Vital Accounts

Quantifying Health and Population in Eighteenth-Century England and France

ANDREA A. RUSNOCK
University of Rhode Island

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CONTENTS

ILLUSTRATIONS

Introduction

This book is about the activity of counting – specifically the counting of births and deaths – during the long eighteenth century. From the 1660s on, the numbers of born or dead, it was argued, would shed light on numerous political and medical issues. Yet despite this emerging desire for numbers, there were almost no government institutions, either at the national or local level, to collect and record these numbers. Rather, it was individuals from rural clergy to metropolitan physicians who did the counting. These political and medical arithmeticians, as they were called, invented ingenious methods of quantifying. They counted not just the number of christenings or burials in a specific geographic area but also, and often more importantly, different groups of individuals identified and classified by particular taxonomic schemes. These activities were as much about *what* to count as about *how* to count: The two were inextricable. Arithmeticians, in this way, brought quantitative analyses to bear on discussions of medical practice and therapy, salubrity and fecundity, and the growth or decline of population. Vital accounts – the numbers of dead and born – became, in short, the quantitative measure of public health and welfare.

Counting, Samuel Johnson told James Boswell in 1783, "brings everything to a certainty, which before floated in the mind indefinitely."[1] Johnson was not the only one to admire the bracing effects of counting. As several scholars have pointed out, quantification was the distinguishing feature of eighteenth-century science, especially in what Thomas Kuhn described as the Baconian sciences, those in which the development and refinement of instruments such as barometers, thermometers, and chemical balances allowed for more exact measurement.[2] The practitioners of political and medical arithmetic shared this

[1] James Boswell, *Life of Samuel Johnson LLD* (1791; reprinted. New York: Modern Library, 1931), p. 1042; quoted in J. Worth Estes, "Quantitative Observations of Fever and Its Treatment before the Advent of Short Clinical Thermometers," *Medical History* 35 (1991): 191.

[2] Thomas Kuhn, "Mathematical versus Experimental Traditions in the Development of Physical Science," in *The Essential Tension* (Chicago: University of Chicago Press, 1977), pp. 31–65; Tore Frängsmyr, J.L. Heilbron, and Robin E. Rider, eds., *The Quantifying Spirit in the 18th Century* (Berkeley:

enthusiasm for quantification and precise measurement, and they focused their efforts on the most basic events of human existence.

When counting births and deaths, eighteenth-century observers used words such as "numbers," "figures," or "accounts," and described their work as political or medical arithmetic. The word quantification was not an eighteenth-century term; it is an analytical concept that refers to the process of representing things by numbers. Quantification can be arrived at by counting, measuring, calculating, estimating, or combining any of these methods. It need not be based on empirical records. (One can construct a quantitative value system by arbitrarily assigning numbers – the judging scale for Olympic figure skating, for example.) The term quantification is useful because it neatly captures an approach that is distinct from mathematics. Mathematics (especially arithmetic) can be employed in quantification, but quantification is not mathematics per se. Mathematics refers to a variety of techniques that relate number and magnitude – it is not referential. Quantification, by contrast, is inherently referential: It is the application of numbers *to* objects, and seventeenth- and eighteenth-century observers recognized this distinction. In 1721, for instance, the English mathematician Edward Hatton described political arithmetic as follows: "This Specie of Arithmetic has nothing new in it, as to the Nature of the Numbers themselves, nor as to the Manner of Operation; but only in the Application or subject about which the Numbers are employ'd. . . . "[3]

Quantification is also distinct from the modern discipline of statistics. In fact, the term "statistics" did not come into widespread use until the 1820s and 1830s.[4]

University of California Press, 1990); J.L. Heilbron, "A Mathematical Mutiny, with Morals," in *World Changes: Thomas Kuhn and the Nature of Science,* ed. Paul Horwich (Cambridge, Mass.: Harvard University Press, 1993), pp. 81–129. Also see M. Norton Wise's helpful introduction to *The Values of Precision,* ed. M. Norton Wise (Princeton, N.J.: Princeton University Press, 1995), pp. 3–13. For quantification and social sciences, see P.F. Lazarsfeld, "Notes on the History of Quantification in Sociology: Trends, Sources and Problems," *Isis* 52 (1961): 277–333.

[3] Edward Hatton, *An Intire System of Arithmetic: Or Arithmetic in All Its Parts* (London, 1721), p. 244.

[4] For histories of statistics, see Theodore M. Porter, *The Rise of Statistical Thinking, 1820–1900* (Princeton, N.J.: Princeton University Press, 1986); Stephen M. Stigler, *The History of Statistics: The Measurement of Uncertainty before 1900* (Cambridge and London: The Belknap Press of Harvard University Press, 1986); Karl Pearson, *The History of Statistics in the 17th and 18th Centuries against the Changing Background of Intellectual, Scientific and Religious Thought,* ed. E.S. Pearson (London: Charles Griffin & Co., 1978); M.J. Cullen, *The Statistical Movement in Early Victorian Britain: The Foundations of Empirical Social Research* (New York: The Harvester Press, 1975). On medical statistics, see Major Greenwood, *Medical Statistics from Graunt to Farr* (Cambridge: Cambridge University Press, 1948); James H. Cassedy, "Medicine and the Rise of Statistics," in *Medicine in Seventeenth-Century England,* ed. Allen G. Debus (Berkeley: University of California Press, 1974), pp. 283–312; James H. Cassedy, *Demography in Early America: Beginnings of the Statistical Mind, 1600–1800* (Cambridge, Mass.: Harvard University Press, 1969); James H. Cassedy, *American Medicine and Statistical Thinking, 1800–1860* (Cambridge, Mass.: Harvard University Press, 1984); J. Rosser Matthews, *Quantification and the Quest for Medical Certainty* (Princeton, N.J.: Princeton University Press, 1995). On quantification and state statistics, see Joshua Cole, *The Power of Large Numbers: Population, Politics, and Gender in Nineteenth-Century France* (Ithaca and London: Cornell University Press, 2000); H. Westergaard, *Contributions to the History of Statistics* (London: P.S. King and Son, 1932); Fernand Faure, "The Development and Progress of Statistics in France," in *The History of Statistics: Memoirs to Commemorate the 75th Anniversary of the American Statistical*

By that time, no one, especially government officials and scientists, questioned the importance of numbers. But seventeenth- and eighteenth-century political and medical arithmeticians had to convince governments, savants, and the literate public of the value of collecting numbers. The eventual overwhelming success of numerical arguments should not obscure the very long and difficult process of establishing what is too easily taken for granted.[5]

In Europe, the first sustained effort at the quantification of things human occurred in Renaissance Italy, and it accelerated during the seventeenth and eighteenth centuries. In trying to account for the increased pace of quantification in early modern Europe, scholars have pointed to large-scale fundamental changes in society. The spur to quantify, for example, has been linked to the growth of capitalism.[6] In the transformation of Europe to a market society where production and consumption became oriented around selling and buying in the marketplace, land, labor, even time, became commodities determined by the calculus of supply and demand and evaluated by the cash nexus. Some sociologists and psychologists have argued that cash supplied the conceptual hinge that allowed for the possibility of turning the qualitative into the quantitative: Assigning something a monetary value remains one of the most fundamental ways of quantifying.[7] The most vivid example of how money promoted the quantification of human society during this period is the slave trade. There, unmistakably, humans were bought, sold, and traded in monetary, quantitative terms.

The demographic revolution – the dramatic growth in population that occurred after 1750 in Britain and France – has also been invoked as a catalyst for quantification.[8] Michel Foucault, for one, argued that increased population encouraged the development of demographic knowledge:

Society (New York: The Macmillan Co., 1918), pp. 219–329; Stuart J. Woolf, "Towards the History of the Origins of Statistics: France, 1789–1815," in Jean-Claude Perrot and Stuart J. Woolf, *State and Society in France, 1789–1815* (New York: Harwood Academic Publishers, 1984).

[5] Simon Schaffer argued that mathematization and quantification were not inevitable and "demand a social history." Simon Schaffer, "A Social History of Plausibility: Country, City and Calculation in Augustan Britain," in *Rethinking Social History: English Society, 1570–1920, and Its Interpretation,* ed. Adrian Wilson (Manchester and New York: Manchester University Press, 1993), pp. 128–157.

[6] Patricia Cline Cohen, *A Calculating People – The Spread of Numeracy in Early America* (Chicago: University of Chicago Press, 1982), esp. pp. 41–47.

[7] See Georg Simmel, *The Philosophy of Money,* trans. Tom Bootmore and David Frisby (1907; London: Routledge & Kegan Paul, 1978). Simmel wrote: "Within the historical-psychological sphere, money by its very nature becomes the most perfect representative of a cognitive tendency in modern science as a whole: the reduction of qualitative determinations to quantitative ones" (p. 277). It is interesting to note that Russian psychologists in the 1920s found that rural villagers could solve certain logical and mathematical problems if and only if the problems were described as monetary transactions. See A.R. Luria, "Towards the Problem of the Historical Nature of Psychological Processes," *International Journal of Psychology* 6 (1971): 259–272.

[8] James C. Riley analyzed various discussions of population during the period of the demographic revolution in his *Population Thought in the Age of the Demographic Revolution* (Durham, N.C.: Carolina Academic Press, 1985). I examine many of the same works as Riley. While he focused primarily on the ideas of these writers, I have concentrated on their *methods*.

The great eighteenth-century demographic upswing in Western Europe, the necessity for coordinating and integrating it into the apparatus of production and the urgency of controlling it with finer and more adequate power mechanisms cause 'population,' with its numerical variables of space and chronology, longevity and health, to emerge not only as a problem but as an object of surveillance, analysis, intervention, modification, etc.[9]

Under the rubric "biopower," Foucault sketched two levels of techniques used by the state to exercise power over human beings.[10] At the individual level (anatomo-politics), a person's body is subject to disciplinary practices.[11] The second level (biopolitics) concerns the aggregate, where a population is controlled through the sciences of demography and statistics.[12] Biopolitics assumed its power only in the nineteenth century with the growth of hospitals, schools, prisons, and state bureaucracies, institutions that recorded and monitored information about their populations. Its origins, Foucault noted in passing, were to be found in the eighteenth century, and not in any particular state institution but, rather, as a diffuse cultural problem associated with the social and economic repercussions of population growth.

For eighteenth-century English and French writers, the demographic problem was not one of overabundance but, rather, insufficient numbers of persons. The Malthusian fear of overpopulation so present just under the surface of Foucault's writings – where population becomes something to watch and discipline – was a demon of the future. The eighteenth-century challenge was how to encourage growth, not restrict it. More important from an analytical perspective is the historical point: Population – the entity itself – had first to be created before it could be controlled. Thus, in contrast to those scholars who have suggested that European society needed to change (as a result of capitalism or population growth) before quantification could become possible at all,[13] this book takes the approach that the large economic, demographic, social, and political transformations and the increasing measurement of the world occurred simultaneously.[14] The modern concept of population and its measurement were mutually constitutive.

[9] Michel Foucault, "The Politics of Health in the Eighteenth Century," in *Power/Knowledge – Selected Interviews and Other Writings, 1972–1977,* ed. Colin Gordon, trans. Colin Gordon, Leo Marshall, John Mepham, and Kate Soper (New York: Pantheon Books 1980), p. 171.

[10] For a critical discussion of Foucault's idea of biopower, see Michael Donnelly, "On Foucault's Uses of the Notion 'Biopower,'" in *Michel Foucault, Philosopher,* trans. Timothy J. Armstrong (New York: Routledge, 1992), pp. 199–203.

[11] This has best been shown in Foucault's analysis of the prison in *Discipline and Punish: The Birth of the Prison,* trans. Alan Sheridan (New York: Vintage Books, 1979).

[12] He only briefly outlined this second level of biopower in his essay on eighteenth-century health and later in *The History of Sexuality*; Foucault, "The Politics of Health"; Foucault, *The History of Sexuality,* Vol. 1: *An Introduction,* trans. Robert Hurley (1976; New York: Vintage Books, 1980), pp. 139–145.

[13] Lorraine Daston, *Classical Probability in the Enlightenment* (Princeton, N.J.: Princeton University Press, 1988), pp. 51–52.

[14] Recent studies in the history and sociology of science have emphasized the coconstructed character of the modern measured world. Bruno Latour characterized this process as metrology. Bruno Latour, *Science in Action* (Cambridge, Mass.: Harvard University Press, 1987). Also see Theodore Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton,N.J.: Princeton

Part of that constitutive process can be traced directly to the central role that population played in political economy, particularly in the theory of mercantilism. For mercantilists and other political philosophers, such as Jean Bodin, a nation-state's wealth and strength depended in part on the size of population. A few of the early mercantilist writers supplied numbers of the total population of a given state; however, they did so without any evidence whatsoever of how they arrived at their figures.[15] Only in the mid–seventeenth century did commentators begin to provide numerical estimates of population based on empirical records. This development had a snowball effect. Population figures facilitated comparison between states, which in turn provoked questions about the accuracy and source of the numbers. Comparison also led to the creation of new measures of population. Total population, for instance, measured the greatness of France, while across the Channel, population density or favorable hospital mortality rates demonstrated the strength and health of England.[16]

METHOD OF TABLES

The work of political and medical arithmeticians depended on the creation of methods to collect, sort, and record numerical information and then to display that information. The proliferation of newspapers, pamphlets, and periodicals – essential components of the emerging public sphere – increased the flow of information, contributed to the spread of numeracy, and proved critical to the exchange, debate, and refinement of quantitative methods.[17] In addition, the circulation of private letters and the growing use of correspondence – the Republic of Letters – encouraged the free exchange of information among quantifiers, who frequently collected and distributed numbers about local populations.[18] In practice, medical and political arithmeticians became individual

University Press, 1995); and Ian Hacking, *The Taming of Chance* (Cambridge: Cambridge University Press, 1990).

[15] For a general introduction to population doctrines, see Charles Emil Stangeland, *Pre-Malthusian Doctrines of Population: A Study in the History of Economic Thought* (New York: Columbia University Press, 1904).

[16] In the mid–eighteenth century, the population of England was roughly 6 million and of France, 26 million. See E.A. Wrigley and R.S. Schofield, *The Population History of England, 1541–1871* (Cambridge, Mass.: Harvard University Press, 1981); Jacques Dupâquier, ed., *Histoire de la population française,* Vol. 2: *De la Renaissance à 1789* (Paris: Presses Universitaires de France, 1988).

[17] Riley underscored the importance of counting populations to the extension of numeracy; see Riley, *Population Thought,* p. xvii; for discussions of numeracy, see Cohen, *A Calculating People*; and Keith Thomas, "Numeracy in Early Modern England," *Transactions of the Royal Historical Society,* 5th ser. 37 (1977): 103–132.

[18] For recent discussions of the Republic of Letters, see Lorraine Daston, "The Ideal and Reality of the Republic of Letters in the Enlightenment," *Science in Context* 2 (1991): 367–386; Anne Goldgar, *Impolite Learning: Conduct and Community in the Republic of Letters, 1680–1750* (New Haven and London: Yale University Press, 1995); and Dena Goodman, *The Republic of Letters: A Cultural History of the French Enlightenment* (Ithaca and London: Cornell University Press, 1994).

centers of calculation; they digested bits of information gathered by many hands into a single product, a table or set of tables.[19]

The table itself was the most important technology for collecting and displaying quantitative information, and its development constitutes one of the central themes of this book.[20] Tables were used extensively and effectively in arguments over the health and wealth of the population. They were heralded as a new method for organizing and displaying knowledge about the natural and social worlds. For Francis Bacon, their most famous advocate, tables were not only persuasive new instruments but also the best means for recording and ordering observations of a world overflowing with facts. Significantly, Bacon's tables did not contain numbers. Nonetheless, his insistence on the role of tables as instruments of discovery strongly influenced John Graunt and William Petty, the first political and medical arithmeticians, who made extensive use of *numerical* tables in their writings.

Building on Graunt's and Petty's work, eighteenth-century arithmeticians stressed the advantages of tables of numbers or accounts. Although numbers embedded in text certainly conveyed information, comparison between figures was not immediate nor easy if numbers were separated by words. Tables displayed numbers in a way that partially eliminated these difficulties. But all tables were not alike. Some were easier to comprehend than others; clearly, a balance had to be struck between the desire to convey as much information as possible and the complexity of the form. Various conventions or styles proved differently convincing and valued, and tables, like other instruments, could be manipulated.

[19] Centers of calculation is Bruno Latour's phrase; Latour, *Science in Action,* chap. 6.

[20] Tables are literary technologies, a term that refers to the ways in which experimental results were communicated to those who had not witnessed an experiment or partaken in the collection of information; the use of the word technology underlines the written account as a "knowledge-producing tool." See Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, N.J.: Princeton University Press, 1985), p. 25. Michel Foucault placed great emphasis on the table as a place where knowledge was ordered and displayed during the Classical episteme; Foucault, *The Order of Things: An Archaeology of the Human Sciences,* trans. anon. (1966; New York: Vintage Books, 1973), esp. pp. 71–76. William Clark has developed the Foucauldian idea of the table as a disciplinary tool in his "On the Table Manners of Academic Examination," in *Wissenschaft als kulturelle Praxis, 1750–1900,* ed. Hans Erich Bödecker, Peter Hanns Reill, and Jürgen Schlumbohm (Göttingen: Vandenhoeck & Ruprecht, 1999), pp. 33–67. Mary Poovey argued that separating numbers from narrative contributed to the idea that numbers form a distinct and special type of evidence; Poovey, *A History of the Modern Fact* (Chicago: University of Chicago Press, 1998), pp. xi–xv, and chap. 2, pp. 29–91; finally Edward Tufte has examined the changing conventions of tables and graphs; Edward Tufte, *The Visual Display of Quantitative Information* (Cheshire, Conn.: Graphics Press, 1983). On the role of visual representation in science more generally, see the fine set of essays in Brian S. Baigrie, ed., *Picturing Knowledge: Historical and Philosophical Problems Concerning the Use of Art in Science* (Toronto: University of Toronto Press, 1996), and Martin Rudwick, "The Emergence of a Visual Language of Geology, 1760–1840," *History of Science* 14 (1976): 149–195. Also see Bruno Latour, "Visualization and Cognition: Thinking with Eyes and Hands," *Knowledge and Society: Studies in the Sociology of Culture Past and Present* 6 (1986): 1–40.

METHOD OF COMPARISON

Quantification and the method of tables facilitated the process of comparison, and comparison was fundamental to medical and political arithmetic.[21] Rational judgments, arithmeticians agreed, could be based on numerical measures: Was Paris larger than London? Was smallpox inoculation less risky than natural smallpox? Were mountainous regions healthier than marshy lands? Comparison, of course, was not limited to medical and political issues; it was key to John Locke's and Étienne Bonnot de Condillac's theories of knowledge, and Bacon, too, had viewed comparison as essential to natural philosophy.

Certain liabilities, however, attended the marriage of quantification and comparison. Of central importance was the problem of classification: what to count. The starting point in any quantitative inquiry was to determine which categories to enumerate. As many recent studies have shown, classificatory schemes are highly culturally specific and frequently political.[22] Classifying deaths was of particular importance to arithmeticians, whether by disease, casualty, age, sex, location, or some combination of these. Moreover, few of these categories were stable; disease, for example, was constantly redefined, and popular and elite classifications increasingly diverged over the course of the eighteenth century. Even when categories were seemingly equivalent, or were construed as equivalent by particular authors – a significant achievement itself – their comparability was frequently challenged by others.[23]

To highlight the cultural and political contingencies of quantification, this book compares political and medical arithmetic in England and France during the long eighteenth century, roughly 1660 to 1800.[24] As several recent studies have emphasized, Britain and France created and expanded the apparatus of the modern nation-state, including standing armies, new forms of taxation, and their concomitant bureaucracies. These developments, especially taxation

[21] Sergio Moravia argued that comparison (*comparaison*) as a method was central to the Enlightenment and critical to the development of the human sciences; Moravia, "The Enlightenment and the Sciences of Man," *History of Science* 18 (1980): 247–268.

[22] Mary Douglas, *How Institutions Think* (Syracuse, N.Y.: Syracuse University Press, 1986), chap. 8; Foucault, *The Order of Things*; Hacking, *The Taming of Chance*; Porter, *Trust in Numbers,* chap. 2; and Geoffrey C. Bowker and Susan Leigh Star, *Sorting Things Out: Classification and Its Consequences* (Cambridge and London: The MIT Press, 1999).

[23] In her study of Napoleonic statistics, Marie-Noëlle Bourguet demonstrated that individual communities in France created their own categories (despite explicit instructions from the central government), which made comparison between communities difficult, if not impossible; Bourguet, *Déchiffrer la France: La statistique départementale à l'époque napoléonienne* (Paris: Édition des archives contemporaines, 1988). Witold Kula also demonstrated how socially embedded quantitative measures could be in early modern Europe. See Witold Kula, *Measures and Men,* trans. Richard Szreter (Princeton, N.J.: Princeton University Press, 1986).

[24] Important work was also done in Sweden and Prussia, especially by Pehr Wargentin and Johann Peter Süssmilch; see Karin Johannisson, "Society in Numbers: The Debate over Quantification in Eighteenth Century Political Economy," in *The Quantifying Spirit in the Eighteenth Century,* pp. 343–362; Hacking, *The Taming of Chance,* chap. 3.

and methods of accounting, encouraged quantification.[25] Yet the substantive political and social differences between the two countries cannot be overstated. France was an absolute monarchy, Britain a constitutional one. France was a *société d'ordres,* where privileges were legally defined; England was a burgeoning commercial society based on common law that emphasized the individual over the corporative. In France, the Catholic Church held considerable power, and the boundaries between ecclesiastical and royal authority were ill-defined and overlapping. In England, the Anglican Church was under state control. Religious intolerence was more pronounced in France, especially after the revocation of the Edict of Nantes in 1685, which ended a royal policy of toleration toward Protestantism. In England, Dissenters found their paths to participation in local and national government blocked by the Corporation Act of 1661 and the Test Act of 1673.

Culturally, the upper classes in both countries shared standards of living, education, and manners. Many embraced the Enlightenment attack on the irrational and superstitious, and supported the promotion of happiness by looking for ways to decrease poverty, disease, and crime. Indeed, some of the most characteristic and lasting contributions to Enlightenment thought grew out of exchanges between French and English savants. Their leading scientific institutions, established within four years of each other, the Royal Society of London in 1662 and the Paris Académie Royale des Sciences in 1666, played highly influential roles in shaping the pursuit of natural philosophy. On the other hand, the two could not have been more different. The London society served as a dues-paying gentlemen's club with a Royal Charter; the Paris academy functioned as an extension of the French state, complete with hierarchical membership and pensioned positions.[26] Although each scientific body published a journal, a quick glance at their contents reveals their divergent interests and approaches. The *Philosophical Transactions* contained a hodgepodge

[25] Ken Alder, *Engineering the Revolution: Arms and Enlightenment in France, 1763–1815* (Princeton, N.J.: Princeton University Press, 1997); Keith Baker, *Inventing the French Revolution* (Cambridge: Cambridge University Press, 1990); John Brewer, *The Sinews of Power* (New York: Alfred A. Knopf, 1988), chap. 8; Éric Brian, *La mesure de l'état: Administrateurs et géomètres au XVIIIe siècle* (Paris: Albin Michel, 1994), Part 2; Alain Desrosières, *La politique des grand nombres: Histoire de la raison statistique* (Paris: Éditions la Découverte, 1993), chap. 1; Julian Hoppit, "Political Arithmetic in Eighteenth-Century England," *Economic History Review* 49 (1996): 516–540; Philip Kreager, "Quand une population est-elle une nation? Quand une nation est-elle un état? La démographie et l'émergence d'un dilemme moderne, 1770–1870," *Population* 6 (1992): 1639–1656; Michael Kwass, *Privilege and the Politics of Taxation in Eighteenth-Century France: Liberté, Égalité, Fiscalité* (Cambridge: Cambridge University Press, 2000); and Jacques Revel, "Knowledge of the Territory," *Science in Context* 4 (1991): 133–161.

[26] In Charles Gillispie's concise formulation, the Académie Royale des Sciences was an official organization, the Royal Society a voluntary one; see Charles C. Gillispie, *Science and Polity in France at the End of the Old Regime* (Princeton, N.J.: Princeton University Press, 1980), pp. 78–80. Margaret C. Jacob also provided an incisive comparison between English and French natural philosophy; Margaret C. Jacob, *Scientific Culture and the Making of the Industrial West* (New York and Oxford: Oxford University Press, 1997).

of short accounts of two-headed monstrous births and other natural wonders, followed by learned mathematical treatises penned in Latin. The *Histoire et Mémoires* presented a well-organized collection of polished scientific articles arranged by subject. "Soldiers who are under a regular Discipline and besides well paid," Voltaire remarked of the members of both societies, "must necessarily, at last, perform more glorious Atchievements than others who are mere Voluntiers."[27]

If the natural philosophers could be divided between the regulars and the volunteers, so too could the physicians. In France, local corporations controlled medical practice to a far greater extent than in England, where medical entrepreneurship flourished.[28] In both countries, medicine provided a route to social advancement in terms of status and income, but religion constrained individual careers. In France, after 1685, Protestants were by regulation excluded not only from university and medical corporations but also from practice. A few Protestant physicians nonetheless created successful practices in France; this became increasingly possible later in the eighteenth century with the growth of religious tolerance.[29] In England, one had to be an Anglican to attend the two medical schools at Oxford and Cambridge, but many Dissenters obtained their MDs at Edinburgh or Leiden and then practiced freely in London and throughout England (although they could not become Fellows of the Royal College of Physicians). Physicians in both countries played prominent roles in the Republic of Letters and the Enlightenment; many of the contributors to the *Encyclopédie,* for example, were physicians. And during the second half of the eighteenth century, the establishment of several new medical and scientific societies, both in the capitals and in provincial cities, encouraged enlightened activities and promoted humanitarian ideals.[30]

These national contours help to explain the particular trajectories of political and medical arithmetic and the course of quantification in each country. Political arithmetic took shape during the Restoration in England where its chief spokesman, William Petty, viewed it as a method to shore up monarchical authority in the wake of England's civil war. In France, the chief advocate of

[27] Voltaire, Letter XXIV, "On the Royal Society and Other Academies," in *Letters Concerning the English Nation,* ed. with notes and introduction by Nicholas Cronk (1733; Oxford: Oxford University Press, 1994), p. 117.

[28] On French medicine, see Laurence Brockliss and Colin Jones, *The Medical World of Early Modern France* (Oxford: Clarendon Press, 1997); on English medicine, see Harold Cook, *The Decline of the Old Medical Regime in Stuart London* (Ithaca, N.Y.: Cornell University Press, 1986); Susan C. Lawrence, *Charitable Knowledge: Hospital Pupils and Practitioners in Eighteenth-Century London* (Cambridge: Cambridge University Press, 1996); and Dorothy Porter and Roy Porter, *Patients and Practitioners: Doctors and Doctoring in Eighteenth-Century England* (Stanford, Calif.: Stanford University Press, 1989).

[29] Brockliss and Jones, *The Medical World of Early Modern France*, pp. 483–485.

[30] Shelby T. McCloy, *The Humanitarian Movement in Eighteenth-Century France* (Lexington: University of Kentucky Press, 1957); Francis M. Lobo, "John Haygarth, Smallpox and Religious Dissent in Eighteenth-Century England," in *The Medical Enlightenment of the Eighteenth Century,* ed. Andrew Cunningham and Roger French (Cambridge: Cambridge University Press, 1990), pp. 217–253.

quantification in the late seventeenth century, Sébastien Le Prestre de Vauban, one of Louis XIV's close advisors, regarded regular censuses as valuable resources for the monarchy. After 1750 in England, political arithmetic became primarily a republican activity practiced by Dissenters who, because of their faith, remained outside of government.[31] In France, enlightened intendants – that is, royal bureaucrats – took up political arithmetic in an effort to reform the French monarchy. Thus, in both countries the politics of political arithmetic changed over the course of the eighteenth century, while the location of the practitioners remained distinct.

Central to this political shift were the medical arithmeticians. The work done by physicians and others to improve public and individual health – central goals of the Enlightenment – recast the ideology and practice of political arithmetic. Living conditions in France and England were horrendous, by modern standards, throughout the eighteenth century. The majority of inhabitants in both countries were poor, illiterate, malnourished, and often starving (an estimated one-fifth of the French population died in the 1709–1710 famine). But there were some glimmers of hope. Bubonic plague, a recurrent feature of European life from the mid-fourteenth century, had disappeared, according to late-eighteenth-century commentators. Smallpox emerged as the most dreaded disease, but here, too, there was room for optimism: Inoculation provided physicians with a technique to reduce mortality.[32] Medical arithmeticians furnished the means for evaluating and encouraging these improvements.

METHOD OF CONTROVERSY

The three most important controversies concerning health and population in eighteenth-century England and France were smallpox inoculation, environmental medicine, and depopulation. An analysis of the types of arguments used in these controversies illustrates and illuminates several styles or patterns of thought. More important, studying these controversies reveals the changes in those styles or patterns, as well as the mechanism (the controversy itself) for change.[33] For the sociology of scientific knowledge, controversies serve as

[31] Peter Buck, "People Who Counted: Political Arithmetic in the Eighteenth Century," *Isis* 73 (1982): 29. Also see Peter Buck, "Seventeenth-Century Political Arithmetic: Civil Strife and Vital Statistics," *Isis* 68 (1977): 67–84. Buck attributes the shifting politics of political arithmetic to a renewed expression of classical republican ideology that emerged out of the unlikely alliance between the political aims of Dissenters and landed gentry.

[32] Peter Gay emphasized the link between medicine and optimism during the Enlightenment; Peter Gay, *The Enlightenment,* Vol. 2: *The Science of Freedom* (New York: Norton, 1969), pp. 8–23.

[33] The French historian Jean-Claude Perrot has recently suggested that "la querelle" – or controversy – played a significant role in the development of ideas during the eighteenth century, in the "history of the conditions of thought." Michel Foucault had earlier written that such an approach (an examination

important sites for research precisely because in these moments, scientists articulate their tacit assumptions, unfamiliar practices, and unchallenged knowledge claims.[34] Political and medical arithmeticians felt impelled and were compelled by outside observers to explain and justify their methods and conclusions.

The order of the controversies is roughly chronological. The debates surrounding smallpox inoculation, which peaked in England in the 1720s and in France in the 1750s, are analyzed in Part I (Chapters 2, 3 and 4). Throughout the eighteenth century, smallpox was a deadly and disfiguring disease. It struck the rich and poor alike, and its sudden and lethal attack on many members of European royalty led in some cases to political crises. The hope that inoculation, introduced into Europe at the beginning of the eighteenth century, could prevent smallpox propelled the practice to the center of public debate. Some advocates of inoculation constructed numerical accounts showing the risks of dying from inoculation to be far smaller than the risks of dying from natural smallpox. This is arguably the first use of numbers to evaluate a medical procedure.

Chapter 2 examines the construction of these numerical risks through a close study of the work of James Jurin, physician and secretary to the Royal Society. As secretary, Jurin solicited and collected accounts of inoculation in correspondence from individuals throughout England during the 1720s; from these accounts he calculated the risks of dying from inoculated smallpox. The chapter details the difficulties Jurin encountered and the kind of work he had to do to make the accounts comparable and thus quantifiable. Many of the techniques Jurin developed were used by later medical and political arithmeticians.

Chapter 3 discusses numerical arguments in French debates over inoculation. Unlike in England, where physicians took the lead in promoting inoculation, most French physicians opposed the practice until midcentury. *Philosophes* from Voltaire to Charles-Marie de La Condamine campaigned to have the procedure accepted. Numerical arguments played a relatively minor role in the debates, except for the well-publicized exchange at the Paris Académie des Sciences between Jean d'Alembert and Daniel Bernoulli. Although both supported inoculation, they disagreed about how to calculate the risks involved. The degree of mathematical specialization evidenced in this exchange discouraged the use and acceptance of quantification by the French medical community during the eighteenth century.

of controversies) would result in "only a history of opinions," not in an understanding of the "general system of thought" – the episteme. See Jean-Claude Perrot, "Les économistes, les philosophes et la population," in *Histoire de la population française,* Vol. 2: *De la Renaissance à 1789,* p. 545; and Michel Foucault, *The Order of Things,* p. 75. My use of the terms styles or patterns of thought is closer to Perrot's "conditions of thought" than to Foucault's more restrictive "episteme."

[34] For a recent discussion of controversy studies, see Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science* (Cambridge: Cambridge University Press, 1998), chap. 1, pp. 13–46.

Chapter 4 looks at numerical arguments in English debates of the 1770s over whether to inoculate the urban poor. Taking figures from the London bills of mortality, physicians constructed a variety of tables to ascertain if smallpox mortality had increased or remained the same over the course of the eighteenth century. Opponents of inoculating the poor argued that their tables demonstrated that smallpox mortality had increased precisely because of the indiscriminate practice of inoculation; that is, inoculated individuals had spread the contagion (unless they had been isolated for two to three weeks). By contrast, advocates used their tables to argue that smallpox mortality (as measured by the London bills) had remained more or less constant over the course of the eighteenth century, and they concluded that inoculating the poor would do more good than harm. In this case, tables failed to secure consensus and instead underlined the malleability of this type of argument.

Controversy about environmental medicine – how the environment affected health – is the focus of Part II (Chapters 5 and 6).[35] Debates were stimulated by the growing recognition of changes in disease patterns (most markedly the disappearance of widespread, epidemic plague from Western Europe after 1721) and the seeming success of inoculation, both of which brought a sense of optimism to the understanding and prevention of disease.[36]

One way to make sense of the effects of the environment was to examine the links between weather and health. Chapter 5 treats attempts to craft a science of medical meteorology, including the proposed techniques to collect, record, and display observations. Like Jurin's inoculation project, medical meteorology projects encountered difficulties in securing accurate and complete information from volunteers. The relatively new and unstandardized meteorological instruments such as barometers and thermometers hindered comparison, and the tabular format proved insufficient to the task of recording two very different phenomena: weather and disease.

Efforts to use mortality figures to address issues of health and geography are the subject of Chapter 6. Contemporaries frequently remarked on the expansion of London and Paris, and many felt that it came at the expense of the population in the countryside. They associated many problems with greater numbers of people within a small compass: higher incidence of disease, breakdown of traditional mores (complaints about luxury and immorality), and anonymity. Debate centered on variations in and causes of salubrity. Physicians began to collect and use mortality and morbidity data (displayed in various tables) in

[35] For an overview of environmental medicine in the eighteenth century, see James C. Riley, *The Eighteenth-Century Campaign to Avoid Disease* (New York: Macmillan, 1987).

[36] For a recent discussion about the changing epidemiology of eighteenth-century England, see Alex Mercer, *Disease, Mortality and Population in Transition: Epidemiological-Demographic Change in England since the Eighteenth Century as Part of a Global Phenomenon* (Leicester, London & New York: Leicester University Press, 1990).