſix Souls to each Freeholder,	6
There might then be in *Weſt-Jerſey*, Souls,	4992

In 1745 there were in the ſame Counties, *viz.*

	Souls.
Burlington, *Hunterdon* and *Morris*, which were in 1699 all *Burlington* County, - -	20280
Glouceſter, which includes *Egg Harbour*,	3506
Salem, - - - -	6847
Cape-May, - - -	1188
In all, Souls,	31821

By which it appears that *Weſt-Jerſey* has increaſed in Forty-ſix Years, more than ſix for one; tho' ſome of its Counties are from their Situation reckoned not very healthy.

A Receipt for curing GAMMONS, *in the beſt Manner.*

FOR three Dozen of Hams, take common Salt, and Sugar, twelve Pounds of each, Salt-petre ſix Pounds, rub it on the Hams after it is powder'd fine, and let them ſtand a Week; then make a Lye, of a Buſhel of Wood Aſhes, with as much common Salt as will make it ſtrong enough to bear an Egg; let the Hams lie in it three or four Weeks: Boil the Lye well, and ſkim it till it is clear, and let it cool, before you pour it on the Hams. When you ſmoke them, rub them with Bran till they are dry.---This Lye will ſerve for your hung Beef, or Tongues, after being boiled over again and ſkim'd.

Note, Gammons thus cured, will fetch a good Price, for Exportation.

The Planet VENUS is Morning-Star until the End of *March*, afterwards Evening-Star to the Year's End.

FIGURE 3. *Poor Richard Improved*, 1754. The Library Company of Philadelphia.

of the 1750 demography piece would not have been disappointed, for it was there in abundance. But for a demographer trying to find evidence of growth rates and population, it offers little in the way of organization and explanation, suggesting hasty preparation, leaving essential material unseparated from the inessential, perhaps just as it had been collected. Franklin was, after all, at the time in the midst of an exciting breakthrough in electrical theory that, within the next several months, would lead directly to his solution of the identity between laboratory-generated electricity and that of lightning (then, "thundergusts"). He wrote to a friend that the work "so totally engrossed my attention and my time" that "during some months past, I had little leisure for any thing else."[48] One imagines Franklin, having just retired from business and no longer personally supervising the production details of the *Poor Richard's Almanac*s, hurriedly taking a sheaf of manuscript pages, ill organized, with material from varied sources and many different writing sessions, and asking his new partner, David Hall, to see to their best arrangement. That would explain the disjunction of several bits of related material in the final printed product. That Franklin was in fact capable of better, is indicated by the far clearer presentation of the 1754 piece, which is concise and logical, moving in orderly progression to a demonstration of the rapid growth of West Jersey Province.

These two Poor Richard demographies have received far less critical attention from Franklin scholars than his *Observations concerning the Increase of Mankind;* indeed, they are most commonly bypassed as inconsequential. And to fill this gap will not be the intent here.[49] The focus, rather, remains sharply on the questions how and from what source Franklin might have derived his doubling period estimate of twenty-five years. For that purpose, it is sufficient to summarize the main themes of the two *Poor Richard Improved* articles: the rate of population increase of the New England provinces had been comparatively rapid; the currently accepted doubling periods for English and European populations (ranging from forty to many hundreds of years, and typified by the cited Breslau data) were substantially longer than those of the American colonies; the prevailing estimate of the colonial doubling period, thirty years, was not an accurate reflection of the New World; and "people increase faster by generation in these colonies,

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[48] Franklin to Peter Collinson, 28 March 1747. *PBF* 3:115.

[49] Of the few who have gone beyond mere mention of the Poor Richard demographies, the most thorough treatment is found in Lemay's *Life of Franklin*, 3:243–46. Similarly, Pasles provides a page and a half of useful, mathematically oriented discussion (Pasles, *Franklin's Numbers*, 70–71). Others who mention it, though with only brief discussion, are Joyce E. Chaplin, *Franklin's Political Arithmetic,* 20; and Cassedy, *Demography in Early America*, 159–61.

where all can have full employ, and there is room and business for millions yet unborn."

The general plan of the 1750 article presents an initial large mass of data (the first three fourths of the material), grouped into tables and paragraphs roughly by province, followed by a two-paragraph conclusion of discussion and comments. The focus on growth rate is clearly indicated by several statements that, for example, Massachusetts Bay increased "near one sixth" from 1735 to 1742, while "New Jersey increased in the same time near one third"; or that Philadelphia is "greatly increased" from 1744 to 1749. But none of these provides a numeric doubling period. Indeed, very few total population counts (required to derive doubling periods) are provided.

Yet the issue of doubling periods makes a definite appearance, most noticeably in two queries that open and close the article. The first mention, at the opening of the article, follows the two prominent tables presenting New Jersey's populations in 1737 and 1745 (fig. 1). In the text inset below the 1745 table, the reader, given the increase of 14,034 for the eight-year period, is challenged: "*Query*, At this rate of increase, in what number of years will that province double its inhabitants?" Then a similar challenge is repeated in the penultimate paragraph (fig. 2, par. 6), contrasting Halley's Breslau study, which describes a decidedly slower growth rate in the older European city. Again Poor Richard asks his "expert calculators" to compute how long it will be before the people of Breslau will double themselves. The pair of contrasting growth rates, like rhetorical bookends, subtly but definitely frames the issue, as it also reflects Franklin's developing thought about the unique demography of a virgin continent.

Such arithmetical challenges were not unusual to readers of colonial almanacs, where puzzles and riddles were staple material. Franklin was especially fond of mathematical puzzles; they made regular appearances in *Poor Richard's Almanack*s.[50] But for these brain teasers about doubling periods, Poor Richard (as was his custom) provided no answers.

We shall return to the Breslau study shortly, but first we turn to the substance of the article, its numbers.

Direct Methods of Computation

In the earliest decades of political arithmetic, as populousness became the touchstone for the vitality of a state or nation, the doubling period

[50] Pasles, *Franklin's Numbers,* 83–86.

became its benchmark, and remained so into the nineteenth century.[51] It was a subject studied by all political arithmeticians and promoted actively by Petty himself, who, in *Another Essay in Political Arithmetick* (1682), highlighted the issue with an entire chapter on "Doubling of the People of London."[52]

The calculation of a doubling period is a straightforward procedure requiring only two given population figures and their respective dates. The requisite population data can be obtained either directly (by census) or indirectly (by calculated estimation). As in any computation of self-generating growth, exponential mathematics is required—as in calculating compound interest; simple linear methods would prove misleading. (See an example of the latter in n. 55.) The computation, greatly facilitated by the use of logarithms, was readily performed by Franklin, whose mathematical capability was well above average.[53] (The doubling formula used for the present study will be found at the foot of table 1.)

In the 1750 Poor Richard article, the New Jersey data were clearly Franklin's exhibit A, not only in the prominence with which he presented them, but also because they represented the only set of data for which he had direct census counts for both population data points. Following two highly detailed population tables for the years 1737 and 1745, ordered by county and by demographic groups (fig. 1), a succinct summary was provided in the subjacent inset: "Total of souls in 1737, 47,369; Ditto in 1745, 61,403; Increase 14,034." The reader was then challenged (as noted earlier) to calculate for himself the doubling period —an exercise that Franklin himself had doubtless already performed. Thus, as shown in table 1, row 1, the given population figures for New Jersey reflect a doubling period of 21.4 years.

One naturally wonders whether any of Poor Richard's readers took up his challenge to attempt the calculation. And, indeed, at least one redoubtable "expert calculator" is known to have done so. Archibald

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[51] Modern-day vital statistics customarily state growth in percentage terms, as with compound interest. In those terms, Franklin's twenty-five-year doubling period represents a yearly growth rate of 2.81 percent, which in compound progression over twenty-five years produces an increase of 100 percent.

[52] William Petty, *Another Essay in Political Arithmetick, concerning the Growth of the City of London: with the Measures, Periods, Causes, and Consequences thereof. 1682,* in Hull, *Petty and Graunt*, 2:456–64.

[53] While there is no documentary evidence to prove Franklin competent with logarithms, it is highly likely that he was. Logarithmic tables had been introduced more than a century earlier, and Franklin's personal library contains, still extant, a dissertation on logarithms and "their usefulness in abridging calculations": Francis Maseres, *Elements of plane geometry, in which is introduced a dissertation on the nature and use of logarithms* (London: Parker, Whiston, and White, 1760), 265–361, listed in Wolf and Hayes, *Library of BF*, 537. See also Pasles, *Franklin's Numbers,* 136 and passim.

Kennedy, a civil official of intellectual bent living in Newark, saw Franklin's material in the 1750 *Poor Richard Improved* and quoted it in a pamphlet on trade difficulties between the colonies and Britain. To bolster his argument for more "proper regulation" of colonial trade by the Crown, Kennedy cited the material from Poor Richard's demographic projections to illustrate the rapidly growing importance of colonial trade. In the process he provided his own answer to Poor Richard's challenge: "By an increase in this proportion, the inhabitants will be doubled in less than twenty four years."[54] Though Kennedy did not cite *Poor Richard Improved* by name, referring to it only as "a publick paper," the origin of his statement in Franklin's material, rather than in a chance simultaneity, is evident in several quotations clearly taken from the Poor Richard article, almost verbatim. Unfortunately, Kennedy, unlike Franklin, was evidently unaware of the mathematical necessity of solving the problem exponentially rather than linearly; and thus his answer erred on the high side.[55]

It is known that Franklin and Kennedy were acquainted thereafter—possibly through this very connection, and probably through mediation by Kennedy's publisher, James Parker, who was also Franklin's New York business partner—since Kennedy became a supporter of Franklin's Albany Plan, and Franklin attended Kennedy's funeral in 1763, referring to him as "my old friend Kennedy."[56] Considering this, the conjecture is attractive that Kennedy's reference in 1750 to rapid colonial growth rate as an argument for fewer trade restrictions may have served as a model for Franklin's similar use of the same approach in his 1751 *Observations concerning the Increase of Mankind*.

As clear and suggestive as New Jersey's shorter doubling period was, a single figure provided insufficient basis to arrive at a useful generalization. More would be required. And there is indeed more.

Indirect Methods of Computation

The remainder of the 1750 *PRI* article appears entirely in text format (fig. 2) and presents a less orderly grouping of material, a vivid contrast

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[54] Archibald Kennedy, *Observations on the Importance of the northern Colonies under proper Regulations* (New York: Printed and sold by James Parker, 1750), 4. For this fascinating connection we are indebted to the encyclopedic work of the late Leo Lemay (*Life of Franklin*, 3:243–48).

[55] Kennedy probably proceeded via an intuitive but misleading linear method: A) In a population of 47,369, an addition over a seven-year period of 14,034 persons represents an increase of 29.6 percent; B) to increase a 29.6 percent growth to 100 percent (i.e., to double the original population) would require a 3.375-fold greater time period (i.e., $100 \div 29.6 = 3.375$); C) 7 years $\times$ 3.375 = 23.6 years, i.e., Kennedy's "less than twenty four years."

[56] BF to Deborah Franklin, 16 June 1763. *PBF* 10:290.

to the New Jersey material so clearly presented at the outset. Included are all the other provinces of New England, many with accompanying statistical data (and some without), although, perplexingly, with wide variations of type of data scattered inconveniently throughout separate paragraphs. It is, nevertheless, possible to discern within those many scattered figures the basic data for three additional cities or provinces, figures sufficient for indirect estimation of population totals usable to compute doubling periods.

It becomes evident that Franklin was familiar with Graunt's and Petty's earlier pioneering methods for estimating population numbers indirectly, i.e., by calculation in the absence of direct census data. The conception of calculated estimation of population had been one of the seminal contributions of John Graunt's 1662 *Natural and Political Observations . . . upon the Bills of Mortality,* by long consensus the founding work of vital statistics, its methodology avidly expanded by his contemporary William Petty, and followed by a growing number of innovative practitioners into the eighteenth century. Such estimations were necessitated by the absence until the late eighteenth century of centralized censuses, which were not widely undertaken until earlier efforts had demonstrated their undeniable value.[57] Methods for indirect estimations of population were varied, often ingenious, and sometimes based on fuzzy supposition. All employed partial counts and accepted ratios, such as counts of dwellings and "souls per household," or empirically established ratios of age groups, births, or burials to total population.[58]

Accordingly, in Franklin's Poor Richard demographic pieces are to be found three of the most popular methods of estimation then in use—albeit with little explanation: 1) the roll of yearly burials × the established ratio of deaths per annum to total population; 2) a counted age segment of a population × its known proportion to the total; and 3) a dwelling count × an empirical number of persons per household. Using these three methods, though lacking direct population figures (except in one instance), Franklin would have been able to derive estimated

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[57] Despite professional and bureaucratic recognition of the benefits of a national census, and despite several parliamentary efforts to enact one, public resistance slowed it considerably, and Britain did not hold its first national census until 1801. Sweden, a notable exception, held its first national census in 1749, the United States did so in 1790 (as noted earlier), the Netherlands in 1795, and France in 1801. Most other European countries did not institute national censuses until later in the nineteenth century.

[58] Petty, for example, described "three ways of numbering the people: 1. By the houses, and families, and heads living in each; 2. By the number of burials in healthful times, and by the proportion of those that live, to those that die; 3. By the number of those who die of the plague in pestilential years, in proportion to those that scape [*sic*]" (*Five Essays in Political Arithmetic* [Hull, *Petty and Graunt,* 2:533]). Also see Harald Westergaard, "Political Arithmetic in the Seventeenth Century," in idem, *History of Statistics*, 16–37.

TABLE 1. Computed doubling periods from population data in *Poor Richard Improved*, 1750 and 1754

		Year A			*Year B*			*Computed Estimates*	
Source	*City or Colony*	*Year*	*Population*	*Method*	*Year*	*Population*	*Method*	*DP**	*Rate*
PRI 1750	New Jersey	1737	47,369	Census	1745	61,403	Census	21.4 yr	3.3%
PRI 1750	Philadelphia	1744	10,500	Known burials (300) × mortality rate 1:35	1749	12,000	2,076 households × 6 pers. each (rounded)	26.0 yr	2.7%
PRI 1750	Massachusetts	1735	35,427	Census of white males >16 yrs	1742	41,000	Census of white males >16 yrs	33.2 yr	2.1%
PRI 1754	West Jersey	1699	4,992	832 households × 6 persons each	1745	31,821	Census of "all souls"	17.2 yr	4.1%
PRI 1750	Boston	1742	18,025	Known burials (515) × mortality rate 1:35	—	—	—	—	—
							Mean of four doubling periods →	24.5 yr	

* DP (doubling period) = LOG(2)/[LOG(Growth)/Period)], where: Growth = population B/population A; Period = Year B – Year A.

populations and doubling periods for Philadelphia, Massachusetts Bay, and West Jersey.

The mere presence of these data, notwithstanding their disorder, strongly suggests an underlying process, while the disorder itself suggests that Franklin had accrued it piecemeal over time, in the process of formulating his ideas and working out his methods.[59]

Philadelphia

The doubling period for Philadelphia presents not only the most interesting, but also the most challenging, pair of population numbers in the set, for the two figures are distantly separated in the text, and thus not readily associated with even a careful reading. Moreover, the numbers are not population censuses, but indirect population indicators, viz., numbers of burials in 1744 and of dwellings in 1749. They would therefore require the use of two different methods of estimation to derive the necessary population data points.

The first population point (which we will call P1) is found in the text paragraph inset in the smaller table of burials at the bottom of fig. 1 and carries over to the next page, in fig. 2. Franklin cites a mean annual burial rate of 300 yearly, applying to it a multiplier of 1:35 to arrive at a population estimate of 10,500 for Philadelphia in 1744. "For in a healthy country (as this is) political arithmeticians compute, there dies yearly one in thirty-five."

The precise source of Franklin's 1:35 mortality rate is unknown, but population estimates computed from mortality rates were used widely by political arithmeticians, and Franklin's doing so demonstrates his familiarity with the methodology of the era. Graunt's estimate in 1662—the first ever made—had stated that "in London . . . one in 32 dies";[60] Petty in 1682 used one in thirty;[61] and Thomas Short in 1750 provided several charts that supported mortality rates of 1:37 and another with a rate of 1:38.[62] Franklin himself (as noted earlier) had

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[59] Franklin, when studying a subject over extended periods, is known to have kept notes for later reference. The best known of these is his "Hints Concerning what is called Catching a Cold," written circa 1770, when he was planning to write a treatise on the subject of respiratory infections (reprinted in *PBF* 20:529–38). Never published, the document exists today as an undated manuscript sheaf comprising a loosely arranged miscellany of paragraphs, sentences, and notes, much as one imagines might have been the state of Franklin's copy for the 1750 *PRI* demography article.

[60] Hull, *Petty and Graunt*, 2:393.

[61] Ibid., 2:459.

[62] Thomas Short, *New Observations, Natural, Moral, Civil, Political, and Medical, on City, Town, and Country Bills of Mortality* (London: Longman and Millar, 1750), 132–33.

collected and published a Boston mortality of 1:40, comparing it with Halley's data, which showed a rate of 1:29. The use of 1:35 appears to have been Franklin's "medium" of the available values.

The source for a second population point (P2) is found, unaccountably, out of context in a later, brief paragraph of only two sentences (fig. 2, par. 5):

> In 1748–9, the Dwelling-houses in Philadelphia were 2,076. The following Summer arrived 24 or 25 Sail of Ships with German Families, supposed to bring near 12,000 Souls.[63]

The misleading phrase "supposed to bring near 12,000 souls" appears to imply that immigrant ships brought 12,000 new persons, rather than that their arrival brought *the total populace to* near 12,000, its intended though enigmatic meaning.[64] Furthermore, the interposition of ambiguous information about newly arrived ships and immigrants obscures the connection between the "dwelling-houses" and the number of "souls." Though no source is explicitly provided for the population figure of "near 12,000 souls," its association with the dwelling count implies that Franklin was using Petty's method of assuming six persons per household as a multiplier, then rounding the product.[65] In fact, in the 1754 Poor Richard article, to be discussed below, he did precisely that: "suppos[ing] six Souls to each Freeholder."

Recognizable here, then, is the dwelling count of 2,076 that Franklin organized and reported in the *Gazette* article only months prior to writing this. Its reappearance here illuminates the serious purpose of the "curiosity" mentioned in the *Gazette,* and underscores the deliberation with which Franklin pursued this interest—he required a second data point with which to compute a doubling period for his home city. Using the two estimated total populations of 1744 and 1749, the doubling period for Philadelphia solves to 26.0 years (table 1, row 2).

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[63] This paragraph, providing data from Philadelphia in 1749, appears to have been unintentionally disjoined from its probable mate at the top of the same page, relating to Philadelphia in 1744. If read with that repositioning, the overall organization by colonies is much clarified.

[64] It would have been impossible for twenty-five eighteenth-century ships to import 12,000 persons (i.e., 480 passengers each). Moreover, an influx of 12,000 new immigrants to a city of only 10,500 (the estimated population in 1744) would have more than doubled the population in one year alone. While Franklin did have a purpose in providing the immigrant information, its positioning here is awkward and varies markedly from his usual clear prose—a further evidence of his haste.

[65] Since 2,076 dwellings with six persons each comes to 12,456, Franklin rounded the product downward to "near 12,000." It may be noted that, whereas in modern English *near* or *nearly* indicates "almost" or "not quite," i.e., rounding only upward, its eighteenth-century sense indicated any rounding, upward or downward. This more flexible usage will be encountered in several instances in the texts discussed here.

Massachusetts Bay Colony

The computation for Massachusetts is more straightforward, since in that province there had been partial censuses of "white Men of 16 Years and upwards," a demographic category widely used to assess numbers of men able to bear arms and to be taxed. The "polls" for this group in 1735 and 1742 are provided (35,427 and 41,000 respectively), although they are somewhat inconspicuous among the other unrelated material of interest to Poor Richard's agrarian readers, such as the numbers of Negroes, horses, cattle, and sheep (fig. 2, par. 2). The accompanying statement that this group had increased "in seven years 5,573, which is near one sixth," implies that its rate of increase may be applied to the population as a whole.

The rationale for that seemingly unwarranted implication follows in the next paragraph (fig. 2, par. 3), where it is pointed out that in the earlier New Jersey figures the same adult male segment ("white males above 16 years") comprised "nearly one fourth part of the whole number of souls." The critical feature of this proportion—unstated by Poor Richard—was that it was consistent in both years (i.e., within one tenth of 1 percent),[66] and therefore could be relied upon as a stable ratio for prediction. Thus, despite the absence of a total population count for Massachusetts Bay, the stability of the proportion of adult males meant that "if the same proportion holds in the [*sic*] Massachusetts, they should have had in that province, in 1742, about 164,000 souls," i.e., four times 41,000. This then yields a total population datum adaptable to computation of a doubling period. Similarly, since the same population segment was provided for 1735, the same multiplier could be used for that year as well, providing the two requisite population points. Thus, as shown in table 1, row 3, the doubling period for Massachusetts Bay Colony solves to 33.2 years.

It is unlikely that Franklin discovered this regularity himself. He could have taken his lead from Edmund Halley, who, in the Breslau study (reviewed by Franklin in the August 1731 *Pennsylvania Gazette*, and again in the Poor Richard article) showed that the distribution of adult males in a given population remained stable at "somewhat more than a quarter of the Number of Souls," and suggested that it could "pass for a Rule for all other Places"—a suggestion obviously not lost on Franklin.[67]

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[66] 26.8 percent in 1738 and 26.7 percent in 1745.

[67] Halley, "Breslau Study," 601.

West Jersey Province

In 1753, when Franklin was compiling the next year's *Poor Richard Improved*, he appears to have been less hurried; for the 1754 demography entry, reporting population data from the province of West Jersey, reads so easily and logically that it is self-explanatory (fig. 3). What is noteworthy in the 1754 entry is that it includes the longest time span of population data for any of Poor Richard's entries thus far (forty-six years, 1699 to 1745), thereby increasing its reliability. To compute an indirect estimate of total population for P1, Franklin again uses the six persons per household multiplier; but this time he does so explicitly: "If we suppose six Souls for each Freeholder."[68] For the P2 figure, he has the convenience of a direct census, and the resulting doubling period solves to 17.2 years (table 1, row 4).

Boston

Although data for Boston (fig. 2, par. 4) provided figures for only one year, 1742 (thus precluding computation of a doubling period), it did permit an estimation of the city population, where Poor Richard, by no coincidence, enjoyed a considerable following. In this case Franklin had only burial records to work with, and thus used the mortality rate of one in thirty-five, applied to 515 burials for that year, to arrive at a rounded estimate of "nearly 18,000 inhabitants" (table 1, row 5).[69] Bostonians would welcome the proof that theirs was the largest city in New England as an expected bit of almanac intelligence.

Aggregate Doubling Period

Although the Poor Richard pieces lead to varied results from widely disparate locales, it is evident throughout the material discussed here

[68] This method of estimation was one of the oldest in use by political arithmeticians, having been introduced by Graunt himself at the birth of the new science in the mid-seventeenth century. Arithmeticians appear to have adjusted their multipliers for "souls per household," varying from six to eight depending upon many factors, which were often simply unstated. While Graunt initially used eight as a household multiplier ("the man and his wife, three children, and three servants or lodgers"), Petty more commonly used six, but on occasion used eight. Though the obvious variability of these numbers admits much room for error, the surprising accuracy of the results so often obtained also suggests that considerable reasonable judgment was used by the estimators.

[69] Though it is conceivable that, using the population of 1742 as a P2 data point, one might attempt to derive P1 from Franklin's earlier burial records of Boston printed in the 1731 *Philadelphia Gazette* (mentioned above), such an attempt is invalidated by the marked distortion of burial rates due to three epidemics of smallpox and measles, as noted by Franklin in his footnotes to the table.

that Franklin commonly applied a political arithmetician's overview by treating them "at a medium" or "taken one with another" (see n. 25). A year later, when assembling his *Observations concerning the Increase of Mankind* with intent to influence policy, Franklin likewise would have good reason to speak of the colonies collectively, as he supposed the policy makers in Parliament also did. Accordingly (as shown in table 1), an arithmetical mean, taking the four doubling periods discussed above "one with another," solves to 24.5 years—almost precisely that which Franklin advanced in his *Observations concerning the Increase of Mankind*. Thus can be posited a feasible explanation of existent numeric sources for Franklin's reckoning of a twenty-five-year doubling period for the American colonies, a figure demonstrably neither "extravagant" nor an "assumption."

It would surely be a stretch to think that Franklin performed these computations in precisely the manner here described. But it is certainly possible, if not probable, that he worked out these doubling periods at various times, by various methods; that as he worked, he continually scrutinized and recalculated their mean; and that more than likely he possessed additional data about them to augment his accuracy, data that were not made available to Poor Richard.

New World vs. Old World Growth

Having laid out his evidence, Franklin turned in his concluding paragraphs to the subject of doubling (fig. 2, par. 6). To his readers, it was clear by this point that the article's focus was on the relative rapidity of growth in the colonies, but readers needed some comparative scale by which they could gauge population growth. For that purpose, Franklin provided two contrasting doubling periods, one short, one long. "It has been computed in England," the discussion begins, "that the Colonies on the Continent, taken one with another, double the Number of their Inhabitants every thirty Years."[70] For a long comparator, Franklin returned to Halley's figures for Breslau, which over a five-year period, in a population of 34,000, provided an average yearly increase of only sixty-four persons—an obviously slow rate at even a casual glance.[71] A

[70] It is impossible to know whether, when Franklin wrote this, he had yet arrived at his doubling period of twenty-five years. He appears here to be accepting the English estimate of thirty years. But he may have been using it only to be able to show later that the colonial growth rate was even faster than suspected.

[71] Poor Richard let pass a substantial misprint in the text of this paragraph, citing Halley's figures as "taken for 30 years together" instead of five years, as in Halley's original data (note that the number of years between two population counts is a critical term in computation of their doubling period; see table 1). Halley's original, as well as Franklin's review of it in the 1731 *Gazette,* reads, "[I]n the five years mentioned, *viz*. from [16]87 to [16]91 inclusive,

touch of colonial swagger is detectable in Poor Richard's tone as he challenges his readers once again: "Let the expert Calculator say how long it will be before, by an Increase of 64 per Annum, 34,000 People will double themselves?" Franklin—who would never have posed the question without first computing its answer—knew that the doubling period for Breslau solves to "near" three and a half centuries.[72] Moreover, he was probably well aware that some of his not-so-expert calculators would take the straightforward (but misleading) approach of simply dividing sixty-four into 34,000, which yields an inflated doubling period of well over half a millennium, further heightening the intended contrast.

In the final paragraph (fig. 2), Franklin offered his conclusion:

> I believe People increase faster by Generation in these Colonies, where all can have full Employ, and there is Room and Business for Millions yet unborn. For in old settled Countries, as England for instance, as soon as the Number of People is as great as can be supported by all the Tillage, Manufactures, Trade and Offices of the Country, the Overplus must quit the Country, or they will perish by Poverty, Diseases, and want of Necessaries. Marriage too, is discouraged, many declining it, till they can see how they shall be able to maintain a Family.

In the development of these thoughts, the vigorous growth rates of the colonies played a defining role, supporting the notion of enhanced fecundity in the New World. Franklin was clearly optimistic about his conclusions—and understandably so. But it is unlikely that he foresaw the larger purpose they would soon serve, and, ultimately, the extent of their influence.

Conclusion

From a modern perspective, it is difficult to believe that imprecise approximations of the kind reflected in the Poor Richard demographic pieces could yield practicable results. Indeed, it is cogently pointed out by D. V. Glass that the eighteenth-century population-depopulation debates discussed above were largely a consequence of "the inadequacy

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there were born 6193 persons, and buried 5869; that is born per annum 1238, and buried 1174; whence an encrease of the people may be argued of 64 per annum" (Halley, "Breslau Study," 598). As this was more likely a manuscript slip than a typesetter's error, it reflects yet another instance of Franklin's haste in its preparation, perhaps carrying over, as he wrote, the number "thirty years" from the first line of the same paragraph.

[72] The result has been rounded—downward, eighteenth-century style—because it varies slightly with the assumptions, i.e., whether the 34,000 population is assigned to P1 or to P2, solving to either 365.4 years or 362 years, respectively, an insignificant difference.

of contemporary population statistics."[73] Historians of demography have noted not only that the methods of population estimation used by early political arithmeticians were fraught with questionable assumptions, but also that its practitioners were often misled into supposing that the numeric precision of their calculations assured inevitably accurate results. Charles Hull, an editor and analyst of the works of Graunt and Petty, observed of Sir William Petty, that "in the ardour of argument he was himself more than once misled into fancying his conclusions were accurate because their form was definite."[74] The historian Harald Westergaard noted of Petty's contemporary Charles Davenant that he was "unable to control his estimates, to find the limits within which the numbers are probably lying; nor do we learn in detail how the estimates are made, and how the results can be anything but a very rough guess."[75] Moreover, such critiques are not limited solely to modern retrospection. A prominent contemporary statistician, Thomas Short, cautioned in 1750 that "the uncertainty of those computers, or random guessers, who have reckoned from 7 to 12 souls each family, one with another, may occasion several mistakes (not to say mischief)."[76]

But these difficulties notwithstanding, the purpose here is descriptive, not evaluative. Consequently, several obvious questions and criticisms of the methods discussed here remain unaddressed. The sole intent has been to discover and describe a pathway, if one existed, by which Franklin might have reached his conclusions, irrespective of modern judgment about inherent weaknesses. In fine, in the case of the Poor Richard demographies the results ably speak for themselves. The historical record clearly shows that the comparatively rough-hewn methods of eighteenth-century political arithmetic, together with the canny judgment of its philomath-cum-statistician, resulted in astonishingly accurate estimates of the burgeoning growth rate of the American colonies.

* * *

With the passage of the Iron Act in June 1750, and as colonial indignation about it grew, Franklin, then at a high point of civic involvement, the printer-journalist who had enjoyed persuasion with numbers since his teen years, was prepared with some ready facts. *Poor Richard Improved* for 1750 was in active circulation, and perhaps, as suggested

[73] Glass, "Population Controversy," 71.
[74] Hull, *Petty and Graunt,* 1:lxviii.
[75] Westergaard, *History of Statistics,* 41.
[76] Short, *New Observations*, 134.

above, Archibald Kennedy's application of Poor Richard's material in a similar political-economic pamphlet had caught Franklin's interest. The ideas—as well as some of the very phraseology—that underlay Poor Richard's articles, together with the doubling periods that supported their reasoning, became the core of the wider-ranging and more polished *Observations concerning the Increase of Mankind.*[77]

Although Franklin's papers reveal little of how or when he decided to write his *Observations,* it is indeed clear that in 1751, when the colonial reaction to the 1750 Iron Act was heating up, he had already developed a philosophy of population growth, and had devoted much thought and calculation to the numbers relating to how the "increase of the people" was proceeding in the American colonies. To one with Franklin's inclination for numeric argument, such material put to good use in a thoughtful piece of demographic philosophy might have persuasive effect in higher places—a form of persuasion much to his liking. The material was intellectually ready; all that remained was to get it onto paper. The rest is history.

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[77] Derivative components are identifiable particularly in articles 1–4, 6, 14, and 22 of the essay. *PBF* 4:225–34.